Abdou *et al.*
Middle East Fertility Society Journal (2023) 28:7
https://doi.org/10.1186/s43043-023-00133-x

Middle East Fertility Society Journal

RESEARCH Open Access

Pregnancy after bariatric surgeries; best time, gestational, and neonatal outcomes

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Abstract

Background Many studies and organizations described bases of pregnancy timing after bariatric surgeries, but there is still a need for uniform scientific evidence for accurate timing.

We aimed to assess pregnancy outcomes and neonatal findings by timing of surgery to pregnancy to compare adverse perinatal outcomes among women who underwent bariatric surgery prior to pregnancy with those who had not.

Patients and methods We included 200 pregnant females who previously performed different bariatric surgeries. All pregnant females were divided into three groups: early group of patients who were conceived ≤ 12 months from bariatric surgery included 50 patients (25.0%), middle group of patients who were conceived from 12 to 24 months from bariatric surgery included 50 patients (25.0%) and late group of patients who were conceived > 24 months from bariatric surgery included 100 patients (50.0%).

Results There is a more liability to preterm deliveries in the early group in comparison with the middle and late group ($P = 0.064$). Gestational weight gain in the early group was lower than the middle and the late group ($P = 0.002$). Females in the early group have a more liability to inadequate gestational weight gain in comparison with in the middle and late group $P < 0.001$).

Neonatal birth weight in the early group was significantly lower than the middle and late group $P < 0.001$).

Conclusion We supported recommendations of postponing pregnancy for more than 12 months after performing bariatric surgery which allowed stabilization of maternal weight, allowing adequate gestational weight gain, better fetal and maternal health later on.

Keywords Bariatric surgery, Pregnancy timing, Fetal, Maternal outcomes

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Introduction

Obesity is a public world health problem affects millions of adults every year with rising incidence, thus it becomes the commonest problem in women in reproductive age [1]. Females were described to have maternal obesity in the case of their body mass index (BMI) before pregnancy was 30 kg/m2, which has many drawbacks on the mother and fetus as high liability of gestational diabetes, hypertension, preeclampsia, congenital anomalies and fetal death [2, 3].

Bariatric surgeries become the most effective interventions that aim to reduce maternal obesity, improve pregnancy outcomes, and reduce long term drawbacks on mother and fetus in addition to maintain long-term weight loss [4, 5].

It was found that infants of mothers who underwent bariatric surgery have some risks as being born premature, small for gestational age in addition to higher liability of neonatal intensive care unit admission [5, 6]. Previous studies showed that drawbacks of bariatric surgeries on the infants were more likely occurred if pregnancy occurs within 12 months after surgery as in such period there will be marked reduction in caloric intake and a rapid rate of weight loss which has highest risk of maternal malnutrition thus low fetal nutritional supply [7].

Additionally, calories loss that is followed by maternal loss of weight during early post-bariatric period of catabolism limits gestational gain of weight [8], gestational weight gain below 5 kg is related to higher risks of new neonates that are small for gestational age (SGA) and reduction in neonatal weight, birth length, and even head circumference [9].

Many studies and organizations described bases of pregnancy timing after bariatric surgeries, but there is still a need for uniform scientific evidence for accurate timing.

Recommendations of the American Association of Clinical Endocrinology, American Society for Metabolic and Bariatric Surgery and the Obesity Society were that pregnancy should be postponed for about 12–18 months after bariatric surgery [10], but guidelines of the American College of Obstetricians and Gynecologists increased the interval to about 24 months after bariatric surgery [11].

Previous studies evaluated pregnancy outcomes and neonatal findings in females who get pregnant after bariatric surgeries at variable time intervals, but their results were not generalized due to many points of weakness as small sample sizes and no sufficient evaluation of impacts of weight gain during pregnancy [9, 12–14].

We aimed to evaluate pregnancy outcomes and neonatal findings by timing of surgery-to pregnancy to compare adverse perinatal outcomes among women who underwent bariatric surgery prior to pregnancy with those who had not. In addition to detecting relation between different bariatric surgery subtypes and periconception maternal outcomes as endocrine changes, irregular menstrual cycles, fertility, miscarriages, and congenital malformations.

Patients and methods

In the present study, we include all female patients who underwent bariatric surgeries in General surgery, then conceived and delivered in Gynecology and Obstetrics Department in Zagazig University Hospitals in the period from 2016 to 2021.

We obtained ethical approval for performing the study from the local ethical committees.

Inclusion criteria

All female patients who conceived and delivered after performing different types of bariatric surgeries included; Roux-en-Y gastric bypass (RYGB), one anastomosis gastric bypasses (OAGB), and sleeve gastrectomy (SG) after taking written informed consents to be included in the study.

Deliveries of all included patients occurred between May2018 and July 2021.

Pre-pregnancy BMI of all included patients was 39 (19–59). Pre-pregnancy BMI of early group of patient 34 (22–45) of middle group of patient 42 (30–59) and of late group of patients was 40 (19–59).

Exclusion criteria

Patients with spontaneous abortion, surgical pregnancy termination, diabetes mellitus, multiple births, and incomplete data about course of pregnancy were excluded from the analysis.

Patients' outcomes

All pregnant females were divided into three groups according to (1) time interval from bariatric surgery to conception (2) recommendations of NAM for degree of gestational weight gain [8].

We defined time interval from bariatric surgery to conception as number of months between the date of performed bariatric surgery and of pregnancy.

Date of conception was calculated as the "1st day of last menstrual period + 2 weeks" or as "delivery date − 40 + 2 weeks" in females who cannot exactly determined the 1st day of the last menstrual period. We categorized patients according to the time interval from bariatric surgery to conception into three groups: early group refereed to patients who get pregnant at time interval of ≤ 12 months from performed bariatric surgery,

middle group refereed to patients who get pregnant at time interval of 12–24 months from performed bariatric surgery, and late group refereed to patients who get pregnant at time interval of > 24 months from performed bariatric surgery. We calculated gestational weight gain by assessment of the differences between weight in late pregnancy and weight before pregnancy in kilograms. Then, we classified weight gain as adequate, inadequate, or excessive according to recommendations of NAM [8].

Primary outcome variables evaluation

We evaluated gestational age at time of delivery, preterm births incidence, neonatal weight, and percentile of fetal weight-for-age using weight charts of Dutch Perined birth which were stratified for gestational age at delivery and sex in days. We defined preterm birth as < 37 weeks of gestation and defined very preterm birth as < 32 weeks of gestation according to classification World Health Organization [15]. Then we considered LGA neonates as (> 90th percentile) and SGA neonates as (< 10th percentile).

Secondary outcome variables evaluation

We evaluated Apgar score below 7 at 5 min, neonatal hospitalization after birth, presence of any congenital anomalies, and any perinatal deaths which were excluded from the study.

We assessed any pregnancy-associated complications as gestational diabetes mellitus recently diagnosed by monitoring glucose during pregnancy, gestational hypertension recently diagnosed hypertension during pregnancy above 140/90 mmHg at 2 occasions), hypertension and proteinuria (preeclampsia), and postpartum hemorrhage of ≥ 1000 ml.

Statistical analysis

The collected data were computerized and statistically analyzed using SPSS program (Statistical Package for Social Science) version 24 and NCSS 12, LLC, USA. Data were tested for normal distribution using the Shapiro Walk test. Chi-square test ($\chi 2$) and Fisher's exact was used to calculate difference between qualitative variables. Kruskal–Wallis test was used to calculate difference between quantitative variables in more than two groups. Post hoc test for multiple comparisons was done by using Dunn's multiple comparison post hoc test, to indicate which groups were significantly different from each other. All statistical comparisons were two tailed with significance level of P value ≤ 0.05 indicates significant, $p < 0.001$ indicates highly significant difference while, $P > 0.05$ indicates non-significant difference.

Results

Demographic characteristics

Pre-pregnancy characteristics and pregnancy and neonatal outcomes were included in Tables 1 and 2.

We included 200 pregnant females who previously performed different bariatric surgeries.

The commonest performed bariatric procedure was Roux-en-Y gastric bypass (RYGB) in 121 (60.5%) patients, followed by sleeve gastrectomy in 46 (23.0%) patients and OAGB one anastomosis gastric bypass (OAGB) in 33 (16.5%) patients. The mean weight loss from bariatric surgery to pregnancy was 33 (15–59) kg at the time of conception.

Early group of patients who were conceived ≤ 12 months from bariatric surgery included 50 patients (25.0%), middle group of patients who were conceived from 12 to 24 months from bariatric surgery included 50 patients (25.0%) and late group of patients who were conceived > 24 months from bariatric surgery included 100 patients (50.0%) (Fig. 1, Tables 1, 2, and 3).

Mean time from bariatric surgery to conception was 8 ± 2.5 months, 20 ± 4.6 months, and 45 ± 15 months, respectively.

No significant differences between groups regarding pre-pregnancy data.

Pregnancy outcomes and neonatal findings according to time interval between surgery and conception (Fig. 2, Tables 2, 3, 4, and 5)

There is significant differences between groups regarding age of the patient, pre-pregnancy BMI ($p < 0.001$) and no significant differences between groups regarding type of performed bariatric surgical procedure.

The early group of patients has lower gestational age than the middle and late groups (272 (250–288) days versus; 277 (248–288) and 282 (245–288) $p < 0.001$.

The early group of patients has a more liability to preterm births than the middle and the late group (16% versus 8%, and 8%, $P = 0.064$).

The early group of patients has a lower gestational weight gain than the middle and the late group (− 0.9 ± 12.0 kg versus 11.2 ± 6.6 kg, and 11.0 ± 7.4 kg, $P = 0.002$).

The early group of patients has a more liability to inadequate gestational weight gain than the middle and late group (70.0% vs 28%, and 36%, $P < 0.001$), but risks of excessive weight gain was lower (8.0% vs 22%, and 25%.

Neonatal birth weight in the early group was significantly lower than the middle and late group (2973 (2300–3479) g versus 3375 (3171–3979) g and late group 3375 (3171–3979) g $P < 0.001$).

Table 1 Pre-pregnancy characteristics and pregnancy and neonatal outcomes of the whole group

Parameter		Total
Age		39 (19–59)
Pre-pregnancy BMI		39 (19–59)
BMI at conception		25 (20–30)
TBWL from surgery to conception		33 (15–59)
Time from bariatric surgery to pregnancy in months		22 (5–30)
Performed bariatric surgery	Roux-en-Y gastric bypass(RYGB)	121 (60.5%)
	OAGB one anastomosis gastric bypass (OAGB)	33 (16.5%)
	Sleeve gastrectomy (SG)	46 (23.0%)
Timing of pregnancy	Early group (≤ 12 months)	50 (25.0%)
	Middle group (12–24 months)	50 (25.0%)
	Late group (> 24 months)	100 (50.0%)
Parity	0	29 (14.5%)
	1	80 (40.0%)
	2	64 (32.0%)
	3	19 (9.5%)
	4	6 (3.0%)
	5	2 (1.0%)
Weight gain during pregnancy adherence to the NAM recommendations	Inadequate	85 (42.5%)
	Adequate	75 (37.5%)
	Excessive	40 (20.0%)
	Total	200 (100%)
Preterm birth	Absent	180 (90.0%)
	Present	20 (10.0%)
Gestational age		280 (245–288)
Neonatal birth weight		3372 (2300–3979)

Variables expressed by median (range) or *n* (%) as appropriate

There are no differences in SGA neonates between both groups.

Pre-pregnancy findings, pregnancy data, and neonatal outcomes according to recommendations of NAM for gestational weight gain were detailed in Table 3.

Post-hoc test using Dunn's multiple comparisons, to indicate which groups were significantly different from each other were detailed in Tables 4 and 5.

Pregnancy-related complications

Pregnancy-related complications as gestational diabetes mellitus (GDM) and hypertension were not related to interval between surgery and conception or to degree of gestational weight gain.

None of included patients have preeclampsia.

Postpartum hemorrhage was found in in (4%) of all included patients. Congenital defects were found in (4%) of neonates. No significant differences between the included three groups of patients regarding incidence of congenital anomalies, perinatal deaths, or admission to neonatal intensive care unit.

Discussion

In the present study when we assessed the value of timing pregnancy after bariatric surgeries, we found that in the early group of patients that have conceived within 12 months gestational weight gain, gestational age at delivery, in addition to neonatal birth weight were lower than those in the middle group of patients that have conceived from 12 to 24 months from bariatric surgeries and also lower than those in the group of patients that have conceived after 24 months from bariatric surgeries, additionally we found that early preterm births were observed more frequently in the early group which was similar to results of Heusschen et al. [14].

Our results were different from results of previous studies that demonstrated no associations between pregnancy timing after bariatric surgeries, pregnancy, maternal or neonatal outcomes. Moreover they stated that there were no increased risks of pregnancy outcomes during the 1st 12 months after performing bariatric surgeries in comparison with later pregnancies [16–20].

We demonstrated that neonatal birth weight and gestational age at delivery were lower in pregnancies

Table 2 Pre-pregnancy, pregnancy, and neonatal findings according to time from surgery to pregnancy

		Timing of pregnancy			*P*
		Early group (≤ 12 months) *N* = 50	Middle group (12–24 months) *N* = 50	Late group (> 24 months) *N* = 100	
Age		34 (22–45)	42 (30–59)	40 (19–59)	< 0.001
Pre-pregnancy BMI		34 (22–45)	42 (30–59)	40 (19–59)	< 0.001
BMI at conception		25 (20–30)	25 (20–30)	25 (20–30)	0.967
TBWL from surgery to conception		22 (15–35)	33 (20–39)	41 (19–59)	< 0.001
Time from bariatric surgery to pregnancy in months		10 (5–11)	18 (13–22)	29 (18–30)	< 0.001
Performed bariatric surgery	RYGB	28 (56.0%)	31 (62.0%)	62 (62.0%)	0.495
	OAGB	6 (12.0%)	9 (18.0%)	18 (18.0%)	
	SG	16 (32.0%)	10 (20.0%)	20 (20.0%)	
Parity	0	5 (10.0%)	12 (24.0%)	12 (12.0%)	0.495
	1	20 (40.0%)	17 (34.0%)	43 (43.0%)	
	2	17 (34.0%)	15 (30.0%)	32 (32.0%)	
	3	4 (8.0%)	5 (10.0%)	10 (10.0%)	
	4	3 (6.0%)	0 (0.0%)	3 (3.0%)	
	5	1 (2.0%)	1 (2.0%)	0 (0.0%)	
Weight gain during pregnancy adherence to the NAM recommendations	Inadequate	35 (70.0%)	14 (28.0%)	36 (36.0%)	< 0.001
	Adequate	11 (22.0%)	25 (50.0%)	39 (39.0%)	
	Excessive	4 (8.0%)	11 (22.0%)	25 (25.0%)	
Preterm birth	Absent	42 (84.0%)	46 (92.0%)	92 (92.0%)	0.064
	Present	8 (16.0%)	4 (8.0%)	8 (8.0%)	
Gestational age		272 (250–288)	277 (248–288)	282 (245–288)	< 0.001
Neonatal birth weight		2973 (2300–3479)	3375 (3171–3979)	3375 (3171–3979)	< 0.001

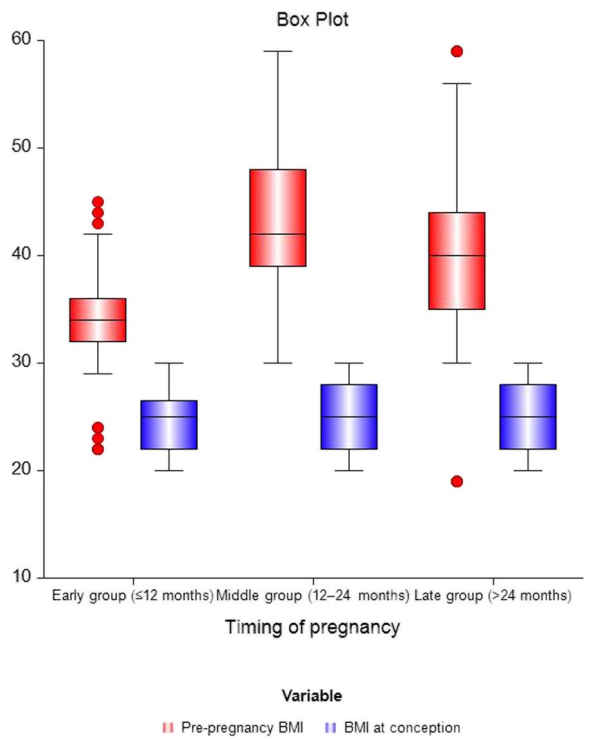

Fig. 1 Box-Plot of timing of pregnancy in the three groups

within 12 months post-surgery. We considered reduction in neonatal birth weight of about ± 200 g although not clinically relevant as previous studies considered it, but we showed that the lower gestational age and high incidence of preterm births in the early group are alarming.

As gestational weight gain has a direct effect on the maternal and child health, so, recommendations of NAM has been put for weight gain during pregnancy which depended on the BMI before pregnancy [8]. In our present study, we showed that gestational gain of weight was lower in the early group who get pregnant within 12 months after performing bariatric surgery and it was below the recommendations of NAM in 75% of those patients. Our results were in line with former studies which found that gestational weight gain was more adequate in patients who conceived in more than 12 months after performing bariatric surgery [14, 19, 21].

We found that low gestational weight gain in the early group was related to a lower gestational age at delivery in addition to many preterm births of < 32 weeks, similarly results of previous studies [12, 18, 19]. Additionally some females had inadequate weight gain in the early group in the form of weight loss during pregnancy,

Table 3 Pre-pregnancy characteristics and pregnancy and neonatal outcomes according to adherence to the NAM recommendations for gestational weight gain

		Weight gain during pregnancy adherence to the NAM recommendations			*P*
		Inadequate 85	Adequate 75	Excessive 40	
Age		37 (19–59)	42 (29–59)	39 (19–59)	0.008
Pre-pregnancy BMI		37 (19–59)	42 (29–59)	39 (19–59)	0.008
BMI at conception		25 (20–30)	25 (20–30)	25 (20–30)	0.71
TBWL from surgery to conception		32 (15–59)	33 (20–59)	36 (19–59)	0.059
Time from bariatric surgery to pregnancy in months		16 (5–30)	25 (5–30)	26 (10–30)	0.006
Performed bariatric surgery	RYGB	78 (91.8%)	43 (57.3%)	0 (0.0%)	< 0.001
	OAGB	6 (7.1%)	21 (28.0%)	6 (15.0%)	
	SG	1 (1.2%)	11 (14.7%)	34 (85.0%)	
Parity	0	9 (10.6%)	7 (9.3%)	13 (32.5%)	0.056
	1	33 (38.8%)	35 (46.7%)	12 (30.0%)	
	2	28 (32.9%)	25 (33.3%)	11 (27.5%)	
	3	10 (11.8%)	6 (8.0%)	3 (7.5%)	
	4	4 (4.7%)	2 (2.7%)	0 (0.0%)	
	5	1 (1.2%)	0 (0.0%)	1 (2.5%)	
Preterm birth	Absent	73 (85.9%)	71 (94.7%)	36 (90.0%)	0.181
	Present	12 (14.1%)	4 (5.3%)	4 (10.0%)	
Gestational age		275 (245–288)	281 (250–288)	282 (250–288)	< 0.001
Neonatal birth weight		3274 (2579–3979)	3375 (2579–3979)	3375 (2300–3979)	0.001

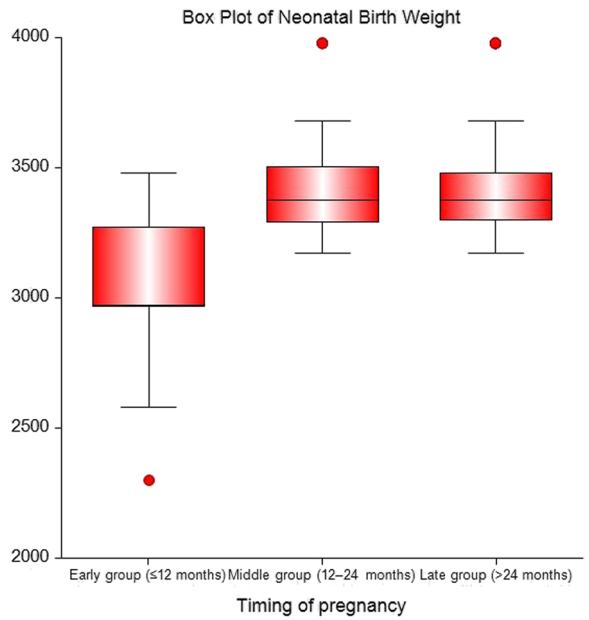

Fig. 2 Box-Plot of neonatal birth weight in the three groups

similar results were showed by Kapadia et al. [22], that, obese females with weight loss during pregnancy had higher liability of SGA fetus and preterm deliveries in comparison with women who conceived late after bariatric surgery and have adequate weight gain.

All these results collectively lead to encouraging women who wish to conceive after performing bariatric surgery to postpone pregnancy until stabilization of their weight so as to decrease inadequate gestational weight gain risks and decrease fetal and maternal morbidities and risks of developing fetal metabolic syndromes later on [23]. Our results are in line with recommendations of [24].

Additionally, another value of postponing pregnancy until the weight is stabilized is avoiding the bad psychological effect of (gestational) weight gain in females underwent bariatric surgeries and seeking for pregnancy.

Conclusion

In the present study, we tried to detect the best time of getting pregnancy in females underwent bariatric surgeries by comparing females conceived after different periods and we supported recommendations of postponing pregnancy for more than 12 months after performing bariatric surgery which allowed stabilization of maternal weight, allowing adequate gestational weight gain, better fetal and maternal health later on.

Table 4 Post-hoc test using Dunn's multiple comparison, to indicate which groups were significantly different from each other

	Early group (≤ 12 months) vs. middle group (12–24 months)	Early group (≤ 12 months) vs. late group (> 24 months)	Middle group (12–24 months) vs. late group (> 24 months)
Age	< 0.001	< 0.001	0.016
Pre-pregnancy BMI	< 0.001	< 0.001	0.016
BMI at conception	0.774	0.854	0.883
TBWL from surgery to conception	< 0.001	< 0.001	< 0.001
Time from bariatric surgery to pregnancy in months	< 0.001	< 0.001	< 0.001
Gestational age	0.009	< 0.001	0.042
Neonatal birth weight	< 0.001	< 0.001	> 0.999

Table 5 Post-hoc test using Dunn's multiple comparison, to indicate which groups were significantly different from each other

	Inadequate vs. adequate	Inadequate vs. excessive	Adequate vs. excessive
Age	0.001	0.388	0.074
Pre-pregnancy BMI	0.001	0.388	0.074
BMI at conception	0.579	0.696	0.406
TBWL from surgery to conception	0.211	0.031	0.267
Time from bariatric surgery to pregnancy in months	0.014	0.001	0.208
Gestational age	< 0.001	< 0.001	0.873
Neonatal birth weight	0.006	0.003	0.479

Points of strengths of the study

The main point of the study which is timing of pregnancy is not sufficiently clarified in previous studies, and out study assessed such point adequately in a prospective manner and on relatively large number of patients in childbearing period underwent bariatric surgeries.

Points of weakness and recommendations

Our study and previous studies have not assessed effect of each subtype of bariatric surgery separately which has different mechanisms with variable physiological consequences.

We recommend to perform large scale study and divide patient according to subtype of bariatric surgery.

Moreover, our study did not assess the long-term effect of bariatric surgeries on fertility and off-springs of females who underwent bariatric surgeries, so we recommend longer follow-up period to females in reproductive age before and after performing bariatric surgery in addition to following up their offspring.

Abbreviations

BMI Body mass index
SGA Small for gestational age
RYGB Roux-en-Y gastric bypass
OAGB One anastomosis gastric bypasses
SG Sleeve gastrectomy
GDM Gestational diabetes mellitus

Acknowledgements

Not applicable.

Authors' contributions

All authors shared in data collection, choosing object, data analysis, patients management, follow-up, writing, editing and reviewing the manuscript. The author(s) read and approved the final manuscript.

Funding

No funds were received from our organization.

Availability of data and materials

Please contact author for data requests.

Declarations

Ethics approval and consent to participate

Ethics approval and consent to participate were acquired from local institutional review board of Faculty of Medicine, Zagazig University.

Consent for publication

Consent for publication is acquired from all patients.

Competing interests

The authors declare that they have no competing interests.

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Received: 6 May 2022 Accepted: 28 March 2023
Published online: 03 April 2023

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