

Maternal Depression and Mother-to-Infant Bonding: The Association of Delivery Mode, General Health and Stress Markers

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Abstract

Aim: The aim of the present study was to examine associations among maternal stress level, general health, mother to infant bonding, maternal depression level, and mode of delivery. **Methods:** Mothers who delivered a single baby at term were recruited with a total 435 mothers participating in the study. **Outcome measures:** Data were collected 6 months after delivery using General Health Questionnaire (GHQ-28), Mother-to-Infant Bonding Scale (MIBS), Edinburgh Postnatal Depression Scale (EPDS) as well as socio-demographic and medical information at 6 months. Additionally, salivary cortisol and chromogranin levels were determined. **Results:** The proportion of breastfeeding mothers in the vaginal delivery group (51.4%) was significantly higher than that of the cesarean section group (24%). GHQ-28 scores were significantly related to EPDS scores and MIBS scores ($P < 0.001$). EPDS scores were also associated with MIBS scores ($P < 0.001$). However, there was no significant relationship between salivary stress marker levels and other questionnaire scores. MIBS scores of the vaginal delivery group (1.3 ± 1.7) were significantly better than those of the planned cesarean section group (2.1 ± 2.8). Multiple regression analysis revealed that maternal age and cesarean section were significantly associated with MIBS and EPDS scores ($P < 0.01$). **Conclusion:** Maternal general health is associated with maternal psychological health. These results suggest that the support of maternal health is important to maintain maternal psychological status and bonding to infants. Because EPDS scores were significantly worse in the planned cesarean section group (4.2 ± 3.3), careful management is needed of mothers who deliver by planned cesarean section.

Keywords

General Health Questionnaire (GHQ-28), Mother-to-Infant Bonding Scale (MIBS), Edinburgh Postnatal Depression Scale (EPDS), Salivary Cortisol, Salivary Chromogranin A

1. Introduction

Women's physical and mental health, endocrine secretion, internal and external genitalia, and other circumstances vary during pregnancy and the postpartum period. The puerperium is a high risk period for mental disorders such as maternity blues and postpartum depression [1]. Maternity blues, which happens within 1 week after birth and remits spontaneously within about 3 days, is found in 30% - 40% of mothers in Japan, and there is no evidence that this affects mother-to-infant bonding. However, postpartum depression, which develops by 3 months after birth and occurs in approximately 10% of mothers in Japan [2], is associated with a high frequency (quantity) of maternal negative emotion toward her infant and is likely to precipitate attachment disorder. At 6 weeks post partum, the frequency of postpartum depression is not affected by mode of delivery [3]. However, studies on the association between maternal mental health and delivery mode are limited.

It is well recognized that promoting good mother-child attachment during pregnancy might influence the level of postpartum depression [4]. The relationship between maternal depression and mother to infant bonding is believed to be important for both maternal and neonatal health. Although delivery mode does not affect contact between mother and the newborn child [3], studies on the association between delivery mode and mother-to-infant bonding are also limited.

The potential for mental health problems can be evaluated by assessing stress-related hormone levels. Evaluation of saliva for levels of physiological stress markers, such as cortisol and catecholamine, is very useful for objectively assessing stress. Salivary cortisol level is often used as a stress index because of various advantages such as a noninvasive collection procedure. Chromogranin A (CgA) is a reliable marker of a psychological stress response because it reflects mental stress rather than physical stress [5] [6]. Therefore, salivary cortisol concentrations and CgA/protein levels are useful in determining maternal stress levels. Salivary cortisol and CgA/protein levels are normally elevated during pregnancy; however, this elevation was suppressed in a chronic high stress group during pregnancy [7].

In Japan several superstitions are believed among individuals of maternal age. Many mothers believe that labor pain brings good motherhood and attachment to the infant. They also believe that a mother's level of satisfaction with delivery affects her postnatal mental health. Those superstitions lack scientific basis, but they affect the behavior of pregnant women such as her choice of a birthing fa-

cility.

Recently, we reported that delivery mode and episiotomy affect sexual function at 6 months after delivery [8]. In the present study, we analyzed the relationship among maternal health, bonding, depression and stress levels using the same population [8]. The present study aimed to demonstrate relationships among maternal stress levels, general health, mother-to-infant bonding, maternal depression level, and mode of delivery. Salivary stress marker levels were measured, and the relationship among delivery method, postpartum general health, mother-to-infant bonding, and maternal depression level was investigated to improve mothers' quality of life and identify good delivery management practices.

2. Methods

2.1. Procedure

Mothers who delivered a singleton baby at term at Kawasaki University hospital and related hospitals were recruited for the present study, as has been previously reported [8]. Six months post partum, questionnaires and devices for obtaining saliva samples were sent by mail to mothers who had given informed consent. The responses and saliva samples were analyzed to detect stress levels. The data were collected from November 2011 to June 2013. A total of 435 mothers participated in the study. Examinations were performed between 10:00 a.m. to 11:00 a.m., starting >2 h after consumption of the morning meal because food should not be consumed for at least 90 min before salivary sampling for cortisol level determination [9]. This study was approved by the Ethical Committees of Kawasaki Medical School.

2.2. Main Outcome Measures

2.2.1. General Health Questionnaire (GHQ-28)

The General Health Questionnaire (GHQ) is a 60-item self-administered screening tool designed to detect nonpsychotic psychiatric illnesses. The GHQ-28, a shorter version of the original GHQ, has been shown to be reliable and valid [10]. The GHQ-28 is used to assess general health problems [11]. It is used in the general population and within communities or non-psychiatric clinical settings such as primary care or general medical outpatient clinics [12].

2.2.2. Mother-to-Infant Bonding Scale (MIBS)

The MIBS is a self-report scale composed of 10 items on a 4-point Likert scale (from 0, "not at all" to 3, "very much"). We used the Japanese version of the MIBS to determine the mother-to-infant bonding level [13].

2.2.3. Edinburgh Postnatal Depression Scale (EPDS)

The EPDS is a self-report questionnaire composed of ten items scored on a four-point Likert scale (0 - 3) designed to assess pregnancy and postpartum depression [14]. Numerous studies have used this instrument during the antenatal and/or postpartum period [15] [16]. In the present study we used the Japanese

version of EPDS, which shows good internal consistency and test-retest reliability [17].

2.3. Characteristics of the Sample

A self-report questionnaire on maternal background was administered. We also assessed the mothers' satisfaction level with delivery, scored on a 5-point Likert scale (0 - 4).

2.4. Determination of Salivary Cortisol Levels

Salivette sampling devices (Sarstedt, Rommelsdorf, Germany) were used to collect a sufficient quantity of saliva. The Salivette includes a small cotton swab and stimulates saliva flow to a rate that enables collection of an adequate specimen within 1 min. The samples were transferred at 4°C, and after centrifugation at 7000 g for 15 min, saliva was stored at -80°C until determination of salivary cortisol levels with a commercial enzyme immunoassay kit (Enzo Life Sciences, PA, USA). The intra- and inter-assay coefficients of variation (CV) were <10%.

2.5. Determination of Salivary CgA Levels

Salivary CgA levels were determined by ELISA using a previously described method (Tsubouchi) with a YK070 Chromogranin A (human) electro-immunoassay kit (Yanaihara Institute, Shizuoka, Japan); the intra- and inter-assay CVs were <5%.

2.6. Statistical Analysis

Data are reported as mean \pm standard deviation (SD). Statistical significance was assessed using ANOVA and the Wilcoxon signed-rank test with a 5% significance level. The correlation coefficients between variables were determined by Spearman rank analysis. A multiple regression analysis was undertaken to identify the variables that predicted maternal general and psychological health. The data were analyzed with IBM SPSS statistics ver. 20 (IBM, Armonk, NY, USA).

3. Results

We received 435 completed questionnaires and samples of saliva samples. **Table 1** presents characteristics of the sample. There were significant differences in the numbers of children and gestational weeks at delivery depending on the mode of delivery. The mean for gestational weeks in the planned cesarean section group (37.7 ± 1.12) was significantly lower, compared with other delivery modes. The ratios for early neonatal attachment in both the planned and emergent cesarean section groups (42.9% and 44%, respectively) were significantly lower. The breastfeeding ratios for both the vaginal delivery groups with and without oxytocin administration (82.6% and 82.9%, respectively) were significantly higher. The degrees of satisfaction with delivery differed significantly depending on delivery mode with higher satisfaction in the vaginal delivery group compared to others.

Table 1. Characteristics of the present study.

	Total	Vaginal delivery	Vaginal delivery with oxytocin	Operative delivery	Planned cesarean section	Emergent cesarean section	P-value	
(n=)	435	282	82	21	23	27		
		65%	19%	5%	5%	6%		
Maternal age	33.2 ± 4.43	33.3 ± 4.17	33.0 ± 4.73	33.7 ± 4.30	33.5 ± 5.33	32.3 ± 5.58	N.S.	
Age at marriage	28.5 ± 4.01	28.4 ± 3.88	28.6 ± 4.24	29.0 ± 4.23	29.0 ± 4.15	29.0 ± 4.56	N.S.	
Income (per year) Dollar	~30,000	41	26	6	2	5	2	P = 0.42
	30,000 ~ 60,000	171	100	40	10	11	10	N.S.
	60,000 ~ 100,000	119	81	20	4	5	9	
	100,000 ~ 150,000	56	39	10	3	1	3	
	150,000~	35	28	2	1	1	3	
Academic background	Junior high school	4	3	0	1	0	0	P = 0.92
	Senior high school	49	29	10	3	3	4	N.S.
	Technical School	87	57	15	5	3	7	
	Junior college	75	45	18	1	7	4	
	College	200	135	37	9	9	10	
Cohabiter	Post graduate school	19	12	2	2	1	2	
	Children	1	1	0	0	0	0	P < 0.001
	Husband and children	392	254	74	19	20	25	
	Parents, husband and children	38	25	6	2	3	2	
	Other	3	1	2	0	0	0	
Numbers of children	1.6 ± 0.71	1.68 ± 0.68	1.45 ± 0.86	1.20 ± 0.41	1.65 ± 0.64	1.11 ± 0.32	P < 0.001	
Nullipara	232	123	58	17	10	24	P < 0.001	
Multipara	202	158	24	4	13	3		
Birth weight (g)	3023.0 ± 424.31	3018.0 ± 389.15	3051.5 ± 444.83	3177.2 ± 478.29	2906.5 ± 372.23	2959.3 ± 644.93	P = 0.234	
Gestational weeks	39.15 ± 1.41	39.1 ± 1.19	39.3 ± 1.63	39.8 ± 1.36	37.7 ± 1.12	39.4 ± 2.25	P < 0.001	
Resuscitation	None	400	271	75	18	17	19	P < 0.001
	Done	35	11	7	3	6	8	
Early neonatal attachment	Done	329	227	69	13	9	11	P < 0.001
	None	73	34	6	7	12	14	
	Unknown	33	21	7	1	2	2	
	Yes	388	269	69	16	15	19	P < 0.001
Rooming-in	Partially	29	8	8	3	4	6	
	No	18	5	5	2	4	2	
	Other	0	0	0	0	0	0	

Continued

	Breastfeeding	346	233	68	15	11	19	P < 0.001
Breastfeeding	Bottle feeding	7	3	1	0	1	2	
	Mixed feeding	82	46	13	6	11	6	
Attendance of husband at delivery	Yes	306	221	60	18	2	5	P < 0.001
	No	129	61	22	3	21	22	
	None	98	88	10	0	0	0	not done
Laceration	Episiotomy	126	67	41	18	0	0	
	Yes	160	127	31	2	0	0	
	Private clinic	336	229	62	17	12	16	P < 0.001
Place at delivery	Hospital	78	36	16	4	11	11	
	Midwifery	21	17	4	0	0	0	
Complication during pregnancy	Yes	77	34	19	3	12	9	P < 0.001
	No	358	248	63	18	11	18	
	Very good	244	192	36	7	8	1	P < 0.001
	Good	155	81	39	10	10	15	
Degree of satisfaction	Average	12	2	0	2	2	6	
	Poor	19	5	7	1	3	3	
	Very poor	5	2	0	1	0	2	

As shown in **Table 2**, we assessed the relationships among the study factors. A number of children were significantly associated with MIBS scores ($P < 0.001$). GHQ-28 scores were significantly related with EPDS scores ($P < 0.001$) and MIBS scores ($P < 0.001$). EPDS scores were also associated with MIBS scores ($P < 0.001$). The levels of chromogranin A/protein in the saliva were significantly associated with the titers of salivary cortisol ($P < 0.001$). However, no significant relationship was observed between the stress markers in the saliva and other variables, such as GHQ-28, EPDS and MIBS scores.

Table 3 shows the GHQ-28 scores and the titers of salivary stress markers in five groups divided by mode of delivery. There were no significant differences in GHQ-28 scores among the 5 groups, nor were there significant differences in salivary stress marker due to the wide distribution. **Figure 1** shows that EPDS scores of the vaginal delivery group (3.3 ± 3.41) were lower than those of the planned cesarean section group (4.2 ± 3.29), but the difference is not significant. As shown in **Figure 1(b)**, there were significant differences in MIBS between the vaginal delivery group (1.3 ± 1.66) and the planned cesarean section group (2.1 ± 2.76). Within the cesarean section group, MIBS scores of nullpara mothers tended to be worse than those of multipara mothers ($P = 0.07$). There were no significant differences in EPDS between any groups.

Table 2. Significance among factors in the present study.

	Numbers of children	GHQ28 score	EPDS score	MIBS score	Salivary chromogranin A	Salivary cortisol
Numbers of children		N.S.	N.S.	0.001	N.S.	N.S.
GHQ28 score	N.S.		0.001	0.001	N.S.	N.S.
EPDS score	N.S.	0.001		0.001	N.S.	N.S.
MIBS score	0.001	0.001	0.001		N.S.	N.S.
Chromogranin A	N.S.	N.S.	N.S.	N.S.		0.001
Cortisol	N.S.	N.S.	N.S.	N.S.	0.001	

Table 3. Association among mode of delivery and results of GHQ-28, MIBS, EPDS, cortisol and CgA.

	Vaginal delivery	Vaginal delivery with oxytocin	Operative delivery	Planned caesarean section	Emergent Caesarean section
GHQ28	47.1 ± 8.3	48.2 ± 9.1	50.5 ± 11.2	49.2 ± 9.5	48.2 ± 7.8
Cortisol (pg/ml)	3463 ± 1258	3472 ± 1375	3759 ± 1802	4168 ± 2243	4731 ± 6337
CgA/protein (pmol/ng)	18.40 ± 64.50	17.54 ± 58.27	6.77 ± 14.10	2.68 ± 6.11	4.53 ± 11.90

Finally, a multiple regression analysis was performed to identify variables that predict maternal general and psychological health. Maternal age and cesarean section were significant predictors of GHQ28 scores ($P = 0.005$ and $P = 0.015$, respectively), EPDS scores ($P = 0.003$ and $P = 0.032$, respectively), and MIBS scores ($P = 0.007$ and $P = 0.036$, respectively).

4. Discussion

The present study analyzed the association between maternal bonding, postpartum depression, and delivery mode. There are several studies associated with maternal bonding, postpartum depression, and delivery mode [18] [19] [20]. As shown in **Table 1**, there were significant differences in breastfeeding ratios among the different delivery mode groups. The breastfeeding ratio of the vaginal delivery, vaginal delivery with oxytocin, operative delivery, planned cesarean section and emergent cesarean section groups were 74.7% (145/194), 66.7% (30/45), 50% (6/12), 36.8% (7/19) and 38.4% (5/13), respectively. These results are similar to the previous study in this series [3] [21]. The reason for the low breastfeeding ratio in the cesarean section group is unknown. Breastfeeding mothers showed greater activations in the superior frontal gyrus, insula, precuneus, striatum, and amygdala [20]. Possibly, the low ratio of early neonatal attachment in both planned and emergent cesarean section groups, as well as oxytocin secretion during labor may affect breastfeeding. The degree of satisfaction with delivery in the vaginal delivery group was higher than that of the cesarean section group, and this factor may also affect breastfeeding.

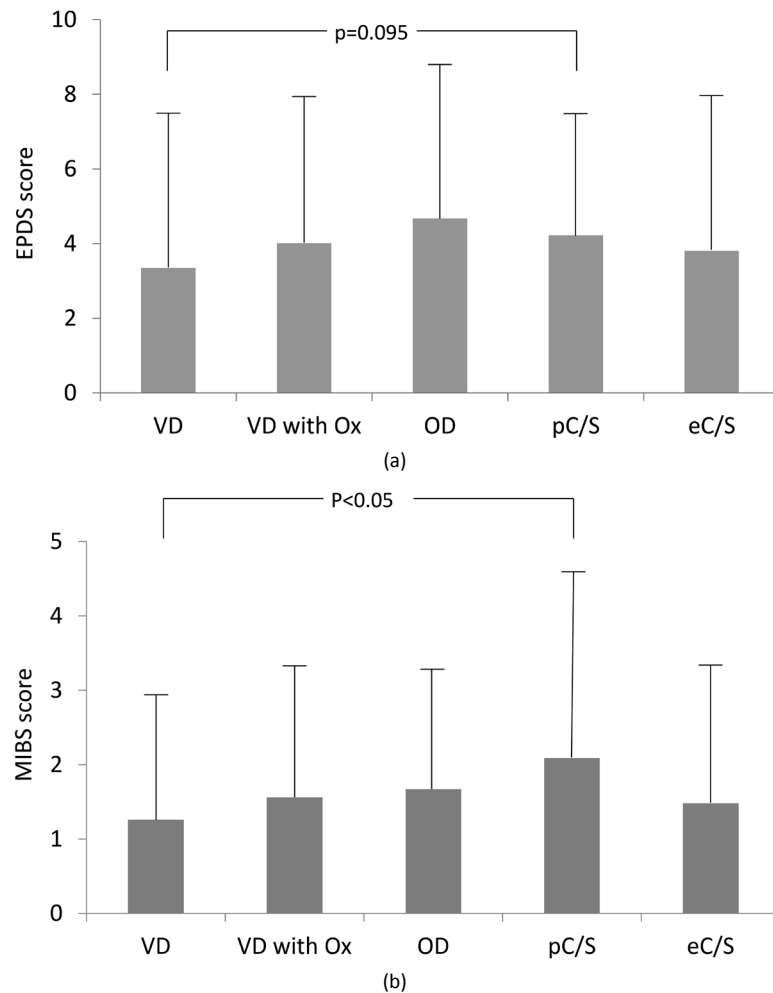


Figure 1. (a) EPDS score and mode of delivery. (b) MIBS score and mode of delivery. VD: Vaginal delivery group, VD with Ox: Vaginal delivery with oxytocin group, OD: Operative delivery group, pC/S: Planned caesarean section group, eC/S: Emergent caesarean section group.

GHQ-28 scores were significantly related to EPDS scores and MIBS scores. Maternal general health level is associated with maternal psychological health and bonding activity. These results suggest that support of maternal health care is important for maintaining maternal psychological status and bonding to infants. EPDS scores were associated with MIBS score. Yamashita reported the same results in an analysis of 88 mothers [2]. Promoting good mother-child attachment during pregnancy may influence the level of postpartum depression [4]. Several studies have demonstrated the association between maternal depression and MIBS [22] [23] [24]. Our present study supports that maternal depressive status affects mother-to-infant bonding in Japan. The levels of chromogranin A/protein in the saliva were significantly associated with the titers of cortisol in the saliva. Evaluation of physiological stress markers in the saliva is useful method for objectively assessing stress. However, salivary stress markers could not be used to detect maternal general health, postpartum depression and bonding to infants.

As shown in **Figure 1(a)**, EPDS scores were not associated with mode of delivery. Previous studies have demonstrated that mode of delivery is not associated with postpartum emotional distress [25] [26] [27]. Adams *et al.* noted that concern for maternal postpartum mental health care should not influence clinical decisions regarding mode of delivery [25]. Our study is consistent with previous studies and supports that maternal health care should be offered independently of mode of delivery. Carlander *et al.* concluded that mode of delivery does not affect how mothers experience contact with their newborn child [3]. However, **Figure 1(b)** demonstrates that MPDS scores were significantly worse in the planned cesarean section group. The low breastfeeding ratio might affect MPDS score in cesarean section group. In general, oxytocin acts to allow the high levels of social sensitivity and attunement necessary for human socializing and for rearing a human child [28]. It could be speculated that the level of oxytocin secretion may affect mother-to-infant bonding. However, further investigation would be necessary to determine the association between bonding and mode of delivery. In the cesarean section group MIBS score of nullipara mothers tended to be worse than those of multipara mothers. Intensive care for nullipara mothers may be necessary to promote maternal bonding to her infant.

Multiple regression analysis revealed that maternal age and cesarean section were significantly associated with maternal general and psychological health. Maternal age and cesarean section affected postpartum maternal health. The negative effects of cesarean sections on maternal psychological health should be considered, and further investigations are needed to study the association between maternal psychological health and delivery mode.

5. Conclusion

Maternal general health is associated with maternal psychological health. These results suggest that maternal health care is important to maintain maternal psychological health and bonding to infants. Further investigation is needed to determine the association between bonding and mode of delivery.

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