

The Effect of a Raised BMI on Surgical Morbidity in Women Undergoing Caesarean Section - a Pilot Study

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ABSTRACT

Introduction: Obesity leads to adverse fetomaternal outcome including higher rates of Caesarean section, with higher incidence of operative complications.

Methods: A retrospective cohort study of all caesarean deliveries between 1st January 2013 and 31st March 2013 was undertaken in our tertiary referral centre. Primary outcome measures included complications such as major postpartum haemorrhage, post-operative fever, wound infection, prolonged hospitalization, maternal intensive care unit (ICU) admission, pulmonary embolism, pulmonary edema, stroke, and death. We considered these outcomes individually and as a composite. Gestational diabetes mellitus, eclampsia and pre-eclampsia were included as secondary outcome measures.

Results: A total of 552 Caesarean deliveries were studied, of which 15.9% were performed on obese women. Complication rates of wound infection (17%), major postpartum haemorrhage (4.6%) and postpartum pyrexia (18.2%) were significantly higher for obese patients.

Conclusion: Obesity during pregnancy increases the rate of a caesarean delivery and associated complications amongst Singaporean women. Further local research would be beneficial to reduce morbidity amongst this population of obstetric patients.

INTRODUCTION

Obesity, defined as a Body Mass Index (BMI) of more than or equal to 30kg/m², is a rising global health concern¹⁻³ and has also become one of the most common obstetric risk factors leading to adverse fetomaternal outcome². A similar trend is reflected in Singapore population, where obesity rates have risen from 6.9% in 2004 to 10.8% in 2010 as reflected by the National Health Survey (NHS 2010). Maternal obesity is implicated in various adverse pregnancy complications such as gestational diabetes, pre-eclampsia and hypertension⁴⁻⁶. It is well established that obese mothers require greater intervention and therefore have higher rates of cesarean sections as well as its associated complications⁷⁻⁹. Whilst operative complications in general remain low for cesarean sections, there is a higher incidence of complications in obese obstetric patients. There is an increased risk of anesthetic complications due to difficulties in

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intubation and placement of regional anesthesia thus increasing the need for a general anesthesia in these high risk patients¹⁰, along with a higher rate of surgical complications¹¹. To add to the morbidity there are also higher postoperative complications such as postpartum haemorrhage, postoperative pyrexia, wound infection, and reduced rate of successful for vaginal birth after caesarean section in subsequent pregnancies¹². Obesity in mothers also affects perinatal and neonatal outcomes, for example, increased risk of preterm delivery⁴, stillbirth¹³, and congenital anomalies such as neural tube defects, cardiovascular anomalies and septal anomalies. While the significance of obesity on pregnancy and maternal outcomes has been extensively studied, we have noted a lack of local data on this subject. Thus, we have conducted this pilot study with the aim of ascertaining the impact of antenatal obesity on adverse maternal outcomes during the postoperative period. The results of this study would allow us to assess the need for larger studies among the local population, as well provide guidance for developing guidelines for intervention at preconception, during pregnancy and labour to reduce the complications related to obesity in pregnancy. We hypothesize that that in keeping with the worldwide trend, Singaporean women with BMI >30, delivered via caesarean section were at higher risk of adverse maternal outcomes than non-obese women undergoing a caesarean delivery.

METHODS

A retrospective cohort study of all caesarean deliveries between 1st January 2013 and 31st March 2013 was undertaken in our hospital, which is a tertiary referral centre with > 12,000 deliveries per year. A retrospective review of obstetric records was conducted, including electronic health records, case notes, and data captured on our hospital Labour and Delivery Database. Maternal characteristics, medical and obstetric risk factors of interest were extracted from obstetric records. We included all women who delivered via caesarean section, and excluded women with a lack of documented height or weight at their first antenatal visit (booking visit), and with missing or incomplete data.

A power calculation was performed to determine the number needed for our project to reach statistical significance, taking into account the prevalence of obesity in our local population. This study is intended as a pilot study to assess the feasibility of our protocol. The primary outcome measures of our study included complications such as major postpartum haemorrhage, post-operative fever, wound infection, prolonged hospitalization

beyond postoperative day 3, maternal intensive care unit (ICU) admission, pulmonary embolism, pulmonary edema, stroke, and death. We considered these outcomes individually and as a composite. Gestational diabetes mellitus, eclampsia and pre-eclampsia were included as secondary outcome measures. Data was compiled in a spreadsheet with Escrow numbers to protect patient confidentiality and anonymity. Women were classified into the following BMI groups using international standard cut-offs: "obese" (BMI \geq 30), and "non-obese" (BMI < 30), based on their weights at their booking visit. We performed univariate and multivariate regression analyses using the Statistical Package for the Social Sciences (SPSS). Odds ratios and adjusted odd ratios were calculated with 95% confidence intervals (CI), utilizing Pearson's Chi-squared test with Yates' continuity correction and Fisher's exact test for count data.

RESULTS

During the study period, there were a total of 2633 women delivered in our centre. Of these, 1829 were included in our study population, 802 were excluded due to incomplete or inaccurate data. In this cohort, the prevalence of obesity was 9.8% (180 out of 1649 women), with BMI ranging from 15.4 to 50.6. The mean BMI of obese women was 34.4, which indicates that a large proportion of our obese pregnant patients are in fact already bordering on Class II obesity at their initial booking visit.

The rate of Caesarean section in our centre during the study period was 30.2%. Of the total number of 552 Caesarean deliveries, 88 (15.9%) were performed on obese patients.

Obese patients had a 48.9% rate of Caesarean section, whereas non-obese patients had a 28.1% rate, giving obese patients an odds ratio (OR) of 2.4 for requiring Caesarean delivery (95% CI 1.79 to 3.36) (Fig 1). Out of the 88 obese mothers who underwent Caesarean section, 50 (56.8%) of them underwent Caesarean section as an emergency, and the remaining 38 (43.2%) of them had planned elective sections.

DISCUSSION

The obesity rate of 9.8% in our study population was comparable to the 10.8% rate of obesity amongst general population in Singapore as noted by the National health survey of 2010. Our study demonstrates that maternal obesity significantly increases likelihood of undergoing

delivery by a caesarean section. It is well known that obese pregnant women undergoing a caesarean delivery are more at risk of postoperative morbidity, and this trend is also reflected amongst the pregnant obese Singaporean women undergoing a caesarean section. There was a positive association between obesity and the risks of wound infection, major PPH and postpartum pyrexia. It was also demonstrated that there is significant association between obesity in pregnancy and the risk of developing comorbidities such as gestational diabetes and hypertensive disorders. These results were in keeping with the trends seen worldwide.

Numerous previous studies have come to the same conclusion that obesity impacts on the need for caesarean section^{3, 4, 8, 10}. Many mechanisms have been proposed to explain this association. There could be more planned caesarean sections in anticipation of complications and difficulty delivering vaginally due to large for gestational age babies from gestational diabetes in obese mothers⁵. Reduced uterine contractility has also been implicated as there could be increased cholesterol in the myometrium¹⁵ however another study demonstrated that cholesterol levels in early pregnancy did not have an effect on requiring caesarean section for failure to progress¹⁶. In addition, leptin causes smooth muscle relaxation and therefore there is a poorer response to oxytocin during labour¹⁷. Another theory is that there is increased fat around the pelvis, narrowing the birth canal⁴, however obstruction of labour was not shown to be significantly associated with BMI, and the main factor implicated for emergency caesarean section was ineffective contractions and foetal distress¹⁸. Furthermore, both animal and human studies have demonstrated differing gene expression of inflammatory and contractility proteins in obesity therefore affecting maternal complications^{19, 20}.

The main postoperative complications amongst our pregnant obese mothers undergoing a caesarean section were wound infection, PPH and postpartum pyrexia. There is increased operative time and delivery interval in obese mothers which could be the reason for higher rates of complications¹¹. The influence of obesity on wound infection has been noted by other studies^{4, 5, 21} and may be due to concurrence of diabetes leading to poor wound healing or the use of low transverse skin incision being in a moist region causing proliferation of bacteria¹¹. A greater proportion of obese women undergoing caesarean sections could be contributing to higher rates of major PPH however, according to Fyfe et al, caesarean section rates are not to blame as obesity in and of itself

demonstrated increased PPH in caesarean as well as vaginal deliveries²². It could also be due to a larger area of implantation of the placenta in large for gestational age fetuses⁵. Postpartum pyrexia could be attributed to urinary tract infections and surgical site infections postpartum^{5, 23}.

Although there was an increased OR of having prolonged hospitalization and pulmonary edema, these were not statistically significant, which could be due to small numbers included in our pilot study. However, there have been other studies which have found increased recovery time and longer hospitalization to be significantly associated with BMI^{4, 10, 11}. Pulmonary oedema has not been studied extensively as a complication post caesarean section but it may be associated with fluid overload and negative pressure due to upper airway obstruction immediately post extubation²⁴. Amongst our study population there were no ICU admissions, strokes, PEs or deaths recorded in any women undergoing caesarean section during the study period. There is also a lack of literature pertaining to this, most likely due to insufficient numbers leading to insignificant results⁵. While our results show significant associations between maternal obesity and gestational diabetes and hypertensive disorders of pregnancy, similar to other studies³⁻⁵, we aim to conduct further studies on these results in order to determine the causal links between these conditions.

There are potential limitations to this study, for example, the number of patients used in the study were small resulting in insufficient numbers with complications. The aim of our pilot study was to assess the impact of antenatal obesity on adverse maternal outcomes among the Singaporean women. In future we aim to undertake retrospective as well as prospective studies on a similar population with larger numbers to be able to provide a meaningful complication rate amongst the local population. There were also confounding variables such as age, race, parity and other comorbidities which significantly different between the obese and non-obese group. The WHO international criteria for obesity (BMI \geq 30) was used although there is evidence for using lower cut off points in Asian population which would have increased the proportion of obese mothers in our study. However, in order to make our study comparable and due to lack of concrete cut off points in an Asian population, we decided to utilise the international standard. Booking weight was recorded at a mean gestational age of 11.6 weeks (range 5 – 35 weeks). The lack of consistency of the gestational age at booking is due to the retrospective nature of this study, but this

should not affect results significantly as 82.6% of study patients booked at or below 15 weeks of gestation.

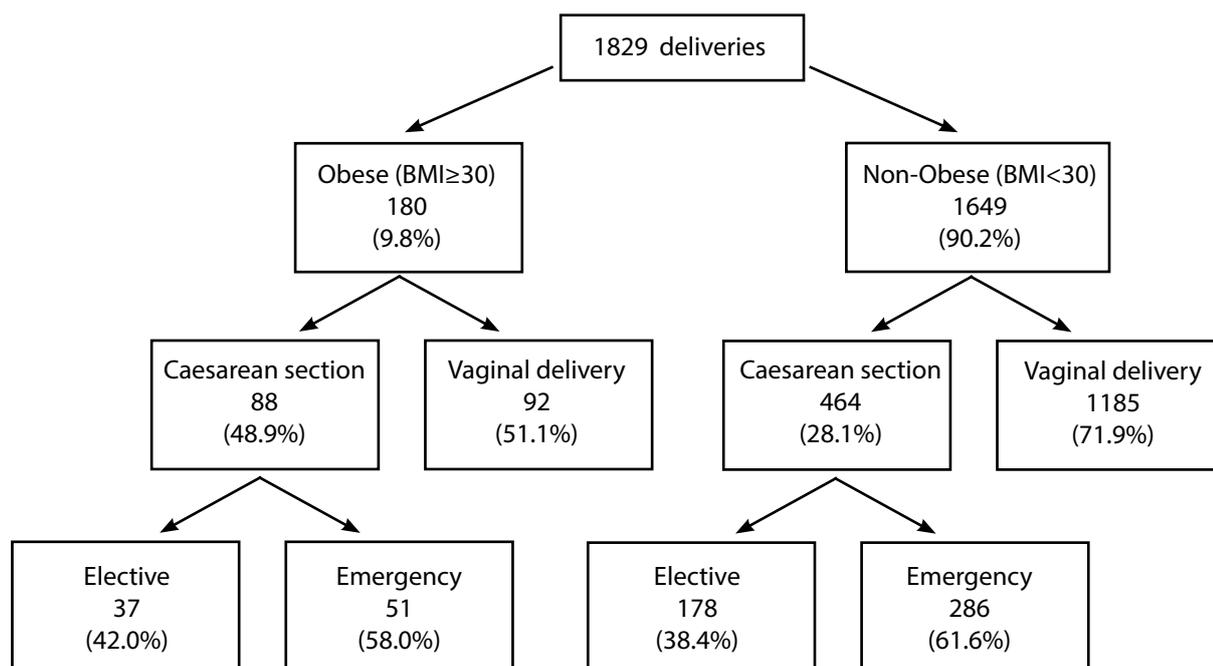
In terms of clinical practice, this study indicates that advice to reduce BMI would be greatly beneficial. The best time to tackle maternal weight is in the preconception period¹¹. Women seeking fertility should be advised to optimize their weight prior to pregnancy, and be advised of the adverse perinatal outcomes associated with obesity. However, previous studies have shown that just antenatal lifestyle advice does not help in reducing caesarean births³¹ and utilising simple methods of self-weighting and dietary advice do not lower gestational weight gain³². Although it is important to limit gestational weight gain in obese mothers, gestational weight loss is also not recommended as it increases the risk of prematurity and small for gestational age foetuses despite decreased emergency caesarean sections in obese women³³. Weight management should also be offered at postnatal reviews with the aim of reducing the recurrence and severity of obesity in subsequent pregnancies. Interpregnancy weight reduction in obese patients has proven benefits³⁴, reducing caesarean delivery rates to baseline³⁵ and a weight loss of at least 4.5kg before a second pregnancy being associated with

an up to 40% reduction in the risk of developing GDM³⁶. In addition, hospital-based standardized protocols could be developed specifically for obese patients undergoing Caesarean sections, as these patients are high risk for post-operative complications. Multidisciplinary team care is beneficial with antenatal anaesthetic review and meticulous care postoperatively to ensure good fluid balance and frequent observation for the development of fluid overload and pulmonary edema³⁷ as well as wound infections. Standard practice of active management of third stage of caesarean section, prophylactic antibiotics and thromboprophylaxis should continue, especially for the obese mothers.

CONCLUSION

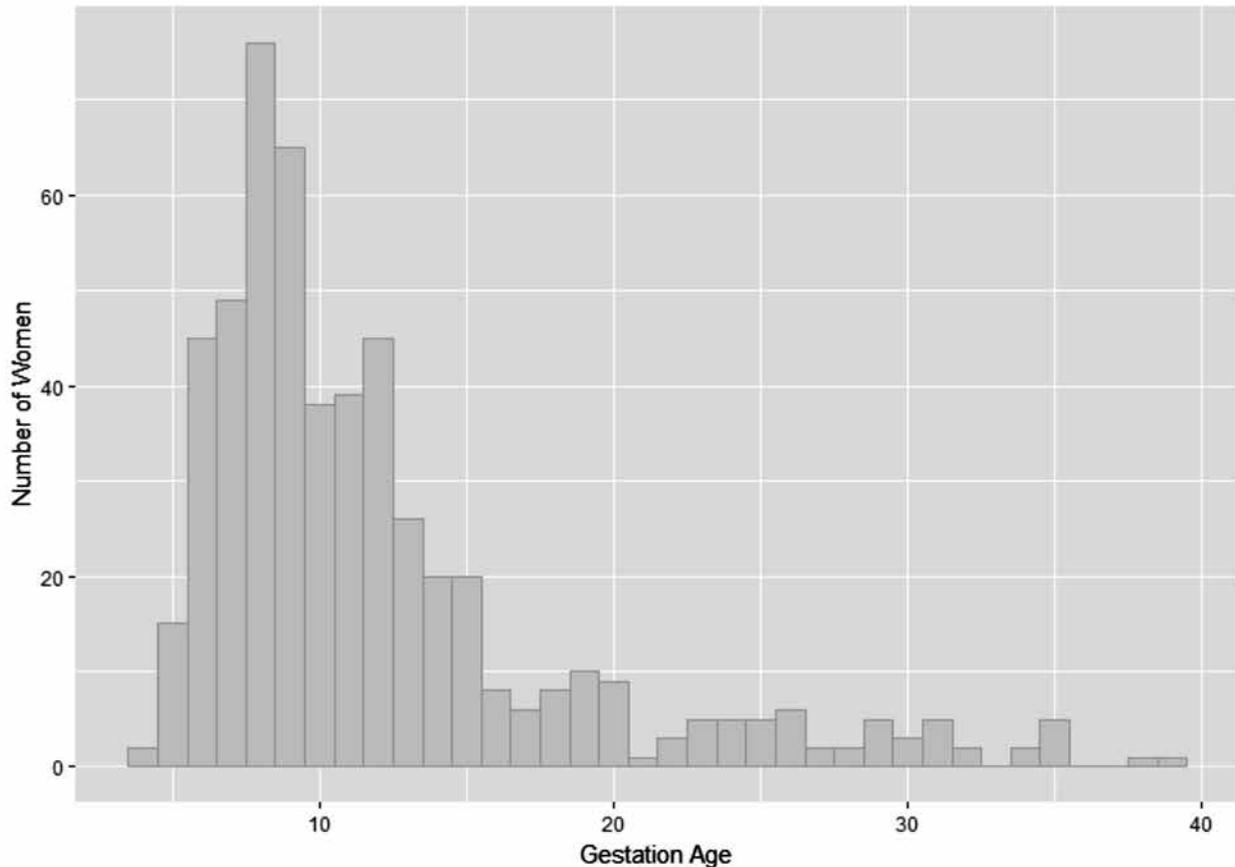
We can conclude that obesity during pregnancy is an important factor that impacts on and increases the rate of a caesarean delivery and associated complications amongst Singaporean women. Given the rising rate of obesity in the region, further local research on specific interventions, and the development of standardized hospital protocols will be beneficial in helping to target and reduce maternal operative morbidity.

Figure 1: Outcomes of labour during study period



Odds ratio of obese patients requiring Caesarean delivery = 2.4 (1.79 to 3.37)

Figure 2: Booking Gestation



We found that the obese patients had an older average age of 33.2 years versus 31.8 years in their non-obese counterparts. Booking weight was recorded at a mean gestational age of 11.6 weeks (range 5 – 35 ± 6.47 weeks). We also found that the prevalence of obesity was higher in Malay (36.3%) and Indian (13.4%) patients undergoing Caesarean section. More non-obese patients undergoing Caesarean sections tended to be primiparous (48.3%) versus obese patients (37.5%).

Out of all the patients who underwent Caesarean section, 38.6% of the obese mothers had a calculated composite adverse outcome, compared to 11.4% of the non-obese mothers with OR of 4.88 (CI 2.92 to 8.18). The main adverse outcomes recorded were wound infection, major postpartum haemorrhage (PPH), postpartum pyrexia and prolonged hospitalization and pulmonary edema. Of these wound infection, major postpartum haemorrhage (PPH) and postpartum pyrexia showed a statistically significant association with obesity. There was no difference in the two groups for prolonged hospitalisation and pulmonary edema. None of the women in either of the two groups included in the study required an ICU admission or suffered from a stroke. The rates of these outcomes amongst the obese women undergoing caesarean delivery compared to the non-obese mothers with caesarean section as well as their OR is shown in Table 2.

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Table 1: Study Demographics

Demographics	Obese (BMI≥30)	Non-obese (BMI<30)	p-value
Type of Caesarean Section			0.516
Elective CS	37 (42.0%)	178 (38.4%)	
Emergency CS	51 (58.0%)	286 (61.6%)	
Age (average)	33.2	31.7	0.0151
Race	23 (26.2%)	256 (55.2%)	<.001
Chinese	32 (36.3%)	80 (17.2%)	
Malay	22 (25.0%)	62 (13.4%)	
Indian	11 (12.5%)	66 (14.2%)	
Other			
Parity (excluding current delivery)			0.002
Para 0	33 (37.5%)	224 (48.3%)	
Para 1	27 (30.7%)	167 (36.0%)	
Para ≥2	28 (31.8%)	73 (15.7%)	

The demographics of these 2 groups of obese and non-obese going patients undergoing Caesarean section are further compared in Table 1.

Table 2. Number of women undergoing caesarean section who experienced primary and secondary outcomes in the obese compared to the non-obese group, along with the odds ratio for each outcome. (*significant)

Pregnancy outcome	Obese (BMI≥30)	Non-obese (BMI<30)	Odds Ratio (OR)	95% Confidence Interval
Primary outcomes				
Composite adverse outcome*	34 (38.6%)	53 (11.4%)	4.88	2.92-8.18
Wound infection*	15 (17%)	1 (0.2%)	95.1	12.38-731.13
Major PPH*	4 (4.6%)	1 (0.2%)	22.0	2.43-199.71
Postpartum pyrexia*	16 (18.2%)	23 (5.0%)	4.26	2.15-8.45
Prolonged hospitalisation	12 (13.6%)	34 (7.3%)	2.0	0.99-4.03
Pulmonary edema	1 (1.1%)	1 (0.2%)	5.3	0.33-85.89
Maternal ICU admission	0	0		
Stroke	0	0		
Pulmonary embolus	0	0		
Death	0	0		
Secondary outcomes				
Eclampsia/ Pre eclampsia*	13 (14.8%)	18 (3.9%)	4.3	2.02-9.13
GDM*	33 (37.5%)	46 (9.9%)	5.45	3.21-9.25

A separate analysis of the secondary outcomes of eclampsia/ pre-eclampsia and gestational diabetes mellitus is also included in Table 2 showing a statistically significant association between obesity and developing these conditions during pregnancy.