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Gestational diabetes and breastfeeding-related pain as major contributors to early breastfeeding cessation

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Purpose: This study aimed to determine the effects of gestational diabetes mellitus, breastfeeding-related pain, and infant growth on the cessation of breastfeeding.

Methods: This is secondary data analysis. This study included 60 pregnant women from 3 prenatal breastfeeding clinics. Pregnant women aged 20–49 years, with or without a diagnosis of gestational diabetes mellitus were enrolled. The participants were administered four self-reported questionnaires, one at 5 days, 14 days, 3 months, and 6 months postpartum. A linear mixed model and Cox regression analysis were used. Data were collected between May 25, 2020 and June 14, 2021.

Results: The rate of breastfeeding cessation was 55.0% (n=33). The average maternal ages were 32.30 (±4.61) and 31.33 (±7.05) years in the cessation and maintenance groups, respectively. The average duration of breastfeeding in the cessation group was 56.27 (±37.48) days. After adjusting for all covariates, the risk of breastfeeding cessation was 2.5 times greater among participants diagnosed with gestational diabetes mellitus (p=.042). Additionally, the risk of breastfeeding cessation was 1.3 times greater among those with severe breastfeeding-related pain (p=.015).

Conclusion: The first two months postpartum is the most essential time for healthcare workers to provide support and address difficulties associated with breastfeeding for mothers with gestational diabetes mellitus.

Keywords: breast feeding; diabetes, gestational; pain; pregnancy

Introduction

Several studies have consistently reported that breastfeeding positively impacts the physical health and neurodevelopment of infants and is associated with improved cognitive development and educational test scores [1-4]. In addition, breastfeeding is reported to benefit maternal health by reducing the risk of obesity and decreasing the incidence of diabetes, high blood pressure, cardiovascular disease, hyperlipidemia, and certain types of cancer [4,5]. Nevertheless, efforts to encourage new mothers to continue breastfeeding have been largely unsuccessful. Since 2001, the World Health Organization has recommended breastfeeding newborns for at least 6 months, but more than 20 years later, some countries in East Asia and the Western Pacific still do not meet this standard [6].

Previous studies have provided various explanations for the early cessation of breastfeeding, including physical and social discomfort experienced by the mother while breastfeeding. According to a systematic literature review of ten studies evaluating the causes of early cessation of breastfeeding in economically developed countries, the two most common causes were insufficient milk supply and pain in the mothers' breasts or nipples [7]. Additionally, in a systematic review of 27 studies examining the sociodemographic, physical, mental, and social factors affecting

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breastfeeding cessation before 6 months postpartum, young maternal age and cesarean section delivery were reported as influencing factors [8]. Furthermore, a questionnaire administered to 500 mothers revealed that the primary reasons for breastfeeding cessation within 6 weeks postpartum included maternal discomfort or fatigue and insufficient milk supply. Moreover, maternal body mass index (BMI) was found to be an important factor affecting postpartum stress [9], and returning to work within 6 weeks of birth affected the duration of breastfeeding [10]. Another study showed that returning to work was the main reason mothers decided to stop breastfeeding in Central Ethiopia [11].

Concerns regarding the health and growth of the newborn also result in the early cessation of breastfeeding. In a previous study, mothers who stopped breastfeeding within the first 2 months postpartum frequently reported concerns regarding adequate nutrition provision for their infants [12]. By examining the experience of breastfeeding mothers with gestational diabetes mellitus (GDM), a previous study showed the baby's birth weight to be a major concern for new mothers [13]. Moreover, interviews with 27 breastfeeding mothers with GDM revealed that they experienced challenges regarding their breastfeeding technique, milk supply, and concerns about their infant's health [14].

According to a recent report, 21.1 million mothers exhibited elevated blood glucose levels during pregnancy in 2021, 80.3% of whom were estimated to have GDM. Although few studies have reported that GDM is a reason that women stop breastfeeding [14,15], current knowledge indicates that breastfeeding has beneficial effects for mothers with GDM [16,17]. To date, few studies have investigated how the factors contributing to breastfeeding cessation evolve over time. Identifying these factors and their relationship with time may provide crucial information for women in the postpartum period.

The Health Plan 2020 of the Ministry of Health and Welfare in South Korea aimed to increase the breastfeeding rate at 6 months after birth from 60.8% in 2010 to 66.8% in 2020 [18]. Therefore, this study aimed to find a way to promote breastfeeding in the community by identifying the factors that affect breastfeeding cessation in mothers with GDM, a population with a lower rate of breastfeeding than those without GDM. We also evaluated the impact of GDM, breastfeeding-related pain, and infant growth on breastfeeding cessation.

Methods

1. Study Design

This is secondary data analysis. The participants were identified from a cohort of women enrolled in a previously published study [19]. The presence of GDM was identified by participants' self-report and confirmation by nurse breastfeeding experts at breastfeeding clinics. The previous study consisted of 30 mothers with GDM and 30 healthy mothers that participated in the study up to 6 months postpartum. Of the 60 mothers in the previous study, 27 continued breastfeeding until the last visit at 6 months postpartum (maintenance group), and 33 stopped breastfeeding before 6 months postpartum (cessation group). This study retrospectively investigated the effects of GDM on breastfeeding cessation, breastfeeding-related pain, and infant growth in the group who had stopped breastfeeding after the end of the study for the past 6 months. To do so, we administered self-report questionnaires at four time points (5 days, 14 days, 3 months, and 6 months postpartum).

2. Setting and Participants

The study participants included pregnant women attending one of two prenatal breastfeeding clinics in South Korea, where internationally certificated breastfeeding nurses provided prenatal and postnatal breastfeeding coaching. The participant selection criteria included women aged 20–49 years, who were pregnant at the time of the initial meeting, with or without a diagnosis of GDM. The participants consented to participate in the study prior to delivery, and they informed the research team of the birth immediately after their delivery.

3. Data Collection

The original data collection for this study was conducted between May 25, 2020, and November 10, 2021. Researchers visited the mothers at 5 days, 14 days, 3 months, and 6 months postpartum and collected the following data: maternal BMI, breastfeeding-related pain, infant height and weight, and breastfeeding status.

4. Variables

4.1. Dependent Variable: Breastfeeding Cessation

The participants' breastfeeding status was determined each time the survey was administered. When breastfeeding cessation was reported, the participants were asked to report how many days after birth they had stopped breastfeeding, as well as the reason for breastfeeding cessation.

4.2. Independent Variables

GDM was diagnosed by a doctor during the prenatal clinic consultation, and GDM status was categorized as 'yes' or 'no,' de-

pending on the presence of the condition. Breastfeeding-related pain was rated on a scale of 0 to 10, with a score of 0 representing no pain, and a score closer to 10 representing extremely severe pain. Infant growth was documented using two measures, height (cm) and weight (kg), according to the information provided by the mother.

4.3. Covariates

Maternal age was self-reported, while BMI (kg/m^2) was calculated using the relevant measures. At each visit, the researcher enquired about the recent weight of the mother, and the BMI recalculations were performed accordingly; these measurements were included in the final analysis. In addition, the current employment status and method of delivery (vaginal delivery vs. cesarean section) were included in the analysis.

5. Data Analysis

The general characteristics and differences between the cessation and maintenance groups were analyzed using descriptive statistics, including percentages and means, independent t-tests, and χ^2 tests. For both groups, a linear mixed model was used to analyze the changes in maternal BMI, breastfeeding-related pain, and growth of the baby over time. The association between the breastfeeding cessation time and nominal variables, such as the diagnosis of GDM (yes or no), employment status (yes or no), delivery method (caesarean section or vaginal delivery), and maternal age ($\geq$35 years and $<$35 years), which were identified as important covariates in previous studies [8,11,13], were analyzed using the Kaplan-Meier (K-M) method. Cox proportional hazard regression analysis was used to analyze the effects of maternal BMI, breastfeeding-related pain, and infant growth on breastfeeding cessation. A p-value $<.05$ indicated statistical significance. Finally, the data were analyzed using the PASW SPSS 26.0 program.

6. Ethical Considerations

This study was approved by the Institutional Review Board of Hoseo University (approval number 1041231-200429-HR-110) and conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent.

Results

1. Characteristics of the Participants

The average duration of breastfeeding in the cessation group was 56.27 (±37.48) days or approximately two months. The average age of mothers in the cessation and maintenance groups was 32.30 (±4.61) and 31.33 (±7.05) years, respectively. The percentage of mothers diagnosed with GDM was 60.6% and 37.0%, and the percentage of mothers who were employed was 27.3% and 37.0% in the cessation and maintenance groups, respectively. Moreover, 45.5% and 51.9% of participants in the cessation and maintenance groups, respectively, delivered via cesarean section. In both groups, the maternal BMI was approximately 25 kg/m^2. Breastfeeding-related pain was recorded on a scale as 6.58 and 5.92 points in the cessation and maintenance groups, respectively. In both groups, the height and weight of the infants were reported to be approximately 51 cm and 3.2 kg, respectively. No significant difference was observed between the two groups (Table 1).

2. Changes in Maternal BMI, Breastfeeding-related Pain, and Infant Growth Profile Over Time

Table 2 shows the maternal BMI, breastfeeding-related pain, and infant growth profiles in each group at 5 days, 14 days, 3 months, and 6 months postpartum. In both groups, the maternal BMI decreased by approximately 2 kg/m^2 at 6 months postpartum ($p<.001$). No significant difference was observed between the groups, nor was a significant interaction between the groups and time of breastfeeding cessation. Breastfeeding-related pain decreased to 1 point at 6 months postpartum, indicating a significant difference ($p<.001$). However, no significant difference was observed in this parameter between the groups, nor was a significant interaction between the groups and the time of breastfeeding cessation. The height and weight of the infants increased with time ($p<.001$), and no significant difference was observed between the groups. Additionally, no interaction was observed between the groups and timing of breastfeeding cessation (Table 2).

3. Factors Affecting Breastfeeding Cessation

Based on our K-M analysis, none of the factors had a significant effect on breastfeeding cessation (Figure 1). Covariates were adjusted to evaluate the effect of maternal BMI, breastfeeding-related pain, and infant growth on breastfeeding cessation. After adjusting for all covariates, the risk of breastfeeding cessation was 2.5 times greater among participants diagnosed with GDM ($p=.042$). Additionally, the risk of breastfeeding cessation was 1.3 times greater among those with severe breastfeeding-related pain ($p=.015$) (Table 3).

Table 1. Characteristics of the Breastfeeding Cessation and Maintenance Groups (N=60)

Characteristics		Cessation group (n = 33)	Maintenance group (n = 27)	t or χ^2	p
		M ± SD or n (%)	M ± SD or n (%)		
Average duration of breastfeeding (days)		56.27 ± 37.48	181.15 ± 2.84		
Age (years)		32.30 ± 4.61	31.33 ± 7.05	–0.64	.524
BMI (kg/m^2)		25.65 ± 2.91	25.41 ± 2.84	–0.32	.751
Employment status	Yes	9 (27.3)	10 (37.0)	0.28	.596
	No	24 (72.7)	17 (63.0)		
Delivery method	Vaginal delivery	18 (54.5)	13 (48.1)	0.06	.815
	Cesarean section	15 (45.5)	14 (51.9)		
GDM	Yes	20 (60.6)	10 (37.0)	2.42	.119
	No	13 (39.4)	17 (63.0)		
Breastfeeding-related pain		6.58 ± 2.12	5.92 ± 2.13	–1.17	.247
Infant height (cm)		51.31 ± 2.12	50.74 ± 2.20	–0.92	.362
Infant weight (kg)		3.23 ± 0.38	3.22 ± 0.41	–0.11	.911

BMI=body mass index; GDM=gestational diabetes mellitus; M=mean; SD=standard deviation.

Table 2. Changes in Important Variables Over Time (N=60)

Variables	Cessation group (n = 33)	Maintenance group (n = 27)	p
Maternal BMI (kg/m^2)			
Time 1	25.65 ± 2.91	25.41 ± 2.84	Group: .418
Time 2	24.48 ± 3.81	24.34 ± 2.92	Time: < .001
Time 3	23.77 ± 2.94	22.94 ± 2.65	Group × time: .943
Time 4	23.75 ± 3.00	23.02 ± 2.61	
Breastfeeding-related pain			
Time 1	6.58 ± 2.12	5.92 ± 2.13	Group: .385
Time 2	4.67 ± 2.15	4.63 ± 2.24	Time: < .001
Time 3	1.64 ± 2.30	2.63 ± 2.62	Group × time: .190
Time 4	1.16 ± 2.29	1.89 ± 2.33	
Infant height (cm)			
Time 1	51.31 ± 2.12	50.74 ± 2.20	Group: .058
Time 2	52.24 ± 3.19	51.50 ± 3.15	Time: < .001
Time 3	61.12 ± 5.24	66.71 ± 15.02	Group × time: .115
Time 4	65.12 ± 11.73	70.63 ± 8.35	
Infant weight (kg)			
Time 1	3.23 ± 0.38	3.22 ± 0.41	Group: .788
Time 2	3.55 ± 0.33	3.45 ± 0.43	Time: < .001
Time 3	6.42 ± 0.69	6.50 ± 0.72	Group × time: .796
Time 4	7.94 ± 1.70	8.08 ± 0.83	

BMI=body mass index; Time 1=5 days postpartum; Time 2=14 days postpartum; Time 3=3 months postpartum; Time 4=6 months postpartum.

Dicussion

This study aimed to determine the factors that affect breastfeeding cessation, specifically focusing on GDM, breastfeeding-related pain, and infant growth. The rate of breastfeeding cessation was 55.0% (33/60). Moreover, the average duration of breastfeeding in the cessation group was 56 days, which is shorter than the 180 days recommended by the WHO.

Moreover, considering national and racial differences, the breastfeeding cessation rate in this study was higher than that in a previous cohort study conducted in the United States, comprising 78 participants, among whom 24.0% discontinued breast-

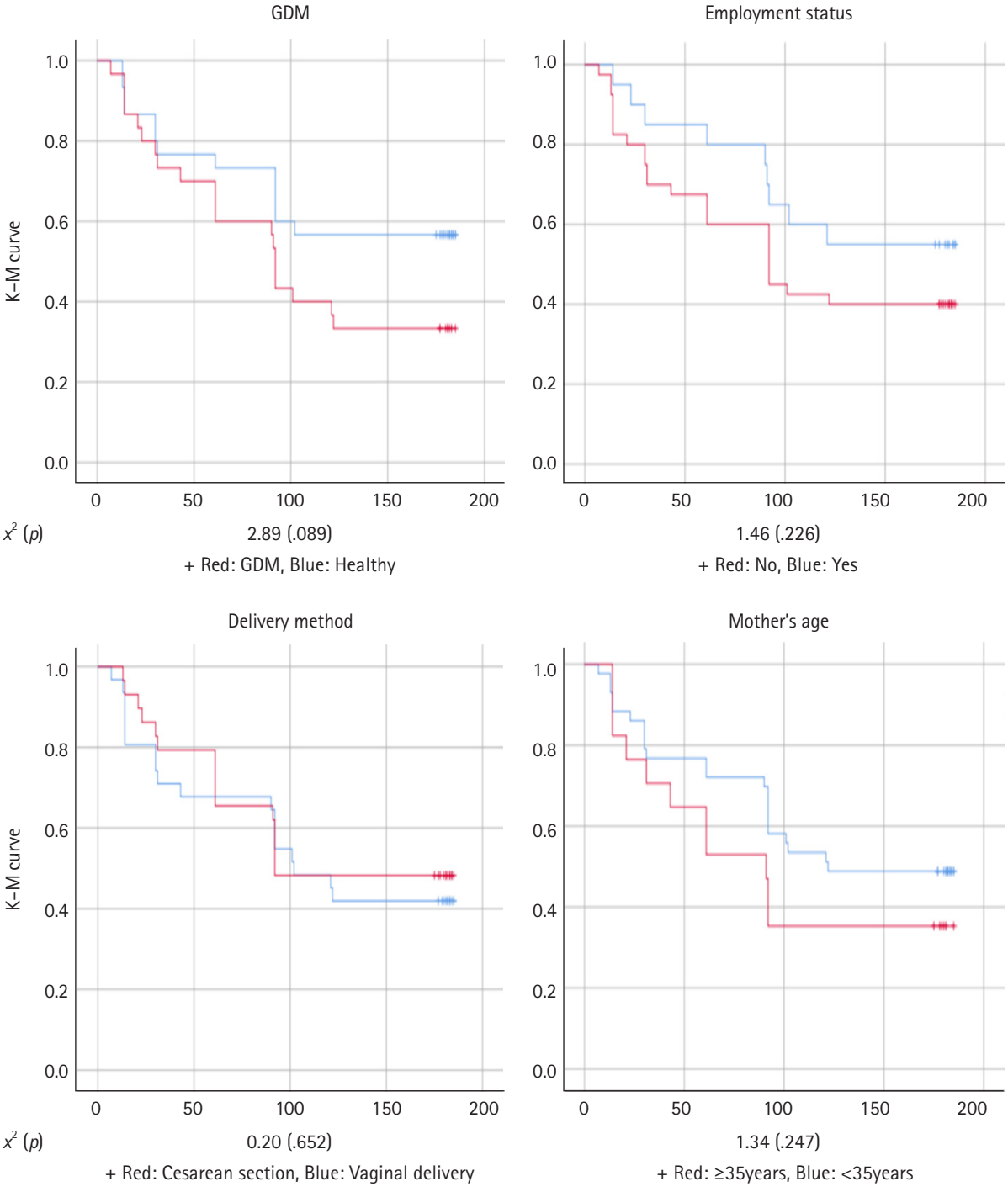

Figure 1. Changes over time in the effects of GDM diagnosis, employment status, delivery method, and maternal age on breastfeeding cessation.

feeding within 6 months [20]. The discrepancy in these results may be explained by the inclusion of mothers at risk of labor, such as those diagnosed with GDM, in the present study.

Our findings suggest that the most influential factor affecting breastfeeding cessation was the diagnosis of GDM. Specifically, mothers with GDM were at a higher risk of discontinuing breastfeeding, which is consistent with the findings of previous studies [14,15]. A Vietnamese study conducted over 12 months com-

Table 3. Cox Proportional Hazards Regression Analysis for Factors Affecting Breastfeeding Cessation (*N*=60)

Variables	HR	SE	*p*	95% CI	
				Lower	Upper
Age	1.04	0.03	.209	0.98	1.12
Maternal BMI (kg/m^2)	1.03	0.09	.751	0.86	1.23
Employment status (yes) (ref: no)	1.52	0.46	.364	0.62	3.72
Delivery method, cesarean section (ref: normal delivery)	0.65	0.46	.348	0.27	1.59
GDM	2.50	0.45	.042	1.03	6.06
Breastfeeding related pain	1.33	0.12	.015	1.06	1.67
Infant height	1.18	0.13	.201	0.91	1.53
Infant weight	0.64	0.69	.517	0.17	2.47

BMI=body mass index; CI=confidence interval; GDM=gestational diabetes mellitus; HR=hazard ratio; SE=standard error.

pared 1,709 healthy mothers with 373 mothers with GDM and reported that women with GDM were 1.39 times more likely to discontinue breastfeeding early [15]. The relationship between breastfeeding and GDM needs to be further elucidated; however, the existing literature shows that mothers with GDM exhibit different levels of sodium in the breastmilk than healthy mothers [19,21]. One study theorized that the accumulation of milk in the mammary glands may increase sodium levels in the breastmilk and cause breast congestion, subsequently affecting the amount of milk produced [21].

Furthermore, our findings revealed that breastfeeding-related pain was associated with breastfeeding cessation. Previous studies have shown that mothers with GDM are at a higher risk of experiencing lactation difficulties due to post-cesarean pain, obstetric complications, and delayed lactogenesis [22,23]. Another study evaluating 219 Brazilian mothers reported that the risk of delayed initiation of breastfeeding was 1.07 times more likely in those diagnosed with both obesity and GDM [24]. Delayed initiation of breastfeeding, or not starting breastfeeding within two days postpartum, significantly reduces prolactin secretion, thus contributing to lactation failure [25]. Additionally, breast milk insufficiency due to decreased prolactin secretion is associated with higher stress levels in infants and may lead to biting behavior, ultimately increasing breastfeeding-related pain for mothers [5,26]. Therefore, ensuring that mothers with GDM begin breastfeeding as soon as possible, raising awareness regarding the pain and discomfort associated with breastfeeding, and providing prenatal and postpartum support for new mothers are crucial.

Nursing interventions to promote mammary gland development and reduce breast pain are needed for women with GDM [9,13]. For these interventions, direct nursing practice by breastfeeding experts is better than breastfeeding education. However, professional breast care programs create an economic burden for women in the community, as the costs of such programs are charged entirely to the patient. A national survey in South Korea reported that 56.9% of mothers answered 'financial support for breast massage' as the most necessary government policy to promote breastfeeding [27]. According to a previous report in the United States, the rate of initiation of breastfeeding at birth increased from 62.0% in 2002 to 83.4% in 2015, exceeding the target rate of 81.9% in 2020 [28]. This value is used to evaluate the achievement of the public sector's effort to promote breastfeeding. The community and governmental policy should also encourage breastfeeding among pregnant women with GDM.

The present study demonstrated that infant growth parameters, such as weight and height did not influence breastfeeding cessation, which is consistent with the results of a previous Chinese study [29]. These results are likely explained by the fact that in making the decision to breastfeed, factors that directly impact maternal health, such as GDM and breastfeeding-related pain, are often more influential. In particular, mothers with GDM experience different psychological stress than healthy mothers due to their babies' BMI [9]. Furthermore, according to a Chinese study examining the factors contributing to breastfeeding cessation before 6 months postpartum, both maternal and newborn medical conditions significantly impacted breastfeeding within 1 month postpartum [29].

The results of this study showed that the passage of time affected the maternal BMI, breastfeeding-related pain, and infant growth profile. Therefore, mothers who start breastfeeding immediately after childbirth must be informed that physical discomfort within 6 months improves over time. In addition, a literature review on breastfeeding among women with GDM suggested that after meeting their physiological needs, multidisciplinary support is needed to improve the sense of love, belonging, and self-esteem of the mother [30]. Thus, further research is

necessary to provide better support for breastfeeding mothers.

This study had several limitations. First, the time of breastfeeding cessation was reported directly by the participants and may have been inaccurate. Second, the height and weight of the mother and baby were not measured by the researcher, but instead, self-reported by the mother through questionnaires, and therefore, may differ from the actual measurements. Thus, future studies with variables measured in a controlled manner by researchers are warranted. Finally, this study did not account for psychological factors that influence the postpartum period, such as postpartum depression. Further research that takes into consideration physical, social, and mental factors affecting the postpartum period would enrich our understanding of the reasons for breastfeeding cessation.

Conclusions

The present study demonstrates that the average duration of breastfeeding for mothers who discontinued breastfeeding within the postpartum study period was approximately two months. Furthermore, our results suggest that GDM and breastfeeding-related pain are significant factors contributing to breastfeeding cessation. New mothers should be provided with greater support to overcome these conditions, both before and after childbirth. Moreover, mothers with risk factors, such as GDM, may benefit from programs in which healthcare workers provide consistent support to address the difficulties of breastfeeding during the first two months of the postpartum period.

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Conflict of interest

The authors declared no conflict of interest.

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Authors' contributions

Min, Deulle contributed to the conceptualization, data curation, formal analysis, methodology, visualization, writing - original draft, investigation, and validation. Kwak, Eunju contributed to the conceptualization, data curation, methodology, visualization, and writing - review & editing. Park, Seungmi contributed to the conceptualization, data curation, funding acquisition, methodology, project administration, writing – review & editing, investigation, supervision, and validation.

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Data availability

Please contact the corresponding author for data availability.

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