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Discrete category of mother-to-infant bonding disorder and its identification by the Mother-to-Infant Bonding Scale: A study in Japanese mothers of a 1-month-old

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ABSTRACT

Background: Difficulty of maternal bonding towards a baby is widely recognised. It is unclear whether this phenomenon is dimensional or categorical. If categorical, an optimal cut-off score of a screening instrument is needed in clinical settings.
Aims: In this study, we investigated whether maternal bonding is dimensional or categorical phenomenon and try to set optimal cut-off score of screening instruments.
Methods: Self-report questionnaire studies were conducted in a general hospital and four antenatal clinics. Two-step cluster analysis was conducted for the Mother-to-Infant Bonding Scale (MIBS) subscale scores in 723 mothers of neonates. ROC curves and optimal cut-off points of the MIBS scores were calculated based on cluster-analysis derived groups.
Results: A 2-cluster structure appeared: "normal" (n = 619) vs. "pathological maternal bonding" (n = 104). Mothers of the latter category scored significantly higher in terms of postnatal depression and neonatal abuse than those of the former category. AUC of the ROC curve by the total MIBS scores both 5 days and 1 month after childbirth were > 0.9. The optimal cut off scores were 3/4 at 5 days, and 4/5 at 1 month, after childbirth.
Conclusions: There was a group of mothers with high MIBS scores discretely different from those with low MIBS scores. MIBS may be a useful tool to identify mothers with a severe bonding disorder that needs clinical intervention.

1. Introduction

Mother-to-infant bonding disorder (or failure) is one of the maternal affective difficulty towards her baby such as lack of affection, anger and rejection. It plays an important role in development of mother-infant interaction and parenting environment. The adverse effects of mother-infant bonding disorder (or failure) on mother-infant interaction [1–3] and parenting behaviours [2] have been reported. Significant positive relationships between bonding disorder and postnatal depression [2,4–10] have also been found. Moreover, the nature of bonding disorder such as dislike, resentment or hatred towards the child, desire for permanent relinquishment, and hopes that the child disappears, [11] may lead to child maltreatment. It is often suggested that maternal depression leads to child abuse [12–14]. Although bonding disorder and postnatal depression have been associated with each, these two psychological states may be independent of each other in longitudinal observations [15]. Additionally, while both postnatal depression and bonding failure were significantly associated with abusive parenting in a cross-sectional observation [16], a longitudinal study reported that psychological abuse at 1 month after delivery was significantly predicted by bonding failure, but not by depression, at day 5 after delivery (Ohashi et al., in preparation). From these findings, an observed association of psychologically abusive parenting with postnatal depression might be confounded by bonding failure. Hence, identification of

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mothers with severe bonding disorder is an important issue in perinatal care.

Another issue of empirical as well as clinical importance is whether mothers with severe bonding difficulties consist of a group discrete from other mothers with varying degrees of bonding difficulties. Normal or exponential distribution cannot necessarily guarantee a dimensional nature of a phenomenon. This is because two discrete groups are likely to show a normal or exponential distribution if the difference in a particular measure score is not great between two groups with relatively small sample sizes. Such a question may be approached by a variety of statistical analyses [17]. Cluster analysis is one of such analyses. Thus, research has shown that discrete clusters were found for those with depressive disorder [18–21], bipolar disorder [22,23], psychotic disorders [24–28], and borderline personality disorders [29]. Therefore, it is to be questioned whether maternal bonding difficulty is a dimensional or categorical phenomenon. If a discrete group of mothers with severe bonding difficulties can be identified, they may be a target of research and clinical intervention.

In Japan, all municipalities conduct home visit services for mothers of a new-born, usually conducted by public health nurses or midwives. They evaluate physical as well as mental health conditions of baby and mother and give advice. The Mother-to-infant Bonding Scale (MIBS) is one of the most frequently used instruments for the evaluation of mother-infant bonding. Based on preliminary work by Kumar [30], the Mother-Infant Bonding Questionnaire (MIBQ) was constructed as a self-rating measure with nine adjectives describing a parents' feeling towards the neonate. Adapting the MIBQ, Taylor, Atkins, Kumar, Adams, & Glover [31] developed a new measurement, the Mother-to-Infant Bonding Scale (MIBS). The MIBQ was later modified by Kumar's colleague Marks, resulting in modification of three items as well as the addition of one new item. Thus, the modified MIBS consists of ten items. This was translated by Yoshida, Yamashita, Conroy, Marks, & Kumar [32] into Japanese. This is widely used in postnatal visits in Japan. However, the optimal MIBS cut-off point has so little been studied that public health nurses and midwives conducting postnatal home find it difficult to use the instrument in their clinical settings.

The aim of this study was two-fold. First, we performed a two-step cluster analysis in order to identify the existence of discrete category/categories in terms of mother-to-infant bonding difficulties. We then examined the screening performance and optimal cut-off point of the MIBS as a screening instrument of bonding disorder based on classification by the cluster analysis using data of the study of postnatal mental health among Japanese mothers already published [33]. Results will be helpful for the specialists who support mothers with new-born babies in both clinical and community settings.

2. Material and methods

2.1. Study procedures

This questionnaire study was conducted in one obstetrics and gynecology department of a general hospital and four antenatal clinics located in Okayama, Japan. Women who gave birth during the 6-month study period in any one of these medical institutions were recruited in the study, except for those who lacked reading capacity or declined from participating. Participants were asked to fill in a set of questionnaires and return them via postal service. Data were collected by two waves: 5 days (Wave 1) and 1 month (Wave 2) after childbirth. At Wave 1, we asked about mother-infant bonding and socio-demographic and delivery-related status including participant's age, their partner's age, birth weight of the present baby, baby's gender, and type of delivery. At Wave 2, we asked about mother-infant bonding, postnatal depression, and neonatal abuse. This is a reanalysis of the data from research project of postnatal mental health among Japanese mothers conducted from August 2001 to May 2002 [33]. All cases with no missing values in the MIBS for both waves were included in the statistical analyses.

2.2. Measurements

2.2.1. Mother-to-Infant Bonding Disorder

The Mother-to-Infant Bonding Scale (MIBS: Marks et al., unpublished) is an instrument to assess mother-infant bonding. This scale consists of 10-items with a 4-point scale. Its total score ranges between 0 and 30. Higher scores indicate worse mother-to-infant bonding. The Japanese translated version of the MIBS [32] was used in this study. Reliability and validity of the Japanese MIBS has already been confirmed [32,34]. A two-factor structure of the MIBS-J has been found [32]: “anger and rejection” and “lack of affection”; each subscale consists of 4 items. We used the scores of each subscale at Waves 1 and 2 for cluster analysis. The total score of the MIBS was calculated by adding the score of each of the 10 MIBS items. This was used for a receiver operating curve (ROC) analysis.

2.2.2. Post-natal depression

The Edinburgh Postnatal Depression Scale (EPDS) [35] was used to assess the severity of depression 1 month after childbirth. The Japanese version of EPDS, validated by Okano et al. [36], consists of 10 items with a 4-point scale. Higher scores indicate more severe post-natal depression.

2.2.3. Psychological abuse towards the baby

Psychological abuse subscale of the Parent-Child Conflict Tactics Scale (CTSPC) [37] was used to measure neonatal psychological abuse which focuses the parental psychological and physical aggression towards the baby. The CTSPC psychological abuse subscale consists of 6 items from the total 19 items of the CTSPC with a 7-point scale. Higher scores indicate more abusive parenting behaviour towards the child. We used the CTSPC that was translated into Japanese under the permission from the original author. In this study, we calculated the CTSPC psychological subscale score by summing the score of each CTSPC subscale item. The Cronbach's alpha of the subscale in this study was 0.61.

2.2.4. Data analysis

Two-step cluster analysis was conducted to classify the participants depending on the scores of the two MIBS subscales at both day 5 and 1 month after childbirth. These scores were log-transformed because of their positive skewness. To examine validation of clustering bonding disorder, MIBS total score at both day 5 and 1 month after childbirth, EPDS subscale and total score, CTSPC subscale score, and socio-demographic variables of each cluster were compared by a Welch's *t*-test or a chi-squared test.

For estimating screening performance of the MIBS for more severe bonding disorders, a ROC curve was drawn to estimate the area under curve (AUC) using the total scores of the MIBS both at 5 days and 1 month after childbirth. In succession, the AUC was compared and optimal cut-off scores were estimated by both the Youden index [38] and the “shortest distance to upper left corner” [39]. By using the Youden index, the score which maximises the sum of sensitivity and specificity was chosen as an optimal cut-off point. In the “shortest distance to upper left corner” method, the cut-off point which was closest to the upper left corner on a ROC curve was selected as the optimal cut-off point.

Two-step cluster analysis was performed by SPSS 21, and further analyses were performed by Stata 14.

2.2.5. Ethical consideration

All participants asked to participate in this study were provided with a document explaining the aim and procedure of this study and security of personal information. Participants were regarded as agreeing to participate by returning the questionnaire to the responsible

researcher (TK) via postal service. This study was conducted under the approval of the Ethical Committee of National Center of Neurology and Psychiatry Kohnodai Campus.

3. Results

Fifteen-hundred and thirty women were eligible for this study. Among them, 1200 (78%) women received the questionnaires, and 758 (63%) returned the questionnaires at both waves. Excluding participants with missing values in the MIBS, 723 (95%) participants were included in the statistical analyses. Therefore, this sample included 60% of the eligible population. The mean (SD) age was 28.7 (4.1) years-old and their partner's age was 30.6 (5.2) years-old. The number of male infants was 340 (47%). The babies' mean (SD) birthweight was 3049.5 (342.5) grams. Regarding type of delivery, 604 (84%) participants gave birth vaginally, 52 (7%) required vacuum extraction, and 51 (7%) gave birth by Caesarean section.

Two-step cluster analysis yielded two clusters: 619 participants were classified into Cluster 1 and the other 104 into Cluster 2. Cluster precision-accuracy was > 0.5, which is considered as good accuracy. Both the Lack of Affection and Anger and Rejection scores were significantly higher among those mothers of Cluster 2 than among those of Cluster 1 at each of the two waves (Table 1). The scores of EPDS as well as the CTSPC psychological abuse subscale were also statistically significantly higher among the mothers of Cluster 2 than among those of Cluster 1 (Table 1). There were no differences between the two clusters in terms of the mothers' age, their partner's age, baby's birthweight, baby gender, type of delivery, and physical abuse.

The screening capacity of the MIBS total score was examined by the AUC. It was 0.902 and 0.943 for the data at day 5 and 1 month after childbirth, respectively (Fig. 1). The AUC of the ROC curve was significantly greater for 1 month after childbirth than for day 5 after childbirth ($P = 0.029$).

Tables 2 and 3 show sensitivity and specificity on each point of the MIBS at day 5 and 1 month after childbirth. The Youden index was maximal for the cut-off point of 3/4 for the day 5 data and 4/5 for the 1 month data. These cut-off points were also optimal in terms of the distance to the upper left corner. A total of 228 (32%) participants were identified as “positive” for the cut-off point of 3/4 at day 5, whereas 148 (21%) were identified as “positive” for the cut-off point of 4/5 at 1 month. Among these 228 mothers with 4 points or more at day 5, 90 (39%) were still “positive” at 1 month after childbirth. On the other hand, among the 495 mothers with 3 points or less at day 5, 58 (12%) indicated 5 points or more at 1 month after childbirth.

4. Discussion

Two-step cluster analysis based on the MIBS score classified the participants into two clusters. There were significant differences in both of the subscale scores of the MIBS over the course of the two waves.

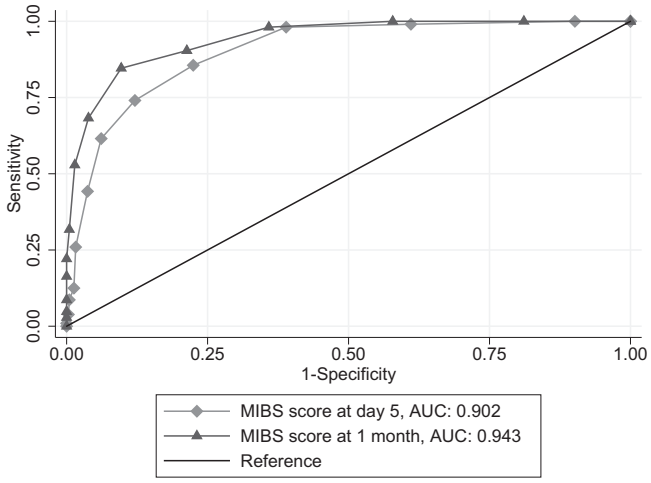

Fig. 1. ROC curve by MIBS score at day 5 and 1 month after delivery.

Table 2
Sensitivity, specificity, Youden index, and distance to upper left corner of each cut-off score of the MIBS at 5 days after delivery.

Cut off score	n	%	Sensitivity	Specificity	Youden index	Distance to upper left corner
0	61	8.44	1.000	0.000	0.000	1.000
1	181	25.03	1.000	0.099	0.099	0.902
2	138	19.09	0.990	0.389	0.380	0.611
3	115	15.91	0.981	0.611	0.592	0.390
4	76	10.51	0.856	0.775	0.631	0.267
5	50	6.92	0.740	0.879	0.619	0.286
6	33	4.56	0.615	0.939	0.554	0.389
7	32	4.43	0.442	0.963	0.405	0.559
8	16	2.21	0.260	0.984	0.243	0.741
9	9	1.24	0.125	0.987	0.112	0.875
10	6	0.83	0.087	0.995	0.082	0.914
11	5	0.69	0.039	0.997	0.035	0.962
13	1	0.14	0.010	1.000	0.010	0.990

These results suggest the existence of a group of mothers with a severe bonding disorder that was discrete from the other group of mothers with a varying distribution of bonding difficulties. We also found that the group of mothers with severe bonding difficulties towards their baby were characterised by more severe depression as well as psychologically harsher parenting styles towards the baby, supporting the discrete nature of this group of mothers. Hence, we interpret this group as “pathological maternal bonding”. The women belonging to the other cluster may be “normal” even though their MIBS scores are relatively high.

The present study demonstrated that the use of the MIBS total score was a much better screening instrument to identify the discrete group of

Table 1
The scores of the MIBS subscales, EPDS and CTSPC psychological abuse at two waves by the clusters.

	Total		Cluster 1 ($n = 619$)	Cluster 2 ($n = 104$)	
	Mean (SD)	Cronbach's alpha	Mean (SD)	Mean (SD)	t
MIBS subscale					
Lack of affection day 5	0.73 (0.89)	0.47	0.50 (0.65)	2.12 (0.91)	− 17.5***
Anger and rejection day 5	0.50 (0.76)	0.68	0.41 (0.69)	1.06 (0.93)	− 6.80***
Lack of affection 1 month	0.75 (0.91)	0.55	0.50 (0.62)	2.23 (0.97)	− 17.54***
Anger and rejection 1 month	0.47 (0.68)	0.73	0.33 (0.53)	1.30 (0.88)	− 10.90***
EPDS	4.96 (3.99)	0.80	4.80(3.81)	5.93 (4.85)	− 2.24*
CTSPC psychological abuse	1.09 (2.28)	0.61	0.91 (1.85)	2.23 (3.82)	− 3.39**

* $P < 0.05$.
** $P < 0.01$.
*** $P < 0.001$.

Table 3
Sensitivity, specificity, Youden index, and distance to upper left corner of each cut-off score of the MIBS at 1 month after delivery.

Cut off score	n	%	Sensitivity	Specificity	Youden index	Distance to upper left corner
0	117	16.18	1.000	0.000	0.000	1.000
1	144	19.92	1.000	0.189	0.189	0.811
2	138	19.09	1.000	0.422	0.422	0.578
3	98	13.55	0.981	0.641	0.622	0.359
4	78	10.79	0.904	0.787	0.691	0.234
5	53	7.33	0.846	0.903	0.749	0.182
6	31	4.29	0.683	0.961	0.644	0.320
7	28	3.87	0.529	0.986	0.514	0.471
8	13	1.8	0.317	0.995	0.313	0.683
9	6	0.83	0.221	1.000	0.221	0.779
10	8	1.11	0.164	1.000	0.164	0.837
11	4	0.55	0.087	1.000	0.087	0.914
12	2	0.28	0.048	1.000	0.048	0.952
15	3	0.41	0.029	1.000	0.029	0.971

mothers with severe bonding difficulty when used at 1 month after childbirth rather than at 5 days after. A seminal clinical report by Robson and Kumar [40] indicated the presence of mothers who experience delayed onset of affection towards their baby. Bonding disorder generally attenuates over time [2,32,41–43]. Bonding disorder scores become narrowly ranged and positively skewed over time [10,31]. These previous studies together with the present study suggest that mothers categorised as "normal" may show as high MIBS scores as those of "pathological maternal bonding" at day 5, whereas mothers with "pathological maternal bonding" may still show high MIBS scores towards the baby 1 month after childbirth. Because of greater AUC of the MIBS scores at 1 month after childbirth and previous reports that bonding disorder score attenuate over time, it would be feasible to use the MIBS 1 month after childbirth as a screening instrument.

In Japan, home visiting service for mothers and new-born babies is generally provided around 1 month after childbirth. Therefore, the MIBS could be distributed by public health nurses around this period without difficulty. The cut-off point of 4/5 made it possible to classify about 90% of "pathological maternal bonding" cases correctly. This rate could be regarded as permissible. On the other hand, the optimal cut-off score at day 5 was found to be 3/4. Mothers and their infants are usually discharged around 5 days after delivery. About 40% of mothers who indicated 4 points or more at day 5 still indicated a score above the cut-off at 1 month in this study. Therefore, it would be recommended that mothers who indicated 4 points or more at discharge from a gynaecological ward be followed by midwives until community health centres provide home visiting services. Use of the MIBS in such a way may facilitate better mother-baby interaction.

Before concluding, we should examine limitations of the study. First, this study relied solely upon self-report questionnaires. The results obtained from self-report should be compared with those obtained from other informants including clinicians conducting structured interviews. It may be better to investigate whether the cluster of "pathological bonding" agrees with a clinical diagnosis. Nevertheless, we are aware that data from clinical interviews should also be subject to the question, "is there a discrete category of bonding disorder?" More detailed studies on the association between bonding disorder, parenting styles, and maternal mental health should also be performed.

Second, the trajectory of bonding disorder is still unclear. Our results showed that the screening performance of the MIBS total score is more effective when used at 1 month after childbirth than at day 5 after childbirth, and that the groups with and without severe bonding disorder become clearly separated over time. However, finding the cases of bonding difficulty and care for mothers with bonding disorder should be conducted as soon as possible. Delay of care may make the problem worse. While this study indicates provisional optimal cut-off scores at day 5 and 1 month after childbirth, we should carefully examine effective schedules to conduct screening of bonding disorder based on further findings about the trajectory of bonding disorder.

Taking these shortcomings into consideration, to the best of our knowledge this is the first study to find optimal cut-off points of MIBS scores using cluster-analysis derived groups as the gold standard. Suggested tentative optimal cut-off scores were 3/4 and 4/5 at day 5 and 1 month after childbirth, respectively. We consider that those mothers scoring as high as these cut-off points should be followed up by perinatal care professionals until home visiting services are provided by community mental health staff.

5. Conclusion

By conducting cluster analysis, discrete category of maternal bonding disorder was found. For screening the bonding disorder, usefulness of MIBS and its optimal cut-off score was 4/5 at 1 month after birth were suggested by ROC curve. These findings would contribute to finding maternal bonding disorder and early intervention for mothers with bonding disorder as well as babies.

Conflict of interest statement

None declared.

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