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Research report

# Risk factors and course patterns of anxiety and depressive disorders during pregnancy and after delivery: A prospective-longitudinal study

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ABSTRACT

*Background:* Peripartum anxiety and depressive disorders are associated with adverse consequences for mother and child. Thus, it is important to examine risk factors, correlates and course patterns of anxiety and depressive disorders during pregnancy and after delivery.
*Methods:* In the prospective-longitudinal Maternal Anxiety in Relation to Infant Development (MARI) Study, $n=306$ expectant mothers were recruited from gynaecological outpatient settings in Germany and completed up to seven waves of assessment from early pregnancy until 16 months postpartum. Anxiety and depressive disorders and potential risk factors/correlates were assessed with the Composite International Diagnostic Interview for Women (CIDI-V), medical records and additional questionnaires.
*Results:* Although peripartum anxiety and depressive disorders appeared to be persistent in some women, others reported major changes with heterogeneous courses and shifts between diagnoses and contents. There was a considerable amount of incident disorders. Strongest predictors for peripartum anxiety and depressive disorders were anxiety and depressive disorders prior to pregnancy, but psychosocial (e.g. maternal education), individual (e.g. low self-esteem), and interpersonal (e.g. partnership satisfaction, social support) factors were also related.
*Limitation:* Knowing the aims of the study, some participants may have been more encouraged to report particular symptoms, but if so, this points to the importance of a comprehensive assessment in perinatal care.
*Conclusion:* Peripartum time is a sensitive period for a considerable incidence or persistence/recurrence of anxiety and depressive disorders albeit the course may be rather heterogeneous. Interventional studies are needed to examine whether an alteration of associated factors could help to prevent peripartum anxiety and depressive disorders.



## 1. Introduction

Anxiety and depressive disorders are the most prominent disorders in females during reproductive age (Kessler et al., 2012; Wittchen et al., 2011) and their occurrences prior to (Martini et al., 2010; Petzoldt et al., 2014), during (Alder et al., 2007; Chen et al., 2010; Field et al., 2010; Grigoriadis et al., 2013; van Batenburg-Eddes et al., 2009) and after (Glasheen et al., 2010; Murray and Cooper, 1996; Wan and Green, 2009 ) pregnancy are associated with adverse consequences for mother and offspring (e.g. preterm delivery, maternal postpartum depression, excessive infant crying, bonding problems, and adverse child development).

Examining potential clinical risk factors for and correlates of peripartum anxiety and depressive disorders may help to more precisely target preventive interventions for mothers and infants at risk. Predictors for postpartum depression have been investigated extensively and some have been reported quite consistently (e.g. high maternal age, low maternal education, parity, being unmarried, mental disorders or trauma experience prior to pregnancy, low social support, low self-esteem; for review see: Austin and Lumley, 2003; Beck, 1996; Henshaw, 2003; O'Hara and Gorman, 2004; Robertson et al., 2004; Ross et al., 2006; Schmied et al., 2013; Scrandis et al., 2007), but

*Abbreviations:* CIDI-V, Composite International Diagnostic Interview for Women; WHO-CIDI, Word Health Organization-Composite International Diagnostic Interview; no AD, no anxiety nor depressive disorder prior to pregnancy; pure D, pure depressive disorder(s) prior to pregnancy; pure A, pure anxiety disorder(s) prior to pregnancy; comorbid AD, comorbid anxiety and depressive disorders prior to pregnancy; OR, odds ratio; 95%CI, 95% confidence interval; *p*, *p*-value

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correlates and risk factors for anxiety disorders during pregnancy and after delivery are less well studied (for review see: Goodman et al., 2014; Grekin and O'Hara, 2014).

Given the evidence that peripartum mental disorders bear potential risks for the (expectant) mother and the offspring (Brockington et al., 2011) more research is warranted to examine the course of pre-existing anxiety and depressive disorders and to investigate how many previously healthy women experience an anxiety or depressive disorder for the first time during peripartum time. Several authors reported rates of DSM-IV anxiety and depressive disorders at particular time points during pregnancy and postpartum period (e.g. Andersson et al., 2003; Andersson et al., 2006; Giardinelli et al., 2012; Reck et al., 2008), but studies seldom distinguish women with a prior history of an anxiety or depressive disorder from cases who are affected for the first time during peripartum period (Altshuler et al., 1998; Buist et al., 2011; Cohen et al., 1996; Goodman et al. 2014; Micali et al., 2011; Ross and McLean, 2006). Thus, in many studies it is not clear whether reported point-prevalence estimates reflect incident cases or a recurrent/persisting pre-existing condition (Banti et al., 2011; Halbreich and Karkun, 2006). Goodman et al. (2014) highlighted in a recent review that incidence information on anxiety disorders during pregnancy often refer to retrospective studies with small sample sizes and reported widely ranging incidence data that are most likely due to differing study designs (e.g. panic disorder: 0–53.8%, obsessive-compulsive disorder: 0–15.4%). Concerning depressive disorders, a methodologically sound study revealed cumulative incidence rates of 2.2% in late pregnancy and 6.8% during the first year after delivery (Banti et al., 2011).

Studies on the course of pre-existing disorders during pregnancy and postpartum time often refer to particular diagnoses (e.g. generalized anxiety disorder: Buist et al., 2011; panic disorder: Cohen et al., 1996, Dannon et al., 2006), are partially based on small sample sizes and clinical populations or refer to retrospective designs (for review see Goodman et al., 2014).

There is a large body of research highlighting the variability of anxiety and depressive symptoms during peripartum period derived from questionnaire studies using dimensional assessment procedures (e.g. stable during pregnancy: Canals et al., 2002; Heron et al., 2004; increasing symptom rates during pregnancy: Da Costa et al., 1999; u-shaped pattern with high rates during first and third trimester: Lee et al., 2007; Teixeira et al., 2009). Similarly, different trends were reported for the course from pregnancy to postpartum (stable rates: Canals, et al., 2002; increasing rates: Stuart et al., 1998; decreasing rates: Heron, et al., 2004). However, such questionnaire studies do not inform about the clinical significance of symptoms nor about the course patterns of specific anxiety and depressive disorders. The comparability of these studies is hampered by different methodological approaches regarding sampling, instruments, and design. Overall, knowledge on course patterns of manifest anxiety and depressive disorders during pregnancy and postpartum remains deficient.

Taken together, results on incidence and course patterns of peripartum mental disorders vary widely due to methodological differences (Goodman et al. 2014; Ross and McLean, 2006), partially retrospective study designs (Schofield et al., 2014), and the fact that lifetime diagnostic information is often not incorporated in the analyses (Halbreich and Karkun, 2006). Prior findings on potential risk factors and correlates are still heterogeneous and further prospective evidence is needed to obtain a better understanding of specific risk constellations for anxiety and depressive disorders during peripartum period. Using data of a prospective-longitudinal study in expectant mothers, the aim of this article was

1. to investigate risk factors and correlates for anxiety and depressive disorders during and after pregnancy and
2. to provide information on incidence and recurrence/persistence of anxiety and depressive disorders during peripartum period highlighting specific pregnancy- and child-related fears and contents.

## 2. Methods

### 2.1. Design and sampling

The Maternal Anxiety in Relation to Infant Development (MARI) Study is a prospective-longitudinal study of expectant mothers, sampled from the community in gynaecological outpatient settings in the area of Dresden, Germany (study period: 01/2009–09/2012). All participants completed up to seven assessments: gestational week 10–12 (T1, baseline), 22–24 (T2) and 35–37 (T3) as well as 10 days (T4), 2 months (T5), 4 months (T6), and 16 months (T7) postpartum.

A total of $n=533$ pregnant women were screened and 50 women met exclusion criteria (gestational age > 12 weeks: $n=8$, younger than 18 or older than 40 years: $n=8$, multiple pregnancy: $n=2$, history of more than 3 spontaneous abortions/(induced) terminations of pregnancy/still births or infant impairment: $n=2$, invasive fertility treatment: $n=9$, severe physical disease/microsomia/skeletal malformation of the expectant mother: $n=6$, substance abuse or heroin substitution during the past 6 months: $n=0$, severe psychiatric illness: $n=2$, expectation to leave the area of Dresden: $n=6$, insufficient mastery of German language: $n=7$). Additionally, $n=9$ women did not participate due to spontaneous abortion/(induced) termination of pregnancy prior to baseline interview, $n=10$ due to lacking consent of the partner, $n=154$ due to lacking time, and $n=4$ due to unknown reasons.

Overall, $n=306$ women were eligible for the MARI study. Sociodemographic and gynaecological characteristics of the participants are provided in Table 1. As compared to the average female population of Saxony (Germany) at this age ($N=370,500$) (Statistisches Landesamt des Freistaates Sachsen, Kamenz, 2014) the participants of the MARI study reported a higher educational level, were more often married and worked more often part-time. No significant differences emerged regarding the percentage of women with very low educational level (9th grade or no degree), separated, widowed, divorced or currently not working women and the monthly household income.

As compared to the average population of pregnant women in Saxony (Germany) including data of $N=34,374$ pregnancies and $N=34,837$ live births (Qualitätsbericht Geburtshilfe der Sächsichen Landesärtzekammer, Jahresauswertung, 2010), participants of the MARI sample were more often primipara and infants were more often born at term and with an average birth weight above 2500 g (comparable distribution of birth weight above 2500 g). Infants of the MARI sample were comparable to infants from the Saxonian population with respect to sex and mode of delivery.

Referring to their baseline diagnostic status (CIDI-V, see below), all participants were assigned to one of the following initial diagnostic groups: no anxiety nor depressive disorder prior to pregnancy (no AD: $n=109$), pure depressive disorder(s) prior to pregnancy (pure D: $n=48$), pure anxiety disorder(s) prior to pregnancy (pure A: $n=84$), and comorbid anxiety and depressive disorders prior to pregnancy (comorbid AD: $n=65$).

### 2.2. Participants flow and retention

Due to spontaneous abortion and induced termination of pregnancy the participation of $n=8$ women ended after T1 (cumulated termination rate: 2,6%). During the study, $n=3$ women

**Table 1**
Sociodemographic and gynecological characteristics at baseline assessment and after delivery.

| Sociodemographic characteristics | MARI baseline assessment ($N=306$) | | Population of Saxony (females aged 20–35 years)[a] | Asymptotic two-sample test of proportions |
|---|---|---|---|---|
| | *N* | % | % | |
| **Education** | | | | |
| No degree or 9th grade | 21 | 6.9 | 9.8 | n.s. |
| 10th grade | 77 | 25.2 | 43.7 | $Z=-6.25$ ($p<0.001$) |
| High school | 110 | 35.9 | 30.3 | $Z=2.13$ ($p=0.033$) |
| University | 98 | 32.0 | 14.8 | $Z=8.46$ ($p<0.001$) |
| **Marital status** | | | | |
| Married | 113 | 36.9 | 19.8 | $Z=7.50$ ($p<0.001$) |
| Never married | 183 | 59.8 | 77.0 | $Z=-7.14$ ($p<0.001$) |
| Seperated/widowed/divorced | 10 | 3.3 | 3.2 | n.s. |
| **Working time** | | | | |
| Full-time job | 117 | 38.2 | 46.8 | $Z=-3.01$ ($p=0.003$) |
| Part-time job | 83 | 27.1 | 20.1 | $Z=3.05$ ($p=0.002$) |
| Currently not working | 106 | 34.7 | 33.1 | n.s. |
| **Monthy household income (after taxes)** | | | | |
| Less than 500€ | 23 | 7.5 | 5.2 | n.s. |
| 500–1000€ | 107 | 35.0 | 37.9 | n.s. |
| 1500–2500€ | 93 | 30.4 | 30.9 | n.s. |
| 2500–3500€ | 55 | 18.0 | 15.3 | n.s. |
| 3500–4500€ | 20 | 6.5 | 6.1 | n.s. |
| More than 4500€ | 8 | 2.6 | 4.3 | n.s. |
| **Gynecological characteristics** | **MARI assessment after delivery ($N=286$)** | | **Birth statistics of Saxony[b]** | **Asymptotic two-sample test of proportions** |
| | *N* | % | % | |
| **Parity** | | | | |
| Primipara | 178 | 58.2 | 51.5 | $Z=2.33$ ($p=0.020$) |
| Multipara | 128 | 41.8 | 48.5 | $Z=-2.33$ ($p=0.020$) |
| **Mode of delivery** | | | | |
| Spontaneous vaginal delivery | 225 | 78.7 | 77.3 | n.s. |
| Assisted delivery/c-section | 61 | 21.3 | 22.7 | n.s. |
| **Infants (singletone pregnancy)** | | | | |
| Boys | 147 | 51.4 | 51.0 | n.s. |
| Girls | 139 | 48.6 | 49.0 | n.s. |
| **Birth outomes** | | | | |
| Preterm delivery ($<37+0$) | 11 | 3.9 | 7.8 | $Z=-2.54$ ($p=0.011$) |
| Birth weight | | | | |
| $<2500$ | 6 | 2.1 | 5.1 | $Z=-2.38$ ($p=0.017$) |
| 2500–2999 | 40 | 14.0 | 14.9 | n.s. |
| 3000–3999 | 206 | 72.0 | 69.5 | n.s. |
| 4000–4499 | 32 | 11.2 | 9.2 | n.s |
| $\geq 4500$ | 2 | 0.7 | 1.4 | n.s |

*Note :* #Monthly household income was evaluated with slightly differing predefined income groups in Microzensus 2009: less than 500€, 500–1500€, 1500–2600€, 2600–3600€, 3600–4500€, more than 4500€.

[a] © Selected data from Microzensus 2009 including data of $N=370,500$ females aged 20–35 years from Saxony, Germany (Statistisches Landesamt des Freistaates Sachsen, Kamenz, 2014).

[b] Quality Report Obstetrics and Gynecology of the Regional Medical Association of Saxony, Germany, 2010, including data of $N=34,374$ pregnancies and $N=34,837$ live births (Qualitätsbericht Geburtshilfe der Sächsischen Landesärztekammer, Jahresauswertung 2010)

moved away, $n=5$ women could not be reached anymore by phone, postal and personal contact, $n=9$ women reported lack of time or interest for further participation, and $n=7$ women refused contact for follow-up assessment (cumulated dropout rate: 7.9%).

Overall, retention rate until 16 months after delivery (T7) was 89.5% ($n=274$) with comparable retention rates in the four initial diagnostic groups (no AD: 89.9%, pure D: 91.7%, pure A: 86.9%, comorbid AD: 90.8%).

Some women did not participate at single assessments, e.g. due to preterm delivery, own/infant sickness or lack of time (T2: $n=0$, T3: $n=10$; T4: $n=2$, T5: $n=5$, T6: $n=1$, T7: $n=7$).

### 2.3. Assessment of DSM-IV-TR anxiety and depressive disorders and sociodemographic and potential clinical risk factors and correlates

At all assessments (except for T4) the Composite International Diagnostic Interview for Women (CIDI-V; Martini et al., 2009) was performed to assess DSM-IV-TR anxiety and depressive disorders (APA, 2000) and the content of the feared or rather avoided situations. The CIDI-V is a modified version of the WHO- (Word Health Organization-CIDI; Kessler and Üstün, 2004) that comprises very good psychometric properties (Reed et al., 1998). To receive valid prospective information, participants were carefully instructed to report the particular symptoms for each assessment period irrespective of the information they gave in the interviews before. Most women were repeatedly assessed by the same investigator to encourage further study participation. Thus, interviewers were aware of previously reported symptoms, but not informed about the resulting diagnoses.

Sociodemographic and potential clinical risk factors for anxiety and depressive disorders during pregnancy and after delivery such as maternal age and education were assessed at baseline. In addition, mode of delivery was considered as potential risk factor for postpartum disorders. Correlates of peripartum anxiety and depressive disorders were also investigated at different

**Table 2**
Overview of main constructs, instruments and assessment waves.

| Constructs | Instruments | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
|---|---|---|---|---|---|---|---|---|
| **Course of DSM-IV anxiety and depressive disorders during peripartum period** | | | | | | | | |
| Incidence, recurrence and content of anxiety and depressive disorders | Composite International Diagnostic Interview for Women (CIDI-V, Martini et al., 2009) | X | X | X | | X | X | X |
| **Risk factors for anxiety and depressive disorders during and after pregnancy** | | | | | | | | |
| Maternal age | CIDI-V (Martini et al., 2009) | X | | | | | | |
| Maternal education | Maternal report | X | | | | | | |
| Marital status | CIDI-V (Martini et al., 2009) | X | | | | | | |
| Intention of pregnancy | Maternal report | X | | | | | | |
| Parity | CIDI-V (Martini et al., 2009) | X | | | | | | |
| Man-made and sexual trauma experience prior to pregnancy | CIDI-V (Martini et al., 2009) | X | | | | | | |
| Premenstrual syndrome prior to pregnancy | Premenstrual Symptoms Screening Tool (PSST, Steiner et al., 2003) | X | | | | | | |
| Anxiety and depressive disorders prior to pregnancy | CIDI-V (Martini et al., 2009) | X | | | | | | |
| Mode of delivery | Medical records (German Mutterpass, 2013) | | | | X | | | |
| **Correlates of anxiety and depressive disorders during and after pregnancy** | | | | | | | | |
| Social support[a] | Social Support Questionnaire (Fydrich et al., 2007) | | X | | | | X | |
| Satisfaction with partnership[b] | Partnership Questionnaire (Hahlweg, 1996) | | X | | | | X | |
| Self-esteem[a] | Rosenberg self-esteem scale (Rosenberg, 1965) | | | X | | | | |
| Self-efficacy[a] | General self-efficacy-scale (Schwarzer and Jerusalem, 1995) | | | X | | | | |

[a] Due to missing data of particular questionnaire scores, these analyses were based on slightly differing sample sizes.
[b] Some women had no partner at the respective assessment points and were therefore unable to provide data concerning partnership quality.

assessment points throughout the study. An overview of the main constructs, instruments and assessment points is provided in Table 2.

Further information on methods and design of the study is published elsewhere (Martini et al., 2013).

### 2.4. Incident and recurrent/persistent cases of anxiety and depressive disorders during peripartum period

Incident and recurrent/persistent cases of anxiety and depressive disorders are reported for initial diagnostic groups and for particular anxiety and depressive disorders.

Incident cases refer to participants who have never fulfilled diagnostic criteria for the respective disorder before and who are affected for the first time during the particular assessment period. Recurrent/persistent cases refer to all women who fulfilled diagnostic criteria of the particular anxiety and/or depressive disorder prior to pregnancy and who are affected again during the respective assessment period. For missing information at particular assessment points it was assumed that no anxiety and depressive disorder was present in the respective participant at this particular assessment point (conservative estimation).

Additionally, pregnancy- and child-related contents of the feared or rather avoided situations for incident disorders as well as shifts in contents for recurrent/persistent diagnoses are described.

### 2.5. Course patterns of peripartum anxiety and depressive disorders

Frequency and percentages of different course patterns are reported for particular anxiety and depressive disorders. The periods i. prior to pregnancy (lifetime information disregarding cases with an onset 4 weeks prior to baseline interview), ii. during pregnancy (4 weeks prior to baseline interview until third trimester of pregnancy) and iii. after pregnancy (birth until 16 months postpartum) are considered to define the following eight mutually exclusive course types: Type I. no disorder prior to, during and after pregnancy; Type II. disorder prior to pregnancy, only; Type III. disorder during pregnancy, only; Type IV. disorder after pregnancy, only; Type V. disorder prior to and after pregnancy; Type VI. disorder prior to and during pregnancy; Type VII. disorder during and after pregnancy; Type VIII. disorder prior to, during and after pregnancy. These analyses were conducted for $N=286$ participants, because for these participants information was available for at least one assessment point during pregnancy (T1, T2, T3) and after delivery (T5, T6 or T7).

### 2.6. Ethical statement

The MARI Study was carried out in accordance with the APA ethical standards (APA, 2003) and the Declaration of Helsinki (2013) and has been approved by the Ethics Committee of the Medical Faculty of the Technische Universität Dresden (No: EK 94042007). All participants provided written informed consent after the study aims and procedures were fully explained. Each subject was free to withdraw anytime during the study.

### 2.7. Statistical analyses

All analyses were performed using STATA (Stata Corp, 2012) to compute descriptive statistics, concurrent and prospective associations. Logistic regression analyses were conducted to calculate Odds Ratios (ORs) with 95% confidence intervals (95%CI) and $p$-values for the association of the above mentioned risk factors/correlates and peripartum anxiety and depressive disorders.

## 3. Results

### 3.1. Correlates and risk factors for anxiety and depressive disorders during peripartum period

Odds ratios examining sociodemographic and potential correlates/clinical risk factors for peripartum anxiety and depressive disorders are presented in Table 3. As shown, strongest predictors for peripartum anxiety and depressive disorders were anxiety and depressive disorders prior to pregnancy. Additionally, man-made and sexual trauma experience predicted anxiety disorders during pregnancy and low maternal age, low education, premenstrual syndrome prior to pregnancy and mode of delivery were associated with postpartum anxiety disorders. Unplanned pregnancy was related to depression during pregnancy and low maternal education, man-made/sexual

**Table 3**
Clinical and sociodemographic correlates and risk factors for anxiety and depressive disorders during pregnancy and after delivery.

| | Anxiety disorders during pregnancy (*N*=97) | | Anxiety disorders after delivery (*N*=58) | | Depressive disorders during pregnancy (*N*=25) | | Depressive disorders after delivery (*N*=24) | |
|---|---|---|---|---|---|---|---|---|
| | **OR (95%CI)** | ***p*** | **OR (95%CI)** | ***p*** | **OR (95%CI)** | ***p*** | **OR (95%CI)** | ***p*** |
| **Risk factors** | | | | | | | | |
| **Low maternal age** (<25 vs. 25–34) | 1.06 (0.59–1.91) | 0.838 | **2.16 (1.11–4.19)** | **0.023** | 0.80 (0.29–2.23) | 0.672 | 1.61 (0.63–4.11) | 0.322 |
| **High maternal age** (>34 vs. 25–34) | 0.93 (0.34–2.53) | 0.889 | 1.64 (0.56–4.80 | 0.368 | *empty* | | 0.63 (0.08–5.00) | 0.661 |
| **Maternal education** (≤10th vs. >10th grade) | 1.50 (0.90–2.48) | 0.119 | **2.18 (1.20–3.94)** | **0.010** | 2.09 (0.92–4.77) | 0.079 | **3.56 (1.51–8.36)** | **0.004** |
| **Marital status** (not married vs. married) | 0.95 (0.57–1.56) | 0.835 | 0.53 (0.28–1.00) | 0.050 | 0.64 (0.26–1.59) | 0.338 | 0.84 (0.35–2.03) | 0.693 |
| **Intention of motherhood** (unwanted vs. wanted) | 1.13 (0.74–1.72) | 0.573 | 0.88 (0.52–1.49) | 0.631 | **2.12 (1.19–3.77)** | **0.011** | 1.17 (0.59–2.33) | 0.655 |
| **Parity** (multiparous vs. primiparous) | 1.09 (0.67–1.78) | 0.723 | 1.01 (0.56–1.81) | 0.983 | 1.10 (0.48–2.51) | 0.819 | 1.23 (0.53–2.84) | 0.635 |
| **Any man-made trauma** (yes vs. no; indicated in *n*=56) | **3.15 (1.74–5.71)** | **<0.001** | 1.90 (0.97–3.73) | 0.061 | 2.28 (0.93–5.60) | 0.071 | **4.31 (1.81–10.25)** | **0.001** |
| **Any sexual trauma** (yes vs. no, indicated in *n*=31) | **2.96 (1.39–6.29)** | **0.005** | 1.91 (0.82–4.45) | 0.134 | 2.45 (0.85–7.08) | 0.097 | **4.49 (1.68–12.00)** | **0.003** |
| **Premenstrual syndrome prior to pregnancy** (yes vs. no, indicated in *n*=35) | 1.98 (0.97–4.03) | 0.062 | **3.37 (1.54–7.37)** | **0.002** | 2.09 (0.73–5.98) | 0.169 | 1.74 (0.55–5.47) | 0.343 |
| **Mode of delivery** (caesarian section vs. assisted/spontaneous vaginal delivery, indicated in *n*=15) | **–** | **–** | **0.98 (0.27–3.60)** | **0.978** | **–** | **–** | **0.77 (0.10–0.612)** | **0.805** |
| **Anxiety disorder/s prior to pregnancy** (indicated in *n*=149) | **14.31 (7.45–27.52)** | **<0.001** | **2.58 (1.41–4.74)** | **0.001** | **2.40 (1.00–5.74)** | **0.049** | **3.44 (1.32–8.95)** | **0.011** |
| **Anxiety disorder/s during pregnancy** (indicated in *n*=97) | **–** | **–** | **5.54 (2.99–10.26)** | **<0.001** | **–** | **–** | **3.30 (1.41–7.75)** | **0.006** |
| **Depressive disorder/s prior to pregnancy** (indicated in *n*=113) | **1.79 (1.10–2.94)** | **0.020** | 1.76 (0.98–3.15) | 0.057 | **10.79 (3.60–32.33)** | **<0.001** | **3.08 (1.30–7.31)** | **0.011** |
| **Depressive disorder/s during pregnancy** (indicated in *n*=25) | **–** | **–** | **4.31 (1.85–10.06)** | **0.001** | **–** | **–** | **7.21 (2.70–19.21)** | **<0.001** |
| **Correlates** | | | | | | | | |
| **Social support** (T2, one unit increase)[a] | **0.44 (0.27–0.70)** | **0.001** | **0.46 (0.27–0.78)** | **0.004** | **0.41 (0.20–0.84)** | **0.015** | **0.47 (0.23–0.97)** | **0.041** |
| **Social support** (T6, one unit increase)[a] | **–** | **–** | **0.41 (0.26–0.64)** | **0.001** | **–** | **–** | **0.45 (0.26–0.79)** | **0.005** |
| **Partnership satisfaction** (T2, one unit increase)[b] | **0.98 (0.96–1.00)** | **0.031** | **0.97 (0.95–0.99)** | **0.017** | **0.96 (0.93–0.99)** | **0.013** | 0.98 (0.95–1.01) | 0.127 |
| **Partnership satisfaction** (T6, one unit increase)[b] | **–** | **–** | **0.97 (0.95–0.99)** | **0.003** | **–** | **–** | 0.98 (0.95–1.00) | 0.092 |
| **Self-esteem** (T3, one unit increase)[a] | **0.89 (0.83–0.95)** | **<0.001** | **0.88 (0.82–0.95)** | **0.001** | **0.86 (0.78–0.94)** | **0.001** | **0.91 (0.83–0.99)** | **0.037** |
| **Self-efficacy** (T3, one unit increase)[a] | 0.98 (0.92–1.05) | 0.596 | **0.92 (0.85–0.99)** | **0.036** | **0.83 (0.73–0.93)** | **0.002** | 0.91 (0.81–1.02) | 0.098 |

*Note*: OR: odds ratio, 95%CI: 95% confidence interval, bold: significant associations at *p*-level < 0.05; T2: week 22–24 of gestation, T3: week 35–37 of gestation, T6: 4 months postpartum.

[a] Due to missing data of particular questionnaire scores, these analyses were based on slightly differing sample sizes.

[b] Some women had no partner at the respective assessment points and were therefore unable to provide data concerning partnership quality.

trauma experience and mode of delivery were associated with postpartum depression.

Furthermore, peripartum anxiety and depressive disorders were associated with less social support, lower partnership satisfaction, and lower self-esteem and self-efficacy.

### 3.2. Incident and recurrent/persistent anxiety and depressive disorders in initial diagnostic groups

Cases of incident and recurrent/persistent anxiety and depressive disorders in initial diagnostic groups are presented in Table 4. Among women with no AD, 1.8% reported incident depressive disorders and 15.6% reported incident anxiety disorders during the total study period. The incidence of depressive disorders was higher in women with pure A (11.9%) with a significantly increased risk (OR=7.2, 95%CI 1.5–34.0, $p=0.012$). Also, the incidence of anxiety disorders was higher in women with pure D (27.1%), but the OR failed to reach significance (OR=2.0, 95%CI: 0.9–4.6, $p=0.095$).

Furthermore about one-fifth (20.8%) of women with a history of pure D prior to pregnancy were again affected by a major depressive episode and at least every second woman (56%) with pure A prior to pregnancy reported an anxiety disorder during peripartum period. Then, nearly one third (29.2%) of the women with a history of comorbid AD indicated a recurrent major depressive episode and almost two thirds (63.1%) of the participants with comorbid AD were again affected by an anxiety disorder during peripartum period.

### 3.3. Incident and recurrent/persistent cases of particular anxiety and depressive disorders

Since women with an anxiety or depressive disorder prior to pregnancy may experience the incidence of another disorder during the study period, diagnosis-specific incidences are reported in Table 5. The majority of incident panic disorders were observed at the second assessment and participants reported inter alia panic because of palpitations, fear of pregnancy complications and panic when talking about feelings associated with pregnancy. After delivery one woman reported panic after changing diapers, because she feared that she will not be able to cope with the new situation. Two incident cases of agoraphobia were seen during pregnancy (e.g. anxiety that the womb is hit when being in a crowd) and additional four new cases after delivery (e.g. being outside the home alone with the child, being too weak after delivery). Two women reported incident social phobia during second trimester after being in the centre of attention on a party and one woman reported social fears at a professional training after job re-entry. Relatively high incidence rates were observed for specific phobia: Five cases were seen during pregnancy (*n*=3

**Table 4**
Incident and recurrent/persistent anxiety and depressive disorders in initial diagnostic groups ($N=306$).

| | Pregnancy | | | After delivery | | | Total pregnancy | Total study period |
|---|---|---|---|---|---|---|---|---|
| | 4w-T1 *n* | T1-T2 *n* | T2-T3 *n* | birth-T5 *n* | T5-T6 *n* | T6-T7 *n* | (4w-T3) *n* (%) | (4w-T7) *n* (%) |
| **In women with no AD ($n=109$)** | | | | | | | | |
| *Incident anxiety disorder* | *1* | *6* | *1* | *6* | *1* | *2* | *8 (7.3)* | *17 (15.6)* |
| *Incident depressive disorder* | *0* | *0* | *1* | *1* | *0* | *0* | *1 (0.9)* | *2 (1.8)* |
| **In women with pure D ($n=48$)** | | | | | | | | |
| *Incident anxiety disorder* | *0* | *4* | *1* | *1* | *1* | *6* | *5 (10.4)* | *13 (27.1)* |
| Recurrent/persistent depressive disorder[a] | 5 | 3 | 1 | 1 | 0 | 3 | 7 (14.6) | 10 (20.8) |
| **In women with pure A ($n=84$)** | | | | | | | | |
| Recurrent/persistent anxiety disorder[a] | 37 | 12 | 9 | 7 | 11 | 8 | 44 (52.4) | 47 (56.0) |
| *Incident depressive disorder* | *0* | *1* | *2* | *3* | *2* | *2* | *3 (3.6)* | *10 (11.9)* |
| **In women with comorbid AD ($n=65$)** | | | | | | | | |
| Recurrent/ persistent anxiety disorder[a] | 27 | 17 | 13 | 7 | 4 | 14 | 40 (61.5) | 41 (63.1) |
| Recurrent/ persistent depressive disorder[a] | 8 | 4 | 4 | 5 | 1 | 9 | 14 (21.5) | 19 (29.2) |

*Note:* 4w: 4 weeks prior to baseline, T1: week 10–12 of gestation (baseline), T2: week 22–24 of gestation, T3: week 35–37 of gestation, T5: 2 months postpartum, T6: 4 months postpartum, T7: 16 months postpartum, *N*: number of participants, %: percentages, *initial diagnostic groups:* no AD: no anxiety nor depressive disorder prior to pregnancy, pure D: pure depressive disorder(s) prior to pregnancy, pure A: pure anxiety disorder(s) prior to pregnancy, comorbid AD: comorbid anxiety and depressive disorders prior to pregnancy. For missing information at particular assessment points it was assumed that no anxiety and depressive disorder was present in the respective participant at this particular assessment point.

[a] Please note that some women experienced persistent disorders at several assessment points (e.g. one woman reported a persistent depressive disorder at each assessment point from T1 until T5).

blood-injection-injury type, $n=1$ situational type, $n=1$ animal type) and 11 cases after delivery ($n=4$ blood-injection-injury type, $n=3$ situational type, $n=2$ animal type, $n=1$ natural environment type, $n=1$ other type). Incident obsessive-compulsive disorders were solely reported during the first four months after delivery by six women (e.g. thoughts about contamination, thoughts about hurting the infant after the infant was fallen from the changing table, obsessions and compulsions regarding the health of the infant, religious compulsions and intensification of ritual behaviour). Incident posttraumatic stress disorders were reported by three women. One woman presented a full-blown clinical picture of an incident posttraumatic-stress disorder because of a traumatic birth experience in an earlier pregnancy. Further two incident cases of posttraumatic-stress disorder were observed following serious harm of family members during the study period. With regard to incident generalized anxiety disorders, worries about the health of family members and the infant, worries about failing an exam because of pregnancy, worries about every day's life, existential fears and worrisome tension while breastfeeding were specified. Interestingly, incident phobia NOS was reported by nineteen women during pregnancy (e.g. anxiety of preterm rupture of membranes outside the home) and further thirteen women after delivery (e.g. public transport with the buggy, shopping with the baby).

A considerable number of women with a history of particular anxiety disorders prior to pregnancy reported the respective symptoms also during peripartum period (see Table 5 below). Interestingly, some of these women indicated a shift in their feared/avoided situations (e.g. panic disorder: fear of dying changed to fear of losing the child; Agoraphobia: fear of being outside the home alone changed to fear of being outside with the child in an unexpected situation; social phobia: fear of performance situations altered to fear of behaving embarrassing during birth or being stared at when the baby is crying; specific phobia: fear of dogs persisted, but the mother stated that she would now protect her infant instead of escaping from the situation; generalized anxiety disorder: unspecific worries about the health of family members shifted to more specific fears about the health of the baby). Some participants also specified the fear to transmit own anxieties to the infant by showing avoidance behavior in the presence of the child.

Overall, incident major depressive episodes/disorders were reported by five women during pregnancy and by further 10 women after delivery. There were no cases with incident dysthymia in this study, but three out of six women with history of dysthymia prior to pregnancy had a persistent dysthymia during pregnancy and the remaining three women reported a full blown major depressive episode during pregnancy (exacerbation to double depression). About 23.4% of the women with major depressive disorders prior to pregnancy were again affected by a recurrent major depressive episode during pregnancy.

### 3.4. Course patterns of anxiety and depressive disorders during peripartum period

For $n=286$ women who participated at least once during pregnancy (T1, T2 or T3) and after delivery (T5, T5 or T7) frequency and percentages of different course patterns are displayed in Table 6. Most prominent course pattern was Type I (no disorder prior to, during and after pregnancy). Commonly seen were also recoveries prior to pregnancy (Type II), recoveries from pregnancy to postpartum (Type VI), and first onsets after delivery (Type IV). A persistent course (Type VIII) of anxiety disorders during transition to motherhood was reported by 12.2% and 2.5% of the participants reported major depressive episodes prior to, during and after pregnancy. A sole occurrence of a disorder during pregnancy (Type III), a recovery during pregnancy followed by a relapse after delivery (Type V) and an ongoing disorder during pregnancy and after delivery in women with no pre-existing disorder (Type VII) were rarely reported (see Table 6).

## 4. Discussion

To our knowledge, this one of the first prospective-longitudinal observational studies with regional-epidemiological sampling in gynaecological outpatient settings examining incidence and course patterns of peripartum anxiety and depressive disorders. Additionally, risk factors and correlates of anxiety and depressive disorders during pregnancy and after delivery were investigated.

Strongest predictors for peripartum anxiety and depressive disorders were anxiety and depressive disorders prior to

**Table 5**
Incident and recurrent/persistent cases of particular anxiety and depressive disorders ($N=306$).

| **Incident cases** | **Subjects at risk** | **Pregnancy** | | | **After delivery** | | | **Total pregnancy** | **Total study period** |
|---|---|---|---|---|---|---|---|---|---|
| | | **4w-T1** | **T1-T2** | **T2-T3** | **birth-T5** | **T5-T6** | **T6-T7** | **4w-T3** | **4w-T7** |
| | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n* (inc.%)** | ***n* (inc.%)** |
| Panic disorder | 283 | 1 | 7 | 1 | 1 | 0 | 1 | 9 (3.2) | 11 (3.9) |
| Agoraphobia | 283 | 0 | 1 | 1 | 4 | 0 | 0 | 2 (0.7) | 6 (2.1) |
| Social phobia | 280 | 0 | 2 | 0 | 0 | 0 | 1 | 2 (0.7) | 3 (1.1) |
| Specific phobia | 210 | 0 | 4 | 1 | 1 | 1 | 9 | 5 (2.4) | 16 (7.6) |
| Obsessive-compulsive disorder | 297 | 0 | 0 | 0 | 3 | 3 | 0 | 0 (0.0) | 6 (2.0) |
| Posttraumatic-stress disorder | 283 | 0 | 1 | 1 | 1 | 0 | 0 | 2 (0.7) | 3 (1.1) |
| Generalized anxiety disorder | 273 | 0 | 0 | 2 | 0 | 4 | 2 | 2 (0.7) | 8 (2.9) |
| Phobia not otherwise specified | 275 | 1 | 9 | 9 | 5 | 2 | 6 | 19 (6.9) | 32 (11.6) |
| Major depressive disorder (MDE) | 199 | 0 | 1 | 4 | 5 | 2 | 3 | 5 (2.5) | 15 (7.5) |
| Dysthymia (dysthymic episode) | 300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 (0.0) | 0 (0.0) |
| Double depression (dysthymia followed by incident MDE) | 6 | 0 | 0 | 1 | 1 | 0 | 1 | 1 (16.7) | 3 (50.0) |
| **Recurrent/persistent cases** [a] | | **Pregnancy** | | | **After delivery** | | | **Total pregnancy** | **Total study period** |
| | **Affected prior to pregnancy** | **4w-T1** | **T1-T2** | **T2-T3** | **birth-T5** | **T5-T6** | **T6-T7** | **4w-T3** | **4w-T7** |
| | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n*** | ***n* (rec. %)** | ***n* (rec. %)** |
| Panic disorder | 23 | 6 | 7 | 0 | 2 | 0 | 2 | 13 (56.5) | 14 (60.9) |
| Agoraphobia | 23 | 7 | 3 | 1 | 1 | 0 | 0 | 9 (39.1) | 9 (39.1) |
| Social phobia | 26 | 7 | 1 | 1 | 1 | 0 | 1 | 7 (26.9) | 7 (26.9) |
| Specific phobia | 96 | 45 | 7 | 6 | 3 | 7 | 11 | 46 (47.9) | 49 (51.0) |
| Obsessive-compulsive disorder | 9 | 6 | 0 | 1 | 0 | 0 | 0 | 6 (66.7) | 6 (66.7) |
| Posttraumatic-stress disorder | 23 | 4 | 0 | 1 | 0 | 0 | 1 | 5 (21.7) | 6 (26.1) |
| Generalized anxiety disorder | 33 | 4 | 1 | 3 | 1 | 1 | 2 | 6 (18.2) | 7 (21.2) |
| Phobia not otherwise specified | 31 | 5 | 2 | 2 | 0 | 0 | 2 | 8 (25.8) | 9 (29.0) |
| Major depressive disorder (MDE) | 107 | 10 | 5 | 3 | 5 | 1 | 11 | 17 (15.9) | 25 (23.4) |
| Dysthymia (dysthymic episode) | 6 | 3 | 2 | 1 | 0 | 0 | 0 | 3 (50.0) | 3 (50.0) |

*Note:* 4w: 4 weeks prior to baseline, T1: week 10–12 of gestation (baseline), T2: week 22–24 of gestation, T3: week 35–37 of gestation, T5: 2 months postpartum, T6: 4 months postpartum, T7: 16 months postpartum. *n*: number of participants. MDE: major depressive episodes. Cumulative incidence percentages (inc. %) were quantified by the number of new cases divided by the number of subjects at risk. Subjects at risk were all women who were not affected by the respective anxiety or depressive disorder before. Percentages of recurrent/persistent cases (rec. %) refer to the number of women who were affected at least once during pregnancy and/or after delivery divided by the number of cases that were affected prior to pregnancy. For missing information at particular assessment points it was assumed that no anxiety and depressive disorder was present in the respective participant at this particular assessment point.

[a] Please note that some women experienced persistent disorders at several assessment points (e.g. one woman reported a persistent depressive disorder at each assessment point from T1 until T5).

**Table 6**
Course patterns of anxiety and depressive disorders during the study period ($n=286$).

| | **Type I** | | **Type II** | | **Type III** | | **Type IV** | | **Type V** | | **Type VI** | | **Type VII** | | **Type VIII** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period i: prior to pregnancy | dis. not present | | dis. present | | dis. not present | | dis. not present | | dis. present | | dis. present | | dis. not present | | dis. present | |
| Period ii: during pregnancy | dis. not present | | dis. not present | | dis. present | | dis. not present | | dis. not present | | dis. present | | dis. present | | dis. present | |
| Period iii: after pregnancy | dis. not present | | dis. not present | | dis. not present | | dis. present | | dis. present | | dis. not present | | dis. present | | dis. present | |
| | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** | ***n*** | **%row** |
| **Any anxiety disorder** | **116** | **40.6** | **57** | **19.9** | **11** | **3.9** | **17** | **5.9** | **4** | **1.4** | **44** | **15.4** | **2** | **0.7** | **35** | **12.2** |
| Panic disorder | 253 | 88.5 | 9 | 3.2 | 8 | 2.8 | 2 | 0.7 | 1 | 0.4 | 9 | 3.2 | 1 | 0.4 | 3 | 1.1 |
| Agoraphobia | 259 | 90.6 | 12 | 4.2 | 2 | 0.7 | 4 | 1.4 | 0 | 0.0 | 8 | 2.8 | 0 | 0.0 | 1 | 0.4 |
| Social phobia | 257 | 89.9 | 19 | 6.6 | 2 | 0.7 | 1 | 0.4 | 0 | 0.0 | 5 | 1.8 | 0 | 0.0 | 2 | 0.7 |
| Any specific phobia | 179 | 62.6 | 46 | 16.1 | 4 | 1.4 | 11 | 3.9 | 3 | 1.1 | 28 | 9.8 | 1 | 0.4 | 14 | 4.9 |
| Obsessive-compulsive disorder | 271 | 94.8 | 3 | 1.1 | 0 | 0.0 | 6 | 2.1 | 0 | 0.0 | 6 | 2.1 | 0 | 0.0 | 0 | 0.0 |
| Posttraumatic-stress disorder | 262 | 91.6 | 15 | 5.2 | 2 | 0.7 | 1 | 0.4 | 1 | 0.4 | 5 | 1.8 | 0 | 0.0 | 0 | 0.0 |
| Generalized anxiety disorder | 245 | 85.7 | 26 | 9.1 | 2 | 0.7 | 6 | 2.1 | 1 | 0.4 | 4 | 1.4 | 0 | 0.0 | 2 | 0.7 |
| Phobia NOS | 224 | 78.3 | 21 | 7.3 | 15 | 5.2 | 13 | 4.6 | 1 | 0.4 | 7 | 2.5 | 4 | 1.4 | 1 | 0.4 |
| **Any depressive disorder** | **167** | **58.4** | **78** | **27.3** | **3** | **1.1** | **8** | **2.8** | **8** | **2.8** | **14** | **4.9** | **1** | **0.4** | **7** | **2.5** |
| Major depressive disorder | 170 | 59.4 | 76 | 26.6 | 4 | 1.4 | 10 | 3.5 | 8 | 2.8 | 12 | 4.2 | 1 | 0.4 | 5 | 1.8 |
| Dysthymia | 280 | 97.9 | 3 | 1.1 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | 3 | 1.1 | 0 | 0.0 | 0 | 0.0 |

*Note*: Period i: prior to pregnancy: lifetime information disregarding cases with an onset 4 weeks prior to baseline interview, period ii: during pregnancy: 4 weeks prior to baseline interview until third trimester of pregnancy; period iii: after pregnancy: birth until 16 months postpartum; The analyses were conducted for $N=286$ participants who provided information at each of the considered periods (i.–iii.).Type I: no disorder prior to, during and after pregnancy; Type II: disorder prior to pregnancy, only; Type III: disorder during pregnancy, only; Type IV: disorder after pregnancy, only; Type V: disorder prior to and after pregnancy; Type VI: disorder prior to and during pregnancy; Type VII: disorder during and after pregnancy; Type VIII: disorder prior to, during and after pregnancy; , *n*: number of participants assigned to the respective course type; % row: row percentages were reported to specify which type was most common in the particular disorder.

pregnancy. For all combinations (except for the relation of depressive disorder prior to pregnancy and anxiety disorders after delivery) ORs were significant indicating that women with an anxiety or depressive disorder prior to pregnancy (as compared to women without a history of anxiety or depressive disorders) are at increased risk to also reveal an anxiety and/or depressive disorder during peripartum period.

Moreover, some risk factors were specific for anxiety and depressive disorders during particular time frames. For example, a history of a sexual or man-made trauma experience was associated with anxiety disorders during (but not after) pregnancy and with postpartum depression (but not with depression during pregnancy). An explanation may be that traumatized women are afraid of the upcoming delivery and their birth-related fears may be resolved by parturition. However, the experience of a problematic delivery may lead to postpartum depression in these women.

In line with other studies (Austin and Lumley, 2003; Beck, 1996; Henshaw, 2003; O'Hara and Gorman, 2004; Robertson et al., 2004; Ross et al., 2006; Schmied et al., 2013; Scrandis et al., 2007) we found lower maternal education, a history of trauma and operative parturition to be risk factors for postpartum depressive disorders. However, unplanned pregnancy was associated with depression during pregnancy and young maternal age, low education and premenstrual syndrome prior to pregnancy were rather associated with anxiety disorders after delivery. Importantly, social support, satisfaction with partnership, self-esteem and self-efficacy were related to both, peripartum anxiety and depressive disorders. Thus, prevention and interventional studies are needed that examine to what extent an improvement of these targets could help to prevent or improve peripartum anxiety and depressive disorders (Mendelson et al., 2013).

A major strength of this study was the discrimination of women with a prior history of an anxiety or depressive disorder from cases that were affected for the first time during peripartum period. In line with studies that revealed anxiety disorders as important risk factors for secondary depression (Beesdo et al., 2010; Sutter-Dallay et al., 2004; Wittchen et al., 2000) the present study also showed that women with pure A prior to pregnancy had a sevenfold risk for incident depressive disorders as compared to women with no AD (OR=7.2, 95%CI: 1.5–34.0, $p=0.012$). The OR for the association of pure D prior to pregnancy and incident anxiety disorders failed to reach significance. Thus, clinicians should not only consider a history of depressive disorders in prenatal care (Micali et al., 2011), but also evaluate lifetime information on the widely neglected anxiety disorders.

Most incident panic disorders were reported particularly during the second trimester of pregnancy. This might be explained by pregnancy-related physical changes (adaption of the cardiovascular system) or increased bodily sensations that are associated with the physical alterations during pregnancy. However, panic disorders seemed to be rather transient given the decreasing overall rates of panic disorder in this study at the third trimester (rates were reported by Martini et al. 2013, Table 2). In contrast, incident obsessive-compulsive disorders were seen during postpartum period only, and may be explained by hormonal changes, but also by new responsibilities of the mother to protect the infant (Abramowitz et al. 2003). Notably many participants with incident phobia NOS reported pregnancy- and child-related fears that may be typical for the time of transition to parenthood. Yet, psychosocial changes could also be relevant for the course of particular disorders, for example women with social phobia are rarely confronted with performance situations of work life during maternity leave, but face the challenge of job re-entry afterwards. Incidence rates of major depressive disorders (cum. incidence pregnancy: 2.5%, cum. incidence total study period: 7.5%) were comparable with the cumulative incidence rates reported by Banti and colleagues (pregnancy: 2.2%, first postpartum year: 6.8%; Banti et al., 2011).

There was a considerable proportion of recurrent/persistent anxiety disorders (21.2–66.7%). For example, almost two thirds of the women with a history of panic and obsessive compulsive disorders were again affected during peripartum period. Interestingly, some of the affected women indicated a shift in their feared/avoided situations and some participants even specified the fear to transmit own anxieties to the infant by showing avoidance behavior in the presence of the child. This is important for diagnostic monitoring, prevention, treatment and treatment evaluation during peripartum time for clinicians as well as affected women. About 23.4% of the women with major depressive disorders prior to pregnancy were again affected by a recurrent major depressive episode during pregnancy. There were no incident dysthymic disorders in this study, but every second women with lifetime dysthymia indicated a major depressive episode and thus the exacerbation to double depression during peripartum time. Hence, women with dysthymia are a particular risk population for major depressive episodes during peripartum period.

Analyses on different course patterns of particular anxiety and depressive disorders revealed heterogeneous results. The vast majority of women with no lifetime diagnosis remained healthy (Type I) or reported transient disorders during pregnancy (Type III). Relatively common was also Type II (disorder prior to pregnancy only), especially for specific phobias and major depressive episodes. But these rather episodic or early disorders (Wittchen et al., 1999) may have been partially resolved already prior to pregnancy. Surprisingly, relatively many women reported postpartum remission of a disorder that was present prior to and during pregnancy (Type VI). For remission of panic disorder, weaning may be an explanation (Ross and McLean, 2006), but the remission of the other disorders was unexpected because this was rarely reported in the literature thus far (Goodman et al. 2014; Ross and McLean, 2006). Given the remission rates of anxiety and depression on the one hand and the incidence rates on the other hand our results emphasize that peripartum time is a sensitive period of considerable change.

Peripartum (Type VII) or postpartum (Type IV) onsets of anxiety and depressive disorders in previously healthy women were also observed indicating a heightened vulnerability during peripartum time. Given the evidence that peripartum anxiety and depressive disorders are associated with adverse consequences for mother and offspring (e.g. Chen et al., 2010; Field et al., 2010; Glasheen et al., 2010; Grigoriadis et al., 2013; Murray and Cooper, 1996; van Batenburg-Eddes et al., 2009; Wan and Green, 2009, for review see Alder et al., 2007; Goodman et al., 2014) these women and women with persistent depressive (2.5%) and anxiety (12.2%) disorders (Type VIII) should receive special attention in perinatal care.

## 5. Limitations

Some limitations of the study should be noted. First of all, recall bias cannot be ruled out. In order to receive valid prospective information, however, the participants were carefully instructed to report the particular symptoms of anxiety and depressive disorders for the particular assessment periods – irrespective the information they gave in interviews before.

Another consideration is the possible role of attrition, but overall retention rate was 89.5% (with comparable retention rates in the four initial diagnostic groups: 86.9–91.7%).

For missing information at particular assessment points it was assumed that no anxiety disorder or depressive disorders was present (conservative estimation). But, replacing missings with 0 (assuming no diagnosis) generally yields an underestimation of rates (because some of the observations replaced with a 0 might truly be a 1). Since there were pretty few missings (at most 3.3% at

one assessment) and dropouts (7.9% throughout the complete study) in this study (cf. Martini et al., 2013; Table 2), replacement/non-replacement of missings is unlikely to yield different results and this conservative strategy is common practice in estimating (cumulative) prevalence and incidence rates. However, the analyses where repeated with the last observation carried forward (LOCF)-method revealing only slightly higher recurrence rates at single assessment points with $N=5$ LOCF recurrence cases of anxiety disorders ($N=2$ at T5, $N=3$ at T7) and $N=2$ LOCF recurrence cases of depressive disorders ($N=1$ at T5, $N=1$at T7). Importantly, LOCF analyses do not lead to differing incidence rates at particular assessment points nor to differing cumulated incidence or cumulated recurrence rates.

Knowing the aims of the study after informed consent, some participants may have been more encouraged to report anxieties, worries and depressive symptoms. Yet, if a careful explanation of the study aims (informed consent) leads to a greater propensity to report clinical symptoms, this should be considered to improve screening methods in perinatal care.

A comparably high number of women reported specific phobias prior to pregnancy (cf. Martini et al., 2013, Table 2; Kessler et al., 2012; Jacobi et al., 2014; Wittchen et al., 1999). However, the vast majority of these phobias had an onset during childhood or adolescence ( < 18 years: 93.8%) and every second women in this sample reported a recurrence of specific phobia during the study. Thus, peripartum period could be a time of retrospection and some women may be reminded of their own childhood and childhood anxieties. Furthermore, one may speculate whether these women were more prone to specific fears and phobias during peripartum time due to hormonal alterations, the forthcoming delivery or the new responsibilities, but such hypotheses need further research attention.

Considering representativeness, it should be noted that participants of the MARI study reported a higher educational level, were more often married and worked more often part-time as compared to the average female population of Saxony (Germany) at this age. The higher educational level of the participants may be due to the recruitment in the area of Dresden, a region with several universities and a relative high educational level. The higher rate of married women can be explained by the fact that married women of this age group may decide more often to get pregnant than unmarried/single women. Due to pregnancy, some of the women may have already reduced their working time and worked part-time. Importantly, no significant differences emerged regarding the percentage of women with very low educational level (9th grade or no degree), separated, widowed, divorced or currently not working women and the monthly household income.

Overall, participants of the MARI sample were more often primipara as compared to the average women from the local birth statistic and infants were more often born at term and with a birth weight above 2500 g. Differences in gynaecological variables can at least partly be explained by the applied exclusion criteria, because women with multiple or high-risk pregnancies (who potentially have more complicated pregnancies and preterm deliveries) were excluded from the MARI sample. Still, the distribution of infants' birth weight above 2500 g, the sex ratio and the mode of delivery were comparable to the reference data.

A last limitation that should be acknowledged is that symptom patterns for specific diagnoses could not be provided in more detail given the comparatively small numbers of some specific diagnoses.

## 6. Conclusion

Taken together, pregnancy is a sensitive time for considerable incidence and changes of pre-existing anxiety and depressive disorders. Young women with low education, sexual or physical trauma experience, unintended pregnancy, operative mode of delivery or a history of anxiety and depressive disorders or premenstrual syndrome seem to be at risk for incident and recurrent anxiety or depressive disorders during peripartum period. Low social support and satisfaction with partnership as well as low self-esteem and self-efficacy were also related to peripartum anxiety and depressive disorders and may be relevant and modifiable targets for prevention and early targeted interventions in women at risk (Mendelson et al., 2013).

Recent studies suggest that anxious and depressive symptoms and also the biological stress response (e.g. cortisol awakening response) can be reduced during peripartum period by implementing relaxation techniques, psychoeducation, and cognitive-behavioural interventions (Bittner et al., 2014; Kozinszky et al., 2012; Richter et al., 2012; Teixeira et al., 2005; Urech et al., 2010; Urizar et al., 2004). These strategies may also have a positive impact on obstetric and neonatal outcomes (Fink et al., 2012).

Treatment studies suggest that cognitive-behavioral therapy, interpersonal therapy (e.g. Goodman et al., 2014; Lilliecreutz et al., 2010; Robinson et al., 1992; Sockol et al., 2011; van Zoonen et al., 2014) and/or medication (e.g. Wisner et al., 2009) might improve maternal disorders and offspring outcomes, but during pregnancy and lactation potential risks and benefits have to be evaluated (Arch et al., 2012; Bonari et al., 2004; Wisner et al., 2009). Psychotherapies involving the family and interventions designed to improve mother-infant-interaction are promising strategies that need further research attention (Sockol et al., 2011; Stein et al., 2014).

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**Conflict of interest**

All authors had complete freedom to direct the analysis and its reporting within the current manuscript without influence from the sponsors. There was no editorial direction or censorship from the sponsors.

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