Original Article

The Association between Body Mass Index and Intra-abdominal Adhesions in Women Undergoing Repeat Caesarean Sections

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ABSTRACT

Background: Obesity is a widely spread health problem, the complications of which are too many, whether general or obstetric.

Methods: In this prospective observational study, 232 pregnant ladies were included. They were divided into two groups to compare the degree of intra-abdominal adhesions between women with BMI less than 30 kg/m2 (group 1) and those with BMI more than or equal to 30 kg/m2 (group 2). We also subdivided group 2 candidates into 3 subgroups to compare different degrees of adhesions among them: Group 2a: women with BMI between 30-35, Group 2b: women with BMI between 35-40 and Group 2c: women with BMI more than 40.

BMI of pregnant women was calculated on admission; preoperative hemoglobin was measured for each patient, and the degree of adhesion intra-operative was observed according to Tulandi's classification of adhesions. Bladder & bowel injuries were recorded. Postoperative hemoglobin for each case was measured.

Results: The current study showed an increased incidence of omental adhesions and adhesions between the uterus and abdominal fascia in group 2 more than group 1, but regarding adhesions between uterus & bladder and adhesions to other pelvic organs, the results were similar in both group. Women with BMI more than or equal to 30 kg/m2 are at higher risk of hemoglobin drop during CS compared to those with BMI less than 30 kg/m2. Bladder and bowel injuries were also similar in both groups.

Conclusion: Women with BMI more than or equal to 03kg/m2 tend to have a higher incidence of omental adhesions and adhesions between the uterus and abdominal fascia than those with BMI less than 30kg/m2. Women with BMI more than or equal to 30 kg/m2 are at higher risk of hemoglobin drop during CS compared to those with BMI less than 30 kg/m2.

Key Words: Adhesions, BMI, caesarean section, obesity.

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INTRODUCTION

Worldwide, the cesarean section rate is increasing rapidly. In the United States, the rate of C-sections is around 33%. The rates in the UK and Australia are 26.5% and 32.3%, respectively. The most recent CS rate reported in China was 41%. In Egypt, the CS rate is 51.8%[1,2].

Women suspected to have considerable intra-abdominal adhesions may benefit from appropriate preparation of blood products, better assignment of surgeons, request for preoperative surgical assistance of other specialties and possibly perform a midline skin incision to enter the peritoneal cavity. Intra-abdominal adhesions are frequently encountered during repeat cesarean delivery and are aggravated in prevalence and severity in multiple repeats cesarean deliveries. Adhesiolysis may result in lengthy fetal extraction, injury to adjacent viscera, and blood loss[3].

Currently, surgeons lack a reliable method for the preoperative prediction of intra-abdominal adhesions in repeat cesarean delivery. Several strategies have been suggested, including skin scar visual characteristics and surgical History. However, these methods suffer from a lack of reproducibility, and there is often no relevant history before the first repeat cesarean delivery. Hence, whether a specific woman before a repeat cesarean delivery is at risk for severe intra-abdominal adhesions remains unknown[4].

Women suspected to have severe intra-abdominal adhesions may benefit from appropriate preparation of blood products, better assignment of surgeons, request for preoperative surgical assistance from other medical specialties and possibly perform a midline skin incision to enter the peritoneal cavity[5].

The present study aimed to evaluate the relationship between obesity and the risk of increased intra-abdominal

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adhesions in patients scheduled for a planned repeat cesarean delivery.

PATIENTS AND METHODS

The present study was an observational cross-sectional study conducted in the Obstetrics and Gynecology department of Kasr El-Ainy Hospitals-Cairo University during the period between January and August 2020.

The study included 232 pregnant women candidates for repeated cesarean section. According to the BMI, they were divided into two groups to compare the degree of intra-abdominal adhesions between women with BMI less than 30 kg/m2 (group 1=30 cases) and those with BMI more than or equal to 30 kg/m2 (group 2= 202 cases).

We also subdivided group 2 candidates into 3 groups:

- Group 2a (96 cases): women with BMI between 30-35.
- Group 2b (81 cases): women with BMI between 35-40.
- Group 2c (25 cases): women with BMI of more than 40.

Inclusion criteria: we included Women over 37 weeks of gestation, Pregnancy of singleton living fetus, Repeated cesarean sections but less than 2 and Women consenting to be included in the study.

Exclusion criteria

we excluded Emergency cesarean delivery, Abnormally invasive placenta, History of appendicitis - in particular, appendix rupture, History of exposure to radiation treatment for cancer, History of gynecological infections (PID), History of abdominal infections, e.g., peritonitis, History of any abdominal or pelvic operation for non-obstetric cause, History of ectopic Pregnancy, Diabetes mellitus, Abdominal malignancy, Endometriosis, Thyroid disorders (hypothyroidism & hyperthyroidism), Cushing disease & females receiving steroids, History of wound infection or burst abdomen, and History suggestive of massive bleeding during previous cesarean section.

Study outcomes

The primary study outcome was to assess adhesions between uterus & bladder, between uterus & abdominal fascia, between uterus & omentum, between omentum & abdominal fascia & adhesions to other pelvic organs in women with BMI more than or equal to 30 kg/m2 in comparison to women with BMI less than 30 kg/m2.

Secondary outcome parameters (other outcomes were assessed)

a. Hemoglobin drop (calculated as the difference between preoperative and postoperative hemoglobin levels).

b. Visceral injuries.

Intervention

Patients included in this study were subjected to Informed consent: which was obtained from all participants included in the study, Full History taking including Name, Age, Number of cesarean sections, Obstetric History and 1st day of last menstrual period (LMP), gestational age documentation.

Medical & operative history especially: History of appendicitis - in particular, appendix rupture, History of exposure to radiation treatment for cancer, History of Gynecological infections (PID), History of abdominal infections, e.g., peritonitis, History of any abdominal or pelvic operation for non-obstetric cause, History of ectopic Pregnancy, Diabetes mellitus, Abdominal malignancy, Endometriosis, Thyroid disorders (hypothyroidism & hyperthyroidism) and Cushing disease or treatment with steroids.

Clinical Examination

Height and weight measurements to calculate the Body mass index (The formula for BMI is weight in kilograms divided by height in meters squared), Detection of fetal heart sounds, Fundal level, Obstetric palpation (Maneuvers of Leopold), Fundal grip to detect the part of the fetus occupying the fundus, Umbilical grip to detect the back and fetal limbs, First pelvic grip to detect part of the fetus occupying the lower uterine segment and to detect engagement and General examination: to detect anemia, exclude thyroid disorders, exclude Cushing disease & to assess any abdominal scars of previous operations.

Laboratory Investigations

CBC: Preoperative to detect anemia for proper preparation of the patient & postoperative Detection of any hemoglobin drop.

Ultrasound: Preoperative routine obstetric ultrasound examination was performed on all women scheduled for repeat cesarean delivery to confirm fetal viability, gestational age, fetal presentation, site of placenta & amount of liquor.

Operative steps of the CS operation

A suprapubic transverse incision or a midline vertical one was chosen for laparotomy. Transverse abdominal entry is by Pfannenstiel, Joel-Cohen Incision or Maylard incisions. The Pfannenstiel incision was selected most frequently for cesarean delivery[6].

The skin and subcutaneous tissue were incised using a low, transverse, slightly curvilinear incision with the Pfannenstiel incision. This is made at the level of the pubic hairline, which is typically 3 cm above the superior border of the symphysis pubis. The incision is extended laterally sufficiently to accommodate delivery (12 to 15cm is typical)[6].

In the Joel-Cohen Incision, the skin incision was placed 3 cm above the original Pfannenstiel incision (straight, not curved). The Maynard incision differs mainly from the Pfannenstiel in that the bellies of the rectus abdomen are muscles are transected horizontally to widen the operating space (when more exposure is needed in transverse incision)

It is technically more difficult due to its required muscle cutting and isolation and ligation of the inferior epigastric arteries, which lie laterally to these muscle bellies. In vertical midline incisions, the incision begins 2 to 3 cm above the superior margin of the symphysis. It should be sufficiently long to allow fetal delivery (12 to 15 cm is typical)[6].

Subsequent tissue layers were opened bluntly and, if necessary, extended with scissors and not a knife) because it is associated with shorter operating times and reduced postoperative febrile morbidity[6].

Sample size

The sample size calculation was based on the correlation between the body mass index (BMI) and the degree of intra-abdominal adhesions in women undergoing repeat cesarean sections. Prior data indicated that the correlation coefficient between BMI and the degree of intra-abdominal adhesions was 0.16 (Mathai *et al*., 2007).

Suppose we assumed that this is the true population coefficient. In that case, we will need to study at least 232 cases to be able to reject the null hypothesis with 80% power setting type I error probability to 0.05. Sample size calculation was done using the G*Power software version 3.1.2 for MS Windows, Franz Faul, Kiel University, Germany.

Statistical analysis

Data were statistically described as mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Numerical data were tested for the normal assumption using Kolmogorov Smirnov test. Comparison of numerical variables between the study groups was done using Student's t-test for independent samples for comparing 2 groups of normally distributed data and/or large enough samples, and one-way analysis of variance (ANOVA) test with posthoc multiple 2-group comparisons when comparing more than 2 groups of normally distributed data and/or large enough samples. Kruskal Wallis test was used when comparing not-normal numerical data. For comparing categorical data, Chi-square (x2) test was performed. Exact test was used instead when the expected frequency was less than 5. Two-sided p values less than 0.05 were considered statistically significant. All statistical calculations were done using the computer program IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA), release 22 for Microsoft Windows.

RESULTS

Our study was a cross-sectional observational study conducted in the Obstetrics and Gynecology department (Kasr Al-Ainy Hospital – faculty of medicine – Cairo University) between January and August 2020.

A total of 232 pregnant women candidates for repeated CS met the inclusion criteria and were included in the final analysis. All cases were operated upon using Pfannenstiel incision.

They were divided into two groups to compare the degree of intra-abdominal adhesions between women with BMI less than 30 kg/m2 (group 1) and those with BMI more than or equal to 30 kg/m2 (group 2). The number of cases in each group was 30 cases in group 1 and 202 cases in group 2.

There was no significant difference among women of the studied groups regarding age (*P-value* =0.11), gravidity (*P-value* =0.74), parity (*P-value* =0.07), gestational age (*P-value* =0.82) & the interval between this cesarean delivery and the last one (*P-value* =0.69) as shown in the table below (Table 1).

Data related to degree of adhesions in women participated in each group:

The median of adhesions between uterus and abdominal fascia in pregnant women with BMI ≥ 30 kg/m2 was 0 (minimum=0 & maximum=16); it was also 0 in pregnant women with BMI <30 kg/m2 (minimum=0 & maximum=4). However, these results were statistically significant (*P-value*= 0.03).

The median of adhesions between uterus and omentum in pregnant women with BMI ≥ 30kg/m2 was 0 (minimum=0 & maximum=8), it was also 0 in pregnant women with BMI < 30kg/m2 (minimum= 0& maximum=0). This results were statistically significant (*P-value*= 0.017).

The median of adhesions between omentum & abdominal fascia in pregnant women with BMI ≥ 30 kg/m2 was 0 (minimum= 0 & maximum=8), it was also 0 in pregnant women with BMI < 30 kg/m2 (minimum=0 & maximum=0). This results were statistically significant (*P-value*= 0.003).

The median adhesions between the uterus and the bladder were higher in pregnant women with BMI ≥ 30kg/m2 than those with BMI < 30kg/m2, however, this difference didn't reach statistical significance (2 versus 0 with a *P-value*= 0.052). There was no statistically significant difference between both groups regarding the adhesions related to other pelvic organs (*P-value*= 0.09) (Table 2).

As we subdivided group 2 into 3 subgroups, the median of adhesions between the uterus and omentum was significantly higher in the group with BMI > 40kg/m2 compared to the group with BMI 35-40kg/m2 and the group with BMI 30-35 kg/m2 (2 versus 0 and 0 respectively) with *P-value* less than 0.001. The same applied to adhesions between the omentum and abdominal fascia. However, there was no statistically significant difference among the 3 subgroups regarding adhesions between the uterus and the bladder, adhesions between the uterus and abdominal fascia or adhesions to other pelvic organs, as shown in (Table 3).

Women with BMI more than or equal to 30 kg/m2 had a higher value of hemoglobin drop (0.56 ± 0.27gm/dl) than those with BMI less than 30 kg/m2 (0.41± 0.17), this difference was statistically significant (*P-value* < 0.001).

There were no significant statistical in the term of Bladder injury, Bowel injury, Hypertrophic scar, Depressed scar, Flat scar and Hyper-pigmented scar (*P-value* > 0.05) (Table 4).

Table 1: Demographic characteristics among the studied groups

Variables	BMI <30 (n=30)	BMI≥ 30 (n=202)	*P value*
Age(years) Mean ± SD	28 ± 5.6	29.8 ± 6	0.11
gravidity Mean ± SD	2.83 ± 1.39	2.99 ± 1.86	0.74
parity Mean ± SD	1.83 ± 1.39	2.32 ± 1.3	0.07
GA (weeks) Mean ± SD	38.3 ± 0.94	38.2 ± 1.13	0.82
interval between CS (years) Mean ± SD	3.93 ± 0.9	4 ± 1.32	0.69

Table 2: Median adhesions between the uterus and pelvic organs

Adhesions between	BMI						*P-value*
	BMI < 30 (group1)			BMI ≥ 30 (group2)			
	Median	minimum	Maximum	Median	minimum	Maximum	
Uterus & bladder	0.00	0	8	2	0	8	0.052
Uterus& abdominal fascia	0.00	0	4	0.00	0	16	0.03
Uterus& omentum	0.00	0	0	0.00	0	8	0.017
omentum& abdominal fascia	0.00	0	0	0.00	0	8	0.003
Other pelvic organs	0.00	0	8	0.00	0	0	0.09

Table 3: Degree of adhesions related to BMI in groups 2a, 2b and 2c

Adhesions between	BMI : 30-35 (n=96) Group 2a			BMI :35-40 (n=81) Group 2b			BMI > 40 (n=25) Group 2c			*P-value*
	Median	minimum	Maximum	Median	minimum	Maximum	Median	minimum	Maximum	
Uterus & bladder	2.00	0	8	2.00	0	8	2.00	0	8	0.353
Uterus& abdominal fascia	0.00	0	8	0.00	0	8	0.00	0	16	0.390
Uterus& omentum	0.00	0	4	0.00	0	8	2.00	0	8	<0.001
omentum& abdominal fascia	0.00	0	8	0.00	0	8	2.00	0	8	< 0.001
Other pelvic organs	0.00	0	0	0.00	0	0	0.00	0	0	1.000

Table 4: comparison between severity of adhesions in different groups

	BMI <30 (group 1) (n=30)	BMI ≥ 30 (group 2) (n=202)	*P value*
Preoperative Hemoglobin(gm/dl) Mean± SD	11.2 ± 0.9	10.97 ± 0.85	0.19
postoperative Hemoglobin(gm/dl) Mean ± SD	10.8 ± 0.9	10.4 ± 0.9	0.1
Hemoglobin drop (gm/dl) Mean ± SD	0.41± 0.17	0.56± 0.27	<0.001
Bladder injury n (%)	0 0.00%	3 1.50%	1
Bowel injury n (%)	1 3.30%	0 0.00%	0.13
Hypertrophic scar n (%)	4 13.30%	38 18.80%	0.61
Depressed scar n (%)	3 10%	27 13.40%	0.78
Flat scar n (%)	23 76.70%	137 67.80%	0.33
Hyper-pigmented scar n (%)	6 20%	68 33.70%	0.13

DISCUSSION

Worldwide, the cesarean section rate is increasing rapidly. In the United States, the rate of C-sections is around 33%. The rates in the UK and Australia are 26.5% and 32.3%, respectively. The most recent CS rate reported in China was 41%. In Egypt, the CS rate is 51.8%[1,2].

Women suspected to have considerable intra-abdominal adhesions may benefit from appropriate preparation of blood products, better assignment of surgeons, request for preoperative surgical assistance of other specialties and possibly perform a midline skin incision to enter the peritoneal cavity[3].

Obesity is associated with several disturbances in hemostasis, especially impaired fibrinolysis. The impaired coagulation profile in obese individuals results from both environmental and genetic factors[7,8].

Fibrinolytic activity is strongly and negatively correlated with both Body mass indexes (The formula for BMI is weight in kilograms divided by height in meters squared). And waist-to-hip circumference ratio (WHR)[9].

Although the pathophysiology leading to adhesion development remains poorly understood, a pivotal role has been ascribed to the ability of plasminogen activator activity (PAA) of the mesothelial cells lining the peritoneal cavity to limit adhesion development[10].

Injury to the peritoneum, with loss of the mesothelial cells and reduction of plasminogen activator activity (PAA), exposes underlying fibroblasts and frequently results in adhesions occurring between adjacent surfaces[11].

The impaired fibrinolysis seen in obese patients is largely secondary to elevated plasma plasminogen activator inhibitor -1 level, which may result from increased release from visceral adipose tissue and fatty liver[12].

In the current study, the mean age of the sample population was (28±5.6) years in women with BMI < 30 kg/m2 and (29.8±6) years in those with BMI ≥ 30 kg/m2. There was no statistically significant difference between both groups (*P-value* =0.11). The mean age was similar to Taylan *et al*. (2016), which was (30.3 ± 5.1) years in a group of women that were found to have adhesions in the studied cases and (29.1 ± 5.5) years in a group of women that were found to have no adhesions. This difference was statistically insignificant, with a *p value*= 0.18.

The mean age also agrees with Kinay *et al*. (2020), which was (29.2 ± 5.2) years in the group of women with BMI less than 30 and (29.1 ± 5.0) years in the group of women with BMI equal to or more than 30. There was no statistically significant difference between both groups (*P-value* =0.9).

Gravidity is another factor that could affect the degree of adhesions. In the current study, the mean gravidity of women included in the study was (2.83 ± 1.39).

with BMI < 30 kg/m2 and (2.99 ± 1.86) in those with BMI ≥ 30 kg/m2. There was no significant difference in gravidity between both groups (*P-value* =0.74).

That was similar to Kinay *et al*. (2020). The mean gravidity in his sample was (2.7 ± 0.9) in the group of women with BMI < 30 kg/m2 and (2.7 ± 1.0) in the group of women with BMI ≥ 30 kg/m2. There was no significant difference between both groups (*P-value*=0.825).

Parity is another factor that was assessed. In the current study, the mean parity of women included in the study was (1.83 ± 1.39) in the group of women with BMI < 30 kg/m2 and (2.32 ± 1.3) in the group of women with BMI ≥ 30 kg/m2. There was no significant difference in parity between both groups (*P-value* =0.07).

In agreement with Kinay *et al*. (2020), the mean parity in his sample was (1.3 ± 0.7) in a group of women with BMI < 30 kg/m2 and (1.3 ± 0.6) in the group of women with BMI ≥ 30 kg/m2. There was no significant difference between both groups (*P-value*= 0.827)[11].

Regarding the interval between the last cesarean delivery and the current cesarean delivery, in this study, the mean interval in the group of women with BMI < 30 kg/m2 was (3.93 ± 0.9) years and (4 ± 1.32) in the group of women with BMI ≥ 30 kg/m2. This was statistically insignificant with *P-value* = 0.69.

These results agree with Kinay *et al*. (2020). The mean interval between cesarean sections in his sample was (4.3 ± 2.9) in the group of women with BMI < 30 kg/m2 and (4.5 ± 2.8) in the group of women with BMI ≥ 30 kg/m2. There was no significant difference between both groups (*P-value*=0.683)[11].

Regarding the relation between BMI & intra-abdominal adhesions in the current study, the median of adhesions between the uterus and abdominal fascia in pregnant women with BMI ≥ 30kg/m2 was 0 (minimum= 0& maximum=16). It was also 0 in pregnant.

women with BMI < 30kg/m2 (minimum= 0& maximum=4). The difference was statistically significant (*P-value*= 0.03).

The median of adhesions between uterus and omentum in pregnant women with BMI ≥ 30kg/m2 was 0 (minimum= 0& maximum=8), it was also 0 in pregnant women with BMI <30kg/m2 (minimum=0& maximum=0). The difference was statistically significant (*P-value*= 0.017).

The median of adhesions between omentum & abdominal fascia in pregnant women with BMI ≥ 30kg/m2 was 0 (minimum= 0& maximum=8), it was also 0 in pregnant women with BMI <30kg/m2 (minimum= 0& maximum=0). This results were statistically significant (*P-value*= 0.003).

The median adhesions between the uterus and the bladder were higher in pregnant women with BMI ≥ 30kg/m2 than those with BMI < 30kg/m2, however, this difference didn't reach statistical significance (2 versus 0 with a *P-value*= 0.052). There was no statistically significant difference between both groups regarding the adhesions related to other pelvic organs.

Group 2 was subdivided into 3 subgroups, the median of adhesions between the uterus and omentum was significantly higher in the group with BMI > 40kg/m2 compared to the group with BMI 35-40kg/m2 and the group with BMI 30-35 kg/m2 (2 versus 0 and 0 respectively) with *P-value* < 0.001. The same applied to adhesions between the omentum and abdominal fascia. However, there was no statistically significant difference among the 3 subgroups regarding adhesions between the uterus and the bladder, adhesions between the uterus and abdominal fascia or adhesions to other pelvic organs (*P-value*= 0.09).

Kinay *et al*. (2020) showed that 40% of women with BMI > 30kg/m2 had omental adhesions, but only 24% of women with BMI < 30kg/m2 had omental[11].

Adhesions, that was statistically significant (*P-value*= 0.016), however, adhesions with uterus & bowel represented only 3% & 1% respectively of women with BMI > 30kg/m2 and 2% & 2% respectively of women with BMI < 30kg/m2 which was statistically insignificant (*P-value*= 0.6).

Hesselman *et al*. (2017) studied abdominal adhesions in gynecological surgeries after cesarean section on 15479 women and assessed intra-operative adhesions subjective, dividing the degree of adhesions into minimal, moderate and extensive also agree with our study. Women with BMI ≥ 30 kg/m2 showed statistically significant more adhesions (OR: 1.91, 95% CI: 1.49–2.45)[12].

That was similar to Gultekin (2017), who studied the effect of parietal peritoneal closure on omental adhesions development in 2048 women; found that 56% of women that were found to have no adhesions had BMI < 25 kg/m2 in comparison to 44% in women with BMI > 25 kg/m2. Also, 72% of women found to have omental adhesions in one space had BMI < 25 kg/m2 compared to 28% of women with BMI > 25 kg/m2. Also, 17.1% of women who were found to have omental adhesions in multiple spaces had BMI < 25 kg/m2 compared to 82.9% of women with BMI > 25 kg/m2. These results were statistically significant, with a *P-value* <0.001[13].

Taylan *et al*. (2016) disagree with our results; they studied 143 patients regarding risk factors for the presence of adhesions. Their results showed that the mean BMI in the group of cases found to have adhesions was (30.1 ± 4.4) kg/m2, while the mean BMI in the group of cases found to have no adhesions were (30.1 ± 4.9) kg/m2. This difference was statistically insignificant, with a *P-value*= of 0.5. The disagreement between their results and ours may be explained by a fewer number of cases examined in their study[14].

Regarding hemoglobin drop in the current study, women with BMI more than or equal to 30 kg/m2 had a higher value of hemoglobin drop (0.56 ± 0.27gm/dl) than those with BMI less than 30 kg/m2 (0.41± 0.17), this difference was statistically significant (*P-value* < 0.001).

Saadia, (2020) was inconsistent with our results; she studied 245 cases to assess the effect of obesity on women undergoing cesarean sections. She divided the studied cases into 2 groups {women with BMI less than 30 (83 cases) & those with BMI more than or equal to 30 (162cases)} her results showed that hemoglobin fall was not correlated with BMI (r =0.083, *P-value*=0.06)[15].

The difference between our results and Saadia (2020) may be attributed to all cases in her studied group being primigravidas with less incidence of adhesions& intra-operative bleeding.

In this study regarding bladder injuries, three pregnant women with BMI more than or equal to 30kg/m2 suffered from bladder injury representing 1.5% of cases in the studied group. On the other hand, no pregnant women with BMI less than 30 suffered from bladder injuries. However, there was no statistically significant difference between both groups, with a *P-value*= 1.

Phipps *et al*. (2020) agree with our results, they studied risk factors of bladder injuries in cesarean sections, and they concluded that BMI has no significant effect on bladder injuries. In their study, several women who suffered from bladder injuries were 42 out of 126 studied women; they had BMI 29.9±5.4 kg/m2 compared to 84 women with BMI 33±6.7kg/m2 and were not complicated by bladder injuries. This difference was statistically significant with a *P-value*= 0.01[16].

Mawaldi *et al*. (2017) disagree with the current study; they discussed complications of cesarean sections in obese women. They studied 971 cases; the cases were divided into 4 groups according to BMI women with BMI <30, 30-34.9, 35-39.9 & >40, they reported that 7 women (77.8%) with BMI 35-39.9 kg/m2 suffered from bladder injury & 2 women (22.2%) with BMI more than or equal to 40 kg/m2 suffered from bladder injury. These results were statistically significant with *P-value* =0.008[17].

The difference between the current study and their study could be explained by a higher number of cesarean sections in women included in their study and, therefore, more liability for adhesions & injuries.

In the current study regarding bowel injuries, No cases with BMI ≥ 30kg/m2 suffered from bowel injuries. One case in a group of pregnant women with BMI < 30kg/m2 represented 3.3% of cases in the studied group. However, this difference was statistically insignificant, with a *P-value*=0.13.

Mawaldi *et al*. (2017) agreed with us; they discussed complications of cesarean sections in obese women. They studied 971 cases, divided into 4 groups according to BMI women with BMI <30, 30-34.9, 35-39.9 & >40[17].

Only 1 woman in the group of cases with BMI 35-39.9 kg/m2 suffered from bowel injury. This difference was statistically insignificant with *P-value* =0.5.

In the current study, Pfannenstiel scar shape is another factor that may indicate the presence of intra-abdominal adhesions.

In the current study, the hypertrophic scar was encountered in 38 (18.8%) women with a BMI ≥ 30kg/m2 compared to 4 (13.3%) women with those with BMI< 30kg/m2. This difference was not statistically significant (*P-value*= 0.61).

These results agree with Kinay *et al*. (2020); a hypertrophic scar was encountered in 21% of women with BMI ≥ 30kg/m2 compared to 13% of women with BMI < 30kg/m2. This difference was not statistically significant (*P-value*= 0.61).

In the current study, the depressed scar was encountered in 27 (13.4%) women with a BMI ≥ 30kg/m2 compared to 3 (10%) women with those with BMI< 30kg/m2. This difference was not statistically significant (*P-value*= 0.78).

These results agree with Kinay *et al*. (2020); a depressed scar was present in 12% of women with BMI < 30 kg/m2 and 6% of women with BMI ≥ 30 kg/m2. This difference was not statistically significant (*P-value*=0.138).

In the current study, the flat scar was encountered in 137 (67.8%) women with those BMI ≥ 30kg/m2 compared to 23 (76.7%) women of those with BMI < 30kg/m2. This difference was not statistically significant (*P-value*= 0.33).

These results were inconsistent with Kinay *et al*. (2020), a flat scar was present in 68% of women with BMI < 30 kg/m2 and 82% of women with BMI ≥ 30 kg/m2. This difference was statistically significant (*P-value*=0.024).

Çöl Madendağ and Eraslan Şahin (2019), who studied the relation between the presence of striae-gravidarum and intra-abdominal adhesions, agree with our results as 57 cases of the studied group had high Pfannenstiel scar, 25 cases had hollow scar & 226 cases had a smooth scar, but this difference regarding the presence of intra-abdominal adhesions was statistically insignificant with *P-value* = 0.215[11].

Taylan *et al*. (2016) disagree with our results. He studied 143 patients regarding risk factors for the presence of adhesions. Fifty-three cases that were found to have adhesions had flat scars (54.2%) & 32 cases that were found to have no adhesions had flat scars (71.1%), 40 cases that were found to have adhesions had slightly intended scars (40.8%) & 9 cases that were found to have no adhesions were found to have slightly intended scar (2%) & 3 cases that were found to have adhesions had hypertrophic scar (3%) & 4 cases that were found to have no adhesions had hypertrophic scar (8.8%). This difference was statistically significant (*P-value*= 0.01). That may be explained by the fewer cases examined in his study and the fact that cases included performed a higher number of cesarean sections[18].

In the current study, a hyper-pigmented scar was encountered in 68 (33.7%) women with those BMI ≥ 30kg/m2 compared to 6 (20%) women with those with BMI< 30kg/m2. This difference was not statistically significant (*P-value*= 0.13).

These results were inconsistent with Kinay *et al*. (2020); a hyper-pigmented scar was present in 40% of women with BMI < 30 kg/m2 and 18% of women with BMI ≥30 kg/m2. This difference was statistically significant (*P-value*=0.001).

The disagreement between the current study results and kinky *et al*. (2020) results regarding flat scars and hyper-pigmented scars may be attributed to racial factors, skin closure techniques, or suture materials.

CONCLUSION

From the current study, we can conclude that women with BMI more than or equal to 03kg/m2 tend to have a higher incidence of omental adhesions and adhesions between the uterus and abdominal fascia than those with BMI less than 30kg/m2. Women with BMI more than or equal to 30 kg/m2 are at higher risk of hemoglobin drop during CS than those with BMI less than 30 kg/m2, which necessitates good preoperative preparation for obese women. Also, women with BMI ≥ 40kg/m2 tend to have a significantly higher incidence of adhesions than women with BMI <40 kg/m2.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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