Risk Factors of Postnatal Depression and Potency of the Distress and Impact Thermometer in the Perinatal Period: A Maternity Hospital Study

Short title: Risk factors of postnatal depression

Yumiko Takahashi[1], Hidemi Yokota[2], Masato Fukuda[1]

1. Department of Psychiatry and Neuroscience, Gunma University Graduate School of Medicine, Gunma, Japan
2. Yokota Maternity Hospital, Gunma, Japan

Department of Psychiatry and Neuroscience,

Gunma University Graduate School of Medicine,

3-39-22 Showa-machi, Maebashi, Gunma 371-8511, Japan

Tel: +81-27-220-8190

Fax: +81-27-220-8190

E-mail address: m14702007@gunma-u.ac.jp

Corresponding Author,

Yumiko Takahashi

Department of Psychiatry and Neuroscience,

Gunma University Graduate School of Medicine,

3-39-22 Showa-machi, Maebashi, Gunma 371-8511, Japan

Tel: +81-27-220-8190

Email: m14702007@gunma-u.ac.jp

Abstract

Background & Aims: Postnatal depression (PND) is a common illness that requires early intervention. However, women's postpartum difficulties are often overlooked. This study aims to identify the risk factors of PND based on data obtained from general obstetrics in a maternity hospital. It also explores the usefulness of the Distress and Impact Thermometer (DIT) as a simple PND screening tool.

Methods: The sample comprised 423 women who had undergone parturition in a private hospital between January to June 2016. The participants were first assessed at a few days and then one month postpartum using self-administered questionnaires. The risk factors of PND were examined using logistic regression analysis while the DIT was assessed using the receiver operating characteristic (ROC) curve for PND.

Results: Depressive symptoms during early postpartum, psychiatric illness history, and primipara were significant risk factors for PND. Epidural delivery significantly reduced the risk of PND in women with early postpartum depressive symptoms. The PND detection test in the DIT had an area of 0.85 under the ROC curve.

Conclusions: Women with early postpartum depressive symptoms or a psychiatric illness history require continuous monitoring and support. Further, the DIT can be a useful screening tool for PND.

Keywords: Depression, Postpartum, Distress and Impact Thermometer, Screening tool, Risk factors

1. Introduction

The prevalence of major depressive disorder is higher among women than men.[1] The perinatal period, with lifestyle adjustments accompanying endocrine and other physical changes, is considered a vulnerable phase. The perinatal period is defined by ICD-10 as lasting from 22 weeks gestation to less than 7 days after delivery. However, in the field of perinatal mental health, the “perinatal period” is often extended from early pregnancy to about one year after delivery, when there are major changes in a woman’s physical condition and life. Estimates of the postnatal depression (PND) prevalence in Western countries range from 13 to 19%.[2] According to Tokumitsu et al., the prevalence of PND in Japanese women is 14.3% at one month postpartum.[3] PND is commonly found in postpartum women with anxiety or adjustment disorders. These disorders have a profound impact on women's well-being during postpartum life.[4,5]

PND significantly impairs attachment between mothers and babies, makes care and emotional expression difficult,[6] and prompts infant rejection and abusive behavior.[7] Long-term effects on infants with PND mothers have also been observed, including cognitive dysfunction, impaired social involvement and emotional regulation, increased negative emotions, and high cortisol responsiveness.[8-10] In

addition, PND is a strong risk factor for partner depression.[11-15] Hence, PND has the potential to adversely affect not only the mother but also her family.

Previous research also stresses the difficulty for postpartum women to express themselves and seek appropriate support.[16-18] In fact, PND is often left undiagnosed.[19] While there is now a global consensus on the importance of identifying mothers with PND and connecting them to necessary support at an early stage, it is still difficult to determine whether sufficient measures have been implemented in strengthening the cooperation between obstetrics and psychiatrists. Therefore, it is important to consider risk factors in general obstetric data so that obstetric staff can identify women at high risk of PND during pregnancy and early postpartum, in order to provide adequate psychiatric care.

Perinatal care professionals need to be aware of the possibility that mothers may face a variety of difficulties, not just depression, and provide relevant support. In relation to PND, the use of the Edinburgh Postnatal Depression Scale (EPDS) has become widespread in Japan. However, mothers may experience distress not only due to depressive symptoms, but also due to maladaptation to the surrounding environment and lack of child-rearing support. Therefore, to assist postpartum mothers in clinical situations, we need to adopt a screening tool that can evaluate the possibility of PND, and provide an opportunity to discuss difficulties, rather than

using a tool specialized for PND screening. Considering this, we explored the possibility of using Distress and Impact Thermometer (DIT) as a screening tool in this study.

The DIT is a two-item, self-administered questionnaire employing an 11-point Likert scale. It is similar in appearance to a thermometer and is used to screen for depression and adjustment disorders in cancer patients. The advantages of this tool are its simplicity, ease of assessing results for non-mental health professionals, and non-stigmatic format. Thus, we believe that DIT may benefit not only cancer patients but also postpartum mothers with difficulties.

This study was therefore conducted to identify risk factors of PND in general obstetric data during pregnancy and early postpartum in order to provide support for women at high risk of PND. Furthermore, the validity of DIT as a screening tool for PND was explored as a sub-analysis.

2. Purpose

The study aims to clarify the temporal changes in depressive symptoms from early puerperium to one month postpartum, and to identify the risk factors of PND for early detection and intervention. Further, it examines the validity of DIT as a screening tool for identifying mothers who might need support after childbirth.

3. Methods

3.1. Study design

This was a prospective observational study where changes in depressive symptoms were observed from a few days to one month postpartum.

3.2 Participants and method

The subjects were 478 women who gave birth at the Yokota Maternity Hospital between January and June 2016. All of them were administered the DIT and EPDS questionnaires, and were instructed by the nursing staff (both verbally and in writing) on how to respond to each form. The responses to the first questionnaire were completed 3-4 days postpartum for mothers who delivered vaginally (including labor analgesia) and 6-7 days postpartum for mothers who underwent caesarean section. The first questionnaire was administered while the mother was alone in a quiet environment. Their response to the first questionnaire was collected prior to discharge, while their response to the second questionnaire was collected during the one-month postpartum check-up, unless an intention to withdraw from the investigation was indicated. In addition, the researchers obtained basic obstetric data of the mothers and their babies based on medical records. A total of 441 women initially consented to the study and participated in both surveys. Of these, the responses of 423 women were utilized to conduct the data analyses.

3.3. Measures

The data collected in this study were measured using the Japanese version of the EPDS and the DIT. The EPDS is a 10-item, self-rating scale developed by Cox et al.,[20] which is widely used in various countries for PND screening. The validity of its Japanese translation has been confirmed.[21] Each questionnaire item is scored on a four-point scale ranging from 0 to 3. The minimum and maximum values of the total score are 0 and 30 points, respectively. Here the threshold for those who are at high risk of PND was 8/9.

Meanwhile, the DIT is used to screen for depression and adjustment disorders in cancer patients. The score ranges from 0 to 10, with higher scores indicating a worsened state of health. If both distress and impact scores were above the threshold, screening was judged to be positive. Depression detection, with a cutoff point of 4/5 for distress and 3/4 for impact, has a sensitivity of 0.89 and a specificity of 0.70.[22] This tool is less burdensome for participants, compared to the EPDS, since it can be completed in a few seconds without using negative words.

Participants' basic data including maternal age, parity, type of pregnancy, method of birth, duration of labor, amount of bleeding, psychiatric illness history, gestational age at birth, and weight and sex of the baby were collected from medical records.

3.4. Statistical Analyses

All analyses were performed using the maximum sample, excluding the missing values. All p values reported were two-tailed. Participants' basic data were categorized as follows: high risk (EPDS ≥ 9, at a few days postpartum), young age pregnancy (<20 years old), older age pregnancy (≥35 years old), multiple pregnancy, parity, psychiatric illness history, guidance on intercourse timing during fertility treatment, artificial insemination and assisted reproduction, method of birth (vaginal delivery, emergency cesarean section, elective cesarean section, epidural delivery), excessive bleeding (≥500 g), prolonged labor (for primipara ≥ 30 hours, for multipara ≥ 15 hours), birth weight (low birth weight < 2500 g, giant baby ≥ 4000 g), preterm delivery (<37w), and sex of the baby. All statistical analyses were performed using Statistical Package for Social Sciences (version 27.0 for Windows).

Analyses 1 to 3 clarify the characteristics of women who should be continuously supported due to being at high risk for PND, based on an assessment done several days after delivery. Analysis 4 examines the potency of DIT as a simple PND screening tool that is useful for continuous support.

3.4.1. Analysis 1: Relationship between EPDS at a few days and one month postpartum

The Spearman's rank correlation coefficient was calculated to evaluate the relationship between the score of EPDS at a few days and one month postpartum.

The difference between said scores was examined using the Wilcoxon signed-rank test.

3.4.2. Analysis 2: Identification of PND risk factors

Binary logistic regression analysis was used to identify risk factors of “depressed” (EPDS ≥ 9, at one month postpartum). For each category of data, the relationship with “depressed” was examined using the χ^2 test or Fisher's exact test, the category data showing statistically significant differences was entered as an independent variable, and “depressed” was used as a dependent variable, employing the forced input method. Variables with a p value less than 0.05 were considered to be statistically significant risk factors of PND.

3.4.3. Analysis 3: Identification of “improvement” and “exacerbation” factors

i : Identify predictors of "improvement" which become "not depressed" (EPDS < 9, at one month postpartum) among participants at high risk (EPDS ≥ 9, at a few days postpartum).

ii : Identify predictors of “exacerbation” which become “depressed” among participants who were not at high risk at a few days postpartum.

In order to execute i and ii , we entered the categorical data with statistically significant differences, or the one with some association suggested between

“depressed” and “not depressed,” as independent variables, and examined them using binomial logistic regression analysis.

We investigated the multicollinearity of logistic regression model in Analysis 2 and 3. We determined the presence of multicollinearity if the tolerance value was less than 0.4, and the variance factor (VIF) was greater than 2.5, using Allison's criteria (refer to Table 7).

3.4.4. Analysis 4: DIT detection for PND

The Spearman’s rank correlation coefficient（ρ）was calculated to evaluate the relationship between DIT and EPDS at one month postpartum. As a sub-analysis, we used the ROC curve to explore the validity of “depressed” screening using DIT. The test variable was the sum of each scale, distress and impact, in the DIT.

4. Ethical considerations

Participation in the research was on a voluntary basis. The research participants were informed that the responses would remain anonymous, and that they can withdraw at any time. The questionnaires were collected by the nursing staff, and high scorers were further assessed. In addition, information about psychiatric outpatient consultation in the hospital was gathered, and psychiatric care was provided to those who requested it. This study was conducted with the approval of the Yokota Maternity Hospital and the Gunma University Ethics Committee.

5. Results

Of the 478 women who gave birth in the Yokota Maternity Hospital between January and June 2016, 441 (92.3%) gave their consent and provided responses. Of these, 18 were excluded (3 were anonymous, 12 participant responses were not obtained twice, and 3 had missing major data). The number of valid responses was 423 corresponding to 88.5%. The EPDS, DIT, and participants' basic data after a few days versus one month are shown in Table 1. The mean age of the participants was 31.3±4.8 (18-45) years. Regarding parity, there were 229 (54.1%) primiparas and 194 (45.9%) multiparas. Fifty-three (12.5%) participants received reproductive treatment in their recent pregnancies. Regarding method of birth, 180 (43%) were vaginal births, 133 (31.4%) were caesarean sections, and 110 (26%) included labor analgesia. There were 26 (6.2%) participants who had a history of psychiatric illness.

The results of Analysis 1 are shown in Figure 1. There was a statistically significant correlation between EPDS scores after a few days and one month postpartum (Spearman's rank correlation coefficient [ρ] = 0.65, 95% confidence interval [95%CI]: 0.59-0.71, p value [p] < 0.001). The mean EPDS score were 5.9 (standard deviation [SD]: 4.0) at a few days postpartum and 5.3 (SD: 3.7) at one month postpartum. The mean EPDS score at one month postpartum were 0.6 points lower than at a few days postpartum ($p < 0.001$).

The results of Analysis 2 are presented in Tables 2 and 3. High risk at a few days postpartum (adjusted odds ratio [aOR] = 5.60, 95%CI: 3.09-10.14, $p < 0.001$), psychiatric illness history (aOR = 5.23, 95%CI: 2.09-13.10, $p < 0.001$), and primipara (aOR = 1.95, 95%CI: 1.05-3.65, $p = 0.036$), were statistically significant predictors of “depressed.” The other basic obstetric data were not statistically significant.

The results of Analysis 3 are shown in Tables 4-7. Epidural delivery (aOR = 0.30, 95%CI: 0.11-0.87, $p = 0.026$) was a statistically significant predictor of "improvement" in participants who were at high risk of PND a few days postpartum and improved at one month postpartum. Conversely, psychiatric illness history (aOR = 10.23, 95%CI: 3.13-33.46, $p < 0.001$) was a statistically significant predictor of "exacerbation" in participants who were not at high risk at a few days postpartum became "depressed" at one month postpartum. There was no multicollinearity for the predictive category data used as an independent variable in the binomial logistic regression analysis.

There was a strong correlation between the DIT and EPDS scores at one month postpartum ($\rho = 0.67$, 95%CI: 0.61-0.72, $p < 0.001$). Figure 2 shows the results of examining the validity of screening by the DIT for "depressed" using the ROC curve. The area under the curve (AUC) was 0.85. (95%CI: 0.81-0.90). When the total DIT

score of 5/6 was used as the cutoff point, sensitivity and specificity were 78.6% and 75.6%, respectively. The sensitivity and specificity of each scale of distress and impact are presented in Table 8.

6. Discussion

With the aim of providing support for postpartum mothers in maternity hospitals, we identified the risk factors of PND, and investigated the DIT's potency as an efficient and easy screening tool for mothers requiring assistance. The present study was conducted on general perinatal data obtained from a maternity hospital, in consideration of clinical versatility. The data of 423 women were utilized to conduct the analyses. The average age of participants was 31.3 years, similar to the average maternal age of 30.7 years reported in Japan in the same year.[23] The study had a small dropout rate, and there was little difference between perinatal obstetric treatment and delivery environment since it was conducted in a single facility. The results indicated that mothers with depressive symptoms at early postpartum (e.g., maternity blues), mothers with a psychiatric illness history, with or without symptoms, and primiparas were found to be at high risk of PND, requiring continuous monitoring and support. It was also observed that the DIT is a useful screening tool for PND.

In this study, the risk factors of PND were examined by focusing only on general perinatal data collected from Yokota Maternity Hospital. Psychiatric illness history, high risk (EPDS ≥ 9) at a few days postpartum, and primipara were confirmed as risk factors. No other obstetric data were identified as risk factors. Previous studies have shown that psychiatric illness histories of depression,[24-29] anxiety,[24] PND,[2,26,30]

premenstrual dysphoric disorder and PMS,[30] other mood disorders,[31] personality disorders, and other psychiatric disorders[30,32,33] are associated with an increased risk of developing PND. Our study also showed that a history of psychiatric illness is a strong predictor of the onset of PND, which is consistent with previous findings.

Psychiatric illness history was also confirmed to be a predictor of "exacerbation" of PND at one month postpartum for women who were not at high risk of PND at a few days postpartum. This means that even if there are no signs of mental illness during postpartum hospitalization, medical staff and family members should closely monitor women with a history of psychiatric illness.

A high risk of PND a few days postpartum was also detected as a predictor of PND at one month postpartum, and the EPDS score at a few days postpartum was correlated with the EPDS score at one month postpartum—no clinical change in scores was observed. A depressive symptom that occurs a few days postpartum, called maternity blues, has long been thought to be transient due to physiological changes, and thus requires no treatment because it disappears in about two weeks. However, in recent years, many studies have reported that depressive symptoms at a few days postpartum are a risk factor of PND.[34,35] This results of this study are consistent with previous studies because the EPDS score from a few days to one month postpartum did not improve.

This study found that obstetric factors, other than primipara, were not predictors of PND at one month postpartum. Previous studies have shown that obstetric factors such as cesarean delivery,[29] emergency cesarean delivery,[36] preterm birth,[2,29,36-38] and postpartum bleeding[39-42] may cause the onset of PND. In contrast, several other studies have concluded that childbirth mode was not a predictor of PND.[43,44] The latter conclusion was verified in this study. The researchers did not find an association between PND and conception modes, such as infertility treatment history, which is consistent with the results of many previous studies.[45-47]

Primipara has been reported as a moderate predictor of PND in previous studies,[39,48] and this conclusion was confirmed in this study as well. Further, it was suggested that primipara's psychiatric symptoms could worsen from a few days to one month postpartum. Postpartum women, especially primiparas, need to adapt to their new role as mothers as well as to changes in marital and family relationships. Psychological isolation and lack of support have been found to be predictors of PND.[49] Primiparas can be a psychosocial factor in developing PND since they tend to lack adequate child-rearing environment and support. In addition, primiparas are more likely to have complications such as breastfeeding problems, pain due to perineal laceration, and urinary incontinence than multipara.[50] These complications can act as risk factors for the onset of PND.[51,52]

Epidural analgesia was found to be a predictor of “improvement.” Women with EPDS ≥ 9 at a few days postpartum became EPDS ＜ 9 at one month postpartum, if they gave birth with epidural analgesia. Therefore, epidural analgesia is a predictor of improvement those who are high risk of PND. Lim et al. showed a significant association between epidural analgesia and a reduced incidence of EPDS positivity at six weeks postpartum[53] which is confirmed by the results of this study. Epidural analgesia has been noted to have increased severe perineal lacerations[54] because of instrument use, and episiotomy due to prolonged labor time. It is controversial whether episiotomy causes severe perineal lacerations, which causes pelvic floor dysfunction and excretory dysfunction. In contrast, there were several reports stating that selective episiotomy reduces the risk of severe perineal laceration.[55,56] In addition, it has been pointed out that a painless delivery by epidural analgesia makes it easier for pregnant women to control their breathing and avoid severe perineal lacerations.[57,58] However, this study suggests that epidural analgesia is less influential than other established predictors because it was not found be a direct predictor of PND at one month postpartum. In this study, the epidural labor analgesia rate was 26%, which was higher than the rate of 6.1% reported in Japan in 2017.[59] The high rate of epidural labor analgesia may have provided a sufficient sample size for statistical analysis and may also have contributed to our result that epidural labor

analgesia was a statistically significant predictor of "improvement" in participants who were at high risk of PND a few days postpartum and improved at one month postpartum. Further research in this area should be conducted. If the use of epidural labor analgesia increases in Japan in the future, its relationship with PND may become clearer.

This study explores the DIT as a feasible, convenient, and useful screening tool to assess the mental health of pregnant women in maternity hospitals. This is the first study to consider the DIT as a tool to support postpartum mothers. Since PND should not be overlooked in supporting postpartum mothers, the researchers examined the relationship between the DIT and the EPDS, which has been validated as a PND screening tool. The results demonstrated a strong correlation between total DIT scores and EPDS at one month postpartum. Further, the area under the ROC curve for the detection of PND high risk at one month postpartum with respect to the total DIT score was 0.85 (95% CI: 0.81-0.90) which confirms the DIT to be a useful PND screening tool. PND is often overlooked because most postpartum mothers have many clinical symptoms, such as acute and chronic stress, sleep deprivation, and hormonal fluctuations. In addition, mothers who are engaged in child-rearing for the first time tend to feel guilty and embarrassed because of the difference between "what they think they should be" and "what they think they are now."[60] They also tend not

to seek help when experiencing depression or other mental illness.[61] It is presumed that the stigma attached to mental health problems, busy schedule of the medical staff, and difficulties in consulting a physician cause the masking of postpartum difficulties. PND screening has the potential to provide postpartum mothers with an opportunity to consult specialists for the same. The DIT consists of two measures: the degree of stress felt by the mother, and the difficulties experienced in life. Therefore, the DIT score reflects the risk of mental illness, physical difficulties, child-rearing environment, and postpartum mothers' life in general. These points may reduce the positive concordance rate between DIT and EPDS for screening for PND. However, these are all significant issues related to postpartum mothers and their families, and it is important to recognize them and provide mothers with the appropriate support.

In Japan, three self-administered questionnaires (Childcare Support Checklist, EPDS, Mother-to-Infant Bonding Scale Japanese version[62]) by Yoshida et al.[63] are used to identify these problems. However, some obstetric medical institutions find it difficult to use these questionnaires due to a lack of manpower. Additionally, perinatal women who are prone to changing conditions should be routinely screened for an early intervention. The DIT can be useful when used alone or in combination with the other questionnaires. This study found that the DIT is a useful screening tool for PND, and the use of the DIT might facilitate a biopsychosocial approach that can

identify mothers requiring assistance as well as mothers experiencing psychiatric symptoms and connect them to the appropriate agencies.

7. Limitation

This study has several limitations that must be addressed. Women at high risk of PND at a few days and one month postpartum were identified by using a self-administered questionnaire (EPDS), and were not clinically diagnosed by a psychiatrist. Since this study was conducted in only one maternity hospital, it is beneficial that there is little difference in the perinatal management received by the participants, while the participants did not represent the socio-demographic reality of Japan. Moreover, pregnant women who required close monitoring in multiple clinical departments due to physical complications or high-dose medications were excluded from this study because they were referred to a general hospital. Additionally, the original scoring of the DIT has cutoff points for each of the two scales, i.e., distress and impact. However, in this study, the total score was adopted because it was more sensitive and specific to PND high risk at one month postpartum. Lastly, there was also no data on using the DIT as a screening tool for postpartum women. Further research using structured interviews are required.

8. Conclusions

Mothers with depressive symptoms at a few days postpartum or with a psychiatric illness history, and primiparas, need to be continuously supported for early detection and intervention of PND. The DIT has the potential to be useful as a simple screening tool for PND, and to promote a biopsychosocial approach by making supporters aware of mothers requiring assistance. We consider these results to be useful for assisting postpartum mothers in maternity hospitals.

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Figure Legends and Tables

Figure 1: Longitudinal comparison of the Edinburgh Postnatal Depression Scale (EPDS) score. The EPDS scores at a few days postpartum and one month postpartum are plotted for each participant. The size of the plot indicates the number of participants. R2: coefficient of determination

Figure 2: Receiver operating characteristic curve and the area under the curve (AUC) for detection of “depressed” according to the total Distress and Impact Thermometer (DIT) score.

Figure 1.

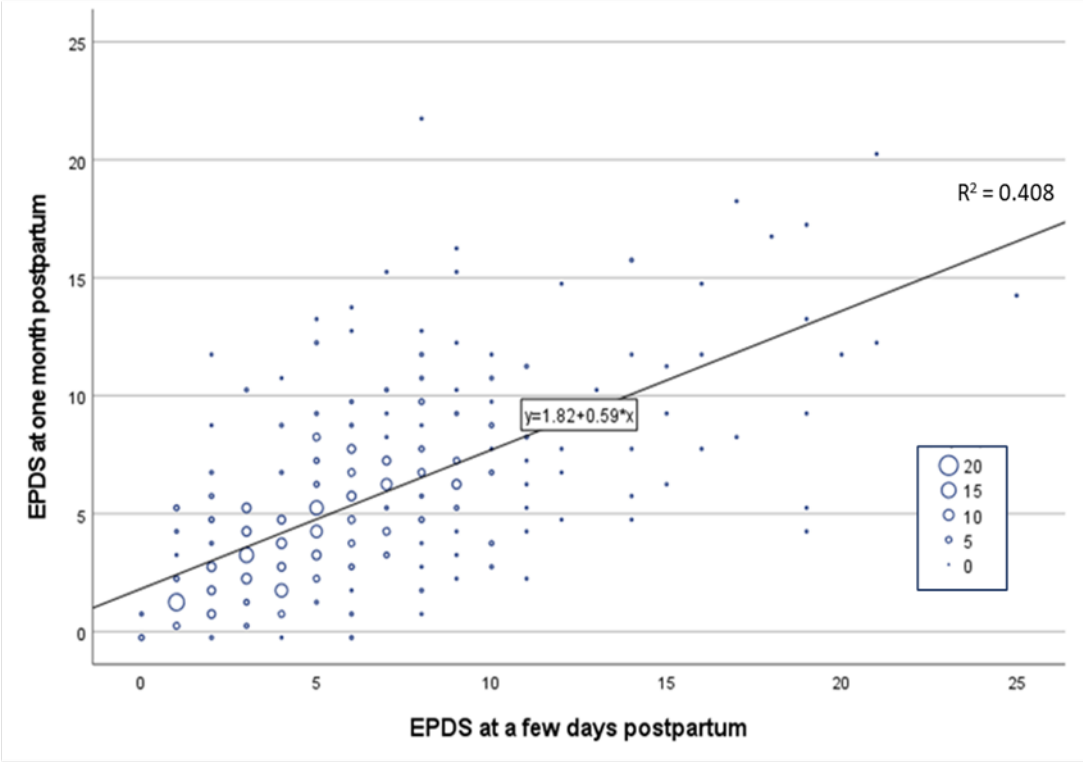
EPDS at one month postpartum
EPDS at a few days postpartum
R² = 0.408
y=1.82+0.59*x
20
15
10
5
0
0
5
10
15
20
25

Figure 2.

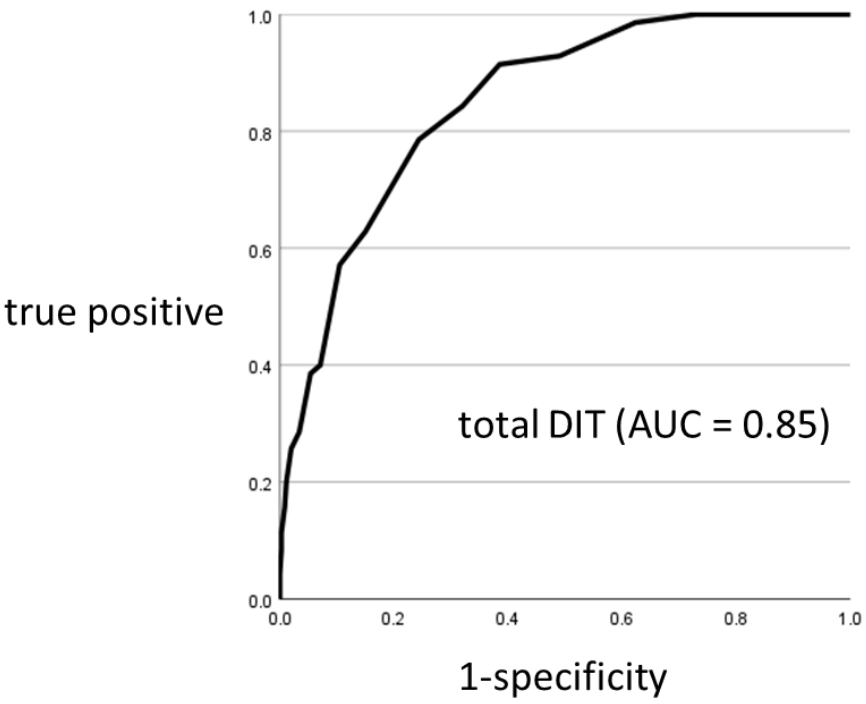
true positive
1.0
0.8
0.6
0.4
0.2
0.0
total DIT (AUC = 0.85)
0.0
0.2
0.4
0.6
0.8
1.0
1-specificity

Table 1.
EPDS, DIT score and basic obstetric data of the participants.

	Mean(SD)	Min – Max	Missing value
Mother's age, years	31.3(4.8)	18 – 44	
Scores for each rating scale		–	
EPDS at a few days postpartum	5.9(4.0)	0 – 25	
EPDS at 1M postpartum	5.3(3.7)	0 – 22	
DIT total point at a few days postpartum	4.5(4.2)	0 – 20	5
Distress	2.8(2.4)	0 – 10	
Impact	1.8(2.1)	0 – 10	
DIT total point at 1M	4.2(4.0)	0 – 20	
Distress	2.5(2.1)	0 – 10	
Impact	1.7(2.0)	0 – 10	
	Number	%	Missing value
Parity			
Primipara	229	54.1	
Multipara	194	45.9	
Reproductive treatment history(+)			
Yes	53	12.5	
No	370	87.5	
Type of pregnancy			
Natural insemination	370	87.5	
Guidance on intercourse timing	19	4.5	
Artificial insemination	17	4	
Extrauteral insemination	7	1.7	
Microinsemination	4	1	
Others	6	1.4	
Twin pregnancy	3	0.7	
Method of birth			
Vaginal birth	180	43	
Caesarean section	133	31.4	
Emergency(+) Yes	25	5.9	
No	108	25.5	
Labor analgesia	110	26	
Baby's sex , boy/girl	217/198	51.3/46.8	8
Psychiatric illness history(+)			
Yes	26	6.2	
Depressive disorder	6		
Panic disorder	6		
Mixed anxiety and depressive disorder	4		
Generalized anxiety disorder	2		
Adjustment disorders	2		
Schizophrenia	2		
Unspecified organic or symptomatic mental disorder	2		
Bipolar affective disorder	1		
No	397	93.9	
	Mean(SD)	Min – Max	Missing value
Duration of labor, min	332.3(399.2)	20 – 4573	
Amount of bleeding, g	352.6(206.1)	50 – 1589	
Gestation age at birth, weeks	38.4(1.2)	26 – 41	
Birth weight, g	2953.2(353.3)	1692 – 4070	

Table 2.
Results of $\chi 2$ tests or Fisher's exact tests at each category data with the mental health risk in the EPDS at one month postpartum.

		Depressed**		Not depressed**			
		Number	%	Number	%	p1)	p2)
EPDS at a few days postpartum						<.001***	
	High risk*	37	8.7	46	10.9		
	Not at high risk*	33	7.8	307	72.6		
Young age pregnancy							0.30
	Yes	1	0.2	1	0.2		
	No	69	16.3	352	83.2		
Elder age pregnancy						0.10	
	Yes	13	3.1	99	23.4		
	No	57	13.5	254	60.0		
Multiple pregnancy							0.42
	Yes	1	0.2	2	0.5		
	No	69	16.3	351	83.0		
Parity						<.001***	
	Primipara	51	12.1	178	42.1		
	Multipara	19	4.5	175	41.4		
Psychiatric illness history							<.001***
	Yes	14	3.3	12	2.8		
	No	56	13.2	341	80.6		
Reproductive treatment						0.52	
	Yes	12	2.8	41	9.7		
	Guidance on intercourse timing	9	2.1	33	7.8		
	Artificial insemination	4	0.9	10	2.4		
	In-vitro fertilization	2	0.5	5	1.2		
	Micro fertilization	1	0.2	3	0.7		
	Others	2	0.5	4	0.9		
	No	58	13.7	312	73.8		
Method of birth						0.83	
	Vaginal delivery	29	6.9	151	35.7		
	Emergency c-section	5	1.2	20	4.7		
	Elective cesarean section	20	4.7	88	20.8		
	Epidural delivery	16	3.8	94	22.2		
Excessive bleeding						0.14	
	Yes	19	4.5	68	16.1		
	No	51	12.1	285	67.4		
Prolonged labor							0.67
	Yes	1	0.2	5	1.2		
	No	69	16.3	348	82.3		
Birthweight						0.78	
	More than 4000g	0	0.0	2	0.5		
	2500～3999g	65	15.4	324	76.6		
	Low birth weight	5	1.2	22	5.2		
	Very low birth weight	0	0.0	0	0.0		
	Extremely low birth weight	0	0.0	0	0.0		
Delivery week							0.61
	Preterm delivery	1	0.2	7	1.7		
	Term delivery	69	1.6	346	81.8		
	Postterm delivery	0	0.0	0	0.0		
Sex of baby						0.78	
	Boy	34	8.3	180	44.0		
	Girl	33	8.1	162	39.6		

p1) Pearson's chi-square test p2) Fisher's exact test.
* "High risk" includes participants with EPDS score of 9 points or higher at a few days postpartum, and "Not at high risk" includes participants with EPDS score of less than 9 points at a few days postpartum.
** "Depressed" includes participants with EPDS score of 9 points or higher at one month postpartum, and "Not depressed" includes participants with EPDS score of less than 9 points at one month postpartum.
*** indicates statistical significance ($p<0.05$) in the analyses.

Table 3.

The results of binomial logistic regression analysis of predictors of "depressed" (EPDS score≥9, which indicates the possibility of PND) at one month postpartum. (n=423)

Predictors	p value	AOR(95% CI)
Psychiatric illness history	<.001**	5.23(2.09-13.10)
Primipara	0.036**	1.95(1.05-3.65)
High risk* at a few days postpartum	<.001**	5.60(3.09-10.14)

* indicates that EPDS score is 9 points or higher.

** indicates statistical significance ($p<0.05$) in the analyses.

Table 4.

The outcomes of depressive symptom in each category data at one month postpartum, divided into a high-risk group and a not at high-risk group for early PND.

		High risk* at a few days postpartum						Not at high risk* at a few days postpartum					
		Total number****	Depressed**		Not depressed**			Total number****	Depressed**		Not depressed**		
			Number	%	Number	%	p 1) p 2)		Number	%	Number	%	p 1) p 2)
Young age pregnancy		83					0.45	340					0.90
	Yes		1	1.2	0	0			0	0	1	0.3	
	No		36	43	46	55.4			33	9.7	306	90	
Elder age pregnancy		83					0.75	340					0.19
	Yes		7	8.4	10	12			6	1.8	89	26.2	
	No		30	36	36	43.3			27	7.9	218	64.1	
Multiple pregnancy		83						340					0.27
	Yes		0	0	0	0			1	0.3	2	5.9	
	No		37	12	46	55.4			32	9.4	305	89.7	
Parity		83					0.44	340					0.068
	Primipara		30	36	34	41			21	6.2	144	42.4	
	Multipara		7	8.4	12	14.5			12	3.5	163	47.9	
Psychiatric illness history		83					0.18	340					<.001***
	Yes		8	9.6	5	6			6	1.8	7	2.1	
	No		29	35	41	49.4			27	7.9	300	88.2	
Reproductive treatment		83					0.15	340					0.24
	Yes		6	7.2	3	3.6			6	1.8	38	11.2	
	No		31	37	43	51.8			27	7.9	269	79.1	
Method of birth													
	Vaginal delivery	21	17	21	14	16.9	0.15	149	12	3.5	137	40.3	0.36
	Elective cesarean sectio	22	11	13	11	13.3	0.55	86	9	2.6	77	22.6	0.78
	Emergency c-section	6	3	3.6	3	3.6	0.55	19	2	0.6	17	5	0.57
	Epidural delivery	24	6	7.2	18	21.7	0.022***	87	10	2.9	77	22.6	0.51
Excessive bleeding		83					0.39	340					0.71
	Yes		12	15	11	13.3			7	2.1	57	16.8	
	No		25	30	35	42.2			26	7.6	250	73.5	
Prolonged labor		83						340					0.46
	Yes		0	0	0	0			1	0.3	5	1.5	
	No		37	45	46	55.4			32	9.4	302	88.8	
birthweight		82					0.36	339					0.55
	2500～3999g		34	42	39	47.6			31	9.1	283	83.5	
	Low birth weight		3	3.7	6	7.3			2	0.6	23	67.8	
delivery week		83					0.6	340					0.69
	preterm delivery		1	1.2	2	2.4			0	0	5	1.5	
	term delivery		36	43	44	53			33	9.7	302	88.8	
Sex of baby		81					0.6	328					0.81
	boy		18	22	20	24.7			16	4.9	160	48.8	
	girl		18	22	25	30.9			15	46	137	41.8	

p1) Pearson's chi-square test p2) Fisher's exact test.

* high risk, not at high risk: Participants were divided into two groups according to their EPDS scores at a few days postpartum. "High risk" includes participants with EPDS score of 9 points or higher at a few days postpartum, and "not at high risk" includes participants with EPDS score of less than 9 points at a few days

** depressed, not depressed: Participants were divided into two groups according to their EPDS scores at one month postpartum. "Depressed" includes participants with EPDS score of 9 points or higher at one month postpartum, and "Not depressed" includes participants with EPDS score of less than 9 points at one month

*** indicates statistical significance ($p<0.05$) in the analyses. **** "Total number" indicates the number of participants included in each analysis.

Table 5.

The Predictor for high risk mothers with depressiove symptom in early postpartum period to improve at one month postpartum. (n=83)

Predictors	p value	AOR(95% CI)
Epidural delivery	0.026*	0.30(0.11-0.87)

* indicates statistical significance ($p<0.05$) in the analyses.

Table 6.

Predictors for mothers who are not at high risk of depression in the early postpartum period to become "depressed" at one month postpartum. (n=340)

Predictors	p value	AOR(95% CI)
Psychiatric illness history	<.001*	10.23(3.13-33.46)
Primipara	0.058	2.11(0.98-4.58)

* indicates statistical significance ($p<0.05$) in the analyses.

Table 7.

The results of multicollinearity studies for the predictive category data used as independent variables in the binomial logistic regression analyses.

Predictors	Tolerance	VIF
Psychiatric illness history	0.96	1.05
Primipara	0.95	1.06
High risk* at a few days postpartum	0.91	1.10
Epidural delivery	0.99	1.01

* indicates that EPDS score is 9 points or higher.

Table 8.
The cutoff point, sensitivity, and specificity values of the Distress and Impact Thermometer for detection of “depressed*”

			Distress						
	score		0	1	2	3	4	5	6
Impact	0	sensitivity	1.00	1.00	0.96	0.86	0.69	0.56	0.30
		specificity	0.00	0.27	0.46	0.63	0.83	0.90	0.97
	1	sensitivity	0.93	0.93	0.90	0.83	0.67	0.54	0.30
		specificity	0.48	0.49	0.56	0.67	0.84	0.90	0.97
	2	sensitivity	0.86	0.86	0.86	0.79	0.63	0.53	0.30
		specificity	0.65	0.65	0.66	0.71	0.85	0.91	0.97
	3	sensitivity	0.70	0.70	0.70	0.70	0.56	0.49	0.27
		specificity	0.79	0.79	0.79	0.80	0.88	0.92	0.97
	4	sensitivity	0.44	0.44	0.44	0.44	0.41	0.37	0.26
		specificity	0.90	0.90	0.90	0.91	0.92	0.94	0.97
	5	sensitivity	0.39	0.39	0.39	0.39	0.37	0.37	0.26
		specificity	0.93	0.93	0.93	0.93	0.94	0.95	0.97
	6	sensitivity	0.20	0.20	0.20	0.20	0.20	0.20	0.16
		specificity	0.98	0.98	0.98	0.98	0.98	0.98	0.99

* indicates that EPDS score is 9 points or higher.