Arch Womens Ment Health (2014) 17:49–56
DOI 10.1007/s00737-013-0377-4

ORIGINAL ARTICLE

# Prevalence of paternal perinatal depressiveness and its link to partnership satisfaction and birth concerns

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Received: 8 February 2013 / Accepted: 27 August 2013 / Published online: 11 September 2013
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**Abstract** Depressive disorders have shown an increasing prevalence over the past decades. Growing evidence suggests that pregnancy and childbirth trigger depressive symptoms not only in women but likewise in men. This study estimates the prevalence of paternal perinatal depressiveness in a German community sample and explores its link to partnership satisfaction as well as birth-related concerns and concerns about the future. Data was gathered in a longitudinal study over the second and third trimester of their partner's pregnancy up to 6 weeks postpartum. In a two-stage screening procedure, 102 expectant fathers were assessed for symptoms of depression, anxiety, and partnership satisfaction using the Edinburgh Postnatal depression Scale (EPDS), the State/Trait Anxiety Inventory, a self-constructed questionnaire for birth concerns and the Questionnaire of Partnership. The prevalence of elevated depressive symptoms among expectant fathers was 9.8 % prenatally and 7.8 % postnatally. Prenatal relationship quality, prenatal EPDS scores, and birth concerns were significantly associated with and explained 47 % of the variance in paternal postnatal depressive symptoms. The prevalence of paternal depressive symptoms is a significant concern. Our findings point out the need for implementing awareness and screening for depressiveness in fathers in clinical routine in Germany as well as the necessity of developing a screening instrument for paternal birth-related anxiety.

**Keywords** Paternal depression · Postnatal · Prenatal · Father's health · EPDS · Birth anxiety

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## Introduction

Major depressive disorder is a common mental health issue worldwide, with an estimated 350 million people affected (WHO International Consortium in Psychiatric Epidemiology 2000). While maternal prenatal and postnatal depression and its effects on both the mother's health and her child's development is a well-recognized health issue (Grigoriadis et al. 2013), there are limited studies on pregnancy-related paternal depression (Figueiredo and Conde 2011). According to a systematic literature review, antenatal depression affects approximately 12 % of women with the highest prevalence in the second and third trimester of pregnancy (Bennett et al. 2004). There is overwhelming amount of data suggesting a correlation between untreated depression or anxiety during pregnancy and unfavorable outcomes for both mother and fetus such as lower birth weight, preterm birth, as well as behavioral problems postpartum (Marcus 2008; Bonari et al. 2004; Grote et al. 2010; Grigoriadis et al. 2013).

However, little is known about the effects of paternal pre- and postnatal depression. While pregnancy is considered a life-changing period for mothers, it also deeply affects fathers transforming their relationships and their standing in the family and community (Marks and Lovestone 1995; Fletcher et al. 2006). Fathers might unintentionally be marginalized from both their partners' focus of attention as well as health services. Consequently, fathers may also be at increased risk to suffer from prenatal and postnatal depression in similar ways as mothers (Fletcher et al. 2006; Field et al. 2006).

While the 12-month general population period prevalence for major depressive disorder among men is estimated around 4.8 % according to the Diagnostic and Statistical Manual of Mental Disorders-fourth edition (DSM-IV) criteria (Kessler et al. 2003), recent studies suggest that the paternal depression rate might be raised during pregnancy and postnatally as is seen in mothers (Field et al. 2006; Paulson and Bazemore 2010). Field et al. claim that depressed fathers experience symptoms of depression and anxiety during pregnancy similar to expectant mothers suffering from depression (Field et al. 2006). In a review by Goodman et al., the incidence of paternal depression in community samples ranged from 1.2 and 25.5 % in the first year postpartum (Goodman 2004). The only existing meta-analysis of paternal prenatal and postnatal depression showed an overall rate of paternal depression between the first trimester and 1 year postpartum of 10.4 %, suggesting that paternal depression represents a significant public health concern (Paulson and Bazemore 2010). Other studies, however, reported prevalence rates at the lower end of this range from 3 to 10 % (Ramchandani et al. 2008; Matthey et al. 2000). The background of these contradictory results is most likely related to differences in study design, sample sizes, as well as timing and method for assessment of depressive symptoms by having questionnaire methods typically produce higher prevalence rates compared to structured interviews (Paulson and Bazemore 2010).

Edoka et al. provided first insights that paternal postnatal depression is also associated with higher community care costs suggesting that paternal depression may represent a major public health concern all over the Western World (Edoka et al. 2011).

Moreover, the most important fact is that paternal postnatal depressive symptoms are unfavorably associated with a child's long-term social–emotional and cognitive outcome through its impact on the parent–child interaction (Ramchandani et al. 2005, 2011; Wilson and Durbin 2010). Ramchandani et al. showed that depressive disorders affecting fathers are associated with an increased risk of interparental conflict and higher levels of difficulties in infant temperament (Ramchandani et al. 2011). As part of the *Avon Longitudinal Study of Parents and Children*, they also assessed paternal depressive symptoms (EPDS) in 10,975 fathers in the prenatal period and followed fathers and their children for 7 years (Ramchandani et al. 2008). Paternal postnatal depression was significantly associated with psychiatric disorders in their children 7 years later (OR, 1.94; 95 % CI, 1.04–3.61). Considering prenatal correlates, Ramchandani and colleagues found paternal prenatal depressive and anxiety symptoms to be the strongest predictors of paternal postnatal depression (Ramchandani et al. 2008).

Few studies and only one systematic review focus on the prenatal correlates of paternal postnatal depression. However, some key findings emerged. Matthey et al. examined the course of depression on 157 first-time mothers and fathers with emphasis on the role of personality and parental relationship as risk factors concluding that maternal and paternal antenatal mood and further relationship quality represent the strongest indicators for paternal postnatal depression (Matthey et al. 2000). In a systematic review, Wee et al. identified several risk factors as most common correlates of paternal pre- and postnatal depression emphasizing the role of having a partner with elevated depressive symptoms or depression as well as poor relationship satisfaction (Wee et al. 2011). Other studies showed that anxiety during pregnancy and the postpartum is also a common phenomenon in men displaying high levels in the first and third trimester (Teixeira et al. 2009) and that these symptoms can be strongly linked to preexisting family and relationship factors (Luoma et al. 2013). While most studies use the State/Trait Anxiety Inventory (STAI) to assess prenatal paternal anxiety in general, Nolan et al. pointed out that especially pregnancy-related anxiety levels are found to be high in men regarding the wellbeing of their partners and babies (Nolan et al. 2011). In women, pregnancy anxiety is already regarded as a relatively distinctive syndrome and can be adequately assessed with the Pregnancy Related Anxiety Questionnaire (Huizink et al. 2004). For men, no such tool exists and general anxiety measures may capture only a small part of the variance of birth specific fears (Nolan et al. 2011). Therefore, we used a questionnaire regarding the fathers' birth-related concerns specifically. Furthermore, concerns about the future, as well as a perceived difference between prenatal expectations and experiences related to family, work, and social life after childbirth seem also relevant for paternal postnatal adjustment (Bronte-Tinkew et al. 2007).

In spite all, research on predictors of paternal postnatal depressive symptoms remains in its infancy. Given the critical period of the postpartum for the development of depression in men and its influences on father–child interaction, a better understanding of the development of depression in fathers both during the prenatal and postnatal period is clearly warranted.

Through this study, we aimed to raise awareness for paternal depressiveness in Germany and to the prenatal predictors of paternal postnatal depressive symptoms. After estimating the prevalence of paternal prenatal and postnatal depressive symptoms in a German community sample, we first aimed to confirm the hypothesis that prenatal symptoms predict postnatal symptoms. Secondly, in a longitudinal approach, we explored the role of several influence factors such as partnership quality, birth-related anxiety, and concerns about the future on paternal postnatal depressive symptoms.

## Methods

### Procedure

Expectant fathers were recruited between the second (>24th week) and third trimester of their partner's pregnancy from

August 2010 till October 2011. Exclusion criteria for participation in the study included age below 18 years, having a partner and/or fetus suffering from serious medical conditions or lacking command of the German language. The participants were approached by a trained interviewer while attending prenatal care together with their partners at the Department of Obstetrics of the University of Heidelberg Medical Center. Following a detailed information and consent, expectant fathers were given the prenatal questionnaire set containing the German version of the EPDS (Cox et al. 1987; Bergant et al. 1998) and a demographic information sheet to be filled out and returned by mail or upon the next visit. Partnership satisfaction was measured with the Questionnaire of Partnership (PFB; Hahlweg 1996). Birth and future concerns were assessed with a self-constructed questionnaire.

For assessment in the early postpartum period (4–6 weeks), 3 weeks after the estimated expected date of delivery of the participant's partner they received a postnatal questionnaire set by mail including questions about the delivery experience, the EPDS and the STAI (Spielberger et al. 1970). This way patients delivering in other medical centers could also be included. A system of follow-up reminders by email was implemented to maximize returns.

## Participants

A total of 320 German-speaking fathers were asked to participate in the study, of which 221 (69.1 %) consented. The participation rate of 69 % is acceptable and comparable with rates from other studies (Ballestrem et al. 2005; Matthey et al. 2003). The return rate at the second point of assessment was 46.2 % (102 of 221) within the sixth week postpartum. To avoid selection bias, we decided to use the consistent dataset of $N=102$ participants for the main analyses. All participants completed a demographic information sheet covering sociodemographic data such as age, previous children, and education level.

## Instruments

*Edinburgh postnatal depression scale* The EPDS was used to detect symptoms of depression during pregnancy (Cox et al. 1987). It is a 10-item self-rating scale, scored from 0 to 3 (normal response, 0; severe response, 3), that has been validated in the detection of prenatal and postnatal depression in numerous studies (Matthey and Ross-Hamid 2012). Originally developed as a screening instrument for the postnatal period, the EPDS is a feasible questionnaire during pregnancy (Cox et al. 1996). The scale is sensitive to changes in severity of depression with a sensitivity and specificity of 91 and 95 % in detecting depressive disorders in mothers and only marginally lower in fathers (Matthey et al. 2001). The recommended cutoff scores for maternal depressive symptoms of 12 or more points for minor depression and of 14 or more points for major depression were applied in several studies. For paternal postnatal major depression, the EPDS was shown to have reasonable sensitivity (89.5 %) and specificity (78.2 %) at a cutoff score of 10 or more (Edmondson et al. 2010). For paternal postnatal major and minor depression, Matthey et al. recommend a cutoff score of 9 or more with a sensitivity of 71.4 % and a specificity of 93.8 % (Matthey et al. 2001). In both studies, the cutoff scores needed to be decreased to 8 or more or 5 or more to include cases of anxiety disorders. In the present study, we used the original threshold of 9 or more to identify probable cases of minor and major depression in fathers (Matthey et al. 2001).

*State/trait anxiety inventory* Anxiety was assessed by the 20-item state subscale of the Spielberger STAI (Spielberger et al. 1970). The STAI differentiates between the temporary condition of "state anxiety" and the more general and long-standing quality of "trait anxiety". The state scale evaluates feelings of apprehension, tension, nervousness, and worry. Scores on the state scale increase in response to physical danger and psychological stress. The state portion of the STAI (STAI-S) was administered to participants, and items were scored from 1 to 4, with higher numbers corresponding to greater agreement. Several studies have demonstrated that the STAI has adequate concurrent validity and internal consistency ($r=0.83$). It takes about 5 min to complete. The recommended cutoff score for high anxiety is 48 or more.

*Questionnaire of partnership* The PFB assesses general quality of partnership (Hahlweg et al. 1996) consisting of 30, four-point items, which are categorized into three scales: conflict behavior, tenderness, and communication. On the scale conflict behavior, higher scores indicate less satisfaction with the partnership, while on the scales tenderness and togetherness/communication higher scores indicate more satisfaction with the partnership. Previous analyses have evinced adequate scale reliability, with Cronbach's $\alpha$ ranging from 0.88 to 0.93 and 6-month test–retest reliability ranging from $r=0.68$ to 0.83 (Hahlweg 1996).

*Assessment of birth and future concerns* We used a self-constructed questionnaire for the assessment of birth and future concerns due to a lack of existing instruments. Regarding birth-related concerns, our instrument consisted of nine 6-point items covering anxieties of unexpected onset of labor, the ability to cope during labor, the fear to let the partner down, not being able to see the partner in pain, experience of unexpected complications, passing out during delivery, loosing consciousness, being needless during the process of delivery, disappointing the partner, and being too late. These questions partially refer to the *Pregnancy Related Anxiety Questionnaire* (Huizink et al. 2004).

Future concerns were assessed with nine 4-point items regarding concerns about spending less time with friends, hobbies, wife, and family as well as concerns regarding financial and employment issues.

### Statistical analysis

For all analyses conducted in this study, we used the Statistical Package for Social Sciences (IBM SPSS v. 20.0). Estimators of effect size and power analyses have been conducted using G-Power v. 3.1.4 (Faul et al. 2007, 2009). Because of scale-specific amounts of missing values, the valid number of cases $n$ varies dependent on the data subsets used for the particular test.

Parametric testing was chosen as linear relationships were postulated. As even with large sample sizes, parametric testing did not turn out to be sufficiently robust against the violation of normal distribution, the SPSS module generalized linear models was used to estimate robust linear parameters of gained regression models (Wald maximum likelihood estimation). Correction for shrinkage ($R^2$ adjustment) was estimated following Olkin and Pratt (1958). Preliminary to main analyses, distributions of demographic and study variables are demonstrated.

As a first step of the main analysis, we tested the confirmative hypothesis that prenatal paternal EPDS scores predict postnatal paternal EPDS scores (linear regression). This hypotheses is tested by a two-sided $t$ test with $\alpha = 0.05$.

Next, in an exploratory and therefore purely descriptive approach, we tested for other influence factors on paternal pre- and postnatal depressiveness without correction of the $\alpha$ errors or testing of selection bias due to missing values.

In a last step, a stepwise linear regression analyses (backward) with the significant variables out of the second step should reduce the variable set to relevant ones and serve as comparison of impact sizes of the different predictive variables in the current dataset.

## Results

### Pre- vs. postnatal depressiveness

The distribution of study variables is demonstrated in Tables 1 and 2. Prenatally, the prevalence of clinical significant depressive symptoms as assessed with the EPDS was 9.8 % (Table 1). In the early postpartum period (4–6 weeks after birth), fewer fathers showed elevated symptoms of depression than prenatally (7.8 %) as shown in Table 2. This effect did not turn out to be significant ($\chi^2 = 0.24$, $p = 0.81$). The probability to find a medium-sized effect ($w = 0.3$) was $1-\beta = 0.85$.

### Prediction of paternal postnatal depressiveness

Paternal prenatal EPDS scores ($M = 4.17$, SD=3.59, $\beta = 0.39$, $t = 4.26$, $p < 0.01$) significantly predict postnatal paternal depressiveness ($M = 4.04$, SD=3.23, $R^2 = 0.15$, $R^2_{adj} = 0.15$, $F_{1,\ 101} = 18.14$, $p < 0.01$). The robust parameter estimates revealed corresponding results (Table 3).

### Other influences on paternal postnatal depressiveness

A $t$ test on postnatal EPDS scores between fathers already having children ($M_{post} = 4.20$, $SD_{post} = 3.63$, $n = 45$) and those who do not ($M_{post} = 3.69$, $SD_{post} = 2.76$, $n = 54$) was revealed to be nonsignificant ($t = -0.80$, $df = 97$, $p = 0.43$, $\beta = 0.13$).

We further tested for differences between men with ($M_{post} = 4.02$, $SD_{post} = 3.23$, $n = 49$) and without an academic profession ($M_{post} = 4.04$, $SD_{post} = 3.27$, $n = 46$). The result was revealed as being nonsignificant ($t = 0.04$, $df = 93$, $p = 0.97$, $\beta = 0.14$).

Table 1 reports all other correlations with paternal postnatal depressiveness. These variables (paternal age, number of previous children, birth concerns, PFB, STAI-S, and concerns regarding the future) and the prenatal EPDS scores were exploratively taken into account for a stepwise multiple linear regression analysis (backward) aiming at the explanation of paternal postnatal depressive symptoms. A specific variable

**Table 1** Description and distribution of parametric study variables

| Variable | M | SE | SD | Min | Max | N | Skewness | Kurtosis | Kolmogorov–Smirnov | Shapiro–Wilk | $r$ to $EPDS_{post}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Paternal age | 35.82 | 0.59 | 5.95 | 23 | 55 | 102 | 0.36 | 0.53 | 0.08 | 0.98 | −0.17 |
| Number of children | 0.61 | 0.08 | 0.83 | 0 | 4 | 102 | 1.58 | 2.75 | 0.35** | 0.72** | 0.00 |
| Birth concerns | 22.08 | 0.80 | 8.04 | 9 | 48 | 100 | 0.58 | 0.15 | 0.08 | 0.97* | 0.34** |
| Future concerns | 11.65 | 0.36 | 3.68 | 5 | 21 | 102 | 0.38 | −0.36 | 0.08 | 0.97* | 0.22* |
| $EPDS_{pre}$ | 4.17 | 0.35 | 3.59 | 0 | 17 | 102 | 1.38 | 2.02 | 0.16** | 0.88** | 0.39** |
| PFB score | 64.04 | 1.29 | 12.47 | 40.67 | 88.89 | 93 | 0.18 | −1.02 | 0.10* | 0.97* | −0.31** |
| STAI-S | 49.61 | 1.12 | 11.19 | 20 | 69 | 99 | −0.39 | −0.55 | 0.13** | 0.97* | 0.25* |
| $EPDS_{post}$ | 4.04 | 0.32 | 3.23 | 0 | 14 | 102 | 0.92 | 0.70 | 0.16** | 0.92** | – |

*$p < 0.05$; **$p < 0.01$

**Table 2** Distribution of nonparametric study variables

| | Frequency ($n$ = 102) | Valid percent (%) |
|---|---|---|
| Matrimonial status | | |
| Widowed | 3 | 2.9 |
| Single | 17 | 16.7 |
| Married | 77 | 75.5 |
| Divorced | 5 | 4.9 |
| Nationality | | |
| German | 97 | 95.0 |
| Romanian | 1 | 1.0 |
| Ukranian | 1 | 1.0 |
| Swiss | 1 | 1.0 |
| Serbian | 2 | 2.0 |
| Preceding paternity | | |
| No | 54 | 54.5 |
| Yes | 45 | 45.5 |
| Profession | | |
| Academic | 49 | 51.5 |
| Trained | 43 | 45.3 |
| Untrained | 3 | 3.2 |
| $EPDS_{pre}$ cutoff | | |
| ≤9 | 92 | 90.2 |
| >9 | 10 | 9.8 |
| $EPDS_{post}$ cutoff | | |
| ≤9 | 94 | 92.2 |
| >9 | 8 | 7.8 |

was deselected if the $F$ values did not change significantly with $p \leq 0.05$. The final model consisting of the prenatal EPDS scores, birth concerns, and the PFB score predicted 47 % of the variance in paternal postnatal depressiveness (Table 4). According to Cohen (1977), this effect is interpretable as large. The robust estimation (global model) yields similar results with the difference that $EPDS_{pre}$ predicts $EPDS_{post}$ only marginally significant (Table 5).

## Discussion

This is the first study in Germany focusing on paternal pre- and postnatal depressive symptoms as well as their mutual correlation, a generally under-researched area. We found that 9.8 % of the expectant fathers showed signs of elevated depressive symptoms during their partner's pregnancy by having scores of 9 or more on the EPDS and are therefore at risk of being diagnosed with a minor or major depressive disorder. These findings are consistent with recent literature. Buist et al. found a prevalence of depressive symptoms of 12 % during the first assessment at 26 weeks of gestation and 8.7 % at 36 weeks of pregnancy by applying the EPDS (Buist et al. 2003). In the sole meta-analysis conducted in 2010 by Paulson and Bazemore, the overall meta-analytic rate of paternal depression between the first trimester and 1-year postpartum was approximately 10 % (Paulson and Bazemore 2010).

The prevalence rate of paternal postnatal depressive symptoms in our study was 7.8 %, which is slightly lower than the rate in the previously mentioned meta-analysis (10 %). Our rate of paternal postnatal depressiveness is comparable with the rate of maternal postnatal depression (8.7 % EPDS) in Germany (Reck et al. 2008).

Considering our results, on the one hand, this could imply that after adjusting to the new life circumstances, fewer fathers tend to suffer from depressive symptoms postnatally compared to the prepartum which is consistent with the findings of previous studies (Boyce et al. 2007; Buist et al. 2003; Condon et al. 2004). They all found that the prenatal period was more stressful for men than the postnatal period implying that most important changes might take place during pregnancy such as adaption to a new lifestyle and preparing for parenthood.

On the other hand, it also might be possible that we assessed paternal postnatal depressiveness in a too early postpartum period referring to the meta-analysis of Paulson and Bazemore (2010), which indicated that paternal postnatal depression peeks later than maternal postpartum depression (Paulson and Bazemore 2010).

Fathers who scored above the cutoff of the EPDS prenatally were more likely to experience depressive symptoms postnatally. We could confirm that depressive symptoms significantly correlate pre- and postnatally ($p < 0.01$) and, further, that paternal prenatal depressive symptoms predict postnatal symptoms.

Additionally, fathers scoring above the cutoff of 9 or more on the EPDS postnatally were also more likely to experience symptoms of anxiety after childbirth. The comorbidity of anxiety and depression is a common phenomenon (Matthey et al. 2003). Although the EPDS is routinely administered, high scores are often interpreted as evidence for depressive illness exclusively. Recent research in maternal samples suggests that the prevalence of anxiety disorders in the perinatal period may be higher than previously thought and more prevalent than depression in certain populations (Grigoriadis

**Table 3** Robust estimation of the regression on $EPDS_{post}$ (single model)

| Model | Variable | $B$ | SE | Lower bound of 95 % CI | Upper bound of 95 % CI | Wald $\chi^2$ | $df_{error}$ | LR $\chi^2$ |
|---|---|---|---|---|---|---|---|---|
| Single | $EPDS_{pre}$ | 0.35 | 0.09 | 0.18 | 0.53 | 16.01** | 100 | 17.00** |

*$p < 0.05$; **$p < 0.01$

**Table 4** Backward regression on $EPDS_{post}$

| Model | Variable | *B* | SE | Lower bound of 95 % CI | Upper bound of 95 % CI | *t* | VIF | $R^2$ | $R^2_{adj}$ [a] | *F* | $df_{error}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PFB score | −0.05 | 0.03 | −0.11 | 0.00 | −2.08* | 1.18 | 0.27 | 0.23 | 6.14** | 88 |
| | $EPDS_{pre}$ | 0.18 | 0.10 | −0.01 | 0.38 | 1.86 | 1.37 | | | | |
| | Birth concerns | 0.08 | 0.04 | −0.01 | 0.16 | 1.84 | 1.31 | | | | |
| | STAI-S | 0.04 | 0.03 | −0.02 | 0.09 | 1.35 | 1.10 | | | | |
| | Future concerns | 0.10 | 0.09 | −0.08 | 0.27 | 1.11 | 1.10 | | | | |
| 2 | PFB score | −0.06 | 0.03 | −0.11 | 0.00 | −2.08* | 1.18 | 0.26 | 0.22 | 7.34** | 88 |
| | $EPDS_{pre}$ | 0.20 | 0.10 | 0.00 | 0.39 | 2.02* | 1.34 | | | | |
| | Birth concerns | 0.09 | 0.04 | 0.01 | 0.17 | 2.10* | 1.26 | | | | |
| | STAI-S | 0.04 | 0.03 | −0.02 | 0.09 | 1.30 | 1.09 | | | | |
| 3 | PFB score | −0.06 | 0.03 | −0.11 | −0.01 | −2.32* | 1.19 | 0.49 | 0.47 | 9.15** | 88 |
| | $EPDS_{pre}$ | 0.20 | 0.10 | 0.00 | 0.39 | 2.00* | 1.34 | | | | |
| | Birth concerns | 0.10 | 0.04 | 0.02 | 0.18 | 2.44* | 1.15 | | | | |

[a] According to Olkin and Pratt (1958)

*$p<0.05$; **$p<0.01$

et al. 2013). Hypothetically, this might also be true for paternal samples. Matthey et al. already clearly showed the need to assess for both depression and anxiety in expectant parents (Matthey et al. 2000). The inclusion of diagnostic assessment for anxiety disorders increased the rates of cases in their study by 31–130 % for fathers over the rates for major or minor depression. Edmondson et al. established the diagnosis of a depressive disorder in 10 % of fathers postpartum after applying DSM-IV criteria and 6.3 % of fathers met criteria for a Generalised Anxiety Disorder (Edmondson et al. 2010). Consequently, our assessment of paternal distress in fathers scoring above the cutoff of 9 or more might have resulted in measuring an affected group consisting of cases being at risk for minor or major depressive disorders, for anxiety disorders or subclinical cases of both. This estimation is fostered through the fact that fathers who scored above the cutoff of the EPDS had significantly higher anxiety scores in the STAI and might potentially attribute to the difference between the prevalence of paternal depressiveness in our study and the population surveys with a population-based 12-months prevalence rate for major depressive disorder in men of 4.8 % according to DSM-IV criteria (Kessler et al. 2003).

Exploring other possible risk factors on paternal postnatal depressiveness, we were able to demonstrate that birth concerns, partnership satisfaction, and concerns for their own and their family's future had a significant correlation with paternal postnatal depressive symptoms.

Hereby, the risk factors detected in our study are partly similar to those found by Wee et al. who concluded that either having a partner with elevated depressive symptoms or poor relationship quality belong to the strongest indicators for paternal postnatal depression. This review also summarized less education, less social support, limited control, and low social gratification at work as important influence factors on depression in fathers (Wee et al. 2011) which is reflected in our assessment of future concerns. Fathers who had stronger concerns about changes in their postnatal social and work life developed more often postnatal depressive symptoms.

Furthermore, prenatal EPDS scores, birth concerns, and the PFB score predicted 47 % of the variance in paternal postnatal depressiveness. Surprisingly, after applying robust estimation of regression on postnatal depressiveness, birth concerns and relationship quality revealed to be even more important than prenatal EPDS scores. In comparison to known aspects, these results add important new and partly preventable aspects to the current body of literature (Wee et al. 2011) by highlighting both the need to adequately assess paternal pregnancy/delivery-related anxieties and the need for fathers to prepare themselves adequately for delivery and fatherhood.

**Table 5** Robust estimation of the regression on $EPDS_{post}$ (global model)

| Model | Variable | *B* | SE | Lower bound of 95 % CI | Upper bound of 95 % CI | Wald $\chi^2$ | $df_{error}$ | LR $\chi^2$ |
|---|---|---|---|---|---|---|---|---|
| Global | PFB score | −0.06 | 0.02 | −0.10 | −0.01 | 6.16* | 89 | 23.59** |
| | $EPDS_{pre}$ | 0.20 | 0.12 | −0.03 | 0.42 | $2.82^{\dagger}$ | | |
| | Birth concerns | 0.09 | 0.04 | 0.02 | 0.16 | 5.66* | | |

*$p<0.05$; **$p<0.01$

Our results indicate that likewise to women, paternal pregnancy-related anxiety should be regarded as a relatively distinctive syndrome and that measuring general anxiety only, e.g., with the STAI might be limited to explain only a small part of the variance of these fears (Huizink et al. 2004). Compared to current literature, Nolan et al. already pointed out that anxiety levels are found to be high in men particularly regarding the wellbeing of their partners and babies (Nolan et al. 2011). Therefore, an aim of future research should involve developing a screening instrument similar to the *Pregnancy Related Anxiety Questionnaire* for women to screen for paternal birth-related concerns and anxieties specifically.

To close information gaps and to prepare for childbirth, more and more couples try to attend prenatal classes together (Fletcher et al. 2006). In recent times, only very few institutions have piloted the inclusion of father-specific sessions into prenatal care programs, which are usually facilitated by male health workers (Friedewald et al. 2005). By doing so, midwifes and obstetricians could better support fathers who plan to accompany their partner in labor by providing them with information on parenting from a father's perspective.

## Limitations

Our study demonstrated prevalence rates and correlates of depressive symptoms in men, but the findings need to be interpreted with caution as the EPDS only measures depressive symptoms; whether or not clinical levels of depression were experienced by the fathers cannot be revealed. However, as shown above, the EPDS has high sensitivity and specificity for depressive disorder. There also remains a possibility that some of the associations described were the result of a confounding factor. Regarding the response rate for fathers in the early postpartum period of 46.2 %, we only used data of participants who took part in both assessment points to avoid response bias.

While interesting correlations have emerged from the study, the design does not permit directional or causal conclusions to be drawn. As a specific characteristic, this sample had a relatively high level of education which should be taken into account when considering the generalization of findings to less-educated populations. Generalization might be further limited to fathers without migration background. Elevated paternal depressive symptoms were assessed once in the late second or third trimester of pregnancy. Matthey et al. states in a recent study that a high percentage of women scoring at or above the cutoff score on the EPDS at one point will score below the cutoff score just a few weeks later (Matthey and Ross-Hamid 2012) suggesting a certain variance. Similar to women, depressive symptoms in men might fluctuate over the pregnancy period. The STAI also has been taken into account as potentially confounding results. While fathers were requested to report symptoms of anxiety and depression at home, and while dropouts partly remain unclear, the assessments are thus possibly subject to either retrospective reporting bias, selective bias, or social desirability.

While the EPDS seems to be an effective and suitable screening instrument for paternal depressiveness, a multicentre follow-up study with a larger sample size and an assessment of affective disorders according to DSM-IV criteria would be desirable. To assess all predictors adequately, their partners should also be examined simultaneously.

## Conclusions

Our findings indicate that the prevalence of paternal prenatal and postnatal depressive symptoms is a significant concern and that the findings reported in this study are of substantial clinical and public health importance in Germany, bringing further insight into the role of influence factors such as birth-related anxieties on paternal depressiveness. This should receive attention in the development of screening and preventative measures such as father-specific childbirth anxiety measurements and preparation classes as well as in the involvement of fathers in the delivery process.

**Acknowledgments** Dr. Stephanie Gawlik was financially supported by the Medical Faculty of the University of Heidelberg.

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

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