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Socioeconomic status and depression during and after pregnancy in the Franconian Maternal Health Evaluation Studies (FRAMES)

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Abstract
Purpose Depression during and after pregnancy can have a negative impact on women's quality of life and on the development of the newborn child. Interventions have been shown to have a positive influence on both mothers and children. Predictive factors for depressive symptoms might possibly be able to identify groups that are at high risk. The aim of this study was to investigate the value of socioeconomic factors in predicting depressive symptoms during and after pregnancy.
Methods Depressiveness was measured using the German version of the 10-item Edinburgh Postnatal Depression Scale (EPDS) at three time-points, in a prospective cohort study ($n = 1{,}100$). Visit 1 (Q1) was at study entry in the third trimester of the pregnancy, visit 2 (Q2) was shortly after birth, and visit 3 (Q3) was 6–8 months after birth. Depression scores were associated with socioeconomic factors and time in linear mixed models.
Results Parity status, education status, monthly income, residential property status, and partnership status, as well as interactions between them, were found to be predictive factors for EPDS scores. The strongest factor influencing depressive symptoms was partnership status. Women who did not have an intact partnership had EPDS scores that were on average four points higher than in women with a partner at all three study visits ($P < 0.000001$).
Conclusions Socioeconomic factors define subgroups that have different depression scores during and after pregnancy. Partnership status appears to be one of the most important influencing factors and could be useful for identifying women who should be offered an intervention to prevent possible negative effects on the mother or child.

Keywords Pregnancy · Depression · Socioeconomic factors · Prediction

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Introduction

Depressions are frequent complications during and after pregnancy. Approximately, 10–13 % of pregnant women suffer from pregnancy-associated depressive episodes [1, 2], and as many as 5–6 % even develop major depression [2]. Pregnancy-associated depression has been shown to correlate with poorer obstetric outcome measures and with fetal and neonatal complications [3, 4], as well as with the length of the mother's hospital stay at the time of delivery [5]. There have also been reports that pregnancy-associated depression has a negative impact on the child's development [6–8]. Interventions in depressive mothers have been shown to have a positive effect on the mother–infant

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relationship and on the children's cognitive function [9]. Information about risk factors for pregnancy-associated depression may, therefore, be helpful for planning early interventions and understanding the pathogenesis of this disease.

A variety of mostly cross-sectional studies have been published on the etiology of depression during pregnancy, examining factors such as stress, substance abuse, socioeconomic status, relationship status, sexuality, and family support (reviewed by Lancaster et al.) [10]. Not all parameters remained statistically significant after adjustment for other possible confounders. Stress, a lack of social support, and domestic violence appeared to be the most stable factors in multivariate models [10].

Other studies have been concerned with risk factors for depression after birth (postpartum depression, PPD). Generally, birth itself is followed by intense physiological and psychological changes in the mother's life. It has been hypothesized that women who develop PPD may be more susceptible to a drop in hormone levels after the end of the pregnancy [11–13]. However, this association is still under discussion. The prevalence of PPD appears to be influenced by genetic and nongenetic risk factors. Genetic factors are being investigated, but only some of the findings have been validated in large cohorts [14–22]. Nongenetic risk factors include a history of depression, increasing age, substance abuse, ethnicity, partnership problems, and social support, as well as anxiety problems during pregnancy [23–29].

Only a few studies have examined socioeconomic status, including employment and income status, in relation to depression during pregnancy, and the findings have been inconsistent [30–36]. The correlations may be highly dependent on a specific society and the mechanisms and strategies available in the social system as well as public health with regard to maternity support [37, 38]. In addition, most of the studies have examined the influence of risk factors on either depression during pregnancy or PPD using a cross-sectional study design. Only a few studies have used prospective designs to examine the influence of factors before or during pregnancy on the prevalence of depressive symptoms during and after birth.

The aim of this study was, therefore, to analyze the effect of socioeconomic factors on depression symptoms during and after pregnancy in a prospective cohort study, conducted in northern Bavaria.

Participants and methods

The Franconian Maternal Health Evaluation Studies (FRAMES) is a prospective and longitudinal cohort investigation, which included a total of 1,100 pregnant women during the period from July 2005 to February 2007. The analysis presented here is a substudy of FRAMES. The methodology and previous findings have been reported elsewhere and include findings about antenatal and postnatal depression relative to birth method, genetic factors, and alcohol abuse [39–42]. The participants completed a structured questionnaire for psychometric assessments, common medical history, and obstetrics-related history. In addition, a structured interview was performed to ensure a high rate of completeness for the questions answered. FRAMES included women aged 18 or older with an intact pregnancy and at least 30 weeks of gestation. The women registered during pregnancy at the outpatient department at the University Perinatal Center. The study was approved by the University Hospital's Ethics Committee. All of the participants received detailed written and oral information and provided written informed consent.

The questionnaires

The initial questionnaire (Q1) was completed in the third trimester, after the 30th week of pregnancy, and included questions about socioeconomic status and social support. This questionnaire was completed by all 1,100 women. The women were asked specifically about their level of school and professional education, employment status before pregnancy, income situation, partnership status, specific details about living arrangements, size of their home city, and social support. A total of 1,028 study participants (93.5 %) completed a second questionnaire 48–72 h after giving birth (Q2). The time interval from 48 to 72 h postpartum was intended to capture the initial phase of baby blues, which usually starts on the third to fifth day [43, 44]. A third questionnaire (Q3) was completed by 895 women (81.4 %) and was scheduled 6 months postpartum. The first two questionnaires were structured as personal interviews using standardized manuals, which were conducted by trained and medically qualified staff. The third questionnaire (Q3) was carried out by phone interview. The reliability of phone questionnaires in this setting can be regarded as confirmed [45]. Depressiveness was measured using the German version of the 10-item Edinburgh Postnatal Depression Scale (EPDS) [46, 47].

Statistical methods

The EPDS values were regarded as a continuous measurement, with a range from 0 to 26. Depression values from three different time-points were compared: prepartum, from the 31st week of pregnancy onwards (Q1); 48–72 h postpartum (Q2); and 6–8 months postpartum (Q3).

The association between patient characteristics and the course of depression was analyzed using linear mixed

models with EPDS as the target variable. Initially, a linear model was fitted (the full model) with patient as a random effect and time (Q1, Q2, Q3) and the following predictors as fixed effects: number of pregnancies (ordinal), parity status (ordinal), education status (high-school diploma vs. lower than high-school diploma), income (ordinal categories), partnership status (single vs. married or in relationship), residential property status (rented house or apartment vs. privately owned house or apartment), occupation before pregnancy/birth (yes vs. no), parents living nearby (yes vs. no), as well as the interactions of these predictors by time as fixed effects. Backward stepwise variable selection was then carried out to obtain the best model in accordance with the Akaike information criterion (the final model). The *P* values for the *F* tests in the final model (type III analysis) and uncorrected *P* values for linear contrasts were shown. Adjusted mean EPDS values based on the final model and 95 % confidence intervals for them were shown as well. The random effect "patient" takes into account the fact that each patient had repeated EPDS measures.

All of the tests were two-sided, and a *P* value of less than 0.05 was regarded as statistically significant. The statistical analyses were carried out using the R system for statistical computing (version 2.14.2; R Development Core Team, Vienna, Austria, 2012) and the SAS software package (version 9.2, SAS Institute, Inc., Cary, NC, USA).

Results

A total of 792 of the 1,100 women participating had a complete set of EPDS values for all three study time-points and were, therefore, included in the analysis. Patient characteristics are summarized in Table 1. The women's average age was 32.8 years; 47 % ($n = 371$) were recruited into the study during their first pregnancy, 31 % ($n = 242$) during the second pregnancy, and 23 % ($n = 179$) had more than two previous pregnancies. More than half of the women (56 %; $n = 444$) had at least a high-school diploma, and most (98 %; $n = 777$) were in a relationship, whether married or not. Approximately, half of the women were living in a household with a monthly income of more than €3,000, and most of the women had been in employment at the time of the start of pregnancy (77 %; $n = 607$).

Linear mixed models were fitted to assess the influence of socioeconomic variables. The predictive factors "number of pregnancies", "occupational status before birth", and "parents (-in-law) living nearby", as well as the interactions of these factors with time, were dropped during the variable selection process—meaning that their predictive value appeared to be irrelevant, or the predictive factors involved were already explained by the other predictors. The final model contained time ($P < 0.001$, *F* test) and the predictors of parity status ($P = 0.25$, *F* test), educational status ($P = 0.78$, *F* test), family status ($P < 0.000001$, *F* test), income ($P < 0.0001$, *F* test), residential property status ($P = 0.10$), and the interactions of parity status ($P < 0.001$, *F* test), education status ($P < 0.01$, *F* test), and residential property status ($P < 0.04$, *F* test) by time. Adjusted mean EPDS values based on this final model are shown in Table 2 and Figs. 1, 2, 3, 4, 5.

Table 1 Patient characteristics, showing frequencies and percentages

Characteristic	*n*	%
Parity		
0	453	57.2
1	252	31.8
2	67	8.5
3	12	1.5
4	8	1.0
Educational status		
Lower than high-school diploma	345	43.7
High-school diploma	444	56.3
Employed before pregnancy/birth		
No	184	23.3
Yes	607	76.7
Family status		
Single	15	1.9
Married or in relationship	777	98.1
Income per month (in Euros)		
<500	2	0.3
500–1,000	27	4.6
1,000–2,000	84	14.3
2,000–3,000	191	32.5
3,000–4,000	134	22.8
4,000–5,000	84	14.3
>5,000	65	11.1
Accommodation status		
Rented accommodation	433	55.0
Privately owned accommodation	354	45.0
Parents (-in-law) nearby		
No	360	45.5
Yes	431	54.5

Overall, the EPDS values changed significantly over the course of time ($P < 0.0001$). Depressive symptoms were greatest during pregnancy and lowest shortly after birth. At the time of study visit Q3, the EPDS scores were slightly higher than at time Q2. However, different patterns for this change over time were observed for some subgroups.

Women who did not have at least a high-school diploma showed the typical pattern, with a clear drop in the depression score shortly after birth and a subsequent increase up to 6 months after birth ($P < 0.0001$), whereas

Table 2 The Edinburgh Postnatal Depression Scale (EPDS) relative to patient characteristics and time-points

Characteristic	Q1	Q2	Q3	*P* value
Parity				
Low (0 children)	7.2 (6.3, 8.0)	6.1 (5.2, 6.9)	6.3 (5.5, 7.2)	<0.001
High (1 child)	7.6 (6.8, 8.4)	5.6 (4.8, 6.4)	6.8 (6.0, 7.6)	<0.00001
P value	0.04	0.03	0.04	
Education				
Lower than high-school diploma	7.5 (6. 6, 8.4)	5.7 (4.8, 6.6)	6.5 (5.5, 7.3)	<0.0001
High-school diploma	6.9 (6.0, 7.8)	6.4 (5.5, 7.2)	6.3 (5.4, 7.1)	0.19
P value	0.09	0.08	0.57	
Family status				
Single	9.2 (7.7,10.7)	8.1 (6.6, 9.6)	8.4 (6.9, 9.9)	<0.00001
Married or in relationship	5.1 (4.7, 5.5)	4.0 (3.6, 4.4)	4.3 (3.9, 4.7)	<0.00001
P value	<0.000001	<0.000001	<0.000001	
Income				
Low (€1,000–2,000)	7.2 (6.3, 8.0)	6.1 (5.2, 6.9)	6.3 (5.5, 7.2)	<0.00001
High (€3,000–4,000	6.5 (5.6, 7.4)	5.4 (4.5, 6.3)	5.6 (4.8, 6.6)	<0.00001
P value	0.16	0.16	0.16	
Accommodation status				
Rented accommodation	7.6 (6.8, 8.5)	6.0 (5.2, 6.9)	6.4 (5.6, 7.3)	<0.0001
Privately owned accommodation	6.7 (5.8, 7.6)	6.1(5.2, 7.0)	6.3 (5.3, 7.2)	0.29
P value	<0.01	0.81	0.62	
Overall	7.2 (6.3, 8.0)	6.1 (5.2, 6.9)	6.3 (5.5, 7.2)	<0.00001

Adjusted mean EPDS values with 95 % confidence intervals in brackets, and *P* values are shown. Ordinal characteristics were evaluated at the first quartile ("low" value) and third quartile ("high" value)

EPDS estimated by a multiple linear mixed model (the final model). Mean EPDS values are adjusted for all other predictors. The predictive factors, previous pregnancy, employment before birth, and parents (-in-law) nearby, were dropped during the variable selection process

women who had at least a high-school diploma did not show this pattern ($P = 0.19$, Fig. 2).

With regard to residential property status, only a marginal decrease in EPDS values was observed after birth in the subgroup of women who were living in their own property ($P = 0.29$), in contrast to women who were not living in their own property ($P < 0.0001$, Fig. 5).

Comparison of the subgroups at the three time points of evaluation showed that there were some differences in the EPDS scores at Q1. Women with a higher parity status, lower level of school education, lower income, who were living in a rented house or apartment, and women without a partner had higher EPDS values than their counterparts (Figs. 1, 2, 3, 4, 5; Table 2). Similar differences were observed at Q3, with the exception of educational status and residential property ownership.

At time Q2, however, women with a higher parity status and women with a lower level of school education had lower EPDS values than the other groups. With regard to residential property, no significant differences were seen between the two groups at times Q2 ($P = 0.81$) and Q3 ($P = 0.62$). The effect of school education on depression disappeared at Q3 ($P = 0.57$). Since family status and income did not interact with time, the differences within these groups at Q1 were also present at Q2 and Q3 as well.

Although the subgroup of women who did not have a current partner at study entry was small, this subgroup had the largest difference in comparison with women in a current partnership. The EPDS scores were approximately four points higher for women without a partner at all three study visits (all $P < 0.000001$, Fig. 3).

Discussion

This prospective study shows that partnership status, previous pregnancies, educational status, income, and accommodation status are predictive factors in relation to the EPDS score during and after pregnancies. Partnership status appeared to have the strongest effect, with women who were in a partnership having far lower scores than women who were pregnant and did not have a partner. Accommodation status during pregnancy appeared to have a positive influence on the depression score when the woman was living in a self-owned property, but this effect disappeared after birth.

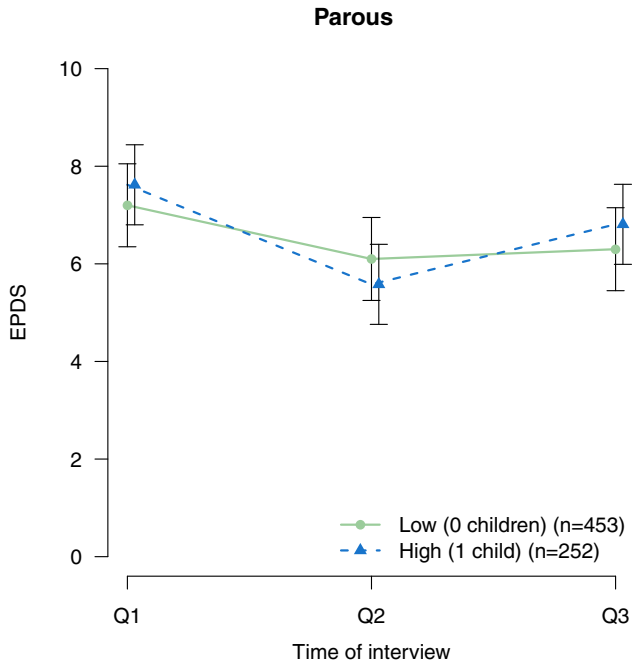

Fig. 1 Adjusted mean Edinburgh Postnatal Depression Scale (EPDS) scores relative to parity status at the times of the study visits (Q1, during pregnancy; Q2, shortly after birth; Q3, 6 months after birth). *Bars* indicate 95 % confidence intervals. The *bars* have been shifted slightly to allow better differentiation

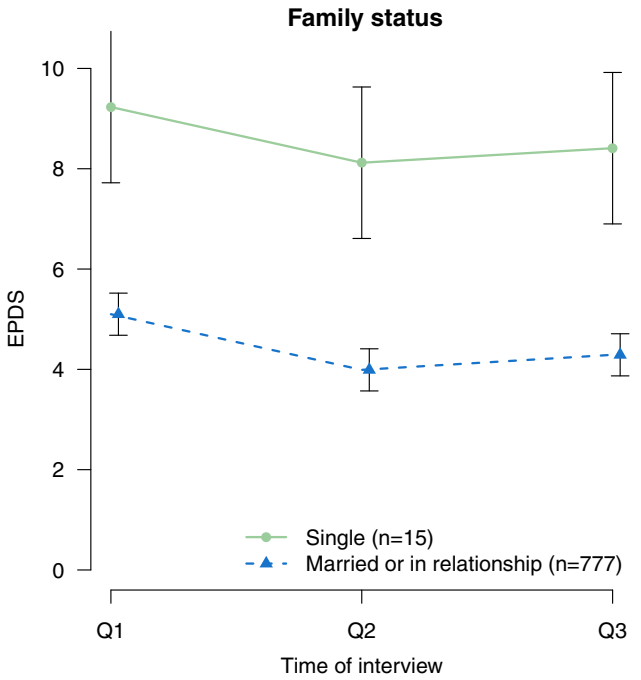

Fig. 3 Adjusted mean Edinburgh Postnatal Depression Scale (EPDS) scores relative to family status at the times of the study visits (Q1, during pregnancy; Q2, shortly after birth; Q3, 6 months after birth). *Bars* indicate 95 % confidence intervals. The *bars* have been shifted slightly to allow better differentiation

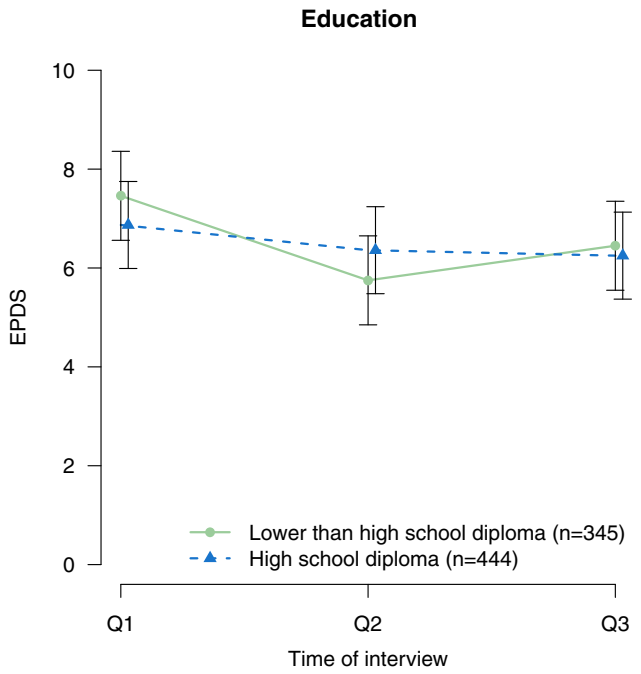

Fig. 2 Adjusted mean Edinburgh Postnatal Depression Scale (EPDS) scores relative to educational status at the times of the study visits (Q1, during pregnancy; Q2, shortly after birth; Q3, 6 months after birth). *Bars* indicate 95 % confidence intervals. The *bars* have been shifted slightly to allow better differentiation

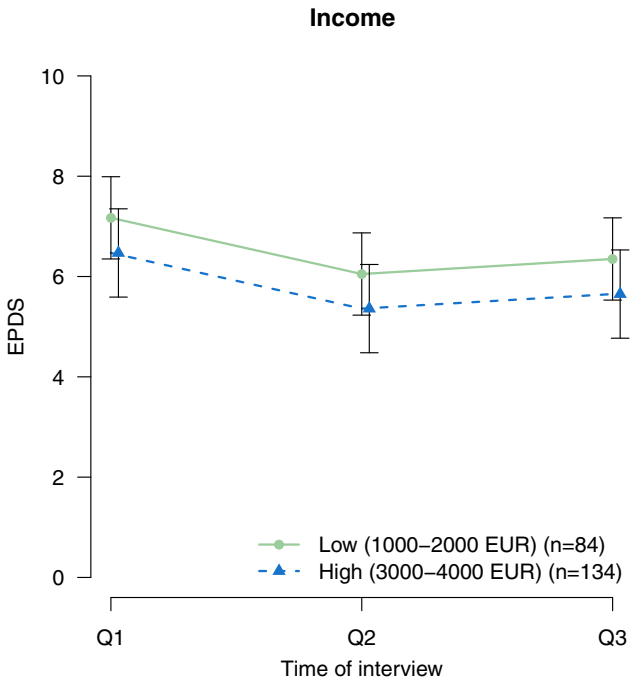

Fig. 4 Adjusted mean Edinburgh Postnatal Depression Scale (EPDS) scores relative to monthly income at the times of the study visits (Q1, during pregnancy; Q2, shortly after birth; Q3, 6 months after birth). *Bars* indicate 95 % confidence intervals. The *bars* have been shifted slightly to allow better differentiation

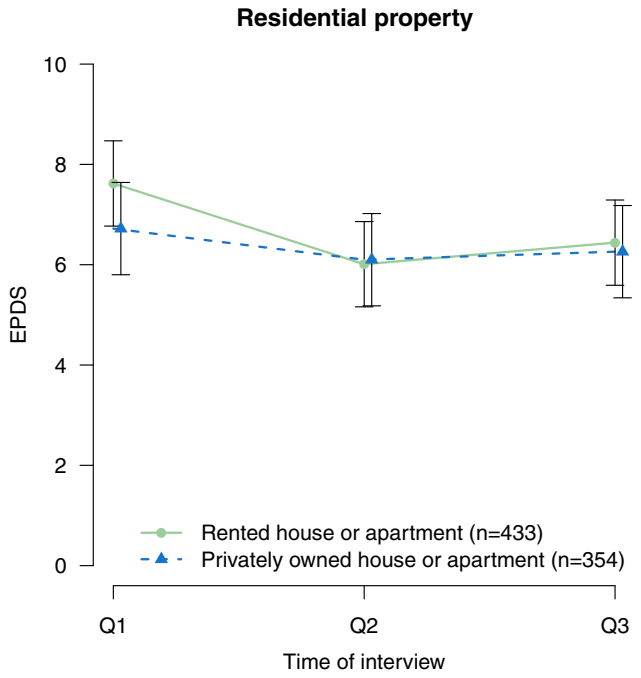

Fig. 5 Adjusted mean Edinburgh Postnatal Depression Scale (EPDS) scores relative to accommodation status at the times of the study visits (Q1, during pregnancy; Q2, shortly after birth; Q3, 6 months after birth). *Bars* indicate 95 % confidence intervals. The *bars* have been shifted slightly to allow better differentiation

It is known from other studies that a lack of social support from the partner is strongly associated with antepartum and postpartum depression in univariate and multivariate analyses [10]. Most of the studies showed that the size of the effect of partner support was medium or large. This is consistent with the present findings. Regarding the study group age, parity and educational status correspond to a previously published cohort of pregnant women in Germany, where educational status was found to increase [48]. However, social support from other sources was not consistently associated with depression values during and after pregnancy. The present study inquired about social support within the family. This factor was not selected as a variable that could help improve the prediction of depression scores. In other studies, the effect size of social support was rather small, and some studies did not observe any influence [10].

Although there was a consistent effect of partnership status at all three study visit time-points, differential effects at each time-point are possible. In a previous study, we examined the effect of 5-HTTLPR polymorphism on peripartum depression symptoms [49]. The S allele was found to increase the negative effect of depressive symptoms associated with dissatisfaction with regard to the patient's partnership. As these effects were only seen at the last study visit, the findings imply that the mechanisms involved in different depression scores during and after pregnancy may be different.

Income status and accommodation status (living in a self-owned apartment or house vs. not) were selected for the final prediction model for EPDS. However, the EPDS score did not differ significantly between income groups. Absolute differences between women with a high income and those with a low income were approximately 0.7 at all study visits. Women who were living in a self-owned property apparently had fewer depressive symptoms during pregnancy, but this effect did not have an impact on depressive symptoms directly postpartum or 6 months later. It may be assumed that problems that had been anticipated by the group of women living in rented properties did not actually ensue.

There was a trend toward educational status playing a role in differences between EPDS scores at the visits during pregnancy and shortly after pregnancy. Women with a high-school degree had nonsignificantly lower depression scores during pregnancy ($P = 0.09$) and nonsignificantly higher depression scores ($P = 0.08$) in comparison with those without a high-school diploma. Women with a high-school diploma apparently did not respond with a strong decrease in depression symptoms in the same way as women without a high-school diploma.

Similarly, the response to giving birth was somewhat stronger among women who had previously given birth in comparison with those experiencing giving birth for the first time. However, the depression scores at time-points Q1 and Q3 were significantly higher in women who had already a child. This might be explained by possibly higher stress levels resulting from having to cope with pregnancy plus an additional child (Q1) or even more than one child (Q3). However, an ability to enjoy the newborn to a greater extent can be attributed to parous women rather than to those who have not experienced this situation before. Other studies are inconsistent with regard to the association between nulliparity and depressive symptoms. As in the present study, however, the effect may be more complicated, and analyses should include the course of depressive symptoms over time to assess this relationship.

Some weaknesses as well as strengths need to be taken into consideration when interpreting the results of this study. The first two questionnaires were structured as personal interviews, while the third questionnaire (Q3) was carried out by phone interview. However, the reliability of phone questionnaires in this setting has been shown to be satisfactory [45]. The socioeconomic status was evaluated only at the first interview. Although these factors were considered stable throughout the study period, they can change and thus influence the reported outcome at following time points. Another problem when comparing studies on this topic is that they use different standardized questionnaires to assess depression. The EPDS was used for the present analysis. While many questionnaires are not

validated for pregnancy, the EPDS is a specific assessment instrument for identifying PPD. The scale was developed by Cox et al. [47]. The German version of it used for the present study was translated in 1998 by Bergant et al. [46] and has been adequately tested for reliability and validity. The EPDS is a simple, user-friendly self-assessment scale consisting of 10 questions in which the level of the score is proportionate to the severity of depressive symptoms. It can already be used during pregnancy and in the first few days after birth [50–52].

With regard to the interpretation of the differences, it has to be kept in mind that for clinical relevant depression cut-off points for the EPDS score >13 are considered clinically relevant and a score >10 with regard to an increased depression risk. The number of patients in this study reaching these high scores was rather low.

One of the main results is the difference in the EPDS score between women with and without a partnership. The sample size of the group of women without a partner was rather small ($n = 15$). There might be limitations with regard to the interpretation of this result, although the difference was statistically significant.

In conclusion, this study emphasizes the effect of an intact partnership status in relation to lower depressive symptoms during and after pregnancy. Other factors in the socioeconomic context are also predictive of the EPDS score during and after pregnancy, but the effect sizes appear to be rather small. For women, partnership appears to provide a fundamentally positive influence on depression status, and this may also have implications for the children's development. The lack of a partnership may influence the child not only directly as a result of the absence of interaction with a father or a male reference person, but also indirectly due to increased depressive symptoms in the mother. As there are large differences between the groups, women who do not have an intact partnership could be selected for possible interventional social support programs, as these patients are capable of obtaining the greatest benefit from such interventions both antepartum as well as postpartum.

Conflict of interest The authors have no conflicts of interest to report.

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