International Journal of Medical Science and Health Research

Vol.8, No. 06; 2024

ISSN: 2581-3366

Effectiveness of Onigirishibori Asa Self-care Technique for Weaning: A Study Using Intra Breast Ultrasound Imaging

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doi: 10.51505/ijmshr.2024.8604 URL: http://dx.doi.org/10.51505/ijmshr.2024.8604

Received: Oct 19, 2024 Accepted: Oct 29, 2024 Online Published: Nov 17, 2024

Abstract

Objective: To anatomically verify the effectiveness of the "compression (onigirishibori)" methods of the breast for weaning from breastfeeding for mammary gland involution using intramammary ultrasound images.

Results: This observational, prospective, longitudinal study was conducted from June2020to July December 2023 and included 13 mothers who had decided to wean. We assigned them to the onigirishibori (n=9) and manual milking groups (n=4). The thickness of the mammary cavity was longitudinally observed from the day before weaning until 30 days after weaning. Ultrasound images revealed that the thickness of the mammary gland cavity was decreased in all the participants and differed significantly between the onigirishibori and manual milking groups, by 1 point in the right breast (30 days after weaning) and 4 points in the left breast (days 1, 3, 7 and 30 after weaning). The USG images showing the involution of the mammary glands from the beginning of weaning revealed that onigirishibori, without nipple stimulation, was effective in suppressing milk production by inhibiting the secretion of lactogenic hormone and avoiding milk stasis. The onigirishibori technique applies pressure from the breast-shaped body part and has been shown to be effective in preventing milk stasis in the duct of milk.

Keywords: breastfeeding, lactation, nursing, weaning, breast care, ultrasound image, diagnostic imaging, mammary gland, mammary gland involution

1. Introduction

Breastfeeding has many nutritional, immunological, and psychological advantages for infants. Many mothers prefer breastfeeding, and midwives provide active support for establishing breastfeeding, increasing milk production, and avoiding associated problems.

With mothers increasingly choosing to work, many mothers are discontinuing breastfeeding when they return to work. "Weaning" for the mother's own reasons is classified as breastfeeding discontinuation, and currently, many mothers choose "weaning" rather than "breastfeeding

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graduation" [1,2]. The "Support Guide for Breastfeeding and Weaning (Ministry of Health, Labor and Welfare) [3] does not provide clear recommendations on when to end breastfeeding. Currently, breast care at the time of weaning is dependent on the mother's self-care, with midwives rarely involved. Mothers who have had inadequate care are unable to completely drain milk produced in the mammary glands, resulting in breast pain due to the imbalance between milk production and milk supply. Failure to drain milk and milk stasis can increase the calcium concentration in the milk, resulting in increased viscosity and white spot formation [4], increasing the risk of stasis mastitis and infectious mastitis, which may lead to a mammary abscess [4,5] Mothers who have breast problems due to breast abstinence often have psychological aversion to the interruption [6]. More midwifery breast care is needed at the time of weaning than at the time of breastfeeding. For this reason, we focused our study on compression (onigirishibori), which has been passed down as a traditional method of milk removal. Onigirishibori is a home-based milk-expulsion technique used by mothers who are weaning or who have excessive milk production or secretion. This technique does not induce the secretion of lactogenic hormones and uses direct compression of the breast to release pressure in the interstitial area, thus relieving breast pain by allowing milk stored in the acinous cavity to drain through milk ducts. This technique is not physiologically interpreted as manual milking because there is no nipple stimulation; consequently, milk production is rapidly reduced based on hormonal dynamics. No studies to date have verified the effectiveness of compression methods that avoid nipple stimulation.

The objective of this study was to verify the effectiveness of onigirishibori for breast care during weaning using a longitudinal design, based on the findings of mammary gland involution using ultrasound imaging techniques.

2. Method

2.1 Design

This study is an observational study with a longitudinal design.

2.2 Sample

Posters inviting applications for the study were distributed at one obstetrics and gynecology hospital in prefecture A that offers outpatient breast care and pediatric vaccine services. Mothers who were willing to participate in the study were checked for eligibility, and were interviewed before being included in the study. Exclusion criteria were (1) mothers with an underlying mental disorder, (2) mothers with a current or previous history of breast or mammary gland disease, (3) mothers with a history of breast or mammary gland surgery, and (4) mothers with a history of mastitis.

Finally, 13 mothers who decided to stop breastfeeding and were available for home visits were included in this study. After obtaining consent to participate from the mothers, the two self-care methods for discontinuing breastfeeding were explained. The participants were voluntarily divided into two groups: 9 mothers used the onigirishibori (onigirishibori group; Figure 1-1) and 4 used the manual milking methods (manual milking group; Figure 1-2).

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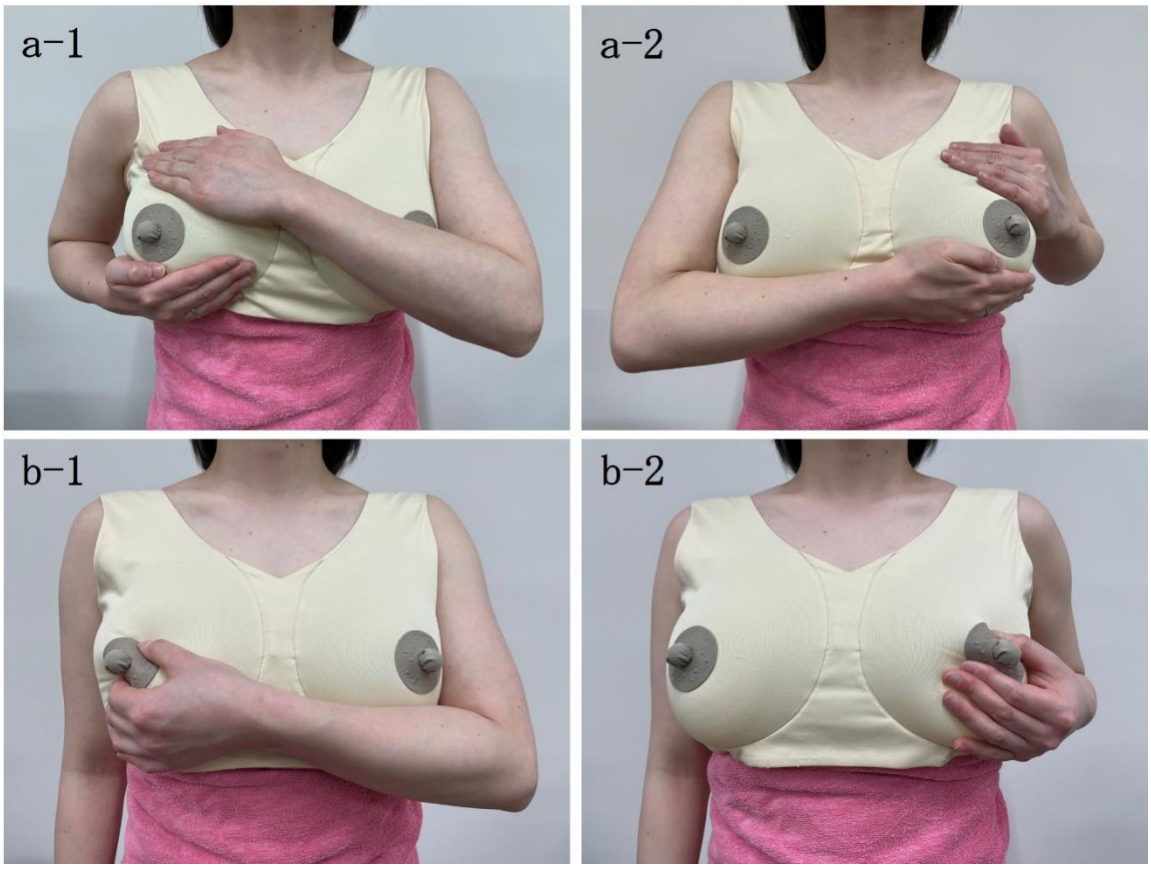

Figure 1. Self-care methods dureing weaning

Figure a . Onigirishibori (1, right breast; 2, left breast). Figure b. the manual milking methods (1, right breast; 2, left breast)

2.3 Measurement

2.3.1Basic attributes

Study participants completed a self-administered questionnaire about their age, child's age, medical history, the mean number of feeding sessions per day, history of nipple and breast problems, birth weight and current weight of the child.

2.3.2Measurement indicators

Mammary gland involution image (thickness of the mammary cavity)

The thickness of the left and right mammary glands were measured on the surface of the left and right nipples using an ultrasound imaging device (portable echo; See More, Medicos Hirata Co., Ltd, Osaka, Japan) the day before the start of breastfeeding discontinuation and days 1, 3, 7, and 30 after starting discontinuation to evaluate the difference over time.

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Ultrasound imaging was conducted with study participants in the supine position, the upper limbs raised, and the fingers folded under the head. Measurements were taken by the same imaging personnel, with three measurements taken on each measurement day. The maximum value of the obtained measurements was designated as the measurement value for that survey day and was used as the representative value because the external pressure on the breast during the measurement was lesser than those of the other two measurements and the mammary gland was not artificially compressed.

2.4 Data collection

The survey was conducted from June 2020 to July December 2023. The researcher (a midwife) conducted home visits for the survey. During the first home visit (the day before breastfeeding abstinence), a written explanation was provided, and a consent form was filled. Because the study included mothers and their children, if the reason for deciding to discontinue breastfeeding was not related to the mother's intention, information on current recommendations for long-term breastfeeding and methods for only night-time breastfeeding was provided, and full consideration was given to the study participant.

The information of the participants and the results of the survey were kept confidential.

2.5Data analysis

Statistical analysis was performed using SPSS Statistics Ver. 25 (IBM Corp, Armonk NY), and the statistical significance level was set at $p < 0.05$. Basic statistics were performed for the target attributes, and the amount of change was calculated for the thickness of the mammary cavity. A comparison test was performed between patients who underwent the onigirishibori versus the manual milking methods.

3. Results

3.1 Characteristics of the sample

The age of all mothers was 30.5 ± 4.1 years (Mean ± SD). None of the participants had a current illness or any breast problems during the current breastfeeding history. The number of breast-feedings before weaning was 2.6±1.7 times/day. The birth weight of all children was 2630.5 ± 570.4 g, the weight at the start of weaning was 7.3 ± 2.7 kg, and the age at the start of weaning was 9.5 ± 5.9 months.

3.2 Involution of the mammary gland

Figure 2 shows an ultrasound image of a representative mammary gland of the left breast of one mother who used compression, observed on the day before the start of breastfeeding discontinuation and on day 30 of breastfeeding discontinuation. This image was obtained in a manner to facilitate the depiction of the area from the basal areola to shallow fascia and the pectoralis major. The thickness of the mammary cavity was measured as the space between the base of the areola and the isthmus, and regression of the mammary gland was evaluated based on changes in the thickness of the mammary cavity. Change in the thickness of the mammary cavity was calculated for each study day after the start of breastfeeding discontinuation by calculating the difference in the thickness of the mammary cavity from the day before abstinence.

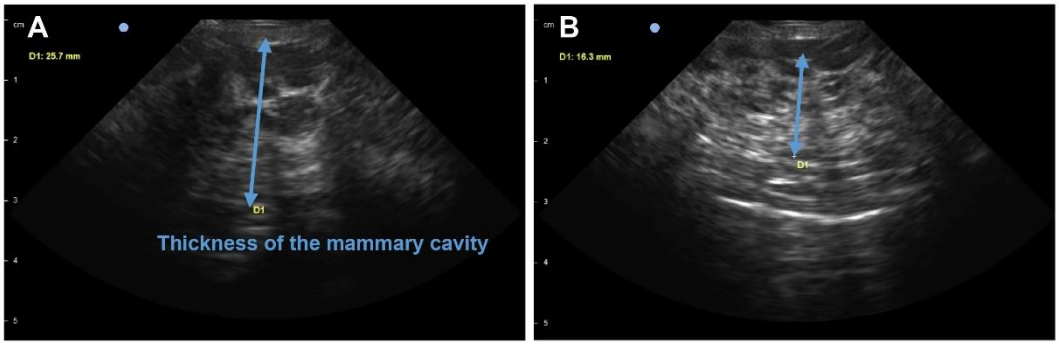

Figure 2. Ultrasound image of the mammary cavity.
a, Left breast, the day before the discontinuation of breastfeeding (onigirishibori); b, Left breast, day 30 (Onigirishibori)

3.3 Thickness of the mammary cavity

The thickness of the left and right mammary cavity is shown in Table 3.

In the right breast, the thickness of the mammary cavity was 25.33 ± 9.69 mm on the day before weaning, 24.81 ± 7.99 mm on day 1, 23.42 ± 8.76 mm on day 3, 20.68 ± 6.17 mm on day 7, and 16.95 ± 4.24 mm on the 30th day of weaning. In the left breast, the values were 28.13± 12.36 mm on the day before weaning, 26.54 ± 7.33 mm on day 1, 25.51 ± 7.73 mm on day 3, 21.92 ± 6.26 mm on day 7, and 17.46 ± 4.39 mm on the 30th day of weaning.

In the onigirishibori group, the right breast thickness was 28.59 ± 9.67 mm on the day before weaning, 27.34 ± 7.99 mm on day 1, 26.06 ± 9.24 mm on day 3, 22.39 ± 6.04 mm on day 7, and 17.47 ± 4.43 mm on day 30In the manual milking group, the values were 18.0±4.78 mm on the day before weaning, 19.75±5.84 mm on t day 1, 17.50±3.46 mm on day 3, 16.83±5.15 mm on day 7, and 15.80±4.13 mm on the 30th day of weaning.

In tyhe onigirishibori group, for the left udder, the values were 32.87 ± 11.69 mm on the day before weaning, 28.99 ± 6.18 mm on day 1, 27.52 ± 7.49 mm on day 3, 23.11 ± 6.37 mm on day 7, and 17.74 ± 5.10 mm on the 30th day of weaning. In the manual milking group, the values were 17.48 ± 5.34 mm on the day before weaning, 21.65 ± 7.74 mm on day 1, 20.98 ± 7.06 mm on day 3, 19.23 ± 5.86 mm on day 7, and 16.83 ± 2.66 mm on the 30th day of weaning. No statistically significant difference was found in the mean thickness of the mammary cavity between the care methods at any of the four time points for either the right or left breast as assessed by an unpaired t-test.

3.4 Change in the thickness of the mammary cavity

The mammary cavity thickness in the right breast was 0.76 ± 3.68 mm on day 1, -1.91 ± 4.69 mm on day 3, -4.65 ± 6.28 mm on day 7, and -8.38 ± 8.19 mm on day 30. For the left breast, the values were 0.53 ± 5.59 mm on day 1, -2.62 ± 7.07 mm on day 3, -6.22 ± 9.45 mm on day 7, and -10.67 ± 11.84 mm on day 30 of weaning.

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In the onigirishibori group, the thickness of the mammary cavity in the right breast was 0.26 ± 4.44 mm on day 1, -2.53 ± 5.55 mm on day 3, -6.20 ± 7.06 mm on day 7, and -11.12 ± 8.44 mm on day 30 of weaning. In the manual milking group, the values were 1.75 ± 1.28 mm on day 1, -0.50 ± 1.36 mm on day 3, -1.18 ± 1.21 mm on day 7, and -2.20 ± 2.28 mm on day 30 (Figure 3). For the left udder, the values were -1.30 ± 5.91 mm on day 1, -5.34 ± 6.82 mm on day 3, -9.76 ± 9.38 mm on day 7, and -15.12 ± 11.55 mm on day 30 in the onigirishibori group. In the manual milking group, the thickness was 4.18 ± 2.50 mm on day 1, 3.50 ± 1.99 mm on day 3, 1.75 ± 0.61 mm on day 7, and -0.65 ± 3.40 mm on day 30 (Figure 3).

Unpaired t-tests were performed at 4 points (days 1, 3, 7, and 30) after the start of weaning. The results showed a statistically significant difference in the change in mammary gland cavity thickness at 30 days after weaning in the right breast and at all 4 points in the left breast (Figure 3). Onigirishibori resulted in more mammary gland retraction than manual milking (Figure 3).

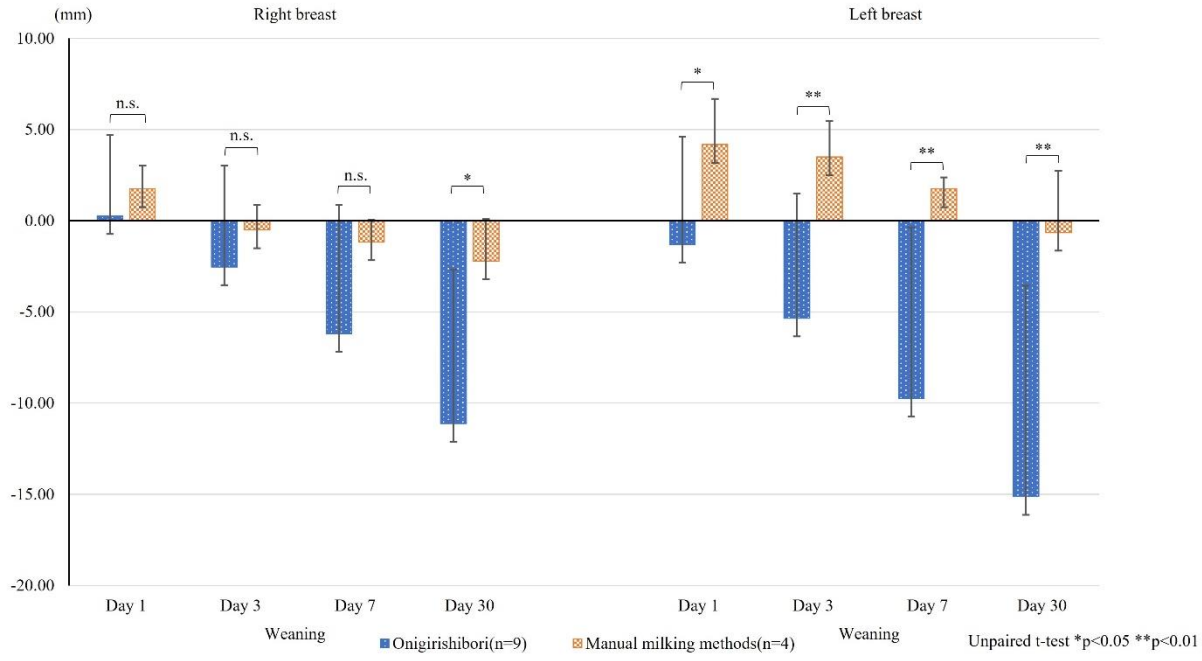

Figure 3. Daily change in breast mammary cavity thickness the day before weaning after breast-care methods

4. Discussion

4.1 Mechanism of mammary gland involution as indicated by changes in mammary lumen thickness

The results showed that in all cases, the thickness of the mammary cavity was smaller at day 30 than on the day before weaning, confirming retraction of the mammary glands. Milk stasis was not observed with the implementation of care, and self-care for weaning effectively improved the

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symptoms of udder turgor and allowed the patients to complete weaning without developing mastitis. Although it has been shown that avoidance of nipple stimulation suppresses prolactin secretion and decreases milk production [7], the mechanism of human mammary gland retraction is not clear. Studies using rat mammary cell tissue have reported two stages of mammary gland involution. In the first stage, milk that is not expelled within 12 hours after the last lactation induces the expression of local factors in the glandular lumen and initiates apoptosis of glandular cells; in the second stage, 72 hours after the last lactation, substrate metalloproteinases are activated and the surrounding tissue in the glandular lumen is shed, leading to remodeling [8]. The adenocytes in the mammary gland undergo apoptosis, adipocyte redifferentiation and remodeling is completed, and the mammary gland returns to its pre-pregnancy state.

In this study, the thickness of the mammary cavity was clearly visible on ultrasound images showed increased thickness of the mammary cavity on the first day of weaning compared with that on the day before weaning. This was associated with the filling and stasis of milk after the initiation of weaning, and was considered to be the first stage of mammary gland involution regulated by milk filling in the glandular cavity. The second stage of mammary gland involution has been reported to be induced between 72 and 144 hours after the last lactation [8], while the redifferentiation and restructuring of adipocytes, the final process of mammary gland involution, was confirmed by ultrasound on the 30th day of weaning. The ultrasound imaging findings on day 30 of breast abstinence of mothers who had undergone onigirishibori confirmed this. Based on the findings of the mammary cavity after the initiation of weaning obtained in this study, it can be inferred that a similar response occurred within the human mammary gland.

4.2 Verification of the effectiveness of weaning care methods based on the findings of mammary gland involution

On the first day of breast abstinence, which is the first stage of mammary gland retraction, the thickness of mammary gland cavities in the right and left udder increased in both the onigirishibori and manual milking groups. This may be due to the fact that milk stasis occurs after the start of weaning, but because the onigirishibori involved squeezing the entire udder to expel milk, the milk filling the gland cavity was expelled more adequately than in the manual milking methods, in which the milk was expelled by squeezing around the nipple. On the third and fifth days of weaning, the second stage of mammary gland involution, there was no difference between the weaning care methods in the right breast, but in the left breast, the thickness of the mammary gland was thinner and the change was greater in the onigirishibori group than with the manual milking group. This difference in thickness in the second stage may be due to the fact that while apoptosis of the glandular cells was induced, the onigirishibori squeezed the entire milk body to drain more milk filling the glandular cavity, thereby promoting redifferentiation and reconstruction of fat cells, the final process of mammary gland involution. The manual milking method drains milk while applying pressure around the nipple; the change in thickness of the mammary gland cavity was small because less pressure was applied to the glandular cavity, so milk remained.

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In mammary gland involution, cell apoptosis must occur along with cessation of milk production due to decreased secretion of lactogenic hormones. Suppression of milk production requires suppression of the binding between prolactin and prolactin receptors. In humans, prolactin production and secretion is controlled by predominantly inhibitory factors mainly dopamine produced within the nerve fibers of the hypothalamus. Dopamine reaches the pituitary gland through the pituitary portal vein, binds to the D2 receptor of prolactin-producing cells, and suppresses prolactin production and secretion [9]. Nipple stimulation and removal of milk from the breast reduce the secretion of dopamine in the hypothalamus and promote the release of prolactin, so reducing nipple stimulation suppresses prolactin secretion [7]. Immediately after the mother stops breastfeeding, nipple stimulation caused by the infant disappears, causing the acinar cavity and milk ducts to become filled and stagnant, causing the acinar cells to become flattened and the acinar cell membrane to deteriorate, inhibiting prolactin production and binding, and suppressing milk production. In this study, no new milk accumulation within the mammary gland was visualized on ultrasound images. This is because both onigirishibori and manual milking methods avoid nipple stimulation, so secretion of lactogenic hormones is not induced, and combined with apoptosis of acinar cells, new milk production does not occur, and weaning is completed. However, differences between the left and right breasts were observed in changes in mammary gland involution, and onigirishibori was effective for the left breast. This may be because all the mothers who performed onigirishibori were right-handed, and it was easier to compress the entire left breast. Therefore, the left breast can easily be drained of milk through the mother's own self-care, but the right cannot, although the mammary glands have eventually receded. In cases where cannot effectively compress the breast on the side opposite to her dominant arm, a midwife should intervene. When it comes to breast care during weaning, this verification proves that compressing the entire breast, rather than just one part of the breast, and draining the milk that has accumulated within the mammary gland will cause the mammary gland to involve more effectively.

5. Limitations

The timing of breastfeeding cessation varies greatly among mothers. As a longitudinal study covering a period of 1 month from the day before the end of breastfeeding to 30 days after breastfeeding, the period of the study was limited. Therefore, it was difficult to recruit many participants at once. Hence, there were nine participants using onigirishibori and four using the manual milking methods. The limited sample size may affect the study results. Moreover, the rationale for why the compression methods were effective in the left breast has not been investigated.

6. Conclusions

This study examined the effectiveness of onigirishibori and presented new findings about breast care during the discontinuation of breastfeeding. We conclude that compression methods are effective in the involution of the mammary gland, but given that the change in involution of the mammary gland varies between the left and right breast, midwives should be involved in the breast care of mothers after the initiation of lactation cessation.

Declarations:

Ethics approval and consent to participate: This study has been approved by the Research Ethics Committee Board of Shiga University of Medical Science (approval no. R2020-005) on June 15, 2020.

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: This work was supported by Grant-in-Aid for Scientific Research by the Ministry of Education, Culture, Sports, Science and Technology [grant number 17K12347].

Authors' contributions: Mami, N.:conceptualization, data curation, formal analysis, investigation, supervision, validation, writing, and visualization; Yumiko, T.: conceptualization, methodology, and validation, formal analysis, writing, visualization, and funding; Fuyuki, I.: investigation.

Acknowledgements: We thank all the mothers who participated in this research. We also wish to acknowledge Edit age for providing editing assistance with the manuscript.

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