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The relationship between maternal psychopathology and maternal-fetal attachment: a cross-sectional study from the Czech Republic

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Abstract

Background Maternal-fetal attachment might be associated with maternal mental health issues, but previous results have been inconsistent, particularly regarding prenatal anxiety. We compared maternal-fetal attachment between pregnant women with and without symptoms of antenatal depression and anxiety. Additionally, we examined the relationships between prenatal depressive and anxiety symptoms, psychosocial stress, and maternal-fetal attachment.

Methods We conducted a cross-sectional study involving a sample of 2,233 pregnant women. The data were collected between March 2021 and March 2023 at outpatient clinics in the Czech Republic. We used self-report questionnaires to assess symptoms of prenatal depression (Edinburgh Postnatal Depression Scale, EPDS), anxiety (Perinatal Anxiety Screening Scale, PASS), psychosocial stress (Prenatal Psychosocial Profile, PPP), and maternal-fetal attachment (Prenatal Attachment Inventory – Revised, PAI-R).

Results Women without symptoms of antenatal depression had higher total scores on the PAI-R ($U = 336,357$; $p = .013$) and on the PAI-R Interaction subscale ($U = 322,913$; $p < .001$), suggesting a higher quality of maternal-fetal attachment than women with symptoms. No other significant associations were found between antenatal depression, anxiety and the PAI-R subscales scores.

Conclusions Our results suggest that women experiencing increased depressive, but not anxiety, symptoms in pregnancy, have a poorer quality of attachment to their child, although the effect size is small. Consequently, treating prenatal depression in women could have a positive effect on maternal-fetal attachment.

Keywords Maternal-fetal attachment, Antenatal depression, Antenatal anxiety, Pregnancy

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Background

Mental Health during Pregnancy.

Pregnancy and early parenthood are transitional periods in a parent's life, marked by numerous physiological, psychological, and social changes that require adjustment. These can make women in the perinatal period especially vulnerable to mental health challenges, with perinatal depression and anxiety being the most common [1]. These conditions are often highly comorbid [2].

According to a recent meta-analysis by Yin et al. [3], the prevalence of major antenatal depression is 15%, with variation depending on factors such as severity, socioeconomic status, and the diagnostic tool used. Several risk factors increase the likelihood of developing depression during pregnancy, including a history of depression, lack of social support, low education, unplanned pregnancy, smoking before or during pregnancy [1, 2], and experiences of maternal childhood maltreatment [4]. Untreated antenatal depression is a risk factor for adverse birth outcomes such as preterm birth and low birth weight [5], adverse maternal outcomes such as postnatal depression [6], impaired postnatal maternal bonding [7], and the internalizing and externalizing problems in the child [8].

Anxiety disorders are also common, with prevalence around 15% [9]. Several factors are associated with antenatal anxiety, including previous pregnancy loss, experiences of childhood abuse, lack of social support, and a history of mental health problems [10]. Women who experience anxiety during pregnancy are at higher risk for lower parenting self-efficacy [11], perceived impaired bonding [12], and postpartum symptoms of mental disorders [13–15]. In addition, their children are more likely to have emotional problems [16] and internalizing difficulties [17, 18].

Maternal-Fetal Attachment.

The mother's sense of the maternal-infant bond begins to form during the prenatal period, a process known as maternal-fetal attachment, prenatal attachment, or prenatal bonding [7, 19]. Cranley (20; p282) describes maternal-fetal attachment as “the extent to which women engage in behaviors that represent an affiliation and interaction with their unborn child”; encompassing cognitive, behavioral, and emotional dimensions. The strength of this prenatal attachment tends to increase during pregnancy [7, 21]. One factor that can enhance this attachment is the use of ultrasound, which offers a visual representation of the fetus, making the connection more concrete and fostering a sense of affiliation [7].

A stronger maternal-fetal attachment is associated with better social support perceived by the mother [22], a higher quality of couple relationship [23], and lower maternal age or lower education [24]. Research also indicates that certain personality traits play a role, with higher levels of conscientiousness, agreeableness, and

extraversion [25], as well as associations with higher sensory seeking and lower sensitivity and aversion to sensory stimuli [26].

Maternal-fetal attachment is a strong predictor of better postnatal bonding [27], which has been linked to positive child development outcomes such as secure attachment, easier temperament, generally more positive infant mood [28], and a higher quality development across several areas. Specifically, this includes better adaptive behavior, greater behavioral and emotional competence, and the timely achievement of early developmental milestones [29, 30].

Previous research has indicated a negative relationship between the quality of maternal-fetal attachment and both antenatal anxiety [31, 32] and depression [33–35]. However, a recent meta-analysis by McNamara et al. [36], examining the relationship between mental health during pregnancy and maternal-fetal attachment, highlighted gaps and inconsistencies in the evidence - particularly regarding the link between maternal-fetal attachment and anxiety - due to mixed and often non-significant findings. Similarly, the latest meta-analysis focusing on the relationship between maternal-fetal attachment and perinatal depression [37] also produced inconsistent results. The authors of this study recommend that future research explore potential confounding factors using larger sample sizes. Additionally, many existing studies do not use tools that distinguish between different aspects of maternal-fetal attachment, such as interaction with the fetus or differentiation of the self from the fetus. To our knowledge, no studies on these relationships have been conducted with a Czech sample, and only a limited number have involved samples from Central or Eastern Europe.

In the Czech Republic, pregnant women attend regular check-ups with their gynecologists every four to six weeks. From around the 36th gestational week, antenatal care is provided by the maternity hospital where the woman is registered. Some women choose to attend antenatal courses or hire a doula or private midwife, who can also offer emotional support. However, there are no national policies or strategies specifically targeting perinatal mental health, and the importance of adequate care and support in this area is often overlooked. Antenatal care is primarily focused on physical health and is mostly delivered by obstetricians, gynecologists, and midwives who do not have specialized training in mental health.

Therefore, the main goal of this study was to examine differences in the strength and nature of maternal-fetal attachment between respondents with and without symptoms of antenatal depression and anxiety. In addition, we aimed to explore the relationships between the severity of prenatal depressive and anxiety symptoms, levels of psychosocial stress, concerns about conception,

demographic factors, and maternal-fetal attachment, as well as its individual dimensions.

Our main hypothesis is that maternal-fetal attachment in participants showing symptoms of depression and/or anxiety will be significantly poorer when measured by the total score and by the subscales of the PAI-R. Other effects and relationships in this study are evaluated in an exploratory manner.

Methods

Research design

The study used a cross-sectional design, and the participants were selected by convenience sampling. The present study was a part of a larger research project conducted by the Center for Perinatal Mental Health of the National Institute of Mental Health in the Czech Republic.

Procedure and sample

In total, 14 outpatient gynecological clinics in three Czech regions participated in the data collection, which took place between March 2021 and March 2023. During one of the regular check-ups with their gynecologist, women aged 18–45 who spoke Czech and had an email address were offered the opportunity to participate in the study by a doctor or nurse at the participating gynecological clinics.

The medical staff provided the informed consent form and the questionnaires used in the study to the participants on tablets. Both the informed consent and the questionnaires were completed in an online form via the cyber-secured platform *forms.nudz.cz*, which is hosted on the internal servers of the National Institute of Mental Health of the Czech Republic.

Measurements

Participants provided demographic information and completed self-report questionnaires assessing maternal-fetal attachment, symptoms of prenatal depression and anxiety, and levels of psychosocial stress. Additionally, they indicated how stressful they perceived the circumstances surrounding the conception of the current pregnancy.

Maternal-fetal attachment

To measure maternal-fetal attachment, we used a Czech translation of the **Prenatal Attachment Inventory – Revised** (PAI-R) [38], which contains three subscales: Anticipation, Differentiation, and Interaction, each with six items. Each item is rated on a 4-point scale, and the rating reflects how often the woman has experienced the situation described in the statement (*1 = Almost never; 2 = Sometimes; 3 = Often; 4 = Almost always*). Total scores range from 21 to 84, with higher scores indicating higher

levels of maternal-fetal attachment. No cutoff scores are used in this scale. The 3-factor model of the scale has adequate internal consistency (Cronbach's α measured with our data)—the Anticipation subscale at $\alpha = 0.80$, the Differentiation subscale at $\alpha = 0.78$, and the Interaction subscale at $\alpha = 0.81$, with the total scale at $\alpha = 0.91$. Both individual subscale scores and the total inventory score were used in the statistical analyses.

Symptoms of depression

Symptoms of depression were measured using a Czech version of the **Edinburgh Postnatal Depression Scale** (EPDS) [39, 40]. The inventory is widely used to screen for a risk of perinatal depression and consists of 10 items, seven of which are reverse coded. Each item is rated on a 4-point scale (e.g., “Please, choose the answer that comes the closest to how you have felt in the past 7 days, not just how you feel today”; 0–3). The internal consistency of the scale using our sample for the calculation is $\alpha = 0.85$. For the statistical analyses, we used the cut-off point of 11 (respondents who scored ≥ 11 were identified as having symptoms of depression). According to the meta-analysis of Levis et al. [41], this cut-off score maximizes the combined sensitivity and specificity for the screening of perinatal depression.

Symptoms of anxiety

To measure symptoms of anxiety, we used a Czech translation of the **Perinatal Anxiety Screening Scale** (PASS) [42]. The inventory contains 31 items. Respondents rate on a 4-point scale (*0 = Not at all; 1 = Sometimes; 2 = Often; 3 = Almost always*) how often in the past month they have experienced the specific concerns listed in each statement. The internal consistency of the scale calculated using the dataset of the current study is $\alpha = 0.93$. For the statistical analyses, we used the cut-off point of 26 (respondents scoring ≥ 26 were identified as having symptoms of anxiety) [43].

Psychosocial stress

We used the Czech translation of an 11-item subscale of the **Prenatal Psychosocial Profile** (PPP) [44] to measure psychosocial stress. Each item is rated on a 4-point scale (e.g., “To what extent do you currently perceive the following items as stressful?” *1 = No Stress; 2 = Some Stress; 3 = Moderate Stress; 4 = Severe Stress*). Using our dataset, the internal consistency of the scale is $\alpha = 0.76$.

Concerns about conceiving current pregnancy

We included an additional item in the PPP regarding the level of stress that women perceived in relation to the conception of the current pregnancy (“*unplanned or difficult conception*”). This item was not included in the total score of the scale.

Statistical analyses

Statistical analyses were performed using Stata software (version 17.0). Where appropriate, we used Pearson's chi-square test to compare the characteristics of respondents between the groups for (a) depression (with and without symptoms) and (b) anxiety (with and without symptoms). We used the median (Mdn) and interquartile range (IQR) for continuous non-normally distributed variables, with a 95% confidence interval (CI)—lower and upper, minimum, and maximum.

For the statistical analyses, age was treated as a continuous variable, while the region of the outpatient clinic was categorized into three groups (Prague, Central Bohemian, and Olomouc). The trimester variable was classified into three categories (1, 2, and 3); and the number of children in the household was analyzed as a continuous variable. Marital status had four options (married, cohabiting, single, and other). Finally, the week of pregnancy was considered a continuous variable. For descriptive statistics, the number of children at home was categorized into four groups (0, 1, 2, and 3+).

The Shapiro–Wilk test was applied to assess the assumption of normal distribution. When necessary, Spearman's rho correlation and non-parametric alternatives of statistical tests were used. A *p*-value of < 0.05 was considered statistically significant, except in cases of multiple testing, where the Bonferroni correction was applied. For the Bonferroni correction, the adjusted significance level was calculated as $p = 0,05/n$, where *n* represents the number of tests conducted. Thus, in cases of multiple testing with three subscales, a *p*-value of < 0.0167 was considered statistically significant.

We performed Spearman's rho correlation to examine the relationships between each PAI-R subscale, the total PAI-R score, and the EPDS, PASS, and PPP scores,

the respondents' age, the gestational week, the number of children in the household, the score on the additional PPP item (addressing perceived stress related to the conception of the current pregnancy), and the 10th item of the EPDS.

As the distribution of the scores was non-normal, we performed the non-parametric Mann–Whitney U test on two independent samples to analyze the mean difference of PAI-R scores between the groups: (a) with and without symptoms of prenatal depression and (b) with and without symptoms of prenatal anxiety. To evaluate differences at PAI-R scores between trimesters, we used Kruskal–Wallis ANOVA.

We used the rank biserial correlation (r_{tb}) to indicate the effect size of the difference in maternal–fetal attachment between the groups (with and without symptoms of prenatal depression or anxiety).

To evaluate the effects of possible confounders, we performed linear regression. We used two statistical models to avoid inaccurate results due to the expected high correlation between the EPDS and the PASS. In both models, we used the PAI-R total score as a dependent variable and (a) using the EPDS, number of children, week of pregnancy, age, and marital status as predictors and (b) using the PASS, number of children, week of pregnancy, age, and marital status as predictors.

Results

Sample characteristics

Of the 2,242 respondents participating in the study, we excluded nine participants who were under the age of 18 or over the age of 45, leaving a sample of 2,233 participants. Data were collected between March 24, 2021, and March 27, 2023. The age of the respondents ranged from 18 to 45 years (Mdn = 30, IQR = 7). The respondents were mostly from outpatient clinics in the Olomouc region (73.6%), while the others were from Prague and the Central Bohemian region (25.4%). The sample included women in all three trimesters: 1,351 in the first trimester, 358 in the second trimester, and 524 in the third trimester (week of pregnancy Mdn = 13, IQR = 13).

Of the participants, 1,037 had no children living in their household (46.4%). The number of participants living with their partner was 2,178 (97.5%), of whom 1,048 were married; 28 respondents (1.3%) lived alone, and 27 (1.2%) stated *other* when asked about their marital status. The nationality of the respondents was 1,560 Czech, 296 Moravian, 45 Slovak, and three Roma (the remaining 329 respondents stated *other* or a combination of nationalities).

Descriptive statistics of continuous variables

Table 1 shows the descriptive statistics of the measures included in the study: PAI-R, PAI-R subscales

Table 1 Psychosocial characteristics of respondents (*N* = 2,233)

Measurements and continuous variables	Median (IQR)	Quartiles		Minimum	Maximum
		Lower	Upper		
PAI-R	47 (15)	39	54	19	72
PAI-R Anticipation	16 (6)	13	19	6	24
PAI-R Differentiation	14 (6)	11	17	6	24
PAI-R Interaction	17 (5)	14	19	6	24
EPDS	5 (7)	2	9	0	28
PASS	20 (15)	13	28	0	76
PPP	14 (5)	12	17	11	44
Age	30 (7)	27	34	18	45
Week of pregnancy	13 (13)	12	25	6	42
Number of children at home	1 (1)	0	1	0	6

PAI-R Prenatal Attachment Inventory – Revised and its subscales: *Anticipation*, *Differentiation*, *Interaction*; EPDS Edinburgh Postnatal Depression Scale; PASS Perinatal Anxiety Screening Scale, PPP Prenatal Psychosocial Profile

(Anticipation, Differentiation, and Interaction), EPDS, PASS, and PPP, and it includes continuous variables (age, the week of pregnancy, number of children at home, concerns about conceiving current pregnancy, and suicidal thoughts). For the whole sample, the median EPDS score was 5 (IQR = 7), the median PASS score was 20 (IQR = 15), and the median PPP score was 14 (IQR = 5). The median age of the respondents was 30 years (IQR = 7), the median number of weeks of pregnancy was 13 (IQR = 13), and the median number of children at home was 1 (IQR = 1). The median score of the item on unplanned or difficult conception was 0 (IQR = 0), and the median score of the item on suicidal thoughts was 0 (IQR = 0).

Symptoms of depression

Of the 2,233 respondents analyzed, 17.8% ($n = 398$) had increased depressive symptoms ($EPDS \geq 11$). There were significant differences in age ($p < .001$), region ($p = .003$), trimester ($p = .034$), and marital status ($p < .001$) between the group with and without depressive symptoms, but not in the number of children at home ($p = .073$). A higher prevalence of depressive symptoms was found at younger ages, in the Olomouc region, in the first trimester, and among single mothers.

Symptoms of anxiety

Of the 2,233 respondents, 31.5% ($n = 703$) had increased anxiety symptoms ($PASS \geq 26$). There were significant differences in age ($p = .012$) and marital status ($p = .006$) between the groups with and without anxiety symptoms: a higher prevalence of anxiety symptoms was found in women of a younger age and among single mothers. There were no significant differences in region ($p = .380$), trimester ($p = .945$), or number of children at home ($p = .739$).

Correlations

A weakly significant negative correlation was found between the total PAI-R score and the EPDS ($r_s = -0.043$; $p = .04$) and between the total score of the PAI-R and the PPP ($r_s = -0.081$; $p < .01$), but not between the total score of the PAI-R and the PASS ($r_s = -0.011$; non-significant). Weak but significant negative correlations were found between age and PAI-R scores: for PAI-R total score $r_s = -0.157$, $p < .001$; for PAI-R Anticipation subscale $r_s = -0.235$, $p < .001$; for PAI-R Differentiation subscale $r_s = -0.057$, $p = .007$; and for PAI-R Interaction subscale $r_s = -0.126$, $p < .001$. Significant positive correlations were also found between gestational age and PAI-R scores: for PAI-R total score $r_s = 0.333$, $p < .001$; for PAI-R Anticipation subscale $r_s = 0.183$, $p < .001$; for PAI-R Differentiation subscale $r_s = 0.403$, $p < .001$; and for PAI-R Interaction subscale $r_s = 0.302$, $p < .001$.

A significant positive correlation was found between the EPDS and PASS scores ($r_s = 0.655$; $p < .001$) and between the EPDS and PPP scores ($r_s = 0.519$; $p < .001$). There was also a significant positive correlation between the PASS and PPP scores ($r_s = 0.578$; $p < .001$) and between the PAI-R score and gestational week ($r_s = 0.333$; $p < .001$).

Table 2 presents the correlations between the PAI-R subscales and the EPDS, PASS, and PPP scores, age, gestational age, number of children at home, and concerns about conceiving current pregnancy.

Outcome results

We found a significant difference between groups with ($n = 398$) and without ($n = 1,835$) increased symptoms of depression in the PAI-R total score ($U = 336,357$; $p = .013$) and in the PAI-R Interaction subscale ($U = 322,913$; $p < .001$). Both the PAI-R total score and the PAI-R

Table 2 Correlations between study outcomes

Correlation	PAI-R	PAI-R Anticipation subscale	PAI-R Differentiation subscale	PAI-R Interaction subscale	EPDS	PASS	PPP
PAI-R							
PAI-R Anticipation	0.872***						
PAI-R Differentiation	0.869***	0.609***					
PAI-R Interaction	0.913***	0.715***	0.716***				
EPDS	-0.043*	-0.019	-0.023	-0.070*			
PASS	-0.011	0.045*	-0.012	-0.056**	0.655***		
PPP	-0.081**	-0.071**	-0.050*	-0.095***	0.519***	0.578***	
Age	-0.157***	-0.235***	-0.057**	-0.126***	-0.066**	-0.032	-0.001
Week of pregnancy	0.333***	0.183***	0.403***	0.302***	-0.018	0.039	0.010
Number of children at home	-0.040	-0.169***	0.067**	-0.005	0.037	-0.030	0.054*
Concerns about conceiving current pregnancy	-0.101***	-0.083**	-0.062**	-0.115***	0.216***	0.250***	0.299***

p-value is provided for Spearman's Rho; * $p < .05$; ** $p < .01$; *** $p < .001$

PAI-R Prenatal Attachment Inventory – Revised and its subscales: Anticipation, Differentiation, Interaction; EPDS Edinburgh Postnatal Depression Scale; PASS Perinatal Anxiety Screening Scale, PPP Prenatal Psychosocial Profile

Table 3 Outcome results: PAI-R total score and subscales comparison for symptoms of depression

Measure	Group	N	Mann-Whitney U	p-value*	Effect size (r_{rb})
PAI-R	With symptoms	398	336,357	0.013	0.08
	Without symptoms	1,835			
PAI-R Anticipation	With symptoms	398	354,975	0.381	0.03
	Without symptoms	1,835			
PAI-R Differentiation	With symptoms	398	343,300	0.06	0.06
	Without symptoms	1,835			
PAI-R Interaction	With symptoms	398	322,913	< 0.001	0.12
	Without symptoms	1,835			

PAI-R Prenatal Attachment Inventory – Revised and its subscales: Anticipation, Differentiation, Interaction

* The Bonferroni correction for multiple measurements was used, thus the α level is 0.017

Table 4 Outcome results: PAI-R total score and subscales comparison for symptoms of anxiety

Measure	Group	N	Mann-Whitney U	p-value	Effect size (r_{rb})
PAI-R	With symptoms	703	521,920	0.262	0.03
	Without symptoms	1,530			
PAI-R Anticipation	With symptoms	703	527,569	0.469	0.02
	Without symptoms	1,530			
PAI-R Differentiation	With symptoms	703	520,758	0.227	0.03
	Without symptoms	1,530			
PAI-R Interaction	With symptoms	703	505,997	0.024	0.06
	Without symptoms	1,530			

PAI-R Prenatal Attachment Inventory – Revised and its subscales: Anticipation, Differentiation, Interaction

* The Bonferroni correction for multiple measurements was used, thus the α level is 0.017

Interaction subscale were higher in the group without increased symptoms of depression, which suggests a better quality of maternal-fetal attachment. The effect sizes for associations in both the PAI-R total score ($r_{rb} = 0.08$) and in the PAI-R Interaction subscale ($r_{rb} = 0.12$) were small. No between-group differences were found in the PAI-R Anticipation subscale ($U = 354,975$; $p = .381$) or in the PAI-R Differentiation subscale ($U = 343,300$; $p = .06$). The Bonferroni correction was used in these analyses. Table 3 shows the differences in the PAI-R between groups with and without increased symptoms of depression.

When using the Bonferroni correction, no between-group difference was found for the PAI-R total score ($U = 521,920$; $p = .262$), the PAI-R Anticipation subscale ($U = 527,569$; $p = .469$), the PAI-R Interaction subscale ($U = 505,997$; $p = .024$), or the PAI-R Differentiation subscale ($U = 520,758$; $p = .227$). Table 4 shows the differences in the PAI-R between groups with and without increased symptoms of anxiety.

Across all trimesters, the PAI-R total score (χ^2 (2, $N = 2233$) = 289.85, $p < .001$), and scores of Anticipation (χ^2 (2, $N = 2233$) = 85.12, $p < .001$), Interaction (χ^2 (2, $N = 2233$) = 231.75, $p < .001$), and Differentiation (χ^2 (2, $N = 2233$) = 439.32, $p < .001$) subscales were significantly different, all showing an increasing trend.

Results of linear regression

Two models using linear regression analysis were conducted to assess the extent to which the week of pregnancy, age, number of children, marital status, and either the EPDS or the PASS could predict the PAI-R total score.

The first model which included the EPDS as a predictor was significant ($F(7, 222) = 65.27$, $p < .001$), $R^2 = 0.17$. Significant predictors were week of pregnancy ($\beta = 0.42$, $p < .001$), age ($\beta = -0.41$, $p < .001$), and the EPDS score ($\beta = -0.13$, $p = .002$).

Similarly, the second model which used the PASS as a predictor also showed a significant effect ($F(7, 222) = 64.25$, $p < .001$), $R^2 = 0.17$. Significant predictors were week of pregnancy ($\beta = 0.42$, $p < .001$) and age ($\beta = -0.40$, $p < .001$). For the effects of the individual predictors, see Tables 5 and 6.

Discussion

The aim of this study was to explore the differences in the strength and nature of maternal-fetal attachment between respondents with and without symptoms of prenatal depression and anxiety. Additionally, the study examined the relationships between levels of prenatal depressive and anxiety symptoms, psychosocial stress, concerns about conception, and various demographic factors, in relation to maternal-fetal attachment. This included a detailed analysis of each of its dimensions separately.

Table 5 Linear regression: model with EPDS

Effect	β	SE	95% CI		p-value
			Lower	Upper	
Number of children	0.5	0.26	−0.02	1.02	0.059
Week of pregnancy	0.42	0.02	0.37	0.46	< 0.001
Age	−0.41	0.04	−0.49	−0.32	< 0.001
Marital status					
Cohabiting - married	0.05	0.41	−0.76	0.85	0.905
Other - married	1.32	1.82	−2.24	4.88	0.468
Single - married	0.29	1.79	−3.21	3.79	0.870
EPDS	−0.13	0.04	−0.21	−0.05	0.002

EPDS Edinburgh Postpartum Depression Scale

Table 6 Linear regression: model with PASS

Effect	β	SE	95% CI		p-value
			Lower	Upper	
Number of children	0.42	0.26	−0.09	0.94	0.108
Week of pregnancy	0.42	0.02	0.38	0.46	< 0.001
Age	−0.40	0.04	−0.48	−0.31	< 0.001
Marital status					
Cohabiting - married	0.05	0.41	−0.86	0.75	0.899
Other - married	1.03	1.82	−2.53	4.59	0.572
Single - married	0.11	1.79	−3.40	3.61	0.952
PASS	−0.03	0.02	−0.06	0	0.057

PASS Perinatal Anxiety Screening Scale

Symptoms of depression in relation to maternal-fetal attachment

Previous research has indicated that prenatal depressive symptoms can negatively affect a mother's ability to bond with her fetus [36]. Consistent with these findings, our results show a significantly weaker maternal-fetal attachment in the group experiencing depressive symptoms compared to the control group. Notably, the effect of depressive symptoms remained significant even after controlling for confounding variables such as maternal age and week of pregnancy.

When examining the subscales of the Prenatal Attachment Inventory (PAI-R), we found a significant difference between women with and without depressive symptoms on the Interaction subscale. The items in this subscale address not only interaction with the fetus but also with other people, suggesting that depressive symptoms may particularly impact the social and communicative aspects of prenatal attachment. This is consistent with previous research, which indicates that mothers with depressive symptoms tend to struggle with social interactions, both with their children and with others [45]. However, no significant differences were found in the Anticipation or Differentiation subscales. This suggests that while depressive symptoms may affect interaction and communication, they may not necessarily influence the mother's ability to recognize the fetus as a separate entity or her ability to engage in future-oriented thoughts about the child. This lack of difference in the Anticipation and

Differentiation subscales indicates that the cognitive and conceptual aspects of prenatal attachment remain intact even in the presence of depressive symptoms. This selective effect could have nuanced implications for postnatal bonding and child development. For example, while the mother may cognitively prepare for her child's arrival, a lack of interactive connection during pregnancy could still translate to challenges in postnatal bonding. Such challenges have been linked to developmental outcomes in children [5, 16–18, 26].

Symptoms of anxiety in relation to maternal-fetal attachment

Contrary to our hypothesis, we found no difference in the PAI-R scores between women with and without increased symptoms of anxiety. Studies on the relationship between maternal-fetal attachment and prenatal anxiety yield various results [31, 32, 46, 47]. These discrepancies may stem from differences in how anxiety and attachment were measured across the studies. Notably, our study used a pregnancy-specific anxiety scale (PASS), whereas some previous studies employed general anxiety measures that may not fully capture the perinatal context. There were also differences in the study samples: some of the studies collected data solely from primiparous [32, 46] or hospitalized women [47]. Moreover, the high prevalence of anxiety in our sample (31.5%) may

have diluted the strength of its association with maternal-fetal attachment.

Other analyzed relationships

Our study also found a small but significant negative correlation between maternal-fetal attachment and perceived psychosocial stress. This contrasts with a study that found a positive relationship between pregnancy-related stress and maternal-fetal attachment [48]. However, our research focused on general psychosocial stress, which is conceptually different [44]. While pregnancy-specific stress may heighten a mother's attention and focus of her resources to the fetus, general psychosocial stress—which encompasses non-pregnancy-related stressors—might divert focus away from the pregnancy, potentially weakening the maternal-fetal bond.

Additionally, we observed a small but significant negative correlation between maternal-fetal attachment and perceived stress regarding the conception of the pregnancy, such as difficulties conceiving or an unplanned pregnancy. This finding aligns with previous research findings in the meta-analysis by Yarcheski et al. [33], which revealed a weak relationship between planned pregnancy and maternal-fetal attachment.

Strengths and limitations

This study has several strengths. First, it was conducted on a Czech sample, making it one of the first studies in Central and Eastern Europe to measure the relationship between maternal mental health and maternal-fetal attachment. Most previous studies in this field have been conducted in Western countries, so our study provides valuable new data. Focusing on local and cultural specifics is crucial, as data relevant to our population are necessary to ensure adequate care for pregnant women experiencing mental health difficulties. In the Czech Republic, prenatal care primarily emphasizes physical health, with limited emphasis on mental health. There is currently no standardized screening for mental health difficulties in prenatal care, and resources for addressing psychosocial stress or bonding difficulties are scarce. The data from this study could support the integration of mental health screenings and attachment-focused interventions into routine prenatal care.

Many studies on the relationship between maternal-fetal attachment and symptoms of mental disorders focus primarily on participants in the second or third trimester of pregnancy [36]. Our study helps fill this gap by examining this relationship throughout the entire pregnancy, as the majority of the participants (60.5%) in our study were in the first trimester. We believe that it is essential to focus on maternal-fetal attachment and related psychosocial factors in early pregnancy to help prevent later impairments in maternal-fetal attachment and bonding.

Our sample size of 2,233 pregnant women is another notable strength, as it is considerably larger than those in most other published studies [37]. Within this sample, 18% of women showed elevated depressive symptoms, which is consistent with the population estimates for antenatal depression [2]. However, the prevalence of anxiety symptoms was higher (31%) compared to typical estimates [9]. We suspect this increase may be linked to the COVID-19 pandemic, which coincided with part of our data collection period. This prevalence aligns with findings by Ravaldi and Vannacci [49], who observed heightened anxiety among perinatal women in Italy during the pandemic. Finally, the prevalence rates in this study may also differ from those based on standard diagnostic criteria, as self-reported screening scales can sometimes overestimate prevalence.

The questionnaires used in this study are of adequate quality, with Cronbach's alpha values ranging from 0.76 to 0.93 in our sample, and they are widely used in perinatal research. However, while most studies in this area use tools like the Maternal-Fetal Attachment Scale [20] or the Maternal Antenatal Attachment Scale [50], we employed the Prenatal Attachment Inventory – Revised (PAI-R), which may explain minor discrepancies in our results and effect sizes compared to other research. A limitation of our measures is the lack of complete validation for the Czech translations of the PAI-R, PASS, and PPP scales.

It is important to mention that the results cannot be interpreted as clinical diagnoses of mental disorders, as we used self-reported screening tools that measure perceived symptoms rather than provide a definitive diagnosis. Studies involving clinically diagnosed samples may yield different findings.

A major limitation of this study is the lack of questions about socioeconomic status (SES) in our questionnaire, preventing us from controlling for its potential effects. SES is an important variable, as it is linked to both mental health and maternal-fetal attachment [2, 24]. Additionally, this study included outpatient clinics from only three of the 14 Czech regions, which excluded some of the poorest regions with higher proportions of lower-SES inhabitants and potentially poorer quality of life. This limitation may introduce bias into our findings.

Although our study design was cross-sectional, future research using a longitudinal design could provide valuable insights into how the relationship between maternal-fetal attachment and maternal mental health symptoms evolves over time. Given the inconsistent results in studies examining prenatal depressive and anxiety symptoms in relation to maternal-fetal attachment, more research is needed to clarify these associations, particularly the impact of prenatal anxiety on attachment. Future studies should consider including a broader range of

demographic, socioeconomic, and clinical variables to better understand this effect.

Conclusion

Our results suggest that women experiencing increased depressive, but not anxiety, symptoms in pregnancy, have a poorer quality of attachment to their child, although the effect size is small. Consequently, treating prenatal depression in women could have a positive effect on maternal-fetal attachment.

Abbreviations

EPDS	Edinburgh postnatal depression scale
PAI	R–prenatal attachment inventory–revised
PASS	Perinatal anxiety screening scale
PPP	Prenatal psychosocial profile

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Author contributions

The first draft was written by HN and all authors (AS, MK, KH, AH) commented on all versions of the manuscript. AS led the study design and conception with HN's contribution. AS collected the data, MK and HN prepared and run the statistical analyses. AH and KH reviewed and edited the final draft. All authors read and approved the final manuscript.

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Data availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval to conduct the research was granted by the Ethics Committee of National Institute of Mental Health (June 17, 2020, No. 130/20) and is in line with the Helsinki Declaration of 1964. All participants gave informed consent before entering the study.

Consent of publication

Not applicable.

Competing interests

The authors declare no competing interests.

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