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Research paper

Postpartum depression and anxiety: a community-based study on risk factors before, during and after pregnancy

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A B S T R A C T

Background: Depression and anxiety occur frequently postpartum, calling for early detection and treatment. Evidence on risk factors may support early detection, but is inconclusive. Our aim was to identify risk factors for postpartum depression and anxiety, before, during and after pregnancy.
Methods: We used data from 1406 mothers of the intervention arm of the Post-Up study. Risk factors were collected at 3 weeks and 12 months postpartum. Depression and anxiety symptoms were measured in the first month postpartum by the Edinburgh Postnatal Depression Scale (EPDS) and 6-item State-Trait Anxiety Inventory (STAI-6), respectively. We used stepwise logistic regression to identify relevant risk factors.
Results: Of the mothers, 8.0% had EPDS-scores $\geq$9 and 14.7% STAI-6-scores $\geq$42. Factors associated with higher risk of depression were: foreign language spoken at home, history of depression, low maternal self-efficacy and poor current health of the mother. No initiation of breastfeeding was associated with lower risk of depression, no breastfeeding at 3 weeks postpartum increased the risk. Factors associated with higher risk of anxiety were: higher educational level, history of depression, preterm birth, negative experience of delivery and first week postpartum, excessive infant crying, low maternal self-efficacy, low partner support and poor current maternal health.
Limitations: Use of a self-report instrument, potential bias by postpartum mood status, and no inclusion of emerging depression cases after one month postpartum.
Conclusions: The shared and separate risk factors for postpartum depression and anxiety may help professionals in identifying mothers at increased risk and provide opportunities for preventive interventions and treatment.

1. Introduction

Maternal mental well-being during the postpartum period is of major importance both for the mother and for a healthy development of the newborn. However, such well-being is not a matter of course, as at least one out of ten mothers suffer from depression symptoms (Gavin et al., 2005). In fact, more recent studies show that a similar or even greater share of mothers experience anxiety symptoms (Falah-Hassani et al., 2016; Farr et al., 2014). A meta-analysis by Dennis et al. showed a postpartum period prevalence (0-24 weeks) of 13.7% for anxiety symptoms and 8.4% for anxiety disorders (Dennis et al., 2017). Infants of mothers with depression have a greater chance of negative outcomes

in development, especially when the mother's symptoms are severe or become chronic (Netsi et al., 2018; van der Waerden et al., 2015). Although the effects of anxiety on child outcomes have been less thoroughly investigated than the impact of depression (Glasheen et al., 2010), recent studies have reported negative effects of anxiety on mother–infant interactions, feeding practices, infant temperament, and social-emotional development (Field, 2018; Mughal et al., 2019; Polte et al., 2019).

Addressing both postpartum depression and anxiety at an early stage may help to reduce the severity and chronicity of symptoms, as well as the impact on the child's health and development. Knowledge of the factors influencing the risk of developing postpartum depression and

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anxiety may support early detection. These factors may already be present before women get pregnant, but may also arise during pregnancy, or afterwards, implying opportunities for health care professionals to reduce risk factors at different stages, thereby preventing mothers from developing depression and/or anxiety.

More than twenty years ago, both O'Hara et al. and Beck et al. published meta-analyses involving broad perspectives on risk factors for postpartum depression (Beck, 1996; O'Hara and Swain, 1996). Factors like history of depression, prenatal depression, lack of social support, and life stress consistently emerged as contributors to the risk of postpartum depression. However, for several other factors effect sizes and associations varied substantially, probably due to methodological differences (e.g. instrument and way of assessment, and interval between birth and assessment). Since then, many articles and several systematic meta-analyses on risk factors for postpartum depression have been published, but with a shift of focus from the broader perspective to specific risk factors (Hutchens and Kearney, 2020). Comparing results across articles has been complicated by the variety of risk factor definitions and statistical methods, and the different sets of variables included (Hutchens and Kearney, 2020). Ideally, a comprehensive approach would include in the same study factors from before, during and after pregnancy. However, factors from the postpartum period received little attention in many studies.

Regarding anxiety, the body of literature on risk factors is far more limited (Field, 2018), with findings limited mainly to single studies (Goodman et al., 2016). Also, some studies reported findings based on univariate analyses only (Martini et al., 2015; Shlomi Polachek et al., 2014). Factors for which associations with anxiety are reported by more than one study, and by studies using multivariate analyses, were: ethnicity (Ahmed et al., 2019; Farr et al., 2014), partner support (Bell et al., 2016; Bener et al., 2012; Martini et al., 2015), (maternal) self-efficacy (Dennis et al., 2016; Martini et al., 2015) and history of depression (Ahmed et al., 2019; Bell et al., 2016). The aim of this study was therefore to identify risk factors for developing postpartum depression as well as anxiety, that occur before, during, and after pregnancy in the general population.

2. Methods

2.1. Study design

Data used for this study were collected as part of the Post-Up study (van der Zee-van den Berg et al., 2017), a prospective, quasi-experimental, comparative study on the effectiveness of screening for postpartum depression in well-child care. Data on potential risk factors (except life events) and on anxiety symptoms were assessed at baseline measurement 3 weeks postpartum, using an online questionnaire. Data on depression symptoms were collected at the well-baby visit one month postpartum. Finally, data on life events (including relationship problems and serious illness) were collected with an online questionnaire 12 months postpartum.

2.2. Sample

The sample consisted of mothers of children born between December 1, 2012 and April 1, 2014. Participants had adequate mastery of the Dutch language and used the services of well-child care in the eastern part of the Netherlands. Enrollment and exclusion criteria are described in detail elsewhere (van der Zee-van den Berg et al., 2017). For the current study, data of 1406 mothers from the intervention arm of the comparative study were used.

2.3. Risk factor measures

We collected data on risk factors before, during and after pregnancy, as shown in Table 1. To measure most factors, including depression

Table 1
Measured maternal risk factors from the periods before, during and after pregnancy.

Before pregnancy	During pregnancy	After pregnancy
Age related factors: - being a young mother (<25 years) - being an older mother (>36 years) Ethnicity related factors: - born non-Dutch - foreign language spoken at home Education level low* Employment related factor: - work <12 hours/week Life events related factors: - experienced ≥3 life events ** - experienced violence **ᵃ Relationship related factors: - experienced relationship problems ** - being a single mother Lifetime history of depression First parity Health related factors: - having been seriously ill ** - poor general health before getting pregnant - poor physical condition before getting pregnant	Unplanned pregnancy Unwanted pregnancy Smoking/Alcohol/ Substance use Life events related factors: - experienced ≥1 life event - experienced violenceᵃ Relationship related factor: - experienced relationship problems Depression during pregnancy Medical complications Negative pregnancy experience Preterm birth Delivery related factors: - complications during delivery - negative delivery experience - delivery at home	Child's gender (male) Child's health problems Negative experience of the first week postpartum Feeding related factors: - no initiation of breastfeeding - no breastfeeding at 3 weeks postpartum - low satisfaction with feeding Crying related factors: - crying meets Wessel criteria - experiencing crying as excessive - experiencing difficulties in soothing Sleep related factor: - sleep of mother disturbed Maternal self-efficacy in parenting - low SENR-score Social support related factors: - low support partner - lows support network - low SSL12-I score Health related factors: - poor current health of the mother

* comparable with level 2 or lower of the ISCED classification (International Standard Classification of Education)
** occurring in the two years before getting pregnant
ᵃ faced aggression, threat or violence, or fell victim to a crimeSENR, Maternal Self-Efficacy in the nurturing role questionnaire; SSL12-I, Social Support List - Interactions.

during pregnancy, we used single questions. To measure social support we used the SSL12-I (Kempen and Eijk, 1995), a shortened version of the Social Support List-Interactions developed by Van Sonderen (van Sonderen, 1993) (Cronbach's Alpha 0.87) (Eijk et al., 1994). To assess maternal self-efficacy we used the Maternal Self-Efficacy in the nurturing role questionnaire (SENR) (Pedersen et al., 1989), a 16 item questionnaire regarding the mother's perceptions of her competence in caring for her infant. The Cronbach's Alpha for the Dutch version ranged from .78 to .89 (Kunseler et al., 2014; Verhage et al., 2013). Excessive crying, as defined by the Wessel criteria, implied an infant crying for > 3 hours per day, ≥ 3 days per week, for ≥3 weeks (Wessel et al., 1954). We assessed life events using a list of 21 items, covering the most important life events (including illness, loss of close relatives, loss of a job, financial problems, experienced violence). All risk factors were dichotomized to yes/no categories.

2.4. Outcome measures

Outcome measures regarded depression and anxiety symptoms. We measured *depression symptoms* using the Edinburg Postnatal Depression Scale (EPDS), a 10-item self-report measure, developed specifically for use in community samples of postpartum mothers (Cox et al., 1987). The Dutch version was validated in 1992 (Pop et al., 1992), showing adequate concurrent validity and a standardized Cronbach's alpha of .82. Presence of depression symptoms was defined by an EPDS score ≥ 9, expected to imply a sensitivity of 85% and a specificity of 82% (minor

and major depression) based on the pooled data of Hewitt et al (Hewitt et al., 2009).

We measured *anxiety symptoms* using the 6-item short form State-Trait Anxiety Inventory (STAI-6) at 3 weeks postpartum (Marteau and Bekker, 1992). Validity and reliability of the Dutch version were good, with a correlation with the STAI full version of .95 and a Cronbach's alpha of .83 (van der Bij et al., 2003). Presence of anxiety symptoms was defined as a score $\geq$ 42 (de Jong-Potjer et al., 2006; van der Ploeg, 2000).

2.5. Statistical analysis

First, we assessed the presence of depression symptoms (EPDS $\geq$ 9) and anxiety (STAI $\geq$ 42) symptoms and calculated the frequencies of each risk factor in the total sample.

Second, we assessed risk factors for developing postpartum symptoms of either depression or anxiety, occurring before, during, and after pregnancy; we used univariable logistic regression analyses for all variables. We included all variables (from the periods before, during and after pregnancy) with *p*-values <.25 (in univariable analyses) in the same multiple logistic regression analysis using stepwise backward selection, for the presence of depression symptoms and anxiety symptoms. The *p*-value for removal was set at .15. These multivariable analyses were performed on the cases with no missing values in the included variables. Finally, we performed sensitivity analyses by repeating the analyses with different cut-off values for the *p*-value ranging from 0.05 to 0.50 and backward, and backward selection based on the Akaike information criterion *(*AIC*)*. Moreover, we used bootstrapping to check the stability of the final models. We performed data analyses using SPSS 24 and R (version 3.6.3).

2.6. Ethical approval

The Medical Ethics Committee Twente assessed the study protocol and concluded that the measures pertaining to confidentiality and informed consent were appropriate, and that the study was beyond the remit of the Medical Sciences Research with Human Subjects Act.

3. Results

The participating women (N=1406) had a mean age of 30.6 years; 96.2% were Dutch born; 0.9% were single mothers; 10.7% were living in an urban area; 89.6% had a medium to high education; and 83.6% were employed (>12hours/week). Of the 1406 included mothers, 113 (8.0%) had an EPDS$\geq$9, and 207 (14.7%) had a STAI $\geq$42.

3.1. Univariable and multivariable associations

Univariable analyses showed many factors to have a significant association with depression symptoms; the same was true of anxiety symptoms (Table 2). For depression, multivariable analyses (Table 2) indicated several factors that were associated with a higher risk: foreign language spoken at home, lifetime history of depression, low score on the SENR, and poor current health of the mother. No initiation of breastfeeding was associated with lower risk of depression, whereas no breastfeeding at 3 weeks postpartum was associated with a higher risk.

For anxiety, factors associated with higher risk in the multivariable analyses were lower education, lifetime history of depression, preterm birth, delivery experienced negatively, first week postpartum experienced negatively, crying experienced as excessive, low score on SENR, low support of partner, and poor current health of mother. For both depression and anxiety, a low SENR-score had the highest OR: 5.84 (CI 3.59-9.49) and 10.01 (CI 6.21-16.15) respectively.

3.2. Sensitivity analyses

Sensitivity analyses, using different cut-off values for the *p*-value and backward selection based on the AIC criterion, indicated the same factors as having the strongest associations.

4. Discussion

We found several factors from the time periods before, during, and after pregnancy to be associated with an increased risk of developing postpartum depression and anxiety. Some factors were associated specifically with a higher risk of either depression or anxiety, whereas others were associated with a higher risk of both. Findings were generally robust, independent of choice of cut-offs or analytic method. To increase our understanding of the discovered associations and the potential role of risk factors in early identification, we will discuss the factors found per period of depression or anxiety, and discuss their differences.

4.1. Factors before, during and after pregnancy associated with higher risk of depression

Two factors from the pre-pregnancy period were found to increase the risk of depression. The first factor, a foreign language spoken at home, was the only demographic factor resulting in a higher risk. This corresponds with previous research which showed few associations between demographic factors and depression (Giallo et al., 2014; O'Hara and Swain, 1996; Yelland et al., 2010), except for ethnicity-related factors. Reported associations with ethnicity are, however, complicated by the use of different definitions, e.g. comparing groups based on history of immigration or other aspects of ethnicity (Anderson et al., 2017). Nevertheless, the language spoken at home may best reflect a person's integration into society, with poor integration most likely to increase the risk of depression. The second pre-pregnancy risk factor was a lifetime history of depression, a factor also consistently found in many other studies. Our findings suggest that these two pre-pregnancy factors indeed increase risks, independent of risks due to other factors.

Our study found that experiencing life events in the two years before pregnancy did not increase the risk of depression. Although previous meta-analyses indicated life events to be an important risk factor, these analyses were based on inconclusive findings (O'Hara and Swain, 1996; Robertson et al., 2004). Recent studies reporting positive associations (Bell et al., 2016; Giallo et al., 2014; Yelland et al., 2010) focused on life events experienced in the recent past (e.g. the past year). Our findings thus suggest that experiencing life events in the period before pregnancy does not independently indicate an increased risk of depression.

Regarding the pregnancy period, we found no factors that increased risks of depression independently. Regarding complications during pregnancy previous findings were inconclusive; some studies showed associations (Berger et al., 2014; Blom et al., 2010), but others did not (Farr et al., 2014; Giallo et al., 2014). This was also the case for preterm birth (de Paula Eduardo et al., 2019). In contrast, depression during pregnancy was shown to be a more consistent risk factor (Beck, 2001; Bell et al., 2016; Fisher et al., 2016; Putnam et al., 2017; Robertson et al., 2004), whereas in our study the association bordered on non-significant. The low prevalence of depression during pregnancy in our sample compared to other studies (Dadi et al., 2020) may play a role here. This may be related to the community nature of our sample, and measurement by a retrospective one-item question, i.e. 'did you experience a depression during pregnancy'. Our outcomes do not indicate pregnancy as a period specifically contributing to greater risk of developing postpartum depression.

We found four factors from the postpartum period associated with a higher risk of depression; two were related to breastfeeding and the other two to maternal self-efficacy and current health of the mother.

Table 2

Risk factors of postpartum depression and anxiety that occur before/during/after pregnancy: results of univariable and multivariable logistic regression with stepwise backward selection.

Variables *before* pregnancy	% of total sample N=1406	Depression Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p	Anxiety Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p
Age mother < 25	9.0%	1.49 (0.83-2.70)	.186			1.25 (0.77-2.04)	.364		
Age mother > 36	10.7%	0.79 (0.41-1.55)	.500			1.44 (0.93-2.22)	.101	1.69 (0.92-3.12)	.093
Born non-Dutch	3.8%	2.11 (0.97-4.60)	.059			3.78 (2.12-6.73)	<.001	2.41 (0.95-6.12)	.064
Foreign language spoken at home	2.1%	3.82 (1.59-9.14)	.003	4.21 (1.25-14.2)	.020	4.28 (2.01-9.10)	<.001	3.01 (0.87-10.4)	.081
Education level low	10.4%	1.13 (0.62-2.08)	.684			1.43 (0.92-2.23)	.110	2.04 (1.05-3.96)	.036
Mother not employed (<12 hours/week)	16.4%	1.42 (0.89-2.29)	.145			1.74 (1.22-2.49)	.002		
Experienced >=3 life-events*	8.3%	2.38 (1.31-4.32)	.004			2.18 (1.33-3.57)	.002		
Experienced violence*	1.9%	3.48 (1.26-9.60)	.016			2.82 (1.14-6.97)	.024		
Experienced relationship problems*	3.6%	1.62 (0.62-4.22)	.325			1.46 (0.66-3.20)	.348		
Single mother	0.9%	2.31 (0.50-10.68)	.283			2.93 (0.88-9.83)	.081		
Lifetime history of depression	17.4%	3.77 (2.52-5.66)	<.001	2.10 (1.22-3.63)	.008	3.16 (2.28-4.39)	<.001	2.19 (1.31-3.65)	.003
First parity	44.8%	1.75 (1.18-2.57)	.005			1.08 (0.80-1.45)	.623		
Having been seriously ill*	2.6%	0.83 (0.19-3.52)	.796			1.21 (0.46-3.21)	.696		
Poor general health before pregnancy	2.4%	2.53 (1.03-6.25)	.044			1.81 (0.81-4.06)	.148		
Poor physical condition before pregnancy	0.6%	1.64 (0.20-13.45)	.645			0.83 (0.10-6.75)	.859		

Variables *during* pregnancy	% of total sample N=1406	Depression Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p	Anxiety Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p
Unplanned pregnancy	17.4%	1.63 (1.04-2.57)	.033			1.54 (1.07-2.19)	.019		
Unwanted pregnancy	1%	1.92 (0.43-8.70)	.396			2.34 (0.73-7.54)	.153		
Smoking during pregnancy	16.1%	1.63 (1.03-2.60)	.038			1.26 (0.86-1.84)	.241		
Alcohol use during pregnancy	21%	0.85 (0.52-1.39)	.514			0.68 (0.46-1.01)	.055	0.54 (0.31-0.96)	.037
Substance use during pregnancy	0.1%	- ***	.999			- ***	.999		
Life Events during pregnancy >=1*	28.9%	1.37 (0.87-2.14)	.173			1.52 (1.08-2.15)	.017		
Experience of violence during pregnancy*	0.9%	1.21 (0.15-9.52)	.859			0.63 (0.08-4.92)	.655		
Relationship problems during pregnancy*	2.7%	1.75 (0.60-5.11)	.304			1.47 (0.59-3.62)	.407		
Depression during pregnancy	1.6%	6.96 (2.86-17.0)	<.001	2.83 (0.91-8.79)	.072	7.32 (3.12-17.17)	<.001	2.87 (0.92-8.94)	.069
Complications during pregnancy	23.6%	1.96 (1.31-2.94)	<.001			1.39 (1.00-1.93)	.049		
Pregnancy experienced negatively	5.5%	3.28 (1.82-5.89)	<.001			1.81 (1.04-3.13)	.034		
Preterm birth**	3.4%	1.14 (0.40-3.26)	.801			1.97 (0.98-3.96)	.058	3.39 (1.32-8.70)	.011
Complications during delivery	26.6%	0.86 (0.55-1.34)	.498			1.00 (0.72-1.40)	.991		
Delivery experienced negatively	12.2%	2.65 (1.67-4.20)	<.001			3.15 (2.19-4.54)	<.001	1.94 (1.11-3.39)	.021
Delivery at home	24.3%	0.74 (0.45-1.19)	.211			0.79 (0.55-1.13)	.198		

Variables *after* pregnancy	% of total sample N=1406	Depression Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p	Anxiety Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	P
Child's gender (male)	50.9%	1.50 (1.02-2.22)	.041			1.10 (0.82-1.48)	.521		
Child health problems after birth	14.0%	1.36 (0.82-2.26)	.241			1.10 (0.72-1.66)	.665		

Table 2 (*continued*)

Variables *after* pregnancy	% of total sample N=1406	Depression Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	p	Anxiety Univariable analyses OR (CI)	p	Multivariable analyses OR (CI)	P
Negative experience of first week postpartum	6.0%	3.19 (1.80-5.64)	<.001	1.90 (.91-3.98)	.087	4.68 (2.95-7.41)	<.001	2.73 (1.31-5.70)	.008
No initiation of breastfeeding	25.0%	0.59 (0.35-0.97)	.039	0.45 (0.23-0.88)	.020	0.76 (0.53-1.09)	.132		
No breastfeeding at 3 weeks postpartum	50.3%	1.32 (0.90-1.95)	.160	1.95 (1.12-3.23)	.012	1.14 (0.85-1.53)	.374		
Low satisfaction with feeding	1.3%	1.44 (0.33-6.33)	.631			3.78 (1.45-9.87)	.007		
Crying meets Wessel criteria	4.1%	1.93 (0.89-4.19)	.095			3.96 (2.27-6.89)	<.001		
Experiencing crying as excessive	8.4%	2.81 (1.68-4.72)	<.001			5.76 (3.86-8.59)	<.001	3.48 (1.90-6.23)	<.001
Experiencing difficulties in soothing	1.4%	3.13 (1.02-9.58)	.046			10.48 (4.08-27.0)	<.001		
Sleep mother disturbed	4.3%	3.45 (1.80-6.58)	<.001			5.40 (3.11-9.03)	<.001		
Low SENR-score	14.1%	6.70 (4.45-10.1)	<.001	5.84 (3.59-9.49)	.001	9.59 (6.82-13.48)	<.001	10.0 (6.21-16.2)	<.001
Low support partner	8.3%	2.49 (1.46-4.25)	<.001			7.04 (4.71-10.52)	<.001	4.17 (2.38-7.33)	<.001
Low support network	15.1%	0.71 (0.39-1.29)	.262			1.03 (0.68-1.55)	.893		
Low SSL12-I score	19.3%	0.84 (0.50-1.39)	.490			0.64 (0.43-0.98)	.664		
Poor current health mother	6.7%	5.75 (3.49-9.45)	<.001	2.47 (1.29-4.71)	.006	5.08 (3.27-7.89)	<.001	2.09 (1.07-4.10)	.031

[*] N = 1186,

[**] N = 1313,

[***] due to low prevalence of this risk factor, OR could not be calculated. OR, Odds Ratio; CI, Confidence Interval; SSL12-I, 12 item Social Support List-Interactions; SENR, Maternal Self-Efficacy in nurturing role questionnaire.

With regards to breastfeeding, in general this is considered to be a potential protective factor (Pope and Mazmanian, 2016), whilst in our study not initiating breastfeeding lowered the risk for depression. An explanation for this might be confounding by underlying factors like background characteristics of the mother. However, this seems unlikely as we already included many of these variables in our analyses. Another explanation for our findings on breastfeeding, with still breastfeeding at 3 weeks postpartum being associated with a lower risk of depression, may be found in early cessation of breastfeeding. Other studies also found breastfeeding duration and breastfeeding self-efficacy to be associated with depression (Dias and Figueiredo, 2015; Henshaw et al., 2015). In our study one third of the mothers who reported initiating breastfeeding after birth, no longer reported breastfeeding at 3 weeks postpartum. This could imply that breastfeeding difficulties may have overruled the positive effects of initiating breastfeeding. Early cessation may lead to negative cognitions of guilt and failure, and conversely, depression may contribute to early cessation. Further research is needed to clarify the association that we found between breastfeeding and postpartum depression.

In our study, low maternal self-efficacy was strongly associated with a higher risk of depression, whereas low level of social support was not. Based on the literature previously mentioned (Beck, 1996; O'Hara and Swain, 1996) and more recent studies (Bell et al., 2016; Bener et al., 2012), social support could be considered to be a protective factor. However, a few recent studies which included also maternal self-efficacy (Giallo et al., 2014; Leahy-Warren et al., 2011) found less strong associations. In the association of social support with depression, maternal self-efficacy may function as a mediator (Leahy-Warren and McCarthy, 2010); social support may reduce depressive symptoms through enhancing maternal self-efficacy. Adding low maternal self-efficacy as a potential risk factor could, therefore, lower the associations between social support and depression.

Finally, regarding post-pregnancy factors we found an association between poor current health of the mother and an increased risk of depression. To our knowledge, previous evidence on this topic is lacking, making comparisons impossible. This lack of evidence on the association between physical health and postpartum depression is remarkable, considering its potential relevance; many women experience physical complaints after birth, and it is generally accepted that a link exists between physical health and mental health (Ohrnberger et al., 2017). Our study shows that this also applies to the period after giving birth. Finally, we could not confirm evidence from other studies that showed crying (Petzoldt, 2018) or quality of sleep of the mother (Okun, 2016) to be risk factors. Those associations may in fact reflect risks related to poor maternal self-efficacy.

4.2. Factors before, during, and after pregnancy associated with higher risk of anxiety

We found several factors associated with anxiety, in particular factors related to the postpartum period. However, comparing these outcomes with previous evidence is hardly possible due to the limited number of studies available.

Our study indicated that factors from the pre-pregnancy period that increased the risk of anxiety symptoms were lifetime history of depression, confirming previous findings, and lower education, on which previous findings were rather heterogeneous: some studies reported that risks were increased (Britton, 2008) (Bjelland et al., 2008), but others that they were not (Bell et al., 2016; Dennis et al., 2016; Yelland et al., 2010). Variation in the degree and nature of the study sample's deprivation may explain this latter heterogeneity, and may have led to deprivation measures prevailing over education in some studies. For example, Yelland et al. found an association between anxiety and maternal country of birth (Yelland et al., 2010), a factor that, along with speaking a foreign language at home, was only marginally significant in our study.

Regarding the pregnancy period, two factors increased the risk of anxiety, i.e. preterm birth and negative experience of the delivery, whereas alcohol use during pregnancy was associated with a lower risk. Findings regarding negative experiences with delivery confirmed

findings by Bell et al (Bell et al., 2016), but evidence on birth experience and preterm birth was fully lacking. Complications during birth were not found to be a risk factor; this was in line with other studies (Bell et al., 2016; Dennis et al., 2016). The overall negative experience of (preterm) birth appears more important than the complications in themselves, and may be related to a sense of losing control, resulting in a heightened state of anxiety.

Remarkably, we found alcohol use during pregnancy to be associated with a lower risk of anxiety after birth. However, Farr et al. did not find an association between the number of pre-pregnancy alcoholic drinks per week and anxiety (Farr et al., 2014). A possible explanation may be a relationship between continued alcohol consumption during pregnancy and a subject's personality (Beijers et al., 2014), e.g. lower levels of conscientiousness, which in turn is associated with less anxiety symptoms (van der Veen et al., 2017). Another explanation could be that our definition of alcohol use may have resulted in inclusion of a considerable number of mothers who stopped drinking alcohol as soon as they knew they were pregnant, making it a protective factor. Evidently further research must be done among postpartum women to determine the role of this factor. Knowing the risk of poor infant outcomes due to alcohol exposure, alcohol use during pregnancy can never be regarded as a 'protective factor' with regard to anxiety.

We found five factors from the postpartum period to be associated with anxiety: low support by the partner, a negative experience of the first week postpartum, experiencing the infant's crying as excessive, poor current health of the mother, and low maternal self-efficacy, the latter with a very high odds ratio. Only very limited evidence is available from other studies using multivariable analyses to examine these risk factors for anxiety. However, low partner support was included in studies by Bener et al. and Dennis et al. (Bener et al., 2012; Dennis et al., 2016); these studies reported comparable associations. Other variables could not be compared as, to our knowledge, they were not included in studies using a similar approach. Still, our findings suggest that experiencing a number of stressors in the period after pregnancy can elicit anxiety.

4.3. Differences and similarities between risk factors for depression and anxiety

Understanding the associations between risk factors of depression and anxiety will support professionals in early detection. As depression and anxiety are interrelated, both being characterized by negative affectivity upon experiencing distress, it is plausible that they share risk factors. One explanation for depression and anxiety is that they are caused by maladaptive cognitive schemas formed during childhood and adolescence and elaborated over time, with the result that normal adaptive responses to stressors are activated by specific triggers in a disproportionate way (Beck and Haigh, 2014). Our shared risk factors may contribute to (activation of) shared maladaptive schemas leading to negative affect, which connects to a history of depression, low maternal self-efficacy, poor integration due to speaking a foreign language, and inadequate mental resilience when experiencing poor physical health.

On the other hand, risk factors for depression and anxiety are likely to differ, as depression is characterized by absence of positive emotion whereas anxiety is characterized by hyper arousal (according to the tripartite theory of Clark and Watson)(Clark and Watson, 1991). Factors related only to anxiety were low education, preterm birth, low partner support, negative experience of delivery and of the first week postpartum, and the infant's crying. Except for low education, these aspects all relate to a current stressful situation, apparently leading mainly to anxiety. However, as anxiety symptoms have also been observed to precede depression symptoms, a depressive response may possibly occur later in time (Eysenck and Fajkowska, 2018).

Our study reported factors related to breastfeeding to be associated only with a higher risk of depression, contrary to some other studies, which reported e.g. early cessation also to form a risk factor for anxiety (Fallon et al., 2016; Ystrom, 2012). This difference may be because we included the factor of maternal self-efficacy which formed a strong risk factor. As hormonal changes may also be a specific trigger of depression, future research should disentangle these potential differences found in studies of the relation between breastfeeding and anxiety and depression.

In summary, factors forming a base for a negative response to distress should alert professionals to the possibility of both depression and anxiety. Apart from this, a negative reaction to a current stressful situation should alert them particularly to the possibility of anxiety.

4.4. Strengths and limitations

Strengths of this study are its large community sample, and its use of a comprehensive approach, involving inclusion of factors from the periods before, during and after pregnancy.

A limitation when interpreting our outcomes may be our use of self-report instruments instead of diagnostic interviews to measure depression and anxiety. However, we used established validated self-report instruments, which are also sensitive in detecting relatively mild symptoms. Another limitation is the timing of assessment of risk factors at 3 weeks postpartum, possibly enabling bias as a result of subjects' postpartum mood. This may in particular apply to associations found for factors from the postpartum period, making it impossible to determine the direction of causal effects and potentially leading to some overestimation of associations during this period. However, even without knowing the direction, these associations are relevant for use in practice, as these factors can nevertheless be indicators of increased risk. Moreover, the assessment of life events occurred at 12 months postpartum for a period extending to before pregnancy. This will thus have been measured less accurately than the other factors, potentially leading to underestimation of the strengths of associations. A final limitation is that we missed cases of postpartum depression that emerged after one month postpartum. This may have affected associations for factors specifically leading to later emerging cases of postpartum depression. This definitely requires further study.

4.5. Implications

Our findings may help health care professionals involved in prenatal and postpartum care, by augmenting early identification of mothers at greater risk of developing postpartum depression or anxiety. Increasing awareness of postpartum anxiety in practice will require more effort, as only since the last decade has anxiety become the object of greater attention.

Recognition that a subject has a lifetime history of psychopathology is important for detecting both depression and anxiety, as well as for assessments during and after pregnancy. Women who speak a foreign language also deserve extra attention; this may present a challenge, as discussing psychological well-being is more complicated when language forms a barrier. Further, professionals should be particularly alert to anxiety when dealing with women who have had negative experiences during pregnancy and the postpartum period, and also alert to depression with women experiencing early cessation of breastfeeding.

The associations we found also provide targets for primary prevention of postpartum depression and anxiety, e.g. by preparing women and their partner for the events to come (delivery, becoming a parent or having an additional child, initiating breastfeeding, finding a new balance as a couple), and developing interventions to strengthen maternal self-efficacy in the first weeks postpartum. The strong association with maternal self-efficacy also has implications for treatment, requiring a specific approach that differs from treatment of depression and anxiety in other stages of life.

Future research should focus on further establishing the risk factor profile of anxiety, using multivariable analyses to search for evidence. The need for further clarification of the direction of associations

between several of our variables calls for additional research assessing anxiety and depression symptoms repeatedly in the periods before, during, and after pregnancy.

4.6. Conclusion

This study has found both shared and separate risk factors for postpartum depression and anxiety, and suggested the importance of the timing of these factors before, during, and after pregnancy. Our findings thus provide valuable information for development of preventive interventions and treatment to improve the mental well-being of mothers during the postpartum period.

Author declaration

"Community-level risk factors for postpartum depression and anxiety: a comprehensive approach with factors before, during and after pregnancy"

1. Contributors

We attest that all authors contributed significantly to the creation of this manuscript. We confirm that the manuscript has been read and approved by all named authors. We confirm that the order of authors listed in the manuscript has been approved by all named authors.

Angarath I. van der Zee-van den Berg was responsible for data analysis, the first draft of the manuscript, and approved the final manuscript as submitted.

Magda M. Boere-Boonekamp and, and Sijmen A. Reijneveld critically interpreted the data, and revised the concept versions of this review and approved the final manuscript as submitted.

Catharina G.M. Groothuis-Oudshoorn supervised the data analysis, reviewed and revised the manuscript, and approved the final manuscript as submitted.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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