Association between Marital Relationship, Bonding, and Depression during Pregnancy

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Abstract：This study aimed to clarify the relationship between the marital relationship, bonding, and depression during pregnancy. We asked 265 mothers and 257 fathers during pregnancy, who consented to participate, to respond to a mail questionnaire, consisting of basic information items, the Quality Marriage Index, Mother-Infant Bonding Questionnaire, and Edinburgh Postnatal Depression Scale. To clarify the association between the marital relationship, bonding, and depression, we analyzed the collected data using structural equation modelling. The marital relationship predicted mother-infant and father-infant bonding （p< 0.01 and p< 0.001）, the marital relationship predicted depression in mothers and fathers （p< 0.01 and p< 0.001）, and mother-infant and father-infant bonding did not predict depression in the mothers or fathers during pregnancy. The goodness-of-fit index values for the mothers and fathers were as follows: CFI: 0.977 and 0.976; and RMSEA: 0.041 and 0.042, respectively. The results revealed that the marital relationship predicts mother-infant and father-infant bonding, as well as depression in mothers and fathers during pregnancy, supporting the effectiveness of providing approaches for both mothers and fathers from the perspective of strengthening their marital relationships as a basis for promoting parent-infant bonding during this period. It was also suggested that support for married couples prevents depression in both mothers and fathers, in addition to promoting parent-infant bonding.

1．Introduction

The emotional bond from a parent to a baby is called "Bonding". And it complements "Attachment" but is a different concept[1]. Since 1990, many studies have been conducted on factors related to perinatal bonding. Recent studies have shown that bonding disorders （not postpartum depression） lead to neonatal abuse[2] and also cause depression[3]. In particular, bonding during pregnancy affects postpartum bonding and depression[4], indicating the importance of forming good bonding during pregnancy. In some studies, assisted reproductive technology[5] and planned or unplanned pregnancies[6] were discussed that influence pregnancy bonding. But it is largely unclear what other factors influence bonding during pregnancy.

In studies from the perspective of adult attachment, it is suggested that perinatal bonding is poor when attachment to adults （particularly a poor marital relationship） is weak[7,8]. Furthermore, with regards to bonding and the marital relationship, Müller reported that the relationship with a fetus's father promotes adaptation to pregnancy, which accelerates attachment to the fetus[9].

We found that the number of studies about perinatal bonding and the marital relationship conducted rapidly increased to 18 after 2010, but studies examining the cause and effect of them

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were 2（under review）. Whether a good marital relationship causes good bonding during pregnancy has been scarcely investigated. In addition, it has been suggested that postpartum perinatal bonding disorder is correlated with postpartum depression and that it precedes postpartum depression, but the relationship during pregnancy has not been fully clarified. Therefore, this cross-sectional study aimed to clarify the association between marital relationship, bonding, and depression during pregnancy.

２．Methods
2.1　Study participants

The sample size was calculated by using G* Power 3.1.9.4. To achieve a power of 0.80, a probability of Type I error of 0.05, and an effect size of 0.25, a sample of 180 couples was needed. Participants in this study were recruited from maternal and child health handbook issuance or childbirth preparation class at 53 public health centers, pregnancy checkup at three obstetrical hospitals, and two maternity homes for mothers and fathers in Japan between April and September 2021. Participants were required to be at least 20 years old and should be capable of understanding the Japanese language. Single mothers were excluded from the study, but they were not asked whether they were legally married.

2.2　Data collection

Couples were given detailed information about the study design and methods. This information was given orally and on paper in each facility. Couples who cooperated were asked to complete self-reported questionnaires, which included social demographic questions, the Quality Marriage Index（QMI）, Mother-Infant Bonding Questionnaire（MIBQ）, and Edinburgh Postnatal Depression Scale（EPDS）, during the pregnancy and return them via mail; each member of a couple sealed an envelope for individual response, and the couple put the 2 envelopes in a single envelop for return. We approached 5,955 couples, 274 mothers and
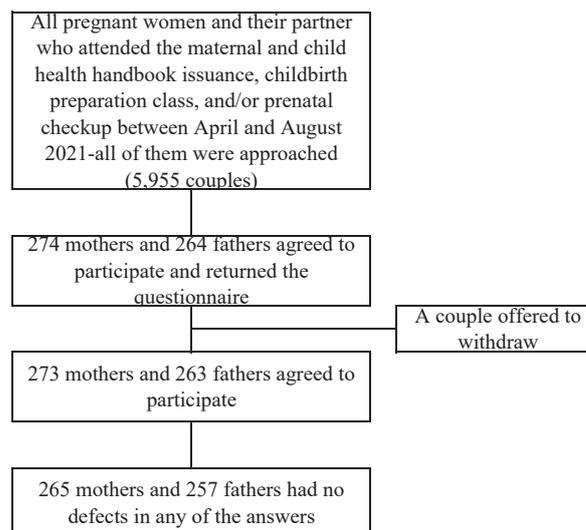
Figure 1. Flow chart of the study.

264 fathers agreed to participate and returned the questionnaire but a couple offered to withdraw. Two hundred and sixty-five（4.5%）mothers and 257（4.3%）fathers had no defects in any of the answers（Figure 1）. When paired, 250 couples had no missing data.

2.3 The instruments
2.3.1　Quality Marriage Index（QMI）

The QMI is a self-reporting scale designed to assess marital relationship[10]. The QMI Japanese version is composed of 6 items, rated on a four-point Likert scale（1 to 4）. The QMI Japanese version showed good internal consistency （Cronbach's alpha= 0.93）[11]. The total scores range from 4 to 24. Higher total scores indicate a better marital relationship.

2.3.2　Mother-Infant Bonding Questionnaire （MIBQ）

The MIBQ is a self-reporting scale designed to assess maternal bonding with their baby[12]. It is composed of 9 items: "loving", "disappointed", "neutral or felt nothing", "possessive", "resentful", "dislike", "protective", "joyful", and "aggressive". It is rated on a four-point Likert scale（0 to 3）, with the scale of some items reversed. It has been used for couples in the previous study, and its reliability and validity have been shown[13]. The MIBQ

Japanese version[14] was retranslated back into English by a native English translator who was unaware of the original wording to confirm that the translation was consistent with the original meaning. This Japanese MIBQ included during pregnancy showed good internal consistency (Cronbach's alpha= 0.584-0.879) and test-retest reliability (Person's correlation= 0.48-0.73, p< 0.01)[15]. The total scores range from 0 to 27. Lower total scores indicate a better bonding. But the MIBQ cut-off point has not been clarified.

2.3.3　Edinburgh Postnatal Depression Scale (EPDS)

The EPDS is a self-reporting scale designed to assess specific to prenatal and postpartum symptoms of depression, anxiety, and feelings of guilt[16]. It is composed of 10 items. It is rated on a four-point Likert scale (0 to 3), with the scale of some items reversed. It was the first scale that was developed for assessing maternal postpartum depression. And it is also widely used for assessing paternal postpartum depression[17]. The EPDS Japanese version showed good internal consistency (Cronbach's alpha= 0.78) and test-retest reliability (Spearman's correlation= 0.92)[18]. The total scores range from 0 to 30, and the Japanese cut-off point is 8/9 in the case of women[18]. In the case of men, a 7/8 cut-off point was suggested in a previous Japanese study[19]. Higher total scores indicate greater depression.

2.4　Demographic characteristics and perinatal conditions

Information on age, parity, due month, key person, financial or living difficulties, history of current pregnancy course, lost baby (miscarriage or stillbirth), and mental illnesses were obtained.

2.5　Statistical Analysis

Analysis comparing differences in the mean of the QMI, MIBQ, and EPDS between mothers and fathers were performed with Mann-Whitney U test. Mother-father correlations were examined by calculating Spearman's rank correlation coefficient using data managed for pairing. Cronbach's alpha was used to examine the internal consistency of the scale. We used no defects data for the analysis of each scale.

Structural Equation Modelling (SEM) was performed to clarify the association between marital relationship, bonding, and depression during pregnancy based on previous studies[3, 7-9]. The fit of the model was assessed using several goodness-of-fit indices including the Comparative Fit Index (CFI), the Goodness of Fit Index (GFI), the Adjusted GFI (AGFI), and the Root Mean Square Error of Approximation (RMSEA). The values of CFI > 0.97, RMSEA < 0.05 indicate good and CFI > 0.95, RMSEA < 0.08 indicate acceptable fit to the data[20]. All statistical analyses were done with SPSS version 28.0 and Amos version 28.0 (IBM Japan, Tokyo, Japan).

3.　Results
3.1　Demographic characteristics and perinatal conditions

The demographic characteristics and perinatal conditions of the study subjects are summarized in Table 1. The mean (SD) age of the mothers was 31.4 (4.8) years, and the fathers was 33.3 (6.0) years. There were 151 primiparas (57.0%).

3.2　The means, standard deviations, and sex differences of each scale
3.2.1　QMI

The means, standard deviations, and sex differences of the QMI items are shown in Table 2. "3: Our marriage is strong" in the mothers was significantly lower than in the fathers. But there was no significant difference in the total score between the mothers and fathers. Cronbach's α was 0.93 for the mothers and 0.92 for the fathers. A significant but weak correlation of $r_s= 0.35$ was found between the maternal and paternal QMI (p< 0.001).

3.2.2　MIBQ

The means, standard deviations, and sex differences of the MIBQ items are shown in Table 3. "6: Disappointed" and "9: aggressive" in the mothers were significantly higher than in the fathers. There was no significant difference between the mothers and fathers. The present study analyzed MIBQ items, excluding those with marked skewness (2, 3, 5, 6, and 9). Cronbach's a was 0.76 for the mothers and 0.73 for the fathers.

A significant but weak correlation of $r_s = 0.26$ was found between the maternal and paternal MIBQ (p< 0.001).

3.2.3　EPDS

The means, standard deviations, and sex differences of the EPDS items are shown in Table 4. "4: I have been worried for no good reason", "5: I have felt scared or panicky for no very good reason", "7: I have been so unhappy that I have

Table 1. Demographic characteristics and perinatal conditions n (%)

	Mothers (n=265)	Fathers (n=257)
Age (years) Mean±SD	31.4±4.8	33.3±6.0
Primiparous	151 (57.0)	
Medical problem with this pregnancy	22 (8.3)	
Miscarriage, stillbirth, the experience of losing a child in the first year after childbirth	51 (19.2)	
Experience in consulting with a counselor, psychiatrist, or psychosomatic physician for psychological or psychiatric problems	42 (15.8)	
I can confide anything to my partner	245 (92.5)	
I can confide anything to my mother (real mother)	210 (79.2)	
I have other people I can talk to besides my partner and mother (real mother)	248 (93.6)	
Life difficulties and financial anxiety	51 (19.2)	
Satisfaction with current home and environment when raising children	198 (74.7)	
Experience of death of family or close relatives, serious illness or accident of themselves, family, close relatives	23 (8.7)	

Table 2. Means, SDs, and sex differences of the QMI items

	Mothers (n=272)		Fathers (n=267)		p value
	M (SD)	Skewness	M (SD)	Skewness	
1: good	3.50 (0.61)	-1.11	3.54 (0.63)	-1.51	0.278
2: stable	3.55 (0.61)	-1.19	3.57 (0.60)	-1.40	0.608
3: strong	3.46 (0.64)	-0.95	3.57 (0.60)	-1.33	0.045
4: happy	3.68 (0.56)	-1.98	3.72 (0.50)	-1.89	0.638
5: part of a team	3.50 (0.72)	-1.40	3.55 (0.64)	-1.38	0.720
6: degree of happiness	3.63 (0.58)	-1.50	3.63 (0.55)	-1.40	0.834
Total	21.32 (3.21)	-1.43	21.58 (2.95)	-1.56	0.479

Each item is scored on a four-point Likert scale ranging from 1 to 4. The total scores can range from 4 to 24.
The Mann–Whitney U test was used to compare between groups.
QMI Quality Marriage Index, M mean, SD standard deviation

Table 3. Means, SDs, and sex differences of the MIBQ items

	Mothers (n=269)		Fathers (n=259)		p value
	M (SD)	Skewness	M (SD)	Skewness	
1: loving	0.48 (0.79)	1.58	0.48 (0.74)	1.34	0.635
2: disappointed	0.03 (0.23)	9.22	0.00 (0.00)		0.009
3: neutral and felt nothing	0.24 (0.57)	2.82	0.16 (0.47)	3.70	0.095
4: possessive	1.32 (1.16)	0.24	1.31 (1.17)	0.24	0.858
5: resentful	0.03 (0.22)	10.78	0.01 (0.09)	11.31	0.274
6: dislike	0.05 (0.31)	7.69	0.07 (0.43)	6.49	0.923
7: protective	0.30 (0.65)	2.28	0.33 (0.65)	1.91	0.328
8: joyful	0.74 (1.08)	1.08	0.78 (1.04)	1.02	0.629
9: aggressive	0.12 (0.43)	3.88	0.06 (0.32)	6.35	0.019
Total	3.30 (3.59)	2.06	3.19 (3.08)	1.00	0.882

Each item is scored on a four-point Likert scale ranging from 0 to 3. The total scores can range from 0 to 27.
The Mann–Whitney U test was used to compare between groups.
MIBQ Mother-Infant Bonding Questionnaire, M mean, SD standard deviation

Table 4. Means, SDs, and sex differences of the EPDS items

| | Mothers (n=271) | | Fathers (n=264) | | p value |
	M (SD)	Skewness	M (SD)	Skewness	
1: laugh	0.11 (0.31)	2.52	0.11 (0.39)	4.18	0.486
2: enjoyment	0.20 (0.47)	2.81	0.14 (0.40)	3.47	0.088
3: self-blame	1.04 (0.86)	0.15	0.98 (0.91)	0.47	0.305
4: anxious	1.07 (0.95)	0.06	0.72 (0.82)	0.69	< 0.001
5: scared	0.66 (0.82)	0.88	0.39 (0.68)	1.82	< 0.001
6: hard to cope	1.00 (0.80)	0.30	0.98 (0.90)	0.66	0.441
7: hard to sleep	0.40 (0.67)	1.72	0.22 (0.49)	2.15	0.001
8: sad	0.56 (0.73)	1.20	0.32 (0.56)	1.57	< 0.001
9: crying	0.24 (0.48)	2.12	0.04 (0.22)	5.59	< 0.001
10: self-harm	0.16 (0.50)	3.76	0.12 (0.40)	3.51	0.307
Total	5.44 (4.37)	1.03	4.02 (3.66)	1.28	< 0.001

Each item is scored on a four-point Likert scale ranging from 0 to 3. The total scores can range from 0 to 30.
The Mann–Whitney U test was used to compare between groups.
EPDS Edinburgh Postnatal Depression Scale, M mean, SD standard deviation

had difficulty sleeping", "8: I have felt sad and miserable", "9: I have been so unhappy that I have been crying" and total scores in the mothers were significantly higher than in the fathers. The present study analyzed EPDS items, excluding those with marked skewness (mothers: 1, 2, and 10; fathers: 1, 2, 9, and 10). Cronbach's α was 0.82 for the mothers and 0.77 for the fathers. A significant but weak correlation of r_s= 0.20 was found between the maternal and paternal EPDS (p< 0.01).

No multicollinearity between items was observed for any of the scales.

3.3 Path Model

Some previous studies reported that the marital relationship during pregnancy and the parenting period influences bonding in the latter[7, 8], and
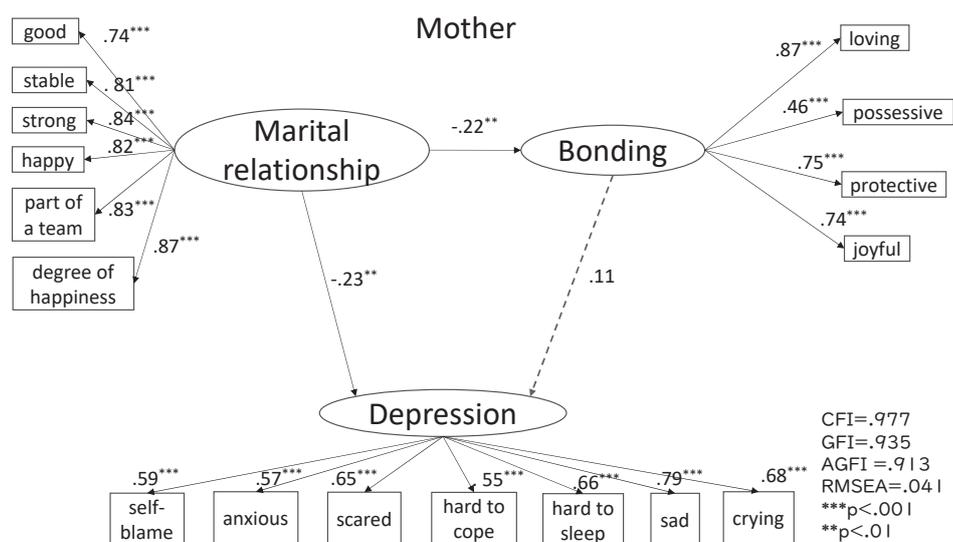
Figure 2. Path model of the association between marital relationship, bonding, and depression during pregnancy for mothers.
Standard errors are omitted in this path model.
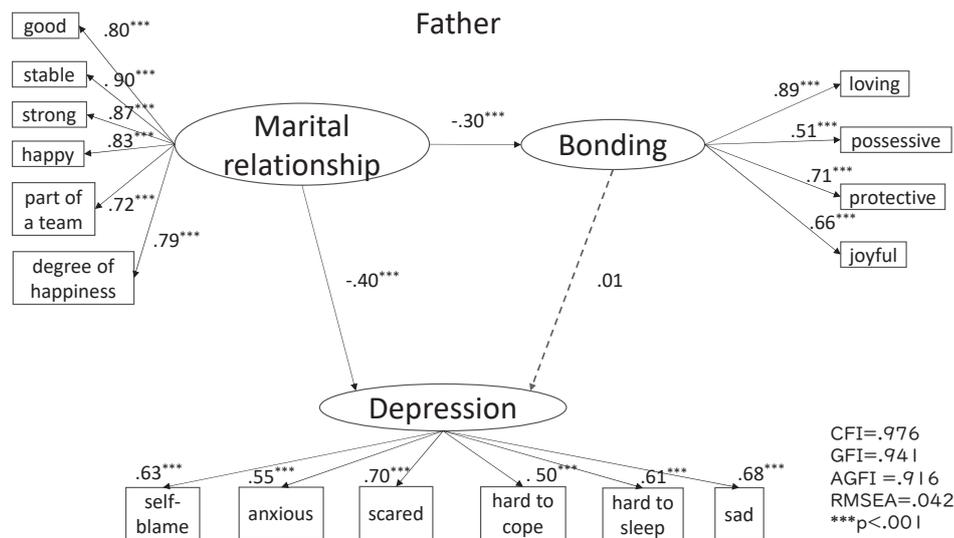
Figure 3. Path model of the association between marital relationship, bonding, and depression during pregnancy for fathers.
Standard errors are omitted in this path model.

that the marital relationship during pregnancy also influences depression[21], while others noted that depression during the parenting period affects bonding[22]. However, bonding during pregnancy has been shown to influence depression, but not vice versa[4]. Based on these findings, we formulated the hypothetical models shown in Figures 2 and 3.

Our models yielded acceptable goodness-of-fit.

With these models, the following results were obtained: 1) The marital relationship predicted mother-infant and father-infant bonding（p< 0.01, r= -0.22; p< 0.001, r= -0.30）; 2) the marital relationship predicted depression in the mothers and fathers（p< 0.01, r= -0.23; p< 0.001, r= -0.40）; and 3) mother-infant and father-infant bonding did not predict depression in the mothers or fathers （r= 0.11; r= 0.01）.

4．Discussion
4.1 Marital relationship during pregnancy

The mean QMI score as an index of the marital relationship during pregnancy was 21.32 among the mothers and 20.58 among the fathers, not revealing

significant differences between them. As these values are similar to the results of previous studies involving Japanese people[23], the participants of the present study may be regarded as a group representing the general public. Belsky[24] examined married couples during pregnancy and 3 and 9 months after delivery, and reported that loving romance diminishes over time. Onodera[25] noted that although marital intimacy declines at the beginning of parenthood, it stabilizes in 2 or 3 years of parenthood. Furthermore, as the mothers' levels of satisfaction with their marital relationships have been reported to be significantly lower than those of the fathers during the postpartum period[26], it is necessary to examine changes in the marital relationships and differences between married couples through longitudinal observations from pregnancy.

4.2 Bonding during pregnancy

Previous studies showed that prenatal bonding is correlated with postpartum bonding, and assessing bonding and providing care based on it during pregnancy promotes bonding during the postpartum period[4]. Furthermore, prenatal

bonding is thought to predict not only postpartum bonding but also postpartum depression[4] . Some reports also indicate that good bonding during pregnancy results in good child growth and development in terms of communication, sociability, gross and fine motor skills, and problem-solving skills during the preschool period[27,28] . The above findings may also be relevant to the participants of the present study, where the mothers' total MIBQ score representing mother-child bonding during pregnancy was similar to those reported in previous studies. However, no previous studies examined the fathers during pregnancy. In the present study, there were no significant differences between the mothers and fathers in the total MIBQ score (Table 3). Klaus et al.[29] described that parents develop thoughts, expectations, and emotions toward the fetus, and prepare for bonding from pregnancy as a process that continues after birth. The results of the present study demonstrated that fathers, who cannot directly perceive the presence of the fetus, also develop bonding with the child, similarly to the case of mothers.

4.3   Depression during pregnancy

The mean EPDS score representing depression measured during pregnancy was 5.44 among the mothers and 4.02 among the fathers, revealing the former's significantly higher score ($p < 0.001$). In a previous study involving Japanese pregnant women[30] , the EPDS score was 5.1 ± 3.4, which is similar to the value in the present study.

The significant difference in the total EPDS score between the mothers and fathers during pregnancy observed in the present study is consistent with the results of a meta-analysis on prenatal depression performed in Japan using findings from 33 research papers[31] . Moreover, with regard to correlations, a previous study on the postpartum period[32] revealed a correlation between the prevalences of depression in mothers and fathers, and a similar tendency during pregnancy was suggested in the present study.

4.4 Association between the marital relationship and bonding during pregnancy

The present study demonstrated that the marital relationship directly predicts bonding during pregnancy. Concerning bonding and the marital relationship, Müller[9] reported that a good father-fetus relationship promotes adaptation to pregnancy, which accelerates attachment to the fetus. However, Müller's study only involved pregnant women, and did not examine how husbands perceive their marital relationships, or father-infant bonding during pregnancy. In the present study, we examined both the mothers and fathers, and clarified the causal associations between the marital relationship and mother-infant and father-infant bonding during pregnancy. The marital relationship also predicted fathers' bonding with the fetus whose presence cannot be directly perceived by them. Another study involving married couples 2-3 months after delivery reported that the marital relationship was correlated only with mother-infant bonding during pregancy[33] . On the other hand, Scism[34] noted that a strong marital relationship was the factor most strongly influencing father-infant bonding during pregnancy. Therefore, further studies are required to clarify how the marital relationship and bonding change during the postpartum and parenting periods, and whether the marital relationship is also a predictor of bonding during these periods.

In a study by Milgrom et al.[35] , a workbook intervention for married couples during pregnancy to strengthen their marital and parent-infant relationships by improving their communication, coping, and parenting skills effectively reduced mild to severe depression, anxiety symptoms, and parenting stress at 12 weeks after delivery, demonstrating that preventive intervention for married couples to build an intimate marital relationship also improves their mental health. As the marital relationship was shown to predict both mother-infant and father-infant bonding during pregnancy in the present study, it may be

effective to provide approaches for both mothers and fathers from the perspective of strengthening their marital relationships as a basis for promoting parent-infant bonding during pregnancy.

4.5 Association between the marital relationship, bonding, and depression during pregnancy

In the present study, it was suggested that prenatal bonding does not predict prenatal depression. In previous studies longitudinally examining maternal depression and mother-infant bonding during the pregnancy and postpartum periods[4], bonding was shown to predict depression, but not vice versa. Therefore, longitudinal studies should be conducted in the future to examine whether prenatal bonding predicts postpartum depression. It has also been shown that prenatal bonding predicts postpartum bonding[4], but few studies have examined therapeutic interventions for postpartum bonding disorders[36,37], and there have been even fewer studies on the treatment of prenatal bonding disorders. The present study revealed that the marital relationship also predicts maternal depression during pregnancy. A previous study involving Canadian pregnant women[21] identified the marital relationship, as well as the need for and level of satisfaction with social support, during pregnancy as factors directly related to prenatal depression. In this respect, approaches to improve their marital relationships during pregnancy may not only strengthen bonding, but also reduce depression during this period.

Limitations and future challenges

This study has some limitations that should be considered. First, although there are several variables that influence perinatal bonding, such as the mothers' attachment styles and levels of satisfaction with the care provided by hospitals, we did not examine the study items, including these variables. Another important limitation is the tendency of the couples included in the study to have a relatively good marital relationship. The couples who cooperated were asked to fill out a self-reported questionnaire, and return it by mail during pregnancy. Thus, we did not sufficiently examine couples with a poor marital relationship.

Conclusion

The results of the present study revealed that the marital relationship predicts mother-infant and father-infant bonding during pregnancy. To our knowledge, this is the first study examining the causes and effects of the marital relationship on mother-infant and father-infant bonding during pregnancy. However, further studies should be conducted, as it is still unclear how the marital relationship, bonding, and depression change during the postpartum and parenting periods, and whether the marital relationship is a predictor of bonding during these periods.

Ethical standards

This study was approved by the ethics committee of Okayama Prefectural University (Approval number 20-57). Participation in the study was voluntary, and the information obtained was made confidential and used solely for research purposes.

Conflict of Interest

The authors confirm that this article content has no conflicts of interest.

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妊娠期における夫婦関係とボンディングおよび抑うつの関連

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和文要旨：本研究は、妊娠期の夫婦関係とボンディング、抑うつの関連を明らかにすることを目的とした。265 人の母親と 257 人の父親に対し、基礎情報、Mother-Infant Bonding Questionnaire、Edinburgh Postnatal Depression Scale、および Quality Marriage Index の回答を郵送で依頼した。構造方程式モデリングを使用して三者の関係性を検証した結果、妊娠期の母親・父親の夫婦関係はボンディングと抑うつを予測し、両者のボンディングは抑うつを予測しないことが明らかとなった。適合度指数は、母親と父親の CFI でそれぞれ 0.977 と 0.976、RMSEA で 0.041 と 0.042 であった。妊娠期のボンディングを強化するために、夫婦関係強化の側面から効果的なアプローチを、母親父親両方に対して提供できる可能性が明らかとなった。

キーワード：ボンディング、アタッチメント、夫婦関係、抑うつ、妊娠期