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Research Article

Impact of Miscarriage on Perinatal Outcomes Including Breastfeeding among Primiparous Women with Class 3 Obesity

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Abstract

Background: Miscarriages are related to adverse perinatal outcomes, however, its association with severe obesity and breastfeeding (BF) initiation is underreported. **Objective:** To determine the impact of miscarriages on perinatal outcomes including BF initiation among primiparous women with Class 3 obesity during birth hospitalization. **Methods:** Retrospective study of 144 women with and 511 without history of miscarriages who delivered at ≥ 34 weeks gestation. Interpregnancy interval (IPI) was calculated from the date of the last miscarriage to conception of the first live birth. **Results:** Of the 144 women, 70% had one miscarriage, 16% had two and 14% had three or more. Women with miscarriages were older (29 *vs* 27y), of advanced maternal age (22 *vs* 10%) and were former or current smokers (40 *vs* 27%). Dates of miscarriage were available from 136 (94%) women, the IPI for 29 (21%) was ≤ 6 months, for 32 (24%) was 7-12 months and for 75 (55%) was > 12 months. Outcomes of women with and without history of miscarriages were similar in comorbidities and in BF initiation rates (70 *vs* 66%) at discharge, however, smoking was a stronger predictor of BF initiation failure (61 *vs* 70%). **Conclusions:** Primiparous women with Class 3 obesity with and without a history of miscarriages have similar perinatal outcomes including low BF initiation rates. Healthcare providers should maintain a supportive attitude toward BF in women with obesity and miscarriages and should implement strategies to modify the high rates of smoking in this population.

Keywords: History of miscarriage; Breastfeeding; Class 3 Obesity

Background

Obesity is the most common medical condition affecting women of reproductive age worldwide [1-4]. Obesity before and during pregnancy are major risk factors for early pregnancy loss, gestational (GDM) and pregestational diabetes mellitus (PGDM), hypertensive conditions, labor complications, severe maternal morbidity and low breastfeeding (BF) initiation rates [1-5]. Miscarriage is defined as a spontaneous nonviable intrauterine pregnancy during the first trimester affecting approximately 19% of pregnancies and is associated with adverse perinatal outcomes in subsequent pregnancies [4-7]. While the benefits of lactation on short and long term maternal and infant health have been clearly documented, and despite numerous publications on birth spacing and perinatal outcomes, the association between miscarriage, interpregnancy interval (IPI) and BF initiation among primiparous women with severe obesity remain underreported [8-12].

Objective

To determine the impact of miscarriages on perinatal outcomes including BF initiation among primiparous women with Class 3 obesity during birth hospitalization.

Subject and Methods

This retrospective cohort investigation was approved by the Biomedical Sciences Institutional Review Board at The Ohio State University Wexner Medical Center [IRB 2024H0198]. Electronic maternal and neonatal records (2013-21) were reviewed. In agreement with the World Health Organization and the American College of Obstetricians & Gynecologists, we categorized women by BMI as Class 1 (29-34 kg/m^2), Class 2 (35-39 kg/m^2) or Class 3 obesity (morbid 40-49 kg/m^2 and extreme ≥ 50 kg/m^2) [1,4]. This study included primiparous women with Class 3 obesity who delivered at ≥ 34 weeks a singleton live birth without major malformations. The study population was composed of 144 primiparous women with history of miscarriages and 511 others without such history prior to the delivery of their first live birth. Not included were six women with a history of ectopic pregnancies, 11 with fetal death after 12 weeks of gestation and six others whose records were incomplete. Women with GDM, PGDM, chronic hypertension (CHTN), preeclampsia, anemia, polycystic ovary syndrome (PCOS), obstructive sleep apnea (OSA), gastroesophageal reflux disease (GERD) and advanced maternal age (AMA, women ≥ 35 years at the estimated date of delivery) were managed following established guidelines [1,4-5,6-19]. Infants born between 34 and 36 6/7 weeks gestation were considered late preterm. Gestational weight gain (GWG) was defined as adequate, inadequate or excessive [15]. According to gestational age (GA) and birthweight, infants were categorized as small (SGA), appropriate (AGA) or large (LGA); those with birthweights ≥ 4000 g were considered macrosomic [17-18]. During the prenatal visit, on arrival to labor and delivery, and shortly after birth, women declared their intended infant feeding choice [16-18]. Clinical and demographics of some mother-infant dyads included in this investigation were reported in earlier publications [4,15-18].

The IPI was calculated as the time in months elapsed between the date of the miscarriage and the conception of the first live birth [11-12,17]. The start of the pregnancy of the live birth was estimated by subtracting the gestational age in weeks from the date of birth [11-12,17]. In cases of women with recurrent (three or more miscarriages), the one immediately prior to the conception of the live birth was used to calculate the IPI [6-7].

Depending on the condition of the mother and infant following delivery, maternal-infant interactions such as holding, skin to skin contact and BF were encouraged. Delivery room and postpartum maternal-infant interactions were observed and documented by nursing staff into the electronic medical record [17-18]. Per our hospital practices, any symptomatic infants were directly transferred from the delivery room to the Neonatal Intensive Care Unit (NICU) [19]. Our family-centered care system has rooming-in available and full-time lactation consultants whose services are offered to all women regardless of their infant feeding preference [17-18].

Screening for hypoglycemia (blood glucose < 40 mg/dl during the first 4 hours of life and < 45 mg/dl between four and twenty four hours of life) 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, U.S.A.) starting within the first hour of life after the first feeding and every 2-4 hours thereafter as needed [17-18]. Asymptomatic infants in the Newborn Nursery with hypoglycemia were promptly BF or formula fed (FF) and those with refractory hypoglycemia were treated with intravenous (IV) dextrose. On admission to the NICU, most infants were started on IV dextrose and those who were able to feed were BF or FF.

Exclusive BF was defined as direct feedings from the breast, expressed breast milk or donor human milk (DHM). Partial BF (BF/FF) was defined by direct BF, expressed breast milk or DHM supplemented with FF. BF was considered initiated if during the 24 hours preceding hospital discharge, infants were exclusive BF or BF/FF [17-18]. Due to the study design, information on infant feeding following discharge was not available.

Statistical analysis

Comparisons of primiparous women with Class 3 obesity with and without history of miscarriages were made with Wilcoxon rank-sum tests for continuous variables that were not normally distributed based on Shapiro-Wilk tests. Kruskal-Wallis tests were used for continuous variables compared across more than two categories. Fisher's exact tests were used for categorical variables. Exploratory subgroup comparisons included analyses by advanced maternal age, smoking status, and IPI length. Significance was established at a p-value < 0.05. Analyses were performed with SAS version 9.4 (SAS Institute, Inc., Cary, NC).

Results

Maternal and clinical demographics according to history of miscarriages

Demographic and clinical maternal characteristics were similar between women with and without miscarriages including morbid and extreme obesity, white, African American, public healthcare assistance, current smokers, GDM A1 and A2, PGDM Type 1 and 2, CHTN with and without medication, severe preeclampsia, vaginal delivery, primary cesarean, median pregestational weight, and median weight at delivery (Table 1).

A separate comparison of women with and without history of miscarriage showed no differences in excessive (76 vs 80%), adequate (18 vs 16%) and inadequate (6 vs 4%) weight gain. On the other hand, women's age, advanced maternal age and former smokers were more common among those with a history of miscarriage.

Table 1: Maternal and Clinical Demographics According to History of Miscarriages.

	No History of Miscarriages	History of Miscarriages	*p*-value
Mother-Infant dyads no.	511	144	n/a
Mothers age (y) median [IQR]	27 [23-31]	29 [26-34]	<0.001
Advanced maternal age no. (%)	50 (10)	31 (22)	<0.001
Race: White no. (%)	333 (65)	92 (64)	0.84
African American no. (%)	156 (31)	47 (33)	
Hispanic no. (%)	9 (2)	3 (2)	
Others no. (%)	13 (3)	2 (1)	
Public healthcare assistance no. (%)	257 (50)	74 (51)	0.85
Smoking: Current no. (%)	36 (7)	7 (5)	0.001
Former no. (%)	101 (20)	50 (35)	
Gestational diabetes A1 no. (%)	28 (5)	7 (5)	0.65
Gestational diabetes A2 no. (%)	41 (8)	15 (10)	
Pregestational Type 1 no. (%)	6 (1)	4 (3)	0.08
Pregestational Type 2 no. (%)	28 (6)	13 (9)	
Gestational hypertension no. (%)	102 (20)	27 (19)	0.19
Chronic hypertension no. (%)	87 (17)	25 (17)	
Chronic hypertension meds no. (%)	49 (10)	23 (16)	
Preeclampsia severe features no. (%)	104 (20)	25 (17)	0.73
Polycystic ovarian syndrome no. (%)	36 (7)	14 (10)	0.29
Obstructive sleep apnea no. (%)	26 (5)	9 (6)	0.54
Gastroesophageal reflux no. (%)	36 (7)	18 (13)	0.04
Asthma no. (%)	85 (17)	29 (20)	0.32
Anemia no. (%)	77 (15)	26 (18)	0.44
Postpartum hemorrhage no. (%)	18 (4)	2 (1)	0.27
Delivery: Primary cesarean no. (%)	253 (50)	71 (49)	0.99
Vaginal no. (%)	258 (50)	73 (51)	
Pregestational weight (kg) median [IQR]	117 [99-135]	117 [99-140]	0.85
Weight at delivery (kg) median [IQR]	131 [116-148]	131 [116-150]	0.90
Mother length of stay (d) median [IQR]	2 [2-3]	2 [2-3]	0.77

Analysis: Fisher's exact test or Wilcoxon rank-sum test.

Neonatal outcomes according to history of miscarriage

Neonatal outcomes of women with and without history of miscarriages were similar in intrauterine fetal growth, median GA, late preterm, median birth weight, admission to NICU and neonatal hypoglycemia (Table 2). Also similar were maternal intention to BF and infant feeding at discharge. Of note, none of the women who prenatally declared intention to feed formula changed their decision. Regrettably, although half of each group intended to exclusively BF, 22% of the 144 women with a history of miscarriage and 25% of the 511 without left the hospital not having BF at least once.

Table 2: Neonatal Outcomes According to History of Miscarriages.

	No History of Miscarriages	**History of Miscarriages**	***p*-value**
Mother-Infant dyads no.	511	144	n/a
Sex (male) no. (%)	261 (51)	79 (55)	0.45
Gestational age (w) median [IQR]	39 [37-39]	38 [37-39]	0.06
Late preterm (34-36wks) no. (%)	57 (11)	19 (13)	0.56
Birthweight (g) median [IQR]	3364 [3005-3737]	3370 [2905-3724]	0.65
Fetal growth: Appropriate for gestation no. (%)	391 (77)	111 (77)	0.99
Small for gestation no. (%)	27 (5)	7 (5)	
Large for gestation no. (%)	93 (18)	26 (18)	
Macrosomia no. (%)	61 (12)	20 (14)	0.57
Neonatal hypoglycemia no. (%)	90 (18)	23 (16)	0.71
Admission to NICU no. (%)	88 (17)	29 (20)	0.46
Infant length of stay (d) median [IQR]	2 [1-4]	2 [2-3]	0.77
Lactation Assistance no. (%)	415 (81)	116 (81)	0.90
Prenatal Intention: Breastfeeding no. (%)	389 (76)	116 (81)	0.25
Breastfeeding and formula no. (%)	47 (9)	7 (5)	
Formula only no. (%)	75 (15)	21 (15)	
First breastfeeding: < 1 hour no. (%)	58 (11)	22 (15)	0.59
2-6 hours no. (%)	235 (46)	65 (45)	
≥ 7 hours no. (%)	92 (18)	26 (18)	
Never breastfed no. (%)	126 (25)	31 (22)	
At discharge: Exclusive breastfeeding no. (%)	159 (31)	45 (31)	0.64
Partial breastfeeding no. (%)	180 (35)	56 (39)	
Formula only no. (%)	172 (34)	43 (30)	
Breastfeeding Initiation no. (%)	339 (66)	101 (70)	0.42

Analysis: Fisher's exact test or Wilcoxon rank-sum test.

Advanced maternal age

Among the 655 women that constituted our study population, 81 (12%) were categorized as AMA and when compared to 574 (88%) women of younger age showed a significantly increased prevalence of miscarriage (38 *vs* 21%), PGDM Type 2 (16 *vs* 5%), CHTN on medications (20 *vs* 10%), severe preeclampsia (30 *vs* 18%), PCOS (14 *vs* 7%), OSA (12 *vs* 4%), GERD (15 *vs* 7%), cesarean (62 *vs* 48%) and preterm delivery (20 *vs* 10%). Except for low mean gestational age (37 *vs* 38w), all neonatal outcomes including NICU admission (25 *vs* 17%), hypoglycemia (19 *vs* 17%), exclusive BF (31 *vs* 30%) and BF initiation (67 *vs* 68%) were similar.

Maternal and clinical demographics and neonatal outcomes according to history of smoking

In our study population, 151 (78%) women were former smokers, while 43 (22%) continued to smoke during pregnancy. To determine clinical and demographic associations, we combined women who acknowledged former smoking with those who continued to smoke through delivery. Further comparison of 194 women with history of smoking with 461 who never smoked (Table 3) showed higher prevalence of miscarriage, African American race, weight gain and public healthcare assistance.

Table 3: Maternal and Clinical Demographics According to History of Smoking.

	History of smoking	No history of smoking	*p*-value
Mother-Infant dyads no.	194	461	n/a
Mothers age (y) median [IQR]	27 [23-31]	28 [24-31]	0.19
Advanced maternal age no. (%)	18 (9)	63 (14)	0.15
Race: White no. (%)	105 (54)	320 (69)	<0.001
African American no. (%)	79 (41)	124 (27)	
Hispanic no. (%)	3 (2)	9 (2)	
Others no. (%)	7 (4)	8 (2)	
Public healthcare assistance no. (%)	120 (62)	211 (46)	<0.001
Miscarriages no. (%)	57 (29)	87 (19)	0.004
Gestational diabetes A1 no. (%)	9 (5)	26 (6)	0.25
Gestational diabetes A2 no. (%)	22 (11)	34 (7)	
Pregestational Type 1 no. (%)	1 (1)	9 (2)	0.38
Pregestational Type 2 no. (%)	14 (7)	27 (6)	
Gestational hypertension no. (%)	41 (21)	88 (19)	0.33
Chronic hypertension no. (%)	33 (17)	79 (17)	
Chronic hypertension meds no. (%)	27 (14)	45 (10)	
Mild preeclampsia no. (%)	10 (5)	30 (6)	0.41
Preeclampsia severe features no. (%)	33 (17)	96 (21)	
Polycystic ovarian syndrome no. (%)	18 (1)	32 (7)	0.33
Obstructive sleep apnea no. (%)	10 (5)	25 (5)	0.99
Gastroesophageal reflux no. (%)	17 (9)	37 (8)	0.76
Asthma no. (%)	32 (16)	82 (18)	0.74
Anemia no. (%)	31 (16)	72 (16)	0.91
Postpartum hemorrhage no. (%)	8 (4)	14 (3)	0.48
Delivery: Primary cesarean no. (%)	103 (53)	221 (48)	0.23
Vaginal no. (%)	91 (47)	240 (52)	
Pregestational weight (kg) median [IQR]	117 [99-135]	117 [99-136]	0.98
Weight at delivery (kg) median [IQR]	135 [117-148]	129 [116-148]	0.37
Weight gain (kg): Excessive no. (%)	37 (19)	68 (15)	0.003
Adequate no. (%)	41 (21)	57 (12)	
Inadequate no. (%)	116 (60)	336 (73)	
Mother length of stay (d) median [IQR]	2 [2-3]	2 [2-3]	0.98

Analysis: Fisher's exact test or Wilcoxon rank-sum test.

Although not statistically significant, prenatal intention to exclusively BF was lower, to feed formula only was higher while BF and formula combined were similar in the smokers group compared to the non-smokers group. At discharge, exclusive BF and BF initiation were higher among non-smokers compared to smokers (Table 4).

Table 4 : Neonatal Outcomes According to History of Smoking.

	History of smoking	No history of smoking	*p*-value
Mother-Infant dyads no.	194	461	n/a
Sex (male) no. (%)	118 (61)	222 (48)	0.004
Gestational age (w) median [IQR]	39 [37-39]	39 [37-39]	0.41
Late preterm (34-36wks) no. (%)	17 (9)	59 (13)	0.18
Birthweight (g) median [IQR]	3354 [2933-3739]	3388 [3009-3728]	0.49
Fetal growth: Appropriate for gestation no. (%)	151 (78)	351 (76)	0.53
Small for gestation no. (%)	12 (6)	22 (5)	
Large for gestation no. (%)	31 (16)	88 (19)	
Macrosomia no. (%)	24 (12)	57 (12)	0.99
Neonatal hypoglycemia no. (%)	32 (16)	81 (18)	0.82
Admission to NICU no. (%)	36 (19)	81 (18)	0.82
Infant length of stay (d) median [IQR]	2 [2-3]	2 [2-3]	0.98
Lactation Assistance no. (%)	143 (74)	388 (84)	0.002
Prenatal Intention: Breastfeeding no. (%)	143 (74)	362 (79)	0.27
Breastfeeding and formula no. (%)	16 (8)	38 (8)	
Formula only no. (%)	35 (18)	61 (13)	
First breastfeeding < 1 hour no. (%)	22 (11)	58 (13)	0.41
2-6 hours no. (%)	83 (43)	217 (47)	
≥ 7 hours no. (%)	34 (18)	84 (18)	
Never breastfed no. (%)	55 (28)	102 (22)	
At discharge: Exclusive breastfeeding no. (%)	54 (28)	150 (33)	0.08
Partial breastfeeding no. (%)	64 (33)	172 (37)	
Formula only no. (%)	76 (39)	139 (30)	
Breastfeeding Initiation no. (%)	118 (61)	322 (70)	0.03

Analysis: Fisher’s exact test or Wilcoxon rank-sum test.

Table 5: Interpregnancy Intervals and Maternal Outcomes.

	≤ 6 months	**7-12 months**	**> 12 months**	***p*-value**
Mother-Infant dyads no.	29	32	75	n/a
BMI (kg/m^2) median [IQR]	47.9 [42.5-53.6]	51.4 [44.4-53.7]	48.4 [41.8-54.4]	0.19
Mothers age (y) median [IQR]	30 [26-34]	26.5 [23-30]	29 [27-37]	0.03
Advanced maternal age no. (%)	7 (24)	6 (19)	17 (23)	0.89
Race: White no. (%)	17 (59)	23 (72)	48 (64)	0.75
African American no. (%)	12 (41)	8 (25)	23 (31)	
Other no. (%)	0 (0)	1 (3)	4 (5)	
Public healthcare assistance no. (%)	14 (48)	16 (50)	39 (52)	0.97
Smoking: Current no. (%)	1 (3)	2 (6)	3 (4)	0.78
Former no. (%)	8 (28)	13 (41)	27 (36)	
Gestational diabetes A1 no. (%)	2 (7)	0 (0)	4 (5)	0.31
Gestational diabetes A2 no. (%)	1 (3)	3 (9)	11 (15)	
Pregestational Type 1 no. (%)	1 (3)	1 (3)	1 (1)	0.63
Pregestational Type 2 no. (%)	4 (14)	2 (6)	6 (8)	
Gestational hypertension no. (%)	3 (10)	7 (22)	15 (20)	0.06
Chronic hypertension no. (%)	4 (14)	4 (13)	15 (20)	
Chronic hypertension meds no. (%)	5 (17)	10 (31)	6 (8)	
Mild preeclampsia no. (%)	1 (3)	2 (6)	6 (8)	0.06
Preeclampsia severe features no. (%)	5 (17)	11 (34)	6 (8)	
Polycystic ovarian syndrome no. (%)	2 (7)	0 (0)	11 (15)	0.04
Obstructive sleep apnea no. (%)	0 (0)	3 (9)	6 (8)	0.33
Gastroesophageal reflux no. (%)	2 (7)	6 (19)	10 (13)	0.43
Asthma no. (%)	5 (17)	5 (16)	19 (25)	0.48
Anemia no. (%)	7 (24)	3 (9)	16 (21)	0.25
Delivery: Primary cesarean no. (%)	15 (52)	17 (53)	36 (48)	0.90
Vaginal no. (%)	14 (48)	15 (47)	39 (52)	
Pregestational weight (kg) median [IQR]	116 [104-131]	113.5 [97.5-137]	123 [92-145]	0.84
Weight at delivery (kg) median [IQR]	126 [117-143]	132 [117-153.5]	134 [112-150]	0.94
Weight gain: Excessive no. (%)	4 (14)	5 (16)	13 (17)	0.53
Adequate no. (%)	2 (7)	5 (16)	15 (20)	
Inadequate no. (%)	23 (79)	22 (69)	47 (63)	
Mother length of stay (d) median [IQR]	3 [2-4]	2 [2-3]	3 [2-3]	0.18

Analysis: Fisher's Exact test or Kruskal-Wallis test (all continuous variables).

Table 6: Interpregnancy Intervals and Neonatal Outcomes.

	≤ 6 months	7-12 months	> 12 months	*p*-value
Mother-Infant Dyads no.	29	32	75	n/a
Sex (male) no. (%)	15 (52)	19 (59)	40 (53)	0.82
Gestational age (w) median [IQR]	38 [37-40]	39 [37-39]	38 [37-39]	0.94
Late preterm (34-36wks) no. (%)	3 (10)	5 (16)	11 (15)	0.89
Birthweight (g) median [IQR]	3295 [2910-3559]	3130 [2791-3690]	3492 [3020-3739]	0.10
Fetal growth: Appropriate for gestation no. (%)	26 (90)	27 (84)	55 (73)	0.21
Small for gestation no. (%)	0 (0)	2 (6)	3 (4)	
Large for gestation no. (%)	3 (10)	3 (9)	17 (23)	
Macrosomia no. (%)	3 (10)	2 (6)	12 (16)	0.41
Neonatal hypoglycemia no. (%)	2 (7)	5 (16)	14 (19)	0.35
Admission to NICU no. (%)	6 (21)	4 (13)	19 (25)	0.35
Infant length of stay (d) median [IQR]	3 [2-4]	2 [2-3]	2 [2-3]	0.18
Lactation Assistance no. (%)	24 (83)	26 (81)	61 (81)	0.99
Prenatal intention: Breastfeeding no. (%)	20 (69)	26 (81)	63 (84)	0.36
Breastfeeding and formula no. (%)	3 (10)	1 (3)	2 (3)	
Formula only no. (%)	6 (21)	5 (16)	10 (13)	
First breastfeeding: < 1 hour no. (%)	8 (28)	1 (3)	12 (16)	0.19
2-6 hours no. (%)	10 (34)	17 (53)	34 (45)	
≥ 7 hours no. (%)	4 (14)	8 (25)	14 (19)	
Never breastfed no. (%)	7 (24)	6 (19)	15 (20)	
At discharge: Exclusive breastfeeding no. (%)	9 (31)	10 (31)	23 (31)	0.99
Partial breastfeeding no. (%)	11 (38)	12 (38)	31 (41)	
Formula only no. (%)	9 (31)	10 (31)	21 (28)	
Breastfeeding Initiation no. (%)	20 (69)	22 (69)	54 (72)	0.90

Analysis: Fisher's Exact test or Kruskal-Wallis test.

Interpregnancy intervals and maternal and neonatal outcomes

One hundred one of 144 (70%) women had one miscarriage, 23 (16%) had two and 20 (14%) had three or more. Most of the miscarriages occurred during the first trimester and all of them were consecutive. Of the 17 women with recurrent miscarriages, seven conceived within one year, four during the second and the remaining six after three years. One hundred and thirty-six of the 144 (94%) women were able to provide the date of the closest miscarriage before the live birth. The IPI between the miscarriages and the date of conception of the first live birth were divided into 29 (21%) whose IPI was ≤ 6 months, 32 (24%) with IPI 7-12 months and 75 (55%) with > 12 months. A comparison of perinatal outcomes between the three IPI groups showed that women with ≤ 6 month IPI or > 12 month IPI tend to be older than the 7-12 month IPI women (Table 5). PCOS was also more common in these groups relative to the 7-12 month IPI group. The remaining maternal and neonatal variables were similar including AMA, GDM, PGDM Type 2, CHTN, CHTN on meds, mild preeclampsia, preeclampsia severe, primary cesarean, gestational age, late prematurity, AGA, macrosomia, hypoglycemia, admission to NICU, intention to BF, exclusive BF, partial BF and BF initiation (Table 6).

Discussion

Miscarriage is generally described as the loss of pregnancy before viability [5-7,12]. The difficulty with that definition is that the limits of viability can vary from 20 to 28 weeks of gestation depending on multiple factors [6-7,12]. Considering the above, we defined miscarriage as an intrauterine pregnancy loss which occurred before the end of the first trimester of pregnancy [5,12,17]. The prevalence of miscarriages in the general population is one miscarriage in about 10.8% of women, two in 1.9% and three or more in 0.7% [5-7]. The chances of miscarriage recurrence are between 1-3% and the chances of the following live birth pregnancy range from 50-70% depending on the maternal comorbidities [7]. Relevant to our study, it is widely known that the risk of miscarriage is higher among women with obesity compared to those with a normal prepregnant BMI [1-3,7,12].

Similar to other investigators, we showed a significant increase in the prevalence of miscarriage in women with AMA [19-22]. In the US and other developed countries there is an upward trend toward AMA that culminated in 2020 in 19% of all pregnancies [12,19-23]. Compared with those of younger age pregnant women with AMA are at higher risk for complications such as miscarriages, chromosomal abnormalities, stillbirth, disorders of fetal growth, preeclampsia, preterm delivery, gestational and pregestational diabetes and increased rates of cesarean delivery [19-23]. Concurrently, infants born to women with AMA are at risk of low birth weight, prematurity, low Apgar scores and admission to NICU [18]. On the other hand, women with AMA intend to BF at a similar rate to that of younger women, however, their BF initiation rates are higher [23]. A recent publication suggests that older mothers are better prepared to face lactation difficulties or disappointments and are thus more likely to be successful and continue to BF longer [23].

Our data is in line with other investigators who demonstrated that pregnant women who smoke are at higher risk of miscarriages [24-26]. Smoking during pregnancy also increases the occurrence of orofacial clefts, fetal growth restriction, ectopic pregnancies, placenta previa, placental abruption and other neonatal comorbidities [24-26]. Smoking before or during pregnancy is a significant risk for BF initiation or BF continuation [26]. Several studies have shown that nicotine inhibits prolactin production and affects the milk ejection reflex, decreases milk supply and leads to poor BF outcomes [27-29]. Our data showed that a significant number of former smokers quit prior to or during pregnancy, unfortunately it is known that about 50% are likely to return to smoking within a year postpartum [29]. Pregnant women should not smoke and should avoid secondhand smoke exposure [29]. Years ago, some investigators advanced the paradoxical notion that smoking may have some protective effects on the rate of preeclampsia, however, recent reliable work disputed that idea [30-31].

The American Academy of Pediatrics recommend exclusive BF for approximately six months after birth and a continuation of BF supplemented with complementary foods thereafter for 6-12 months [32]. Long standing data confirmed that otitis media, diarrheal disease, lower respiratory illness, sudden infant death, bowel disease, leukemia, diabetes, obesity, asthma and atopic dermatitis occur less often among infants who BF during their first year [32]. Concurrently, women who BF decrease their risk for Type 2 diabetes, breast and ovarian cancer, endometrial carcinoma and hypertensive disorders among other comorbidities [8-10].

The categorization of women with obesity according to severity showed significant differences in BF initiation [4,33-35]. In the US in 2019, 83.2% of the general obstetrical population initiated partial BF at hospital discharge, thereafter rates of any BF declined to 55.8% at six and to 35.9% at 12 months [34]. Although literature on BF in women with and without obesity is abundant the impact of miscarriages on BF initiation remains unexplored [4,16-18]. The data presented here showed that BF initiation, albeit low, was similar between women with and without history of miscarriages [34].

The strongest predictors of successful BF are intention to BF among primiparous women and prior BF experience among multiparous women [35-38]. In the current study, intention to BF and BF initiation were similar between women with and without a history of miscarriage. The discrepancy between intention to BF and BF initiation highlights the many obstacles that affect not only mothers but also their infants. Similarly, neonatal obstacles that delay, interrupt or discourage BF include prematurity, respiratory disorders, poor latching, ineffective sucking behavior and mother-infant separation [18,38]. Regardless of the rate of BF initiation, fewer than 20% women with obesity BF exclusively at six months and less than 20% continue with any BF at one year [36]. Furthermore, a random forest algorithm found that BMI category, prenatal BF intention and health care insurance are stronger predictors of BF failure [36].

Relevant to our study, a comparison of short (< 6 months) IPI with intermediate and long IPI did not show any significant adverse neonatal outcomes. This observation is in line with that of Kandatharan et al. that reported no risk of adverse outcomes after delaying pregnancy for 6 months or less following a miscarriage [11]. Furthermore, Tessema et al. and Farahi et al. suggested that following a miscarriage or induced abortion, women could attempt pregnancy earlier without increasing their perinatal healthcare risks [12,31].

Early pregnancy losses are common but the psychological sequela for their parents is often overlooked [39-40]. Following miscarriages or ectopic pregnancies women experience posttraumatic stress, anxiety, and depression that can remain clinically significant up to nine months later [39-40]. Recent studies also suggest that perinatal losses might have consequences on parents' mental health which may persist even following the birth of subsequent children [41-42]. Unfortunately, associations of psychological challenges with miscarriages and lactation remain underreported.

Limitations

Limitations of this investigation are those inherent to a retrospective design and to the lack of follow-up information on infant feeding after discharge. The strength of the present investigation included the definitions of BF at discharge and the data on mothers and infants which were obtained directly from medical records and not from maternal recall. More importantly, to our knowledge, this is the first investigation relating miscarriages to BF initiation in this study population.

Conclusions

Primiparous women with Class 3 obesity with and without a history of miscarriages have similar perinatal outcomes including low BF initiation rates. While the rate of intention to BF was similar to that of the general population, the low BF initiation rates reported here are common in women with obesity, hypertensive disorders, diabetes and other social and demographic factors that included smoking. Additionally, our study highlights the negative impact of smoking on BF initiation and provides a potentially modifiable target for improvement.

Authors' contributions

LC: Conceptualized and designed the original study, collected data, assisted with data analysis, and drafted the initial and subsequent manuscripts. CAN/MRS: Assisted with the study design and data analysis and critically reviewed and revised several drafts of the manuscript. EMM: Designed and implemented statistical analysis and revised the manuscript accordingly. MBL/CHB: Review and revise the manuscript for important intellectual contents

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Competing Interests

The authors declare to have no conflict of interest.

Ethics approval and consent to participate

The Ohio State University Biomedical Science IRB (#2010H0198) approved through 4/17/2025 this retrospective study 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.

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