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Effect of Maternal Obesity on Operative and Post-Operative Complications of Elective Cesarean Section: An Observational Cross-Sectional Study

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ABSTRACT

Background: Numerous studies indicate that difficulties during and after cesarean section may be linked to maternal obesity. **Objective:** This study aimed to assess the consequences of maternal obesity on intra-operative and post-operative sequelae of elective Cesarean delivery.

Patients and methods: Based on maternal BMI at time of delivery, patients were categorized into 3 groups: Normal weight, overweight and obese women. Operative data were documented including operative time, estimated blood loss during CS, etc. Post-operative data included post-operative care timing of catheter removal, return of intestinal sounds, mobilization, initiation of oral feeding, etc. Post-operative complications included postpartum hemorrhage, surgical site infection, DVT, blood transfusion, ICU admission and pulmonary embolism. Fetal outcome was documented including 1 & 5 minute Apgar score, RDS, birth injuries, NICU admission. **Results:** Operative time was statistically significant longer 40.30 ± 3.28 vs. 33.19 ± 4.42 vs. 27.80 ± 5.16 mins, need insertion of intra-peritoneal drain was higher (7.3%) vs. 0 (0.0%) vs. 0 (0.0%), timing of catheter removal was more delayed 5.48 ± 1.19 vs. 4.06 ± 0.82 vs. 3.00 ± 0.88 hours among obese. Incidence of postpartum hemorrhage was statistically significant higher 16 (14.5%) vs. 12 (10.9%) vs. 6 (5.5%) among obese compared to overweight and normal weight women.

Conclusion: Adverse consequences for either mother or baby have been linked to maternal obesity. BMI > 30 kg/m^2 was linked to a higher risk of postpartum hemorrhage, a longer length of stay in the operating room, and delayed urinary catheter removal as maternal outcomes. In terms of fetal outcomes, a greater risk of fetal macrosomia and the newborn's transient tachypnea were linked to higher BMI. [

Keywords: Maternal obesity, Operative complications, Cesarean section.

INTRODUCTION

Obesity and overweight are chronic non-communicable disorders that raise the possibility of mental and physical health issues. The obesity pandemic worldwide has worsened delivery outcomes and added to the burden of obesity throughout pregnancy. The percentage of women who are obese grew globally from 6.4% in 1975 to 14.9% in 2014. Egypt is ranked 18th in the world for the highest prevalence of obesity, in accordance to the World Health Organization (WHO) [(1)].

During pregnancy and childbirth, as well as in the newborn period and beyond, maternal obesity has detrimental effects on both the mother and the baby. In addition, pregnancy and delivery-related problems claim the lives of roughly 830 women each day. The majority of them are found in developing nations [(2)].

Elevated maternal body mass index (BMI) has been attributed in latest studies to hypertensive complications, infertility, cesarean sections, maternal mortality, newborn admission to the neonatal intensive care unit (NICU), premature birth, congenital anomalies, low birth weight (LBW), respiratory issues like asthma and childhood mortality. Nevertheless, it is still unclear how maternal BMI and these results are clearly related [(3)].

Furthermore, it has been noted that a significant risk factor for both operational and postoperative problems following an elective cesarean section is maternal obesity. Women who are obese are prone to have longer surgical times, suffer problems with anesthesia, and bleed excessively after having surgery. They may also need an intraperitoneal drain following surgery, and they have a greater likelihood of bladder or intestinal damage [(4)].

Moreover, a high BMI may be linked to postoperative complications from an elective cesarean section, including deep vein thrombosis (DVT), pulmonary embolism, blood transfusion, postpartum bleeding, urinary tract infections, infections of the respiratory system, and surgical site infections [(5)].

Our research seeks to evaluate the effects of obesity of mothers on the operative and post-operative problems associated with elective cesarean sections.

PATIENTS AND METHODS

This cross-sectional research was conducted from September 2023 to March 2024 at Obstetrics and Gynecology department, Cairo University Hospitals.

I. Study population:

Inclusion criteria: Pregnant women who addressed the obstetrics outpatient clinic: Age between 20 and 40, parity ≤ 3, BMI < 18.5 kg/m^2, with a gestational age of around 38 weeks, singleton pregnancy, who was scheduled for a scheduled Cesarean section under the influence of spinal anesthesia.

Exclusion criteria: Women who had multiple pregnancies, known fetal malformations, IUGR and IUFD, placental abnormalities (placenta previa, accidental hemorrhage, and placenta accreta) and medical illnesses during pregnancy (hypertension, diabetes, anemia, etc.), or multiple pregnancies.

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II. Sampling method "Convenient targeted sampling":

Convenience sampling is the practice of selecting participants who are "convenient" for the researcher. These responders can be located by simply approaching people who are present everywhere; there is not a single pattern in how they are located. They are frequently mistaken for "random sampling" due to the idea that they are being stopped "at random" or carelessly. A convenience sample has a very high level of bias, in contrast to the proper definition of random sampling, which is selecting possible responders or participants from a sampling frame using random numbers. This method typically yields a statistically balanced selection of the population.

III. Sample size: Three groups consisting of 330 women were recruited in total (normal weight, overweight and obese).

IV. Sample size justification: We used Power Analysis and Sample Size Software (PASS 2020) "NCSS, LLC. Kaysville, Utah, USA, to escalate the sample size. A minimum total postulated sample size of 300 eligible women was required, according to a prior published research [(6)], taking into account a 95% level of confidence, an effect size of 1/100 and 5% margin of error using two-sided proportional Z- test. Sample size will be increased 10 % for possible dropout rate, so 330 women will be enrolled in the study (110 in each group).

V. Ethical considerations: The patients gave their acceptance to take part in the clinical study prior to enrollment after being given a clear explanation of its purpose, scope, and potential outcomes. The Helsinki Declaration was complied with throughout the entire investigation process.

VI. Study interventions and procedures:

1. After approval of study protocol, all women went through:
   a) **History including:** Personal, menstrual, obstetric, medical and surgical history.
   b) **Full clinical examination with special emphasis on:** Vital signs, pallor and signs of associated medical disorders and body mass index. The BMI (kg/m^2) was estimated as body weight (kg) / height (m) squared [(6)]
   c) **Investigation:** Routine antenatal care investigations as complete blood picture, urine analysis, blood group (ABO) and Rh.
   d) **Routine Ultrasonography:** To perform fetal biometry, viability check, fetal presentation, assessment of AFI, estimation of EFW and localization of placenta.
2. Based on maternal BMI at time of delivery, patients were categorized into 3 groups [(6)]:
   - **Group A "normal weight" (n=110):** BMI 18.5 – 24.9 kg/m^2.
   - **Group B "overweight" (n=110):** BMI 25 – 29.9 kg/m^2.
   - **Group C "obese" (n=110):** BMI ≥ 30 kg/m^2.
3. We documented the data using specific data collection sheet.
4. Operative data was documented including**:** anesthetic details, operative time, estimated blood loss during CS, bladder or intestinal injury and insertion of intra peritoneal drain.
5. Patients were followed **twenty-four to forty-eight** hours post-delivery in the hospital then patients were discharged and follow-up after **one week for wound infection and other late outcomes** and post-operative CBC were done.
6. **Estimated blood loss during CS** was calculated from this **formula [(7)]**:

EBL = (EBV × Pre-op Hct – Post-op Hct) / Pre-op Hct

*EBL (Estimated blood loss) *EBV (estimated blood volume) *Pre-op Hct (preoperative hematocrit) *Post-op Hct (post-operative hematocrit) * estimated blood volume= booking weight (Kg) ×85.

7. **Post-operative data including:**
   a) **Post-operative care**: Timing of catheter removal, return of intestinal sounds, mobilization, initiation of breast feeding, oral feeding and need for analgesia.
   b) **Post-operative complications including**: Postpartum hemorrhage, surgical site infection (SSIs), urinary tract infection (UTIs), respiratory tract infection (RTIs), deep venous thrombosis, blood & plasma transfusion, ICU admission and pulmonary embolism
   c) **Fetal outcome**: was documented including: 1 & 5 minute Apgar score, weight at birth, respiratory distress syndrome (RDS), birth injuries, NICU admission.

VII. Study outcomes:

- **Primary outcomes:** Effect of maternal obesity on operative and postoperative complications of elective Cesarean section regarding: **Intra-operative complications (e.g.:** Anesthetic complication, operative time, estimated blood loss during CS, bladder or intestinal injury & insertion of intra peritoneal drain), **post-operative care (**Timing of catheter removal, return of intestinal sounds, mobilization, initiation of breast feeding, oral feeding and need for analgesia.) and **post-operative complications (**Surgical site infection, postpartum hemorrhage, urinary tract infections, respiratory tract infections, blood transfusion, ICU admission, postoperative DVT & pulmonary embolism).
- **Secondary outcomes: (foetal outcome):** One minute and 5-minute Apgar score, Birth weight, RDS, birth injuries & NICU admission.

VIII. Statistical analysis

We analyzed the recorded data by applying the statistical software for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were displayed as ranges and mean ± standard deviation. Numbers and percentages were used to display qualitative statistical data. To compare more than two

means, we adopted the one-way analysis of variance (ANOVA). The Post Hoc test was used for multiple comparisons between several variables at once. We also considered the Kruskall Wallis test for multiple-group analysis with non-parametric data. When comparing groups, we used the appropriate of either Fisher's exact test or Chi-square test if qualitative data was analyzed. P-values ≤ 0.05 were considered statistically significant. P-values were considered highly significant if they were ≤ 0.001. Negligible was defined as a P-value > 0.05.

RESULTS

Our study focused on 330 patients who were allocated into three groups to look into how maternal obesity affects the operative and post-operative issues of elective Cesarean sections. With standardized inclusion and exclusion criteria, group A comprised 110 women with a BMI from 18.5 to 24.9 kg/m², group B included 110 women with a BMI of 25–29.9 kg/m^2, and group C that contained 110 women with a BMI of ≥ 30 kg/m².

Results are displayed in the following tables:
Table (1): The distinct groups do not significantly differ in terms of obstetric history gravity, parity, full-term, pre-term, abortion, and living, with a p-value > 0.05.

Table (1): Comparison between groups according to baseline data

Baseline data	Group A (n=110)	Group B (n=110)	Group C (n=110)	Test value	p-value	Sig.
Age (years)						
Mean ± SD	27.39±4.97	28.42±4.96	27.65±5.19	1.234	0.293	NS
Range	20-40	21-40	20-39			
Weight (kg)						
Mean ± SD	70.26±4.23	79.08±4.98	87.64±4.86	374.944	0.000	HS
Range	63-79	70-87	75-95			
Height (cm)						
Mean ± SD	172.86±3.49	170.00±4.70	169.14±4.56	1.764	0.592	NS
Range	169-181	162-178	156-177			
BMI [wt/ (ht)^2]						
Mean ± SD	22.72±1.32	27.37±1.38	32.75±1.41	1191.637	0.000	HS
Range	20-24.8	25.1-29.8	30-35.4			
Gravidity						
Mean ± SD	2.25±1.00	2.33±0.90	2.23±0.95	0.324	0.723	NS
Median (IQR)	2 (1-3)	2 (2-3)	2 (1-3)			
Range	1-4	1-4	1-4			
Parity						
Mean ± SD	2.16±0.88	2.23±0.79	2.11±0.85	0.545	0.581	NS
Median (IQR)	2 (1-3)	2 (2-3)	2 (1-3)			
Range	1-3	1-3	1-3			
Full-term						
Mean ± SD	1.45±0.50	1.42±0.51	1.41±0.51	0.246	0.782	NS
Median (IQR)	1 (1-2)	1 (1-2)	1 (1-2)			
Range	1-2	1-3	1-3			
Pre-term						
Mean ± SD	0.71±0.61	0.81±0.57	0.71±0.60	1.048	0.352	NS
Median (IQR)	1 (0-1)	1 (0-1)	1 (0-1)			
Range	0-2	0-2	0-2			
Abortion						
Mean ± SD	0.10±0.30	0.11±0.31	0.13±0.33	0.211	0.810	NS
Median (IQR)	0 (0-0)	0 (0-0)	0 (0-0)			
Range	0-1	0-1	0-1			
Living						
Mean ± SD	2.14±0.90	2.20±0.79	2.07±0.89	0.602	0.548	NS
Median (IQR)	2 (1-3)	2 (2-3)	2 (1-3)			
Range	0-3	1-3	0-3			
Gestational age	40.25±0.97	40.09±1.07	40.18±0.97	0.701	0.497	NS
	38.1-41	38-41	38-41			

Using: One way Analysis of Variance test was performed for Mean ± SD & Multiple comparison between groups through Post Hoc test: Tukey's test x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate, Different capital letters indicate significant difference at ($p<0.05$) among means in the same row, NS: Non significant; S: Significant; HS: Highly significant

Table (2): There was a highest mean value of operative time "min." in group C was 40.30 ± 3.28, followed by group B that was 33.19 ± 4.42, and then group A (27.80 ± 5.16, with p-value p < 0.05). Also, there was a highest mean value of timing of catheter removal in group C (5.48 ± 1.19), followed by group B (4.06 ± 0.82), and then group A (3.00 ± 0.88, with p-value p < 0.05). As for the insertion of intra peritoneal drain, there was a higher frequency in group C (8 women (7.3%), while there was no cases in group A and in group B, with p-value p < 0.05.

Table (2): Comparison between groups according to Intra-operative complication

Intra-operative complication	Group A (n=110)	Group B (n=110)	Group C (n=110)	Test value	p-value	Sig.
Operative time (min)						
Mean ± SD	27.80±5.16	33.19±4.42	40.30±3.28	227.770	0.000	HS
Range	20-36	25-40	35-45			
Bladder or intestinal injury						
No	110 (100.0%)	109 (99.1%)	108 (98.2%)	2.018	0.365	NS
Yes	0 (0.0%)	1 (.9%)	2 (1.8%)			
Insertion of intra peritoneal drain						
No	110 (100.0%)	110 (100.0%)	102 (92.7%)	16.398	0.000	HS
Yes	0 (0.0%)	0 (0.0%)	8 (7.3%)			
Timing of catheter removal						
Mean ± SD	3.00±0.88C	4.06±0.82B	5.48±1.19A	179.878	0.000	HS
Range	2-4	3-5	4-7			

Using: One-way Analysis of Variance test was performed for Mean ± SD & Multiple comparison between groups through Post Hoc test: Tukey's test, x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate, Different capital letters indicate significant difference at (p<0.05) among means in the same row, NS: Non significant; S: Significant; HS: Highly significant.

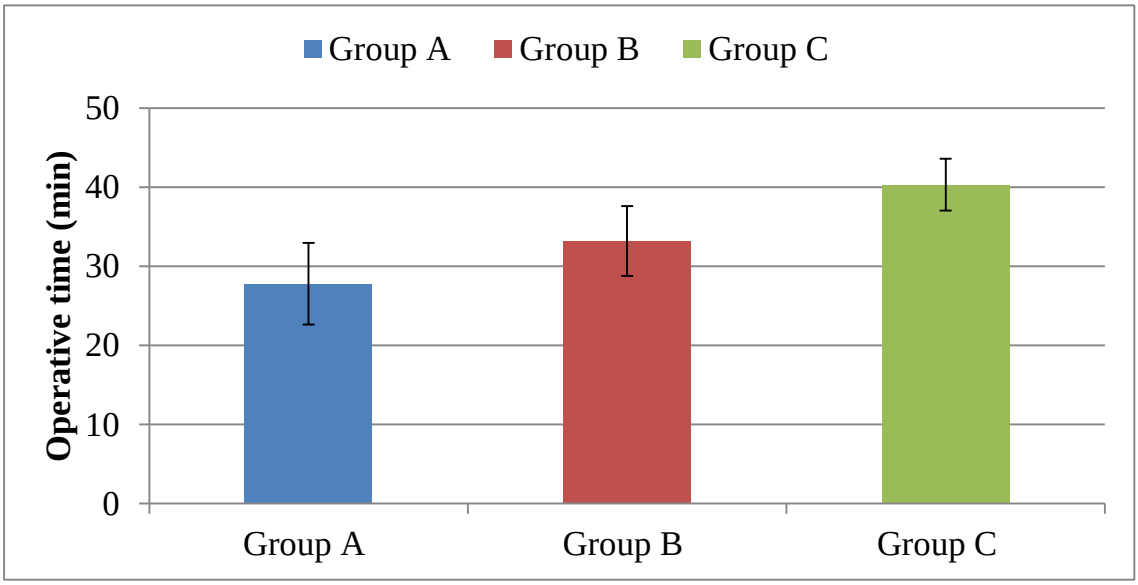

Figure (1): Comparison between groups according to Operative time (min)

Table (3): There was no statistically significant disparity amongst the groups regarding post-operative care about over dose for analgesia, return of intestinal sounds (hrs.), initiation of breast feeding (hrs.) and surgical site infection ($p < 0.05$).

Table (3): Comparison between groups according to Post-operative Care

Post-operative Care	Group A (n=110)	Group B (n=110)	Group C (n=110)	Test value	p-value	Sig.
Over dose for analgesia						
No	103 (93.6%)	102 (92.7%)	100 (90.9%)	0.606	0.739	NS
Yes	7 (6.4%)	8 (7.3%)	10 (9.1%)			
Return of intestinal sounds (hrs.)						
Mean ± SD	1.96±0.85	2.08±0.80	2.11±0.83	0.965	0.382	NS
Range	1-3	1-3	1-3			
Initiation of breast feeding (hrs.)						
Mean ± SD	4.13 ± 1.48	4.25 ± 1.36	3.93 ± 1.45	1.393	0.250	NS
Range	2-6	2-6	2-6			
Surgical site infection						
No	110 (100.0%)	110 (100.0%)	108 (98.2%)	4.024	0.134	NS
Yes	0 (0.0%)	0 (0.0%)	2 (1.8%)			

Using: One way Analysis of Variance test was performed for Mean ± SD x^2: Chi-square test for Number (%) or Fisher's exact test, when appropriate NS: Non significant; S: Significant; HS: Highly significant.

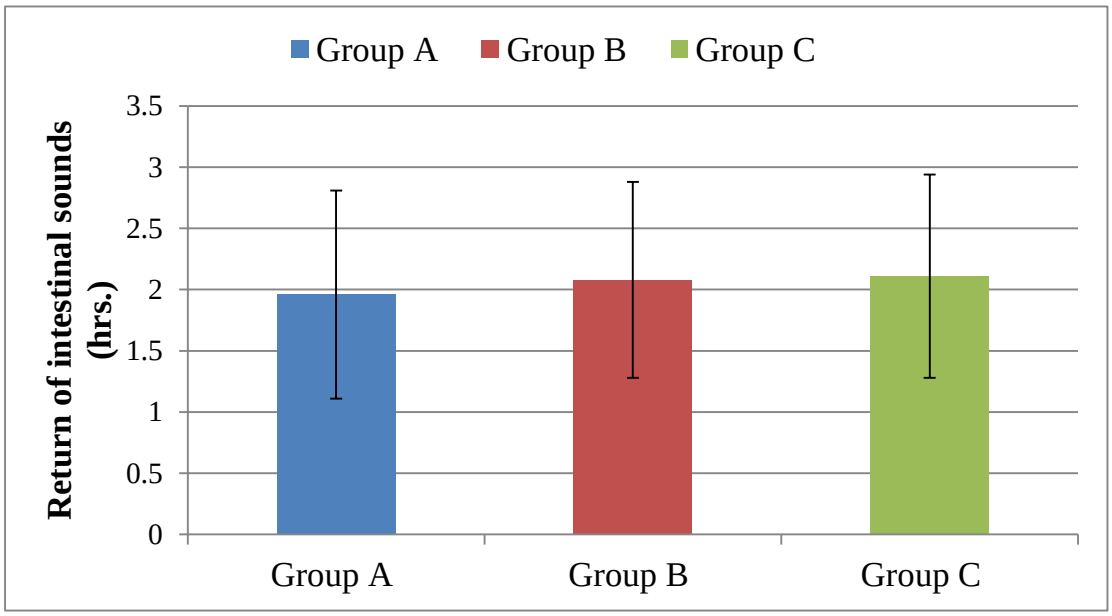

Figure (2): Comparison between groups according to Return of intestinal sounds (hrs.)

Table (4) showed a statistically significant higher frequency of major bleeding in group C (16 women, 14.5%), followed by group B (12 women, 10.9%), and then group A (6 women, 5.5%), with a p-value of $p < 0.05$. Also, there was a statistically significant increase macrosomia in group C (11, 10%), followed by group B (5, 4.5%) and group A that was 2 (1.8%) with a p-value < 0.05).

Table (4): Comparison between groups according to Post-operative complications.

Post-operative complications	Group A (n=110)	Group B (n=110)	Group C (n=110)	Test value	p-value	Sig.
Postpartum hemorrhage						
Major bleeding >1000ml	6 (5.5%)	12 (10.9%)	16 (14.5%)	5.993	0.042	S
Minor bleeding <1000ml	104 (94.5%)	98 (89.1%)	94 (85.5%)			
Post-operative DVT						
No	110 (100.0%)	110 (100.0%)	110 (100.0%)	0.000	1.000	NS
Blood transfusion						
No	110 (100.0%)	107 (97.3%)	101 (91.8%)	10.896	0.004	S
Yes	0 (0.0%)	3 (2.7%)	9 (8.2%)			
ICU admission						
No	110 (100.0%)	110 (100.0%)	109 (99.1%)	2.006	0.367	NS
Yes	0 (0.0%)	0 (0.0%)	1 (.9%)			
Pulmonary embolism						
No	110 (100.0%)	110 (100.0%)	110 (100.0%)	0.000	1.000	NS
Birth weight						
Macrosomia	2 (1.8%)	5 (4.5%)	11 (10.0%)	7.404	0.025	S
Normal	108 (98.2%)	105 (95.5%)	99 (90.0%)			
RDS						
No	110 (100.0%)	109 (99.1%)	109 (99.1%)	1.006	0.605	NS
Yes	0 (0.0%)	1 (0.9%)	1 (0.9%)			
Birth injuries						
No	110 (100.0%)	110 (100.0%)	110 (100.0%)	0.000	1.000	NS
NICU admission						
No	109 (99.1%)	108 (98.2%)	107 (97.3%)	1.019	0.601	NS
Yes	1 (0.9%)	2 (1.8%)	3 (2.7%)			
TTN						
No	108 (98.2%)	105 (95.5%)	99 (90.0%)	7.404	0.025	S
	2 (1.8%)	5 (4.5%)	11 (10.0%)			

Using: x2: Chi-square test for Number (%) or Fisher's exact test, when appropriate Different capital letters indicate significant difference at ($p<0.05$) among means in the same row NS: Non significant; S: Significant; HS: Highly significant.

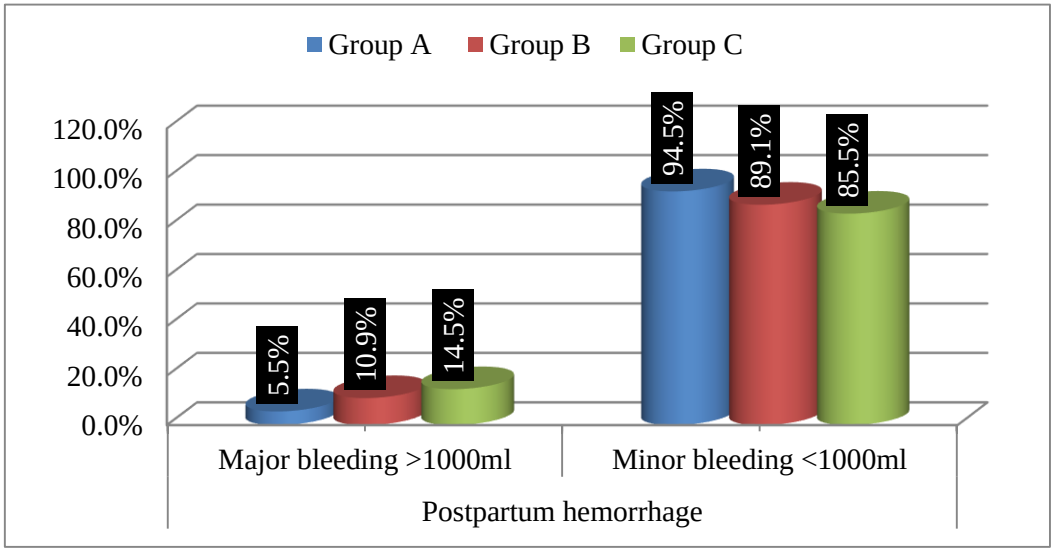

Figure (3): Comparison between groups according to postpartum hemorrhage.

DISCUSSION

There is a considerable impact of obesity on the pregnancy outcome. Obesity during pregnancy has been blamed for poorer perinatal and neonatal outcomes, in addition to an increased risk of diabetes and hypertension [8].

Obese mothers are more likely to experience pregnancy sequelae as anemia, elevated blood pressure, pre-eclampsia, preterm birth, emergency Cesarean section, and gestational diabetes [9].

There is ample evidence that doing surgery on severely obese individuals poses a number of operational, anesthetic, and logistical obstacles. Furthermore, individuals with BMI > 40 kg/m^2 have a longer duration from skin incision to delivery, a longer overall surgical time, and a higher risk of hemorrhage after giving birth [10].

In our study, **operative time** was statistically longer (40.30±3.28 vs. 33.19±4.42 vs. 27.80±5.16 mins), need **insertion of intra peritoneal drain was higher [**8 (7.3%) vs. 0 (0.0%) vs. 0 (0.0%)] and **timing of catheter removal** was delayed (5.48±1.19 vs. 4.06±0.82 vs. 3.00±0.88 hours) among obese compared to overweight and normal weight women. **Girsen *et al.*** [11] concurred with us and found that a higher BMI is associated with a longer interval from incision-to-delivery as well as a longer operative duration during Cesarean birth, with women who have a BMI that is morbidly obese being most at risk for a protracted incision-to-delivery interval. Compared to women with normal BMIs at delivery, women with overweight, obese, and morbidly obese BMIs had longer operating times. Women who were morbidly obese had a higher frequency of incision-to-delivery intervals lasting eighteen minutes or more. A period from incision to delivery exceeding 18 minutes was substantially associated with all classes of obesity at birth, even after controlling for the number of previous cesarean deliveries**.**

Known risk factors for longer operating times, such as the type of skin incision, the number of previous Cesarean deliveries, and the weight of the newborn, did not affect the relationship between higher BMI and the incision-to-delivery delay. Furthermore, a longer overall operating time during a Cesarean delivery was linked to higher BMI. Our results are in line with earlier, more focused researches by **Conner *et al.*** [12] **and Rossouw *et al.*** [13]indicating a link between obesity and longer recovery times following surgery **. Edwards *et al.*** [14] looked at 5,742 women, including those who underwent spinal anesthesia during a prelabor Cesarean delivery and resulted in a live, full term, non-anomalous single baby. Our findings corroborate those of **Edwards *et al.*** [14] and imply that longer operating times may affect the outcomes of newborns delivered via Cesarean section**.** The findings of **Butwick *et al.*** [15] as well as **Doherty *et al.*** [16] who demonstrated in cohorts of women approximating 1600 to 2200 that the mother's BMI above 30 increased the length of the cesarean procedure, are in line with our research**.** Additionally, **Butwick *et al.*** [15] showed that women with a BMI of ≥ 40 had longer intraoperative times for Cesarean sections. The limited size of each BMI group (n = 25) may have contributed to the lack of differences found in the incision-to-delivery timings across the different groups.

According to a different study, even among women who are extremely obese, the likelihood of intraoperative sequelae does not seem to be elevated, in contrast to the probability of postpartum issues [17]. The belief is that obesity is a significant and common risk factor for pregnancy problems, raising the probability of primary postpartum hemorrhage and pulmonary embolism [18].We reported that incidence of **postpartum hemorrhage** was statistically significantly higher [16 (14.5%) vs. 12 (10.9%) vs. 6 (5.5%)] and need for blood transfusion was statistically significant higher 9 (8.2%) vs. 3 (2.7%) vs. 0 (0.0%) among obese compared with overweight and normal weight women.

Our results are consistent with the slight association **Butwick *et al.*** [15] found between obesity in mothers and the risk of bleeding after delivery. Depending on the mode of birth, the relationship between bleeding and body mass index may go in different directions. In comparison with women with a normal BMI, overweight and obese class I women had slightly greater risks of bleeding and atonic hemorrhage. Overweight & obese women had a 19% higher risk of atonic bleeding after giving delivery. However, women of any category of obesity are exposed to a 14% fewer chance of experiencing significant bleeding following cesarean delivery [19]**.** **According to Knight *et al.*** [20] the relationship between body mass index category and bleeding after childbirth is noticeably unclear. In a population-based study, **Kim *et al.*** [21] found no correlation between postpartum hemorrhage and obesity when comparing the perinatal outcomes of singleton pregnancies in obese and non-obese women. Data from earlier research by **Lisonkova *et al.*** [22] imply that obese women might have a lower chance of experiencing bleeding and morbidity. Of the 743,000 Washington State pregnant women who were delivered in the years from 2004 to 2013, class III obese cases had a 30% lower risk of severe PPH than women with an average body mass index. According to **Butwick *et al.*** [19], obese females were less subjected than non-obese females to experience hemorrhage-related morbidity when they experienced uterine atony following Cesarean delivery.

Prior research has indicated a correlation between rising BMI and perioperative maternal complications, such as difficulties from anesthesia, elevated estimated blood loss, and more wound issues following surgery [23]. Additionally, **fetal macrosomia** and **frequency of transient tachypnea of the newborn** were statistically significant higher [11 (10.0%) vs. 5 (4.5%) vs. 2 (1.8%)] and [11 (10.0%) vs. 5 (4.5%) vs. 2 (1.8%)] respectively. We were not alone when **Avcı *et al.*** [24] reported that obesity increases the probability of

maternal-fetal illness and death during pregnancy and is a major contributing factor to pregnancy issues. During the perinatal period, the obese group showed significantly higher rates of gestational hypertension, diabetes mellitus, Cesarean section, premature membrane rupture, shoulder dystocia, meconium-stained amniotic fluid, abnormal CTG pattern, and postpartum infectious morbidity. Compared to cases of normal weight, adverse maternal effects were substantially more common in obese cases.

Obese individuals had considerably greater rates of prematurity, perinatal mortality, low Apgar scores, the need for NICUs, hypoglycemia, and macrosomia than in non-obese cases did. Nevertheless, compared to the other BMI groups, the LBW infant rate was greater in the lower BMI instances ($p < 0.01$). In correspondence with us, **Minsart *et al.*** [25] discovered that offspring born to obese women had greater likelihood of low Apgar scores and neonatal admission to critical care following both spontaneous and induced birth. In comparison with non-obese moms, the adjusted odds ratio for neonatal intensive care unit admission was greater for obese mothers by 38%, and following spontaneous and induced labor, it was higher by 45% and 34%, respectively. Following a Cesarean section, in comparison with non-obese women, obese women had an increased probability of a 1-minute Apgar score < 7, which is increased by 31%, and following spontaneous and induced labor, by 26% and 38%, respectively.

Finally, **different BMI values had no impact on** incidence of bladder or intestinal injury, need for additional analgesia, return of intestinal sounds, initiation of breast feeding, surgical site infection, post-operative DVT, ICU admission, pulmonary embolism, RDS, birth injuries and need for NICU admission.

The strength points of this study:

The cross-sectional study design and the fact that throughout the research duration, no patients were withdrawn. Prior to analysis, a few potential confounders were initially eliminated, such as pregnant women with known fetal malformations, repeated pregnancies and medical conditions during pregnancy or placental abnormalities that could have an impact on the accuracy of our study's findings. This was the first study conducted at Cairo University Hospitals to assess how maternal obesity affected the surgical and post-operative risks associated with elective cesarean sections. We studied a variety of body mass indices among pregnant subjects.

All possible efforts were made to guarantee that all information was captured and that the data analyses only included full information. Instead of serving as a referral center for women at high risk, our hospital network served both rural and urban populations that were representative of the general public. The delivery outcomes were prospectively recorded in the hospitalization database. All evaluations in clinical setting and trial results analyses were carried out by the same team.

Drawbacks of the research:

The study's limitations are noteworthy to emphasize. Because it was conducted in a hospital, there were relatively smaller number of cases compared to the study outcomes. Considering the study was not multicentric, there was a substantial risk of publishing prejudice and failed to speak for a certain community. Furthermore, our hospital's database did not include information on the socioeconomic status, BMI predating pregnancy, or pregnancy weight gain for mothers. Overestimating the likelihood of poor birth outcomes or potential statistical bias could result from not accounting for these variables.

Substantial prospective multicenter research studies involving more participants are essential to evaluate the association between obesity and pregnancy outcomes and to further examine the influence of obesity before, during, and after pregnancy.

As a recommendation, sufficient maternal weight reduction should be taken into consideration before conception. Public health initiatives to inform the public about the importance of eating a balanced diet either before or at the start of a pregnancy are becoming more and more necessary. It is necessary to include this knowledge into prenatal care, premarital counseling, and educational curriculum. When mothers first see a healthcare provider, they should be given the proper nutritional guidance and supplements. The present study broadens the repository of knowledge and offers some guidance for future multicenter prospective studies that will reassess our results using longer follow-up periods and larger sample numbers.

CONCLUSION

Our research concludes that unfavorable maternal and fetal outcomes were linked to maternal obesity. BMI equal or greater than 30 kg/m^2 was linked to a higher risk of postpartum hemorrhage, a longer length of stay in the operating room, and an earlier urinary catheter removal date. In terms of fetal outcomes, a greater likelihood of fetal macrosomia and the newborn's transitory tachypnea were linked to higher BMI. It is said that maintaining appropriate weight control throughout pregnancy is essential for good health. However, in many impoverished nations, it might not be feasible to implement effective dietary control and health initiatives.

The manuscript's authors declare that:

1) The work is not being considered by anybody else.
2) None of the material has been previously published.
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REFERENCES

1. **Aboulghate M, Elaghoury A, Elebrashy I *et al.* (2021):** The burden of obesity in Egypt. Frontiers in public health, 9: 718978.
2. **Sofer D (2018):** Why are women still dying of pregnancy and childbirth? AJN The American Journal of Nursing, 118 (9): 12.
3. **Papachatzi E , Dimitriou G, Dimitropoulos K *et al.* (2013):** Pre-pregnancy obesity: maternal, neonatal and childhood outcomes. Journal of neonatal-perinatal medicine, 6 (3): 203-216.
4. **Yang X, Sun S (2017):** Comparison of maternal and fetal complications in elective and emergency cesarean section: a systematic review and meta-analysis. Archives of gynecology and obstetrics, 296: 503-512.
5. **Girsen A, Osmundson S, Naqvi M *et al.* (2014):** Body mass index and operative times at cesarean delivery. Obstetrics & Gynecology, 124 (4): 684-689.
6. **Yagur Y, Ribak R, Ben Ezry E,*et al.* (2022):** Do maternal albumin levels affect post-operative complications after cesarean delivery? BMC pregnancy and childbirth, 22 (1): 1-6.
7. **World Health Organization (2022):** Obesity: preventing and managing the global epidemic: Report of a WHO consultation, 19 (4): 56-59.
8. **Kassab A, Sedek A (2021):** Comparative study between intramyometrial oxytocin and oxytocin analogue (carbetocin) in prevention of postpartum hemorrhage following cesarean section. Al-Azhar Assiut Medical Journal, 19 (4): 556-559, | DOI: 10.4103/AZMJ.AZMJ_126_20
9. **Langley-Evans C, Pearce J, Ellis S *et al.* (2022):** Overweight, obesity and excessive weight gain in pregnancy as risk factors for adverse pregnancy outcomes: A narrative review. Journal of Human Nutrition and Dietetics, 35 (2): 250-264.
10. **Razzaq L, Devi R, Tariq S *et al.* (2021):** Pregnancy outcomes do influence by extremes of body mass index. Pakistan Armed Forces Medical Journal, 71 (2): 690-93.
11. **Racusin D , Vidaeff A (2019):** Cesarean delivery in the obese parturient. In Evidence-based Obstetrics and Gynecology (eds E. Norwitz, D. Miller, C. Zelop and D. Keefe). https://doi.org/10.1002/9781119072980.ch55
12. **Rossouw J, Hall D, Harvey J *et al.* (2013):** Time between skin incision and delivery during cesarean. International Journal of Gynecology & Obstetrics, 121 (1): 82-85.
13. **Conner S, Tuuli, G, Longman R *et al.* (2019):** Impact of obesity on incision-to-delivery interval and neonatal outcomes at cesarean delivery. American journal of obstetrics and gynecology, 209 (4): 386-e1.
14. **Edwards K, Cantu J, Cliver S *et al.* (2023):** The association of maternal obesity with fetal pH and base deficit at cesarean delivery. Obstetrics & Gynecology, 122 (2 PART 1): 262-267.
15. **Butwick A, Carvalho B, Danial C *et al.* (2010):** Retrospective analysis of anesthetic interventions for obese patients undergoing elective cesarean delivery. Journal of clinical anesthesia, 22 (7): 519-526.
16. **Doherty D, Magann E, Chauhan S,*et al.* (2008):** Factors affecting caesarean operative time and the effect of operative time on pregnancy outcomes. Australian and New Zealand Journal of Obstetrics and Gynaecology, 48 (3): 286-291.
17. **Saadia A, Zaheera D (2020):** Association between Maternal Obesity and Cesarean Delivery Complications. Cureus, 12: 10.7759/cureus.7163
18. **Machado L (2012):** Cesarean section in morbidly obese parturients: practical implications and complications. N Am J Med Sci.,4 (1): 13-8. doi: 10.4103/1947-2714.92895.
19. **Butwick A, Abreo A, Bateman B *et al.*** (2018): Effect of maternal body mass index on postpartum hemorrhage. Anesthesiology, 128 (4): 774-783.
20. **Knight M, Callaghan M, Berg C *et al.* (2009):** Trends in postpartum hemorrhage in high resource countries: a review and recommendations from the International Postpartum Hemorrhage Collaborative Group. BMC pregnancy and childbirth, 9: 1-10.
21. **Kim S, Zhu Y, Grantz K *et al.* (2016):** Obstetric and neonatal risks among obese women without chronic disease. Obstetrics & Gynecology, 128(1), 104-112.
22. **Lisonkova S, Muraca G, Potts J *et al.* (2017):** Association between prepregnancy body mass index and severe maternal morbidity. Jama., 318 (18): 1777-1786.
23. **Reed J, Case S, Rijhsinghani A *et al.* (2023):** Maternal obesity: Perinatal implications. SAGE Open Medicine, 11: 20503121231176128.
24. **Avcı M, Şanlıkan F, Celik M *et al.* (2015):** Effects of maternal obesity on antenatal, perinatal and neonatal outcomes. The Journal of Maternal-Fetal & Neonatal Medicine, 28 (17): 2080-2083.
25. **Minsart A, Buekens P, De Spiegelaere M *et al.* (2013):** Neonatal outcomes in obese mothers: a population-based analysis. BMC pregnancy and childbirth, 13: 1-6.