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Prepregnancy obesity as a risk factor for exclusive breastfeeding initiation in Japanese women

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ABSTRACT

Objectives: Breastfeeding rates in many countries fall short of the World Health Organization's recommendations. It has been reported that exclusive breastfeeding (EBF) is negatively associated with obesity; however, the association varies with ethnicity, and little information is available from Asia. We explored whether prepregnancy body mass index (BMI) and gestational weight gain (GWG) were associated with initiation of EBF.

Methods: We investigated 6125 Japanese women with full-term (37–42 wk of gestation) singleton babies between January 2010 and June 2013, in a hospital with the largest annual number of deliveries in Tokyo, Japan.

Results: Successful EBF initiation was observed in 72% of women 1 mo after delivery. The average GWG was 10 kg in underweight (BMI < 18.5 kg/m^2) and normal weight (BMI 18.5–24.9 kg/m^2) women; 7 kg in overweight (BMI 25–29.9 kg/m^2) women, and 4 kg in obese (BMI ≥ 30 kg/m^2) women. After adjusting for covariates, stepwise modeling revealed that compared with women of normal weight, obesity (odds ratio [OR], 0.29; 95% confidence interval [CI], 0.16–0.53), and a single-unit increase in the GWG (OR, 0.98; 95% CI, 0.96–1.00) were significantly associated with unsuccessful EBF initiation. No statistical interaction was evident between prepregnancy BMI and GWG. Other significant risk factors for unsuccessful EBF initiation included older maternal age ($P < 0.001$), nulliparity ($P < 0.001$), cesarean delivery ($P < 0.001$), an earlier gestational week ($P < 0.001$), a light-for-date infant ($P < 0.05$), and mother–child separation for clinical reasons ($P < 0.001$).

Conclusions: This study suggested that prepregnancy obesity is a risk factor for EBF initiation among Japanese women.

Introduction

It is well known that breastfeeding affords significant nutritional and immunologic benefits to infants, who are less likely to develop illnesses or infections than are infants who are not breastfed and who are at reduced risk for diabetes and overweight in adulthood [1]. Furthermore, breastfeeding strengthens the infant–mother bond and may prevent later maternal breast or ovarian cancer [1]. The World Health Organization (WHO) recommends exclusive breastfeeding for 6 mo followed by continued breastfeeding for up to 2 y [2], and even beyond. However, the breastfeeding rates in many countries fall short of these recommendations. In Japan, the 2017 National Infants Nutrition Survey (a nationwide survey performed every 10 y) found that the rate of EBF 1 mo after delivery remained low (51%), although >93% of expectant mothers reported that, before delivery, they intended to initiate EBF.

Previous studies in Western countries found that risk factors for unsuccessful EBF initiation included younger maternal age, low income, parity, cesarean delivery, low educational attainment, and smoking [3,4]. Special attention has been paid to prepregnancy body mass index because this is one of the most modifiable factors affecting breastfeeding initiation [5,6]. A recent systematic review suggested that obese women are more likely to unsuccessfully

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initiate or to terminate breastfeeding for various reasons, including perceived low maternal self-efficacy, poor social support, and poor body image or body comfort issues [7]. Some studies reported that the prolactin response to suckling may be reduced [8,9] or milk production may be delayed in obese women [10,11]. In addition, previous literature investigates the influence of ethnicity. Compared with other racial or ethnic groups, non-Hispanic black women were least likely to initiate breastfeeding [12]. In Asia, where the prevalence of obesity is very low compared with Western countries (e.g., 20.6% in women according to Japanese Nutrition Survey in 2016), very few studies have explored factors associated with breastfeeding initiation. Here, we explored the association between prepregnancy BMI or weight gain during pregnancy with EBF initiation in Japanese mothers.

Methods

Participants

Our data set comprised all consecutive deliveries between January 2010 and June 2013 extracted from the electronic medical records of the Japanese Red Cross Medical Center located in the Tokyo metropolitan area. The annual number of deliveries in this hospital exceeds 3000, which is the largest number of deliveries in Tokyo at the time of investigation. The hospital has a Maternal-Fetal Intensive Care Unit, a Neonatal Intensive Care Unit, a Growing Care Unit, and is also a "baby-friendly hospital" promoting the "Ten Steps to Successful Breastfeeding" (a 10-step guideline program) strongly recommended by the WHO and UNICEF.

We previously reported one paper by using the 2010 data of our dataset [13]. The present study was approved by the ethics committee of Teikyo University School of Medicine, Tokyo, Japan.

Study enrollment

The study enrollment is shown in Figure 1. Inclusion and exclusion criteria were defined regarding the relevance of mothers with full-term, single, live-born infants. The exclusion criteria included the following:

- women who had multiple pregnancies (n = 568), early miscarriage (n = 144), or stillbirths (n = 55)
- women who had missing data on gestational week (n = 430)
- women who had preterm (at a gestational week <37; n = 743) or post-term births (at a gestational week ≥42; n = 24)
- women whose data were missing on maternal body weight at delivery (n = 473), prepregnancy body weight (n = 121), and height (n = 113)
- women with weight gain during pregnancy ≤-8 kg which was an unrealistic value (n = 5)
- women with missing data on breastfeeding status at discharge (n = 763) and 1 mo later (n = 1540).

Finally, the analysis included 6125 women at discharge and 5348 women 1 mo after delivery.

Data collection

The items retrieved from medical records were maternal age and height, prepregnancy weight reported at the first medical checkup (first trimester), body weight measured at the time of admission for delivery, gestational week of delivery, parity (nulliparity or multiparity), delivery method (cesarean or vaginal delivery), maternal lifestyle habits including smoking (current, past, or never) and alcohol consumption (current, past, or never), infant birthweight (g), and any maternal–child separation for clinical reasons.

The outcome of interest was EBF based on the WHO/UNICEF definition (http://www.who.int/nutrition/topics/exclusive_breastfeeding/en/): infant nutrition via breast milk from the mother or wet nurse (delivered directly from the breast or expressed) with no other liquid or solid (except for drops or syrups [nutritional supplements or medicines]). We asked EBF status within 24 h of hospital discharge and at 1 mo after delivery because this period of time is the only chance when we were able to contact the study participants. In Japan, mothers come back to medical institutions where they delivered their child for postnatal health checkup at the time of 1 mo after delivery. After this time period, they visit a public health center for subsequent baby checkups. Of these measures at two different points in time, we consider that EBF status at 1 mo after delivery a more reliable measure for EBF initiation than EBF at discharge because it is known that initiation of breastfeeding is sometimes delayed owing to a number of factors [14].

Study design

Because we retrospectively collected prepregnancy BMI and gestational weight gain (GWG) information from medical records and investigated whether these two were associated with EBF initiation, this study was a retrospective cohort study.

Statistical analyses

The prepregnancy BMI was the weight in kilograms divided by the height in meters squared (kg/m^2) and was graded using the WHO criteria: underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2). GWG (kg) was the difference between prepregnancy body weight and body weight at the time of admission for delivery and was treated as a continuous variable. A light-for-date infant refers to an infant born with a birthweight <10th percentile for the estimated gestational age; we used the latest version of the Japanese birthweight centile charts issued by the Japan Pediatric Society [15]. These charts distinguish between the sexes. As we lacked data on infant sex, we averaged the male and female chart data for each gestational week and used those averages in calculations.

Bivariable associations were compared using the t test for continuous variables and the χ^2 or Fisher's exact test for categorical variables. To explore whether prepregnancy BMI and GWG were associated with successful EBF initiation, we performed logistic regression modeling (i.e., successful EBF initiation = 1 versus partial breastfeeding or formula only = 0) computing odds ratios (ORs) with 95% confidence intervals (CIs). The covariates were maternal age, parity, delivery method, smoking and drinking habits, gestational week at delivery, a light-for-date infant, and maternal-child separation for clinical reasons. Logistic modeling was performed at two points in time (i.e., at time of hospital discharge and 1 mo after delivery).

To explore interactions between prepregnancy BMI and GWG, we included a statistical interaction term in multivariable logistic regression models in which GWG was treated as a continuous variable. In addition, we included the GWG categories (by prepregnancy BMI) of the US Institute of Medicine (IOM) guidelines [16] in other logistic models. These guidelines recommend a 12.5- to 18-kg weight gain for underweight, 11.5 to 16 kg for normal weight, 7 to 11.5 kg for overweight, and 5 to 9 kg for obese women.

Model selection for multivariable analyses was performed using the stepwise method (SLENTRY = 0.20, SLSTAY = 0.20). To afford a power of 0.90 and an α value of 0.05, calculations showed that 1842 participants were required in each group to detect a 5% difference in terms of successful EBF initiation between normal weight women, on the one hand, and overweight and obese women on the other.

All data were analyzed using SAS version 9.4 (SAS, Cary, NC, USA). A two-tailed $P < 0.05$ was considered statistically significant.

Results

Table 1 lists the prepregnancy BMIs at discharge and 1 mo after delivery. Approximately 25% of women were underweight, 3% overweight, and <1% obese. Mean maternal age was youngest in the underweight group and highest in the overweight group ($P < 0.001$). The average weight gain was 7 kg in overweight and 4 kg in obese women compared with 10 kg in underweight women. Nulliparous women were most common in the underweight group, followed by the normal and obese groups ($P < 0.001$). Smoking was most frequently observed in the obese followed by the underweight group ($P = 0.005$ at discharge and $P = 0.08$ 1 mo later). Overweight mothers most frequently required cesarean delivery ($P < 0.001$). Underweight mothers were more likely to have a light-for-date infant, followed by normal weight and overweight mothers ($P < 0.001$). Maternal–child separation was most frequently observed in normal weight mothers at discharge ($P < 0.001$) but not 1 mo later (P not significant).

Table 2 shows the numbers and percentages associated with successful and unsuccessful EBF initiation at discharge and 1 mo after delivery. EBF initiation was successful in 83% of women at discharge and in 72% 1 mo later. Mothers who successfully initiated EBF (the P-values at discharge and at 1 mo after delivery) were more likely to be younger ($P < 0.001$), to weigh less before pregnancy ($P < 0.001$), to have a lower prepregnancy BMI ($P < 0.001$) and BMI at delivery ($P < 0.001$), to be of a later gestational week at birth ($P < 0.001$), to be multiparous ($P < 0.001$), to

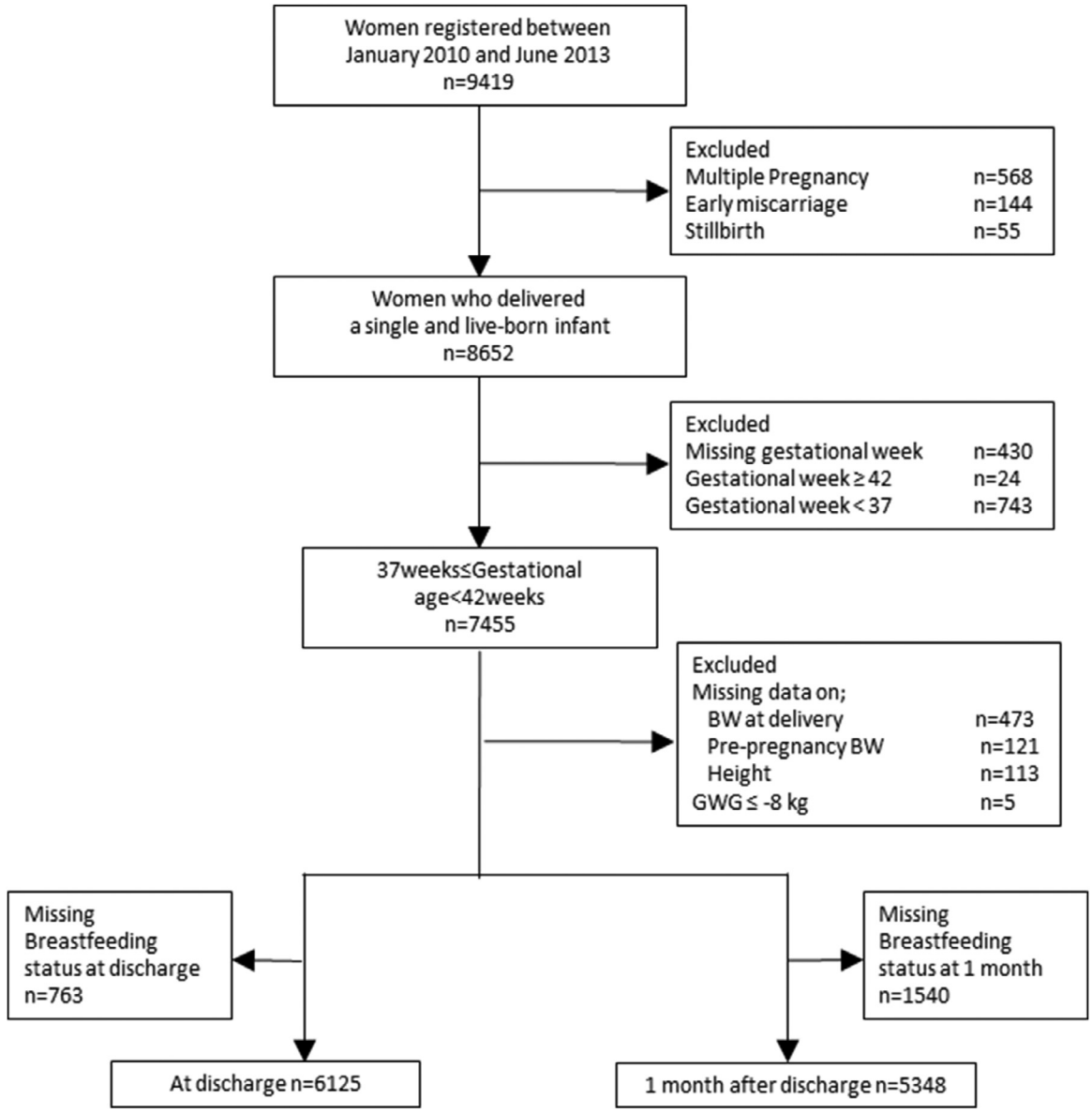

Fig. 1. Study enrollment. From 9419 women registered between 2010 and 2013, we excluded women who had multiple pregnancies, early miscarriage, stillbirths, missing data on gestational week, those who had preterm births and post-term, if data were missing on maternal body weight at delivery, prepregnancy body weight and height, women with weight gains during pregnancy ≤-8 kg (which was an unrealistic value), and those who had missing data on breastfeeding status at discharge and 1 mo later. Finally, participants for analyses included 6125 women at discharge and 5348 women at 1 mo after delivery. BW, birthweight; GWG, gestational weight gain.

experience vaginal delivery ($P < 0.001$), and not to have been separated from the baby after delivery ($P < 0.001$).

Tables 3 and 4 show the results of logistic regression seeking factors associated with successful EBF initiation at discharge and 1 mo after delivery, respectively. Significant risk factors for unsuccessful EBF initiation evident on univariable logistic regression modeling included prepregnancy overweight and obesity (EBF at discharge: $P < 0.001$), obesity (EBF 1 mo after delivery: $P < 0.001$), older maternal age (EBF both at discharge and 1 month later: both $P < 0.001$), nulliparity (both $P < 0.001$), cesarean delivery (both $P < 0.001$), an earlier gestational week (both $P < 0.001$), a light-for-date infant ($P < 0.001$ at discharge and $P = 0.36$ at 1 mo), and maternal–child separation for clinical reasons (both $P < 0.001$). Stepwise multivariable modeling showed that, compared with normal weight status, both overweight (OR, 0.27; 95% CI, 0.15–0.51) and obesity negatively affected EBF at discharge (OR, 0.70; 95% CI, 0.50–0.99), as did obesity EBF 1 mo later (OR, 0.29; 95% CI, 0.16–0.53). Although GWG was not significant in univariable models, after adjusting for covariates, a single-unit increase in GWG was negatively associated with successful EBF initiation both at discharge (OR, 0.98; 95% CI, 0.96–1.00; $P = 0.026$) and 1 mo after delivery (OR, 0.98; 95% CI, 0.96–1.00; $P = 0.024$). The other risk factors identified by stepwise regression were similar to those identified in the univariable models (and exhibited the same associations), except for the effects of alcohol consumption status and a light-for-date infant on EBF 1 mo after delivery. These two factors were not selected on univariable modeling but were selected during stepwise regression after adjusting for covariates. However, we could not explore a possible dose–response relationship between alcohol consumption status (the only available data were current drinker [OR, 0.97; 95% CI, 0.65–1.45] and past drinker [OR, 1.34; 95% CI, 1.15–1.56] compared with never-drinker [$P < 0.001$]), and the association with a light-for-date infant was weak (OR, 0.77; 95% CI,

Table 1
Participants' characteristics according to prepregnancy BMI at discharge and at 1 mo after delivery

	BMI (kg/m^2) at discharge (N = 6125)					BMI (kg/m^2) at 1 mo after delivery (N = 5348)				
	<18.5 (n = 404)	≤18.5 to <25 (n = 4443)	≤25 to <30 (n = 224)	≤30 (n = 54)		<18.5 (n = 1236)	≤18.5 to <25 (n = 3900)	≤25 to <30 (n = 164)	≤30 (n = 48)	
Variables	N (%) or Mean ± SD	N (%) or Mean ± SD	N (%) or Mean ± SD	N (%) or Mean ± SD	*P*-value*	N (%) or Mean ± SD	N (%) or Mean ± SD	N (%) or Mean ± SD	N (%) or Mean ± SD	*P*-Value*
Maternal age, y	33.1 ± 4.8	34.3 ± 4.8	35.5 ± 4.8	34.4 ± 5	<0.001	33 ± 4.9	34.3 ± 4.8	35.5 ± 4.8	34.5 ± 4.7	<0.001
Maternal height, cm	160.2 ± 5.4	159.3 ± 5.4	158.9 ± 5.6	157.7 ± 9.1	<0.001	160.2 ± 5.5	159.4 ± 5.4	158.6 ± 5	157.5 ± 8.1	<0.001
Prepregnancy weight, kg	45.3 ± 3.5	52.2 ± 5.0	67.8 ± 5.6	80.8 ± 8.2	<0.001	45.3 ± 3.6	52.3 ± 5	67.4 ± 5.5	80.4 ± 8.5	<0.001
Prepregnancy BMI, kg/m^2	17.6 ± 0.8	20.6 ± 1.5	26.8 ± 1.3	32.7 ± 4.6	<0.001	17.6 ± 0.7	20.6 ± 1.5	26.8 ± 1.3	32.5 ± 3.3	<0.001
Nulliparity	944 (69.3)	2764 (63.9)	132 (60.6)	33 (62.3)	0.0015	827 (69.7)	2370 (63.2)	95 (59.8)	29 (61.7)	0.0004
Smoking*					0.005					0.08
During pregnancy	33 (2.4)	57 (1.3)	3 (1.3)	2 (3.7)		26 (2.1)	44 (1.1)	3 (1.8)	2 (4.2)	
Past	187 (13.3)	563 (12.7)	39 (17.4)	12 (22.2)		162 (13.1)	493 (12.7)	26 (15.9)	7 (14.6)	
Never	1184 (84.3)	3820 (86.0)	182 (81.3)	40 (74.1)		1048 (84.8)	3360 (86.2)	135 (82.3)	39 (81.3)	
Drinking†					0.045					0.028
During pregnancy	39 (2.8)	96 (2.2)	8 (3.6)	0 (0)		39 (3.2)	88 (2.3)	7 (4.3)	0 (0)	
Past	330 (23.6)	1098 (24.8)	50 (22.3)	5 (9.3)		290 (23.5)	967 (24.9)	34 (20.7)	4 (8.3)	
Never	1031 (73.6)	3236 (73.1)	166 (74.1)	49 (90.7)		903 (73.3)	2833 (72.9)	123 (75)	44 (91.7)	
Cesarean delivery	145 (10.3)	805 (18.1)	66 (29.5)	14 (25.9)	<0.001	120 (9.7)	694 (17.8)	48 (29.3)	13 (27.1)	<0.001
GWG, kg	10.5 ± 3.2	10.2 ± 3.3	7.3 ± 4.6	4.4 ± 4.5	<0.001	10.5 ± 3.2	10.2 ± 3.3	7.1 ± 4.8	4.4 ± 4.5	<0.001
BMI at delivery, kg/m^2	21.7 ± 1.4	24.6 ± 1.9	29.7 ± 2.1	34.4 ± 4.4	<0.001	21.7 ± 1.4	24.6 ± 1.9	29.6 ± 2.1	34.3 ± 3.4	<0.001
Gestational week	39.2 ± 1.1	39.3 ± 1.1	39.3 ± 1.1	39.4 ± 1	0.09	39.2 ± 1.1	39.3 ± 1.1	39.3 ± 1.1	39.4 ± 1	0.06
Status of a light-for-date infant	141 (10)	299 (6.7)	14 (6.3)	2 (3.7)	<0.001	122 (9.9)	239 (6.1)	9 (5.5)	1 (2.1)	<0.001
Maternal–child separation owing to clinical reasons	81 (5.8)	317 (7.1)	34 (15.2)	4 (7.4)	<0.001	24 (1.9)	90 (2.3)	5 (3.1)	1 (2.1)	0.67

BMI, body mass index; GWG, gestational weight gain.
*Based on a χ^2 test or a Fisher exact test for categorical variables and a *t* test for continuous variables.
†Summation does not reach total number due to missing values.

Table 2
Variables in relation to successful and unsuccessful initiation of EBF at discharge and at 1 mo after delivery

	Discharge (N = 6125)			1 mo after delivery (N = 5348)		
	Successful EBF initiation n = 5092 (83.1%)	Unsuccessful EBF initiation n = 1033 (16.9%)		Successful EBF initiation n = 3872 (72.3%)	Unsuccessful EBF initiation n = 1476 (27.6%)	
Variables	N (%) or Mean ± SD	N (%) or Mean ± SD	*P*-value*	N (%) or Mean ± SD	N (%) or Mean ± SD	*P*-value*
Maternal age, y	33.7 ± 4.8	35.8 ± 4.7	<0.001	33.7 ± 4.7	35.1 ± 5.2	<0.001
Maternal height, cm	159.6 ± 5.4	159.2 ± 5.5	0.08	159.5 ± 5.5	159.4 ± 5.4	0.57
Prepregnancy weight, kg	51.3 ± 6.7	52.2 ± 8.2	<0.001	51.2 ± 6.5	51.9 ± 7.8	<0.001
Prepregnancy BMI, kg/m^2	20.2 ± 2.5	20.6 ± 3	<0.001	20.1 ± 2.4	20.4 ± 2.8	<0.001
<18.5	1190 (84.8)	214 (15.2)		912 (73.8)	324 (26.2)	
18.5–24.9	3699 (83.3)	744 (16.8)		2827 (72.5)	1073 (27.5)	
25–29.9	169 (75.5)	55 (24.6)		110 (67.1)	54 (32.9)	
≤30	34 (63)	20 (37)		23 (47.9)	25 (52.1)	
BMI at delivery, kg/m^2	24.2 ± 2.6	24.5 ± 3	<0.001	24.1 ± 2.5	24.4 ± 2.8	<0.001
GWG, kg	10.2 ± 3.4	10 ± 3.6	0.12	10.1 ± 3.4	10.1 ± 3.6	0.92
Gestational week	39.3 ± 1.1	39 ± 1.2	<0.001	39.3 ± 1.1	39.1 ± 1.1	<0.001
Parity			<0.001			<0.001
Nulliparity	3100 (80)	773 (20)		2288 (68.9)	1033 (31.1)	
Multiparity	1846 (88.5)	239 (11.5)		1442 (79.2)	379 (20.8)	
Delivery method			<0.001			<0.001
Cesarean	778 (75.5)	252 (24.4)		525 (60)	350 (40)	
Vaginal	4314 (84.7)	781 (15.3)		3347 (74.8)	1126 (25.2)	
Smoking†			0.15			0.09
Current	86 (90.5)	9 (9.5)		46 (61.3)	29 (38.7)	
Past	668 (83.4)	133 (16.6)		504 (73.3)	184 (26.7)	
Never	4336 (83)	890 (17)		3320 (72.5)	1262 (27.5)	
Drinking†			0.86			0.028
Current	121 (84.6)	22 (15.4)		91 (67.9)	43 (32.1)	
Past	1229 (82.9)	254 (17.1)		973 (75.1)	322 (24.9)	
Never	3729 (83.2)	753 (16.8)		2799 (71.7)	1104 (28.3)	
Status of a light-for-date infant			<0.001			0.36
(+)	351 (77)	105 (23)		261 (70.4)	110 (30)	
(−)	4741 (83.6)	928 (16.4)		3611 (72.6)	1366 (27.5)	
Maternal–child separation owing to clinical reasons			<0.001			<0.001
Separated	280 (64.2)	156 (35.8)		70 (58.3)	50 (41.7)	
Not separated	4812 (84.6)	877 (15.4)		3802 (72.7)	1426 (27.3)	

BMI, body mass index; EBF, exclusive breastfeeding; GWG, gestational weight gain.
*Based on a χ^2 test for categorical variables and a *t* test for continuous variables.
†Summation does not reach total number due to missing values.

0.60–0.99; $P = 0.039$). No significant statistical interaction between prepregnancy BMI and GWG was evident in terms of EBF either at discharge ($P = 0.60$) or 1 mo later ($P = 0.50$).

We evaluated the associations between the GWG categories recommended by the IOM in terms of prepregnancy BMIs, and successful EBF at discharge (Supplementary Table 1) and 1 mo later (Supplementary Table 2). The IOM categories were not significantly associated with successful EBF initiation at discharge and 1 mo after delivery based on stepwise model selection. No significant nor gradient was observed within each weight gain category based on prepregnancy BMI levels.

Discussion

We studied Japanese women who delivered full-term singleton babies and found that prepregnancy obesity was independently and significantly associated with unsuccessful EBF initiation both at discharge and 1 mo after delivery. Our results are consistent with a recent Canadian study of 6592 women with single pregnancies [17]. When the weight gains recommended by the IOM with reference to prepregnancy BMIs were investigated, no specific association was observed between GWG and success of EBF.

Among relevant Chinese studies, Zhu et al. [18] found that both prepregnancy underweight status and excessive GWG were associated with increased risk for breastfeeding termination, whereas Tao et al. [19] reported that prepregnancy obesity was only a risk factor. The differences between the two studies may be explained by the numbers enrolled: Zhu et al. analyzed 1602 mothers and Tao et al. 3196; both groups were recruited in maternity hospitals. Because Asian women are generally lean and very few women were overweight or obese, given the small sample size, Zhu et al. [18] were able to investigate only underweight and normal weight women, whereas the study conducted by Tao et al. [19] had a larger sample size, enabling them to investigate overweight and obese women. Even in Western countries where prevalence of underweight is very low, a recent study in the Netherlands reported that both underweight and obese were negatively associated with EBF initiation [20]. However, the sample size of this study was relatively small (i.e., 50 for each BMI category) and the analyses appeared to be unadjusted. In contrast, the present study with a much larger sample size enabled us to sufficiently investigate both underweight and overweight and obese women, which is one of the strengths of the study.

Several previous studies in this area of breastfeeding research have investigated GWG, but the interaction between prepregnancy BMI and GWG with EBF establishment was inconsistently observed [18,19,21–24]. In the present study, no statistical interaction was apparent between GWG recommended by the IOM and prepregnancy BMI. The IOM guidelines were established in a Western country, where overweight and obese women are more common.

Table 3
Factors associated with successful EBF initiation at discharge (N = 6125)

	Univariable	Stepwise multivariable (n = 5939)
Variables	OR (95% CI)	OR (95% CI)
Maternal age (OR per 5 y)	0.63 (0.59–0.68)*	0.61 (0.56–0.66)*
Prepregnancy BMI, kg/m^2		
<18.5	1.12 (0.95–1.32)	1.03 (0.87–1.23)
18.5–24.9	1.00 (ref)	1.00 (ref)
25–29.9	0.62 (0.45–0.85)	0.70 (0.50–0.99)
≤30	0.34 (0.20–0.60)†	0.27 (0.15–0.51)*
GWG	1.02 (0.99–1.04)	0.98 (0.96–1.00)‡
Parity		
Nulliparity	0.52 (0.44–0.61)*	0.43 (0.37–0.51)*
Multiparity	1.00 (ref)	1.00 (ref)
Delivery method		
Cesarean	0.56 (0.48–0.66)*	0.81 (0.68–0.96)*
Vaginal	1.00 (ref)	1.00 (ref)
Smoking		Not selected
Current	1.96 (0.98–3.91)	
Past	1.03 (0.84–1.26)	
Never	1.00 (ref)	
Drinking		Not selected
Current	1.11 (0.70–1.76)	
Past	0.98 (0.84–1.14)	
Never	1.00 (ref)	
Gestational week	1.24 (1.17–1.32)*	1.28 (1.20–1.36)*
Status of a light-for-date infant	0.65 (0.52–0.82)*	0.68 (0.53–0.88)†
Maternal–child separation due to clinical reasons	0.33 (0.27–0.40)*	0.38 (0.30–0.47)*

BMI, body mass index; CI, confidence interval; EBF, exclusive breastfeeding; GWG, gestational weight gain.
P-value for interaction between prepregnancy BMI and GWG = 0.60; OR, odds ratio.
*$P < 0.001$.
†$P < 0.01$.
‡$P < 0.05$.

Table 4
Factors associated with successful EBF initiation at 1 mo (N = 5348)

	Univariable	Stepwise multivariable (n = 5124)
Variables	OR (95% CI)	OR (95% CI)
Maternal age (OR per 5 y)	0.73 (0.69–0.78)*	0.71(0.66–0.75)*
Prepregnancy BMI, kg/m^2		
<18.5	1.07 (0.92–1.24)	0.99 (0.85–1.16)
18.5–24.9	1.00 (ref)	1.00 (ref)
25–29.9	0.77 (0.55–1.08)	0.81 (0.56–1.16)
≤30	0.35 (0.20–0.62)*	0.29 (0.16–0.53)*
GWG	1.00 (0.98–1.02)	0.98 (0.96–1.00)†
Parity		
Nulliparity	0.58 (0.51–0.67)*	0.49 (0.43–0.57)*
Multiparity	1.00 (ref)	1.00 (ref)
Delivery method		
Cesarean	0.50 (0.43–0.59)*	0.64 (0.54–0.75)*
Vaginal	1.00 (ref)	1.00 (ref)
Smoking		–
Current	1.96 (0.98–3.91)	
Past	1.03 (0.84–1.26)	
Never	1.00 (ref)	
Drinking		
Current	1.11 (0.70–1.76)	0.97 (0.65–1.45)
Past	0.98 (0.84–1.14)	1.34 (1.15–1.56)†
Never	1.00 (ref)	1.00 (ref)
Gestational week	1.18 (1.11–1.24)*	1.20 (1.13–1.27)*
Status of a light-for-date infant	0.90 (0.71–1.13)	0.77 (0.60–0.99)†
Maternal–child separation due to clinical reasons	0.53 (0.36–0.76)*	0.56 (0.38–0.83)‡

BMI, body mass index; CI, confidence interval; EBF, exclusive breastfeeding; GWG, gestational weight gain.
P-value for interaction between prepregnancy BMI and GWG = 0.50.
*$P < 0.001$.
†$P < 0.05$.
‡$P < 0.01$.

When the IOM was applied to Asian women who are leaner, excess weight gain in pregnancy may cause critical hemorrhage or immediate adverse health effects (gestational diabetes and pregnancy-induced hypertension) [25]. In fact, a previous study reported that a case of obstetric critical hemorrhage at delivery (hemoglobin level <9 g/dL immediately after delivery) was associated with failure of EBF initiation [26]. In this regard, given no clear evidence accumulated, the application of the IOM to Asian women may require a careful attention.

Significant risk factors for unsuccessful EBF initiation consistently observed both at discharge and 1 mo later included older maternal age, nulliparity, cesarean delivery, an earlier gestational week, status of a light-for-date infant, and maternal–child separation. We previously reported that studies were inconsistent in the significance and trend of the effects of maternal age and parity on successful breastfeeding practice, and furthermore, ethnicity and cultural background makes the evaluation more complicated [13]. In the present study, we found that older maternal age and nulliparity were both negative factors for successful EBF initiation, which were consistent with the results from the longitudinal 21st Century (N = 53 575) study conducted by the Japanese Ministry [27]. Cesarean delivery, earlier gestational week, and status of a light-for-date infant carry a number of risks to the success of EBF establishment through pregnancy complications, a weak suckling ability, and swallowing problems [5,28]. Maternal–child separation interferes with the establishment of breastfeeding and thus the WHO and UNICEF recommended that all healthy mothers and babies have uninterrupted skin-to-skin contact beginning immediately after birth for at least 1 h, and until after the first feeding, for breastfeeding women [29].

The present study had several limitations. First, all study participants had delivered infants in a single, large, "baby-friendly" hospital and thus the EBF success rates were higher than the nationwide rate (i.e., 51%) reported by the most recent Infant Nutrition Survey in 2017. In addition, the hospital in question is located in the heart of Tokyo, which is a wealthy area, and the sample may have been particularly health conscious to the extent that the women carefully followed the 10-step guidelines. Thus, we may have overestimated the success of EBF initiation. Second, the hospital is one of five certified (in 2018) emergency maternal–child care centers in Tokyo; some patients were critically ill and were transferred in from their original medical institutions. To minimize bias, we included only healthy mothers with full-term singleton pregnancies. Third, EBF was earlier shown to be affected by maternal socioeconomic and psychological factors including working status, income, and educational attainment [7]. Cultural influences on infant feeding beliefs and practices also were reported in a recent review [30]. Although we lacked such information, according to Japanese labor law, postnatal leave does not allow women to work for ≥6 wk after childbirth. Thus, our result was not influenced by the return to work. Fourth, some of our exclusion criteria may cause bias if some mothers were systematically excluded from data collection based on their prepregnancy BMI category. However, our subanalyses indicated that these were, in fact, random exclusions, having similar prepregnancy BMI distribution between those excluded and those included in this study. Fifth, at 1 mo after delivery, multivariable modeling indicated that past alcohol consumption was a risk factor for failure of EBF establishment, but we could not explore a possible dose–response relationship. Only a history was

available (i.e., current-, past-, or never-drinker). Similarly, smoking was not measured using the Brinkman index. Thus, the possibility of error in terms of drinking and smoking status cannot be excluded.

Conclusion

The present study demonstrated that prepregnancy obesity may be a risk factor for successful EBF initiation among Japanese. By contrast, weight gain during pregnancy, according to prepregnancy BMI recommended by the IOM, was not associated with EBF success. Educational intervention to stay at a healthy weight for young childbearing-age women may be a useful approach for EBF promotion in Japan.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.nut.2018.11.003.

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