



Research Article

Bariatric Surgery to Conception Intervals and Breastfeeding Initiation

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Citation: Cordero L, Stenger MR, Landon MB, Needleman BJ, Noria S, et al. (2023) Bariatric Surgery to Conception Intervals and Breastfeeding Initiation. Arch Pediatr 8: 244. DOI: 10.29011/2575-825X.100244

Received Date: 11 February 2023; **Accepted Date:** 16 February 2023; **Published Date:** 20 February 2023.

Abstract

Background: Current guidelines advise women who had bariatric surgery (BS) to delay pregnancy for 12-24 months. Reports on their perinatal outcomes are abundant, however, information on breastfeeding (BF) following BS is limited. **Objective:** To evaluate the impact of BS to conception intervals on exclusive BF and BF initiation on 149 mother-infant dyads. **Methods:** Retrospective cohort study. BS to conception intervals in months (mos.) were: **short** (≤ 24 mos., 52 dyads), **intermediate** (25-72 mos., 52 dyads) and **long** (≥ 73 mos., 45 dyads). **Results:** Comparison of 21 women with ≤ 12 and 31 with 13-24 mos. intervals showed no significant differences in perinatal outcomes, except that the ≤ 12 mos. group had lower BF initiation rates. The **short**, **intermediate** and **long** groups were similar in ethnicity: white (69, 79 & 69%), African American (23, 17 & 27%), other races (8, 4 & 4%), advanced maternal age (29, 38 & 49%) and primiparity (54, 38 & 33%) but were different in diabetes (38, 58 & 33%), chronic hypertension (19, 27 & 9%) and NICU admission (33, 15 & 13%). Sleeve gastrectomy prevailed in the **short** group (52, 35 & 11%) and Roux-en-Y in the **long** (40, 52 & 69%). At delivery, cesarean (46, 44 & 38%), gestational age (38, 39 & 39w), late preterm (19, 13 & 13%), and obesity grade 3 (60, 54 & 51%) were similar. At discharge, rates of exclusive BF (40, 33 & 36%) and BF initiation (69, 66 & 80%), albeit comparable, were low. **Conclusion:** Regardless of BS to conception interval length, exclusive BF and BF initiation rates although similar, are lower than in the general population. In women who conceive during the first post-BS year, or who are of advanced age, primiparous or severely obese, their low BF initiation rates are of specific concern.

Keywords: Bariatric surgery; Conception intervals; Breastfeeding

Background

Obesity is the most common medical condition affecting women of reproductive age and is increasing worldwide [1,2]. Bariatric surgery (BS) is considered one of the most effective methods for substantial and sustained weight loss [3,4]. During the first year following BS, women are in a catabolic phase with rapid weight loss and at a higher risk of developing nutritional deficiencies that may affect mothers and infants [5,6]. These concerns evolved into guidelines for BS to conception intervals such as 12-24 months (mos.) proposed by ACOG in 2009 [7] and

12-18 mos. proposed by others later [3].

The benefits of lactation on short and long term maternal and infant health are no longer in dispute [8,9]. More specifically, exclusive breastfeeding (BF) during birth hospitalization and for the first postpartum year have been declared desirable goals for women with comorbidities such as diabetes, severe obesity, hypertension, and other conditions [10,11]. Unfortunately, few studies included BF among their perinatal outcomes [5-6,12-15]. A provocative recent review of the impact of BS on BF emphasized the need for additional research to find ways to improve BF rates in this special patient population [15].

Objective

To evaluate exclusive BF and BF initiation rates following BS with **short** (≤ 24 mos.), **intermediate** (25-72 mos.) and **long** (≥ 73 mos.) conception intervals.

Subjects and Methods

This retrospective cohort investigation was approved by the Institutional Review Board of The Ohio State University Wexner Medical Center (IRB 2010H0198). Electronic maternal and neonatal records (2013-21) were reviewed. Some data obtained from women who delivered during that period was used in previous investigations [16-19]. Gestational diabetes mellitus (DM), Type 1 and Type 2 DM, chronic hypertension (CHTN) and preeclampsia were diagnosed and treated in accordance with established guidelines [18]. Women were categorized by prepregnancy BMI as normal (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), obese grade 1 (30-34.9 kg/m²), obese grade 2 (35-39.9 kg/m²) or obese grade 3 (≥ 40 kg/m²) [1]. Gestational weight gain (GWG) was categorized as adequate, inadequate or excessive [20].

In this study, BS procedures included Roux-en-Y Gastric Bypass (RYGB), Sleeve Gastrectomy (SG), Laparoscopic Gastric Band (LGB) and duodenal-ileal anastomosis (DS) [3-4,21,22]. Indications for BS were consistent with those of the American Association of Clinical Endocrinologists/American College of Endocrinology, The Obesity Society, American Society for Metabolic and Bariatric Surgery, Obesity Medicine Association and The American Society of Anesthesiologists [3,4] as well as the American College of Obstetrics and Gynecology [2]. The interval from BS to conception was calculated as the time in mos. that elapsed between the surgical date and the start of the following pregnancy which was estimated by subtracting the gestational age in weeks from the date of birth. Following BS, 96 women delivered 1 infant, 25 delivered two and one delivered three infants. These 149 singleton live births and their mothers constituted the study population that was categorized according to BS to conception intervals as **short** (≤ 24 mos.), **intermediate** (25-72 mos.) and **long** (≥ 73 mos.). Multiple births, infants born before 34 weeks or those affected by major malformations were not included. Upon arrival to Labor and Delivery, each woman stated her infant feeding preference and her BF experience, if any. In our institution, maternity practices include BF within 1 hour of delivery, no formula supplementation unless indicated, rooming in, on demand BF, full-time lactation consultants and post discharge BF support [16-18]. Furthermore, our institution reports BF data to the Joint Commission as required for hospital accreditation [11].

Per our hospital practice, any symptomatic infants were directly transferred from the delivery room to the NICU for further care. If the condition of the mother and her infant allowed, holding, skin-to-skin contact and BF were encouraged. Asymptomatic

infants able to feed were transferred to the Newborn Nursery with their mothers for routine care and glucose monitoring if indicated [16]. According to standard intrauterine growth charts, infants were categorized as appropriate for gestational age (AGA), small for gestational age (SGA), large for gestational age (LGA) or macrosomic (birthweight ≥ 4000 g) [16].

Screening for hypoglycemia (blood glucose < 40 mg/dl) was done via serial point of care testing (Accu-Chek®) or by plasma glucose measurement in the laboratory (Beckman Coulter AU5800, Beckman Coulter Inc., Brea, CA, USA) starting within the first hour of life after the first feeding and every 2-4 hours thereafter as needed. Infants in the Newborn Nursery with hypoglycemia were promptly BF, formula fed (FF) or given dextrose gel and those with recurrent hypoglycemia were transferred to the NICU for further care. On admission to the NICU, most infants were started on intravenous dextrose and those who were able to feed were BF or FF [16].

Exclusive BF was defined as direct feedings from the breast or by expressed breast milk alone or in combination with direct BF. Partial BF was defined as formula supplementation with direct BF or with expressed breast milk. BF was considered initiated if, during the 24 hours preceding hospital discharge, infants were exclusively BF or BF partially [16-18]. Due to the retrospective study design, no follow-up information was available on infant feeding practices after hospital discharge.

Statistical Analysis

Comparisons between women of the different BS to conception intervals were made with Wilcoxon Two Sample test for continuous variables and Chi-square tests for categorical variables. Multivariate logistic regressions were used to determine if BS to conception interval length predicted exclusive BF and BF initiation at discharge. Variables entered into both models included DM, CHTN, age, race, public assistance, smoking, BMI, obesity grade, BS to conception intervals, parity, mode of delivery, prior BF, late prematurity, AGA, SGA, LGA, hypoglycemia, admission to NICU and length of stay. Significance was established at a p-value < 0.05 .

Results

Clinical and demographics according to short BF to Conception intervals

A preliminary comparison of maternal and neonatal characteristics of 21 dyads in the ≤ 12 mos. and 31 others from the 13-24 mos. BS to conception groups was made (Table 1). At the onset of the current pregnancy both groups were similar in mother's age (32 vs 33y), history of DM (33 vs 42%), CHTN (19 vs 19%), preeclampsia (10 vs 6%) and median pregestational BMI (41 vs 41 kg/m²). Racial distribution was (white 76%, African American

19% and other 5%) for the ≤ 12 mos. interval and (white 64%, African American 26%, other 10%) for the 13-24 mos. interval. Age at BS (31 vs 31y), procedure type (RYGB 33 vs 45%, SG 52 vs 52%, LGB 14 vs 3%), rate of vaginal (52 vs 55%) and cesarean deliveries (48 vs 45%), gestational weight gain (inadequate 19 vs 3%, adequate 24 vs 13% or excessive 57 vs 84%) were statistically

comparable. Additionally, at the time of delivery, women with ≤ 12 mo and those with 13-24 mo intervals were similar in grade 1 (14 vs 23%), in grade 2 (10 vs 19%) and in grade 3 obesity (67 vs 55%). History of smoking (14 vs 35%), smoking during the current pregnancy (5 vs 3%) and public assistance (38 vs 42%) was similar.

Table 1: Clinical and Demographics According to Short BS to conception Intervals.

	≤ 12 months	13-24 Months	<i>p</i> -value
Mother-Infant Dyads no.	21	31	
Mothers age at delivery (y) mean \pm SD	32 \pm 5	33 \pm 6	0.4857*
Race: White no. (%)	16 (76)	20 (64)	0.2854†
African American no. (%)	4 (19)	8 (26)	
Other no. (%)	1 (5)	3 (10)	
Diabetes mellitus no. (%)	7 (33)	13 (42)	0.5316^
Chronic hypertension no. (%)	4 (19)	6 (19)	1.0000†
Preeclampsia no. (%)	2 (10)	2 (6)	1.0000†
Pregestational BMI (kg/m ²) median [IQR]	41 [38,44]	41 [34,46]	0.9925‡
Normal/Overweight (BMI ≤ 30 kg/m ²) no. (%)	2 (10)	1 (3)	0.5256†
Obese 1 (BMI 30-34.9 kg/m ²) no. (%)	3 (14)	7 (23)	
Obese 2 (BMI 35-39.9 kg/m ²) no. (%)	2 (10)	6 (19)	
Obese 3 (BMI ≥ 40 kg/m ²) no. (%)	14 (67)	17 (55)	
Type: Roux-en-Y gastric bypass no. (%)	7 (33)	14 (45)	0.3564†
Sleeve gastrectomy no. (%)	11 (52)	16 (52)	
Laparoscopic Gastric Banding no. (%)	3 (14)	1 (3)	
Mothers age at surgery (y) mean \pm SD	31 \pm 6	31 \pm 6	0.7071*
Surgery to conception (mos.) median (range)	9 [5-10]	22 [15-24]	<.0001‡
Public assistance no. (%)	8 (38)	13 (42)	0.7818^
Never smoked no. (%)	17 (81)	19 (61)	0.1793†
Current smokers no. (%)	1 (5)	1 (3)	
Former smokers no. (%)	3 (14)	11 (35)	
Nulliparous no. (%)	12 (57)	16 (2)	0.6947^
#GWG: Inadequate no. (%)	4 (19)	1 (3)	0.0696†
Adequate no. (%)	5 (24)	4 (13)	
Excessive no. (%)	12 (57)	26 (84)	
Delivery: Vaginal no. (%)	11 (52)	17 (55)	0.9271^
Primary section no. (%)	5 (24)	8 (26)	
Repeat section no. (%)	5 (24)	6 (19)	
Mothers length of stay (d) median [IQR]	3 [2,3]	2 [2,3]	0.5627‡

Analysis: #GWG: gestational weight gain, † Fisher's Exact Test, ^ Chi-Square, * T-Test, ‡ Wilcoxon Two Sample Test.

Table 2: Neonatal Outcomes According to Short BS to Conception Intervals

	≤12 months	13-24 months	p-value
Mother-Infant Dyads no. (%)	21	31	
Multiparous no. (%)	9 (43)	15 (48)	0.6947 [^]
Prior BF experience no. (%)	8 (38)	9 (29)	0.4942 [^]
Gender (male) no. (%)	11 (52)	15 (48)	0.7775 [^]
Gestational age (w) median [IRQ]	38 [37,39]	38 [36,39]	0.7088 [‡]
Late preterm (≥ 34 weeks) no. (%)	2 (10)	8 (26)	0.1739 [†]
Birthweight (g) mean ± SD	3094 ± 662	3102 ± 546	0.9616 [*]
Intrauterine Fetal Growth			
Appropriate for gestation no. (%)	14 (67)	27 (87)	0.1848 [†]
Small for gestation no. (%)	6 (29)	3 (10)	
Large for gestation no. (%)	1 (5)	1 (3)	
Neonatal hypoglycemia no. (%)	2 (10)	5 (16)	0.6872 [†]
Admission to NICU no. (%)	8 (38)	9 (29)	0.4942 [^]
Infant length of stay (d) median [IRQ]	3 [2,3]	3 [2,3]	0.9451 [‡]
Mothers Intention to Feed			
Exclusive BF no. (%)	12 (57)	26 (84)	0.0815 [†]
Partial BF no. (%)	3 (14)	2 (6)	
Formula only (%)	6 (29)	3 (10)	
Infant Feeding at Discharge			
Exclusive BF total no. (%)	6 (29)	15 (48)	0.0943 [^]
Partial BF total no. (%)	6 (29)	9 (29)	
Formula only no. (%)	9 (43)	7 (23)	
Breastfeeding Initiation no. (%)	12 (57)	24 (77)	0.138 [^]

Analysis: † Fisher's Exact Test, ^ Chi-Square, * T-Test, ‡ Wilcoxon Two Sample Test.

Neonatal outcomes according to short BF to conception intervals

Infants born to women from the ≤12 mos. and those from the 13-24 mos. intervals were statistically comparable in median gestational age (38 vs 38w), prevalence of late-prematurity (10 vs 26%), birthweight (3094 vs 3102g), rates of AGA (67 vs 87%), LGA (5 vs 3%) and SGA infants (29 vs 10%), neonatal hypoglycemia (10 vs 16%) and admission to the NICU (38 vs 29%) (Table 2).

Mothers infant feeding preferences for the ≤12 and 13-24 mos. groups, were not statistically different: BF exclusively

(57 vs 84%), BF partially (14 vs 6%) and FF only (29 vs 10%) (Table 2). Lactation consults were accepted by 76% of women in the ≤12 mos. and by 87% of those in the 13-24 mos. group. At discharge, both groups were similar in exclusive BF (29 vs 48%) and partial BF (29 vs 29%) but those in the ≤12 mos. group were higher in rate of FF (43 vs 23%) and lower in BF initiation (57 vs 77%). Regression analysis showed that women who received public assistance were less likely to BF exclusively at discharge (a OR 0.151, CI 95%, 0.036-0.641). On the other hand, women who conceived during the second post-BS year were more likely to initiate BF (a OR 8.027, CI 95%, 1.511-42.636).

Table 3: Clinical and Demographics According to BS to Conception Intervals.

	≤24 months	25-72 months	≥73 months	p-value
Mother-Infant Dyads no.(%)	52 (35)	52 (35)	45 (30)	
Mothers age at delivery (y) mean ± SD	33 ± 5	34 ± 5	34 ± 5)	0.1335*
Advanced maternal age no. (%)	15 (29)	20 (38)	22 (49)	0.1285^
Race: White no. (%)	36 (69)	41 (79)	31 (69)	0.7723†
African American no. (%)	12 (23)	9 (17)	12 (27)	
Other no. (%)	4 (8)	2 (4)	2 (4)	
Diabetes mellitus no. (%)	20 (38)	30 (58)	15 (33)	0.0353^
Chronic hypertension no. (%)	10 (19)	14 (27)	4 (9)	0.0761^
Preeclampsia no. (%)	4 (8)	4 (8)	4 (9)	1.0000†
Pregestational BMI (kg/m ²) median [IQR]	41 [35,45]	41 [34,46]	40 [35,46]	0.9717‡
Normal/Overweight (BMI ≤ 30 kg/m ²) no. (%)	3 (6)	2 (4)	4 (9)	0.3026†
Obese 1 (BMI 30-34.9 kg/m ²) no. (%)	10 (19)	14 (27)	5 (11)	
Obese 2 (BMI 35-39.9 kg/m ²) no. (%)	8 (15)	8 (15)	13 (29)	
Obese 3 (BMI ≥ 40 kg/m ²) no. (%)	31 (60)	28 (54)	23 (51)	
Type: Roux-en-Y gastric bypass no. (%)	21 (40)	27 (52)	31 (69)	0.0003†
Sleeve gastrectomy no. (%)	27 (52)	18 (35)	5 (11)	
Laparoscopic Gastric Banding no. (%)	4 (8)	7 (13)	6 (13)	
Duodenal-ileal anastomosis no. (%)	0 (0)	0 (0)	3 (7)	
Mothers age at surgery (y) mean ± SD	31 ± 6	29 ± 6	24 ± 5	<.0001*
Surgery to conception (mo) median (range)	14 [10-22]	48 [35-60]	108 [96-132]	<.0001‡
Public assistance no. (%)	21 (40)	26 (50)	27 (60)	0.1559^
Never smoked no. (%)	36 (69)	33 (63)	30 (67)	0.9332†
Current smokers no. (%)	2 (4)	4 (8)	3 (7)	
Former smokers no. (%)	14 (27)	15 (29)	12 (27)	
Nulliparous no. (%)	28 (54)	20 (38)	15 (33)	0.0984^
GWG#: Inadequate no. (%)	5 (10)	2 (4)	1 (2)	0.1896†
Adequate no. (%)	9 (17)	12 (23)	16 (36)	
Excessive no. (%)	38 (73)	38 (73)	28 (62)	
Delivery: Vaginal no. (%)	28 (54)	29 (56)	28 (62)	0.7340^
Primary section no. (%)	13 (25)	16 (31)	10 (22)	
Repeat section no. (%)	11 (21)	7 (13)	7 (16)	
Mothers length of stay (d) median [IQR]	2 [2,3]	3 [2,3]	2 [2,3]	0.2045‡

Analysis: #GWG: gestational weight gain, † Fisher's Exact Test, ^ Chi-Square, * T-Test, ‡ Wilcoxon Two Sample Test.

Neonatal outcomes according to BS to Conception intervals

The prevalence of multiparous women increased from the short through the long intervals (46, 62 & 67%), however, only 54 (63%) of these women reported prior BF experience (Table 4). Median gestational age (38, 39 & 39 weeks), late prematurity (19, 13 & 13%), SGA (17, 8 & 22%) and LGA (4, 2 & 5%) occurred with similar frequency in the three BS to conception interval groups. Admission to the NICU was higher (33%) for the infants in the short interval than among those in the intermediate (15%) and in the long group (13%). Primary diagnoses on admission for these three subgroups combined included respiratory distress (55%), hypoglycemia (26%) and miscellaneous (19%).

Mother infant feeding preferences were similar across the

BS to conception intervals: BF (73, 69 & 73%), partial BF (10, 8, & 7%) and FF (17, 23, & 15%). At discharge, exclusive BF rates (40, 33 & 36%) albeit low, were comparable across the BS to conception intervals. Furthermore, only 38 of the 54 (70%) women who BF exclusively did so by direct BF, while the remaining 16 (30%) received expressed breast milk. Partial BF (29, 33 & 44%) and BF initiation (69, 66 & 80%) were also statistically similar. Combining all 28 women from the three interval groups who intended FF at discharge, only one changed her mind and partially BF. Regression analysis showed that 23 women who delivered prematurely and 74 other women who received public assistance were less likely to BF exclusively (a OR 0.210, CI 95%, 0.056-0.788 and a OR 0.391, CI 95%, 0.185-0.825, respectively). Exclusive BF and BF initiation rates at discharge for 108 white women and 33 African American women were similar (38 vs 31% and 72 vs 74%, respectively).

Table 4: Neonatal Outcomes According to BS to Conception Intervals

	≤24 months	25-72 months	≥73 months	p-value
Mother-Infant Dyads no. (%)	52 (35)	52 (35)	45 (30)	
Multiparous no. (%)	24 (46)	32 (62)	30 (67)	0.0984 [^]
Prior BF experience no. (%)	17 (33)	20 (38)	17 (38)	0.8024 [^]
Gender (male) no. (%)	26 (50)	30 (58)	16 (36)	0.0896 [^]
Gestational age (w) median [IQR]	38 [37,39]	39 [37,39]	39 [37,39]	0.3980 [‡]
Late preterm (≥ 34 weeks) no. (%)	10 (19)	7 (13)	6 (13)	0.6436 [^]
Birthweight (g) mean ± SD	3099 ± 589	3101 ± 501	3060 ± 559	0.9199 [*]
Intrauterine Fetal Growth				
Appropriate for gestation no. (%)	41 (79)	47 (90)	33 (73)	0.2372 [†]
Small for gestation no. (%)	9 (17)	4 (8)	10 (22)	
Large for gestation no. (%)	2 (4)	1 (2)	2 (5)	
Neonatal hypoglycemia no. (%)	7 (13)	12 (23)	7 (16)	0.4006 [^]
Admission to NICU no. (%)	17 (33)	8 (15)	6 (13)	0.0316 [^]
Infant length of stay (d) median [IQR]	3 [2,3]	2 [2,3]	2 [2,3]	0.4085 [‡]
Mothers Intention to Feed				
Exclusive BF no. (%)	38 (73)	36 (69)	35 (78)	0.8661 [†]
Partial BF no. (%)	5 (10)	4 (8)	3 (7)	
Formula only (%)	9 (17)	12 (23)	7 (15)	
Infant Feeding at Discharge				
Exclusive BF total no. (%)	21 (40)	17 (33)	16 (36)	0.4759 [^]
Partial BF total no. (%)	15 (29)	17 (33)	20 (44)	
Formula only no. (%)	16 (31)	18 (34)	9 (20)	
Breastfeeding Initiation no. (%)	36 (69)	34 (66)	36 (80)	0.2728 [^]

Analysis: [†]Fisher's Exact Test, [^] Chi-Square, ^{*}ANOVA, [‡]Kruskal-Wallis Test.

Discussion

The National Institute of Health indications for BS include grade 3 obesity (BMI ≥ 40 kg/m²) or grade 2 obesity (BMI 35-39 kg/m²) with one or more associated co-morbidities like DM, cardiovascular disease, obstructive sleep apnea and previous weight loss attempts [3-4]. RYGB is known for its long term sustainable weight loss and reduced risks of obesity-related comorbidities, however, it is associated with adverse pregnancy related outcomes [21-22]. SG is an alternative technique that causes less perioperative and late complications, however, long term weight results appeared to be inferior to RYGB and gastroesophageal reflux disease is a major problem [21-23]. The prevalence and changing choices of BS procedures over time (i.e., decreasing rate of LGB, steady rates of RYGB and increasing preference for SG) that we observed is commensurate with that seen across the world [21-23].

Earlier studies of perinatal outcomes following BS showed increased rates of SGA or LGA infants, some of which were associated with the type of surgery and others with short BS to conception intervals [5,23-27]. The data presented here showed no significant difference in prevalence of SGA or LGA in any of the BS interval groups similar to that noted by others [28-30]. Germane to this investigation, recently we reported that exclusive BF and BF initiation rates were comparable regardless the type of BS procedure [19].

Since the original ACOG guidelines were published in 2009, eleven investigators compared perinatal outcomes of BS to conception of <12 mos. with longer intervals. Seven of them concluded that conception delay remained advisable while four considered it unnecessary or questionable [24,31-40]. Of the five investigators who studied conception delays of up to 18 mos., four deemed that unnecessary [29-30,41-43]. In spite of the ongoing controversies, current consensus is for women to postpone pregnancy for at least 12 to 18 mos. or until their weight loss has subsided and their nutritional condition stabilized [15, 44].

In our preliminary analysis of 21 women whose BS to conception intervals were ≤ 12 mos. and 31 others with conception intervals of 13-24 mos. we learned that both groups were similar with the exception that BF initiation (any BF) was at a lower rate for those infants conceived within the first 12 months after BS. Thus, in relation to our main research objective and due to the small sample size, we combined both groups into the **short** interval.

Our data showed that about half of the women in the **short** and **intermediate** intervals and a third of those in the **long** interval group were primiparous (Figure 1). Coincidentally, the prevalence of advanced maternal age increased from a third in the **short** to a half in the **long** interval group. These two factors may have

contributed to the low BF rates considering that both are known to increase the risks of adverse perinatal outcomes [45-46].

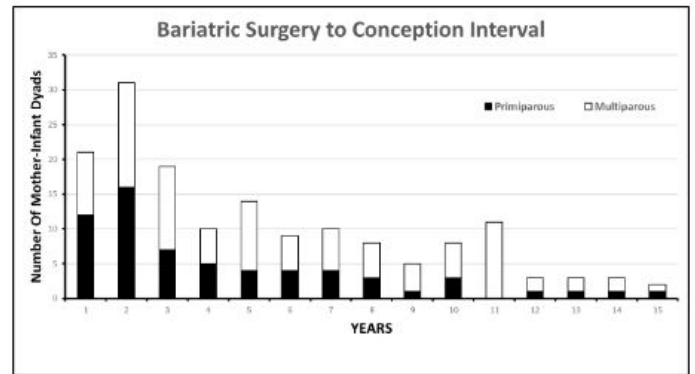


Figure 1: Bariatric surgery to conception interval for 149 women who delivered live born infants after surgery.

At the time of delivery, obesity grade 3 was present in half of the women in each of the interval groups, thus the occurrence of low BF rates are in line with the knowledge that women in the higher obesity grades, with or without previous BS, are less likely to initiate BF [1,19].

The American Academy of Pediatrics and the Academy of Breastfeeding Medicine recommend exclusive BF for all healthy infants during birth hospitalization because of its predictive value for BF six months or longer [10]. In a recent study of maternity care practices and policies in 1,305 hospitals in the United States, the mean in-hospital exclusive BF rate for infants in the general population was 51.4% and for those in the most BF supportive hospitals was 64.7% [10]. Previously, we reported low exclusive BF rates among women with severe preeclampsia (37%) [47] or with severe CHTN superimposed on pregestational diabetes (19%) [48]. Considering the similarity in comorbidities described above with that of women who underwent BS, their low exclusive BF rates are to be expected.

BF initiation (any BF) at discharge, which is also a predictor of BF duration, albeit not as strong as exclusive BF, was 84.1% for the general United States population in 2017 [49]. In our study we observed that BF initiation among women who conceived in ≤ 12 mos. was 57% as compared to the 80% for women who conceived during the 13-24 mos. post BS. The small sample in these two subgroups of the *short* BS to conception interval limits the strength of this interesting observation.

The higher prevalence of excessive GWG reported here in the three interval groups (73, 73 & 62%) may be a contributor to the low exclusive BF and BF initiation rates similar to that reported by others [50]. Recent published results from our Institution also showed that excessive GWG among women with obesity and Type

1 or Type 2 DM was a contributor to low exclusive BF rates [18].

In our study population, one third of the women were either former smokers or acknowledged smoking during the pregnancy. Smokers are less likely to initiate BF and breastfed for shorter duration than non-smokers [51]. Of further concern is that smoking is a preoperative risk that if uncorrected significantly increases morbidity and mortality in patients undergoing BS [52]. Wolvers et al. concluded that unfortunately, despite advice and temporarily quitting, a considerable number of patients continue to smoke up to and beyond BS [52].

The lower prevalence of African American women compared to white women undergoing BS in our study population is similar to that reported in the literature [53]. However, the BF initiation rates reported here for both groups are closer (72 vs 74%) to that of the 84.1% in the general population [49].

Public assistance was recorded for 40% of the dyads in the **short**, 50% in the **intermediate** and 60% in the **long** interval groups. Regression analysis showed that regardless of BS to conception interval length, women who received public assistance were less likely to BF exclusively. This finding is not surprising since it is well known that among the many barriers to BF, socioeconomic background, race, obesity and diabetes are major contributors [54]. As a group, publicly insured patients are significantly less likely to undergo BS, and yet these patients experience higher rates of obesity and related complications that could qualify them for this surgical option [53].

Contraception and preconception counseling should be critical for any women undergoing BS especially if BS to conception guidelines are to be followed. A recent study in the US of 750 women who had BS provided valuable insight on contraception [55]. These investigators reported that during the first post-surgical year, 12.7% of the women had no intercourse, 40.5% had protected intercourse, 41.5% had unprotected intercourse while not intending to conceive and 4.3% tried to conceive [55]. The prevalence of the first three groups did not change during the seven years of the study, with the exception that more women (13%) tried to conceive during the second year. If this data represents the prevailing contraceptive practices, it is likely that most of the planned and unplanned pregnancies may occur beyond advisable time guidelines.

A major limitation of this investigation is that the definition of exclusive BF and BF initiation at discharge used here may be applicable only to women with high risk obstetrical conditions whose early mother-infant interactions may be delayed. Another limitation is the absence of information on contraceptive practices that preceded the pregnancies and the lack of follow-up information regarding BF after discharge from the hospital. The strength of

this investigation is the inclusion of specific information regarding exclusive BF and BF initiation rates in pregnancies following BS. Finally, the obstetrical and neonatal data was obtained directly from medical records, and not via post-delivery maternal questionnaires.

In conclusion, regardless of BS to conception interval length, exclusive BF and BF initiation rates although similar are lower than in the general population. In women who conceive during the first post bariatric year, or who are of advanced maternal age, primiparous or severely obese, the observed low BF initiation rates are of specific concern. Learning about obstacles to BF following BS would be helpful to design special strategies for successful lactation.

Authors' contributions

All authors participated in planning and research design, data analysis and manuscript preparation - LC, Manuscript revisions - LC, CAN, MRS, MBN, BJN and SN. The author(s) read and approved the final manuscript.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Availability of data and materials

The data sets generated during and analyzed during the current study are not publicly available due to limitations of ethical approval involving the patient data and anonymity but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The Ohio State University Biomedical Science IRB approved on 05/02/2022 the continuation of the study #2010H0198 with waivers of informed consent and HIPAA research authorization. All methods were performed in accordance with the relevant guidelines and regulations of the declaration of Helsinki.

Consent for publication

Not applicable

Competing interests

The Author(s) declare(s) that there is no conflict of interest.

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