

# Stress response after breastfeeding and breastfeeding self-efficacy as modifiable predictors of exclusive breastfeeding at 3 months postpartum: a longitudinal study

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## Research article

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# Abstract

**Background:** Only 50% of mothers in Japan exclusively breastfeed their infants during the postpartum period. To increase this rate, we aimed to examine modifiable factors at 1 month postpartum related to exclusive breastfeeding at 3 months postpartum by focusing on breastfeeding-related and psychosocial variables.

**Methods:** This prospective cohort study was a secondary analysis of a longitudinal study, which was conducted in a secondary medical care center in Osaka, Japan from 2017 to 2018. Demographic variables, infant feeding modality, breastfeeding-related variables, and psychosocial variables were obtained using questionnaires at 1 month postpartum. Daytime salivary cortisol levels before and after breastfeeding at 1 month postpartum were measured as a biological marker for stress responses associated with breastfeeding. Each infant's feeding modality was re-assessed at 3 months postpartum. A multiple logistic regression analysis was performed to examine the factors affecting exclusive breastfeeding at 3 months postpartum.

**Results:** Of the 104 participants, 61 reported exclusive breastfeeding at 3 months postpartum. The following factors significantly affected exclusive breastfeeding at 3 months postpartum: multipara (adjusted odds ratio, 95% confidence interval: 11.128, 2.078–59.594), having a university degree (5.246, 1.037–26.526), no plan to return to work by 6 months postpartum (0.021, 0.001–0.460), exclusive breastfeeding at 1 month postpartum (42.841, 6.047–303.515), higher breastfeeding self-efficacy scale score at 1 month postpartum (1.070, 1.004–1.139), and lower cortisol level after breastfeeding at 1 month postpartum (0.000, 0.000–0.020).

**Conclusions:** Stress levels after breastfeeding and breastfeeding self-efficacy were identified as modifiable factors related to subsequent exclusive breastfeeding. Healthcare professionals need to develop effective approaches to reducing breastfeeding-related stress and improving breastfeeding self-efficacy to help women fulfill their antenatal breastfeeding intentions and increase exclusive breastfeeding practices.

## Background

The World Health Organization recommends exclusive breastfeeding for at least 6 months after childbirth for optimal growth, development, and well-being of children [1]. However, in Japan, the rate of exclusive breastfeeding in the first 3 months postpartum ranged only from 51 to 55% in 2015 [2]. The rate has increased by 9–16% in 2015 compared with that in 2005, but it is insufficient. According to a national survey in Japan [3], 41.7% of pregnant women definitely wanted to breastfeed their infants. Of them, 67.6% were practicing exclusive breastfeeding at 1 month postpartum. In addition, 49.3% of pregnant women reported wanting to breastfeed their infants if possible. Of them, only 40.7% practiced exclusive breastfeeding. Although more than 90.0% of pregnant women have a desire to breastfeed, actual postpartum feeding modality does not necessarily conform to antenatal intent.

Several demographic factors including age, parity, and education level have been identified as factors related to exclusive breastfeeding practice [4–6]. Physiological and psychosocial factors could be significant predictors for subsequent breastfeeding. For instance, mothers without breast complications such as breast pain reported practicing exclusive breastfeeding more than those with breast complications [7]. Such physiological barriers are likely to increase stress levels and cause women to discontinue breastfeeding sooner [8]. Psychosocial factors including breastfeeding self-efficacy, stress levels, and family support might predict exclusive breastfeeding practice. According to Otsuka et al. [9], low breastfeeding self-efficacy is associated with the perception of insufficient milk. This perception may lead to milk supplementation [3]. In a cross-sectional study, subjective child-related stress responses were reported to be higher in women who were partially breastfeeding than in those who were exclusively breastfeeding [10]. Kaneko et al. [11] reported that husband support such as advice on child-rearing is associated with exclusive breastfeeding. However, the effects of these physiological and psychosocial factors on subsequent exclusive breastfeeding practice have not been thoroughly examined.

To meet the breastfeeding expectations of women and promote exclusive breastfeeding practices, we aimed to examine the modifiable factors at 1 month postpartum related to exclusive breastfeeding at 3 months postpartum. In particular, we focused on breastfeeding-related variables and psychosocial variables such as breast complications, breastfeeding self-efficacy, stress levels, depressive symptoms, bonding, and family support. Stress levels associated with breastfeeding were assessed using salivary cortisol measurement. A clearer understanding of these associations may help healthcare professionals form important intervention components to promote exclusive breastfeeding.

## Methods

### Participants and Setting

This prospective cohort study was a secondary analysis of a longitudinal study. The longitudinal study from the third trimester to 5 months postpartum was conducted in a secondary medical care center in Osaka, Japan from 2017 to 2018. The research hospital was not a baby-friendly hospital as defined by the World Health Organization/United Nations International Children's Emergency Fund. Healthy Japanese women at 34–36 weeks' gestation who visited the hospital for medical checkup were recruited. The following women were excluded: those younger than 20 years old, those with inadequate Japanese literacy, and those with psychiatric diseases. All participants provided written informed consent prior to the baseline investigation. Of the investigation data available at the third trimester, a few days after childbirth, and 1, 3, and 5 months postpartum in the longitudinal study, we used the data from the third trimester and at 1 and 3 months postpartum. We also used data on delivery outcomes from the participants' medical charts.

## Variables

The original questionnaire distributed to the mothers at 34–36 weeks' gestation contained questions on age, parity, education level, height, and pre-pregnancy weight. After childbirth, we obtained information about delivery mode, blood volume during delivery, and infant's birth weight from the medical charts. At 1 month postpartum, we mailed a questionnaire and a box containing two tubes for saliva sampling and icepack to the participants. The participants collected 1.0-mL saliva samples twice (before and after breastfeeding of 11:00–15:00). Salivary cortisol levels were measured as an indicator of physiological and psychological responses associated with breastfeeding. The participants were asked not to eat or drink in the 15 minutes before the saliva sampling. After the sampling, they packed the two saliva samples and the icepack into the box and mailed them to the research university using a frozen delivery service. After delivery, the saliva samples were stored at  $-30^{\circ}\text{C}$  until analysis. The salivary cortisol levels were measured using a Cortisol Salivary Immunoassay Kit (Salimetrics, LLC, CA, USA).

The questionnaire at 1 month postpartum contained questions on infant feeding modality, the Japanese version of the Breastfeeding Self-Efficacy Scale Short Form (BSES-SF) [9], the Japanese version of the Perceived Stress Scale-10 (PSS-10) [12], the Japanese version of Edinburgh Postnatal Depression Scale (EPDS) [13], the Japanese version of Postpartum Bonding Questionnaire (J-PBQ) [14], and support from husbands or parents. Infant feeding modality was selected from among exclusive breastfeeding, partial breastfeeding, or formula feeding. The BSES-SF was developed to assess a person's belief and confidence in their ability to breastfeed [9, 15]. The breastfeeding self-efficacy theoretical framework developed by Dennis [16] was based on Bandura's social cognitive theory [17]. This scale consists of 14 items that require five-point Likert scale responses ranging from "not at all confident" to "very confident" (total, 14–70 points). Higher scores indicate a higher level of self-efficacy. Cronbach's  $\alpha$  of the present study was 0.849. The PSS-10 was used to assess the degree to which situations in one's life are appraised as stressful [12, 18]. This scale consists of 10 items requiring five-point Likert scale responses (total, 0–40 points). Higher scores indicate higher levels of stress. Cronbach's  $\alpha$  of the present study was 0.854. The EPDS assesses whether a person had depressive symptoms within the preceding 7 days [13, 19]. This scale is a 10-item self-reported screening tool for perinatal depression with a total score between 0 and 30. In Japan, a postpartum woman with a score  $> 8$  points is considered to have depressive symptoms [13]. Cronbach's  $\alpha$  of the present study was 0.792. The J-PBQ, which consists of 14 items, was used to assess whether participants had bonding disorders [14]. The J-PBQ was developed based on the original PBQ by Brockington et al. [20], which consists of 25 items. The J-PBQ has six-point Likert scale responses ranging from "never" to "always" (total, 0–70 points). Higher scores indicate a greater bonding disorder. Cronbach's  $\alpha$  of the present study was 0.813.

At 3 months postpartum, we re-assessed each infant's feeding modality.

## Statistical Analysis

Student's t-test, Mann-Whitney U test, Chi-square test, or Fisher's exact test was used to compare participant characteristics between women who were exclusively breastfeeding and those who were not,

at 3 months postpartum. Multiple logistic regression analysis was performed to examine the factors related to exclusive breastfeeding at 3 months postpartum. Variables with  $p$  values  $< 0.10$  for binary analyses and demographic variables (age, parity, and education level) that were detected as related factors to breastfeeding by previous studies [4, 11] were entered as independent variables into the multiple logistic regression models. Independent variables in the regression final model were determined using backward elimination (Wald). All differences with a 2-sided  $p$  value  $< 0.05$  were considered statistically significant. Statistical analyses were performed using Statistical Package for Social Sciences v. 24.0® (IBM Corp, Armonk, NY, USA).

## Results

Of the 349 healthy women at 34–36 weeks' gestation who were asked to participate in the research, 269 provided written informed consent. Among them, 70 were excluded due to consent withdrawal by 1 month postpartum ( $n = 66$ ), psychological condition due to after-effects of earthquake ( $n = 2$ ), severe infant condition ( $n = 1$ ), and isolation by infection ( $n = 1$ ). Thus, we asked 199 (74.0%) women to answer questionnaires and collect saliva samples at 1 month postpartum. Forty-one women did not submit questionnaires and salivary samples. Of the 158 (58.7%) kits received, 43 were excluded due to incomplete data ( $n = 33$ ), answering questionnaires over 60 days after childbirth ( $n = 5$ ), inadequate salivary sampling ( $n = 4$ ), and formula feeding ( $n = 1$ ). At 3 months postpartum, we asked 115 (42.8%) women to answer a questionnaire about infant feeding modality. Eleven women did not return the questionnaire. A total of 104 (38.7%) women provided complete baseline data, answered further questionnaires, and provided daytime saliva samples. No differences in demographic variables were found between the dropouts and the participants who completed all of the investigations.

Table 1 shows the summary of participant characteristics. The mean age (standard deviation) was 34.0 (4.7) years. Of the 104 women, 61 (58.7%) reported exclusive breastfeeding at 3 months postpartum; 33 (31.7%), partial breastfeeding; and 10 (9.6%), formula feeding. Multiparas ( $p = 0.001$ ), women who had no plan to return to work by 6 months postpartum ( $p = 0.031$ ), women who had a natural childbirth ( $p = 0.019$ ), and women with lower blood loss during delivery ( $p = 0.032$ ) showed significantly higher rates of exclusive breastfeeding at 3 months postpartum.

The associations between breastfeeding-related and psychosocial variables at 1 month postpartum and exclusive breastfeeding at 3 months postpartum are shown in Table 2. Exclusive breastfeeding at 1 month postpartum ( $p < 0.001$ ), presence of breast complications ( $p = 0.003$ ), BSES-SF scores ( $p < 0.001$ ), EPDS scores ( $p = 0.006$ ), J-PBQ scores ( $p = 0.014$ ), salivary cortisol levels before breastfeeding ( $p < 0.001$ ), and salivary cortisol levels after breastfeeding ( $p = 0.013$ ) were significantly associated with exclusive breastfeeding at 3 months postpartum. Forty-five (43.3%) women had higher salivary cortisol levels after versus before breastfeeding.

On multiple logistic regression analysis (Table 3), the following factors significantly affected exclusive breastfeeding at 3 months postpartum: multipara status (adjusted odds ratio, 95% confidence interval:

11.128, 2.078–59.594), having a university degree (5.246, 1.037–26.526), no plan to return to work by 6 months postpartum (0.021, 0.001–0.460), exclusive breastfeeding at 1 month postpartum (42.841, 6.047–303.515), higher BSES-SF score at 1 month postpartum (1.070, 1.004–1.139), and lower cortisol level after breastfeeding at 1 month postpartum (0.000, 0.000–0.020).

Factors related to exclusive breastfeeding at 1 month postpartum included multipara status ( $p = 0.018$ ), higher rates of natural childbirths ( $p = 0.001$ ), lower rates of breast complications ( $p = 0.001$ ), higher BSES-SF scores ( $p < 0.001$ ), lower EPDS scores ( $p = 0.006$ ), lower J-PBQ scores ( $p = 0.039$ ), and support from husbands ( $p = 0.037$ ) (data not shown). Both salivary cortisol levels before and after breastfeeding were not associated with exclusive breastfeeding at 1 month postpartum. Of the women who were not exclusively breastfeeding at 1 month postpartum, 26.9% changed to exclusive breastfeeding at 3 months postpartum. By contrast, among the women who were exclusively breastfeeding at 1 month postpartum, 10.4% shifted to partial breastfeeding by 3 months postpartum.

## Discussion

As modifiable predictors of exclusive breastfeeding at 3 months postpartum, a lower cortisol level after breastfeeding and a higher BSES-SF score at 1 month postpartum were identified on multiple logistic regression analysis. In addition, multiparity, higher education levels, and no plan to return to work by 6 months postpartum were significantly associated with exclusive breastfeeding at 3 months postpartum.

Lower cortisol levels after breastfeeding at 1 month postpartum were associated with exclusive breastfeeding at 3 months postpartum. Notably, the relationship was observed despite no cross-sectional relationship between cortisol levels and exclusive breastfeeding at 1 month postpartum. Cortisol levels usually decrease after breastfeeding since oxytocin inhibits cortisol secretion in women without mood distress [21]. Nevertheless, more than 40% of our participants had increased cortisol levels after versus before breastfeeding. High cortisol levels after breastfeeding despite oxytocin action seem to reflect physiological and psychological stress related to breastfeeding. A stress response after breastfeeding is a modifiable factor. Approaches to stress reduction including preventing breast complications and relieving anxiety by providing advice about breastfeeding concerns could be effective. Maternal cortisol responses to breastfeeding may also vary according to the function of CD38, an ectoenzyme that mediates the release of oxytocin [22]. A recent study has indicated that the CD38 rs3796863 CC genotype is associated with a reduced release of oxytocin during breastfeeding and, accordingly, fewer cortisol-reducing responses to breastfeeding [23]. Thus, women with this genotype may have difficulty establishing and maintaining exclusive breastfeeding due to insufficient milk ejection by decreased oxytocin release. In this manner, the specific gene might influence the relationship between breastfeeding and cortisol responses to breastfeeding through oxytocin secretion. Further studies are needed to clarify the relationship.

A higher BSES-SF score was associated with subsequent exclusive breastfeeding as reported by a previous study of another population [24]. Breastfeeding self-efficacy reflects a mother's confidence in her

ability to breastfeed her infant. The BSES-SF contains the following items “I can always keep wanting to breastfeed” and “I can always be satisfied with my breastfeeding experience” [9, 15]. Women with positive answers against such items seemed to be less stressed about breastfeeding. A systematic review showed that the prenatal and postpartum intervention focusing on improving breastfeeding self-efficacy leads to exclusive breastfeeding [25]. However, in Japan, the effects of prenatal intervention using a breastfeeding self-efficacy workbook are limited and effective in only baby-friendly hospitals and in the early postpartum period [26]. Thus, consideration of more effective approaches is needed for postpartum Japanese women. Women with lower breastfeeding self-efficacy were also reportedly more likely to perceive milk insufficiency [9, 27]. Such a perception has been pointed out as a factor of exclusive breastfeeding cessation [28]. The perception of milk insufficiency itself was not assessed in our study because this concept was supposed to be contained in questions of the BSES-SF. A further detailed study regarding the relationship among breastfeeding self-efficacy, perception of milk insufficiency, and subsequent exclusive breastfeeding might contribute to suggestion of concrete intervention methods for increasing the rate of exclusive breastfeeding.

As with previous studies, parity and education level were associated with exclusive breastfeeding [4, 11]. However, the effect of parity on exclusive breastfeeding practice is not a simple correlation; rather, it varies among study populations [5, 29]. In multiparas, the perception of successful breastfeeding of the previous child is likely to be positively correlated with exclusive breastfeeding duration [30]. By contrast, previous unsuccessful breastfeeding experiences often negatively affect subsequent breastfeeding initiation and duration [30, 31]. In this manner, the association between parity and exclusive breastfeeding practice may be mediated by previous breastfeeding experience. The relationship observed in the present study might imply that most multiparous participants had positive impressions of previous breastfeeding experiences.

Women with a university education or above were more likely to exclusively breastfeed. Women with higher education levels easily access health-related information and have more favorable attitudes toward breastfeeding [32, 33]. Such behavioral characteristics in women with higher education levels might help them achieve exclusive breastfeeding.

Returning to work by 6 months postpartum was associated with less exclusive breastfeeding at 3 months postpartum. Postpartum women who planned to return to work in the earlier postpartum period tend to select partial breastfeeding or formula feeding [25, 34]. In Japan, continuing exclusive breastfeeding for some working women is difficult because of the work environment and nursery policies. A private space and consideration for expressing breast milk during working hours are often lacking, although many companies have been trying to arrange such environments. Nursery policies often refuse breast milk storage due to hygienic reasons. Such situations sometimes make women discontinue exclusive breastfeeding [35]. In addition, partners’ attitudes against breastfeeding and childcare could be important elements that prevent women from discontinuing to breastfeed after returning to work [36]. Environmental and emotional support from family members, employers, and nursery staff members might be essential for working women to continue exclusive breastfeeding.

Exclusive breastfeeding at 1 month postpartum is a strong predictor of the same at 3 months postpartum. However, even if women are not exclusively breastfeeding at 1 month postpartum, they may transition to exclusive breastfeeding as observed in the present study. The first 3 months after childbirth remain a critical period for the establishment of exclusive breastfeeding. Stress levels after breastfeeding and breastfeeding self-efficacy are key modifiable predictors. Thus, healthcare providers' advice and intervention for reducing stress responses associated with breastfeeding and improving breastfeeding self-efficacy may be effective to establish and continue exclusive breastfeeding.

The present study had two limitations. First, the dropout rate was higher than expected. This might attenuate its statistical power. Second, we could not follow the participants for a full 6 months postpartum, although exclusive breastfeeding for 6 months is recommended. However, the key strength of this study is that we showed the relationship between stress responses associated with breastfeeding and subsequent exclusive breastfeeding, using objective measures of stress.

## **Conclusions**

Stress levels associated with breastfeeding and breastfeeding self-efficacy at 1 month postpartum were identified as modifiable predictors of exclusive breastfeeding at 3 months postpartum. Multipara status, higher education level, and no plan to return to work by 6 months postpartum were also associated with exclusive breastfeeding practices. Healthcare professionals need to develop effective approaches to reducing breastfeeding-related stress and improving breastfeeding self-efficacy as well as considering the demographic characteristics that influence breastfeeding to help women fulfill their antenatal breastfeeding intentions and increase exclusive breastfeeding practices.

## **Abbreviations**

BSES-SF, Breastfeeding Self-Efficacy Scale Short Form; PSS-10, Perceived Stress Scale-10; EPDS, Edinburgh Postnatal Depression Scale; J-PBQ, the Japanese version of Postpartum Bonding Questionnaire

## **Declarations**

### **Ethics approval and consent to participate**

The ethics committee of the university and a research hospital approved the study procedures and protocol (No. 15539 and No. 2016-15, respectively). All participants provided written informed consent prior to the baseline investigation.

### **Conflicts of interests**

The authors declare that they have no conflicts of interest.

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## Authors' contributions

All authors contributed to the planning of study design. M.S., S.K., and M.I. carried out the data collection. M.S. performed the statistical analysis and wrote the manuscript. M.M. and M.S. supervised the study. All authors reviewed and approved the final manuscript.

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## Tables

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