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Mini-invasive Surgery

Meta-Analysis

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Maternal and fetal delivery outcomes in pregnancies following bariatric surgery: a meta-analysis of the literature

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Abstract

Aim: The objective of this study is to evaluate maternal and fetal outcomes following pregnancies after bariatric surgery as compared to the general population affected by obesity.

Methods: A systematic review was conducted through MEDLINE, Cochrane, and EMBASE to identify relevant studies from 2007 to 2016 with comparative data on the maternal and fetal delivery outcomes following bariatric surgery as compared to the population affected by obesity. The primary outcome analyzed was the rate of cesarean deliveries. Other outcomes included intrauterine growth restriction, small for gestational age, large for gestational age, macrosomia pregnancy-induced hypertension, gestational diabetes, assisted vaginal delivery, and preterm delivery. Statistical analysis was done using fixed-effects meta-analysis to compare the mean value of the two groups (Comprehensive Meta-Analysis Version 3.3.070 software; Biostat Inc., Englewood, NJ).

Results: Out of 549 studies, 13 were quantitatively assessed and included for meta-analysis. The need for caesarean sections in post-bariatric women was found to be significantly lower when compared to women affected by obesity [odds ratio (OR) 0.623, $P < 0.001$). There were also significant reduction in the incidence of LGA (OR 0.491, $P < 0.001$), macrosomia (OR 0.251, $P < 0.001$), and assisted vaginal delivery (OR 0.807, $P < 0.001$) in the post bariatric group of women. There was an increase in the incidence of PIH (OR 1.113, $P < 0.001$), SGA (OR 2.305, $P < 0.001$) and IUGR (OR 2.099, $P < 0.001$). The incidence of preterm delivery (OR 0.982, $P > 0.05$) and gestational diabetes (OR 1.046, $P > 0.05$) were similar in both groups.

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Conclusion: Patients affected by obesity considering conceiving in the near future should consider bariatric surgery prior to conception to lower their risk of potentially adverse delivery outcomes.

Keywords: Bariatric, pregnancy, neonatal, maternal

INTRODUCTION

Currently in the United States, more than two-thirds of the adult population is overweight and one-third are obese[1,2]. The most widely accepted measure used to define obesity is a body mass index [BMI; weight (kg)/height (m^2)] of more than 30 kg/m^2, as recommended by the National Heart, Lung and Blood Institute's North American Association for the Study of Obesity[3].

In general, being obese carries increased health risks for the individual. Serious health consequences associated with obesity include type 2 diabetes, osteoarthritis, heart disease, stroke, and certain cancers[4]. More specifically, obesity in women of childbearing age is associated with subfertility/infertility due to increased rates of anovulation[5,6]. Pregnancy associated complication rates are also increased in obese women, including gestational diabetes, preeclampsia, cesarean delivery, and infectious morbidity[5,7].

The neonate of a mother who is obese is also at increased risk for complications. While studies have not found higher incidence of spontaneous preterm labor, there are increased rates of preterm delivery for maternal or fetal indications[8]. In addition, studies have found an increase in macrosomic and large for gestational age (LGA) infants among mothers who are obese[9]. Finally, there are multiple congenital obesity-related abnormalities such as neural tube defects, cardiac anomalies and facial clefting as well as increased risks with miscarriage and stillbirth[9].

Weight loss outside of pregnancy, whether achieved via surgical or nonsurgical methods, has been shown to be the most effective intervention to improve medical comorbidities, especially diabetes and hypertension. Nonsurgical approaches to weight loss include diet, exercise, behavioral changes, and pharmacotherapy. However, bariatric surgery has been found to be both a clinically and cost-effective intervention for people affected by obesity as compared to the nonsurgical approaches[4]. There are several bariatric procedures available to qualifying patients, with the four most common being: adjustable gastric band, laparoscopic sleeve gastrectomy, gastric bypass, and biliopancreatic diversion with duodenal switch.

While there have been several studies on the effects of obesity on maternal and fetal outcomes, there have only been a few systematic reviews looking at these outcomes in patients that have undergone bariatric surgery[10-12]. However, multiple papers have been published in the last few years to further explore the topic. Our goal in this systematic review is to compare maternal and neonatal outcomes in patients who are obese that have undergone bariatric surgery and those that have not.

METHODS

A systematic review was conducted through MEDLINE, Cochrane, and EMBASE to identify relevant studies from 2007 to 2016 with comparative data on the maternal and fetal delivery outcomes following bariatric surgery as compared to the population affected by obesity. The following terms were searched: pregnancy outcomes AND bariatric surgery, neonatal outcomes AND bariatric surgery, maternal outcomes AND bariatric surgery, delivery outcomes AND bariatric surgery and perinatal outcomes AND bariatric surgery. The following outcomes were recorded: (1) the primary outcome was rate of cesarean delivery; (2) the secondary outcomes included small for gestational age (SGA) or < 10% of birthweight as compared to infants of same gestational age, LGA or > 90% of birthweight as compared to infants of same gestational age, macrosomia (> 4000 g at birth), assisted vaginal delivery, and preterm delivery (< 37 weeks gestational age at delivery).

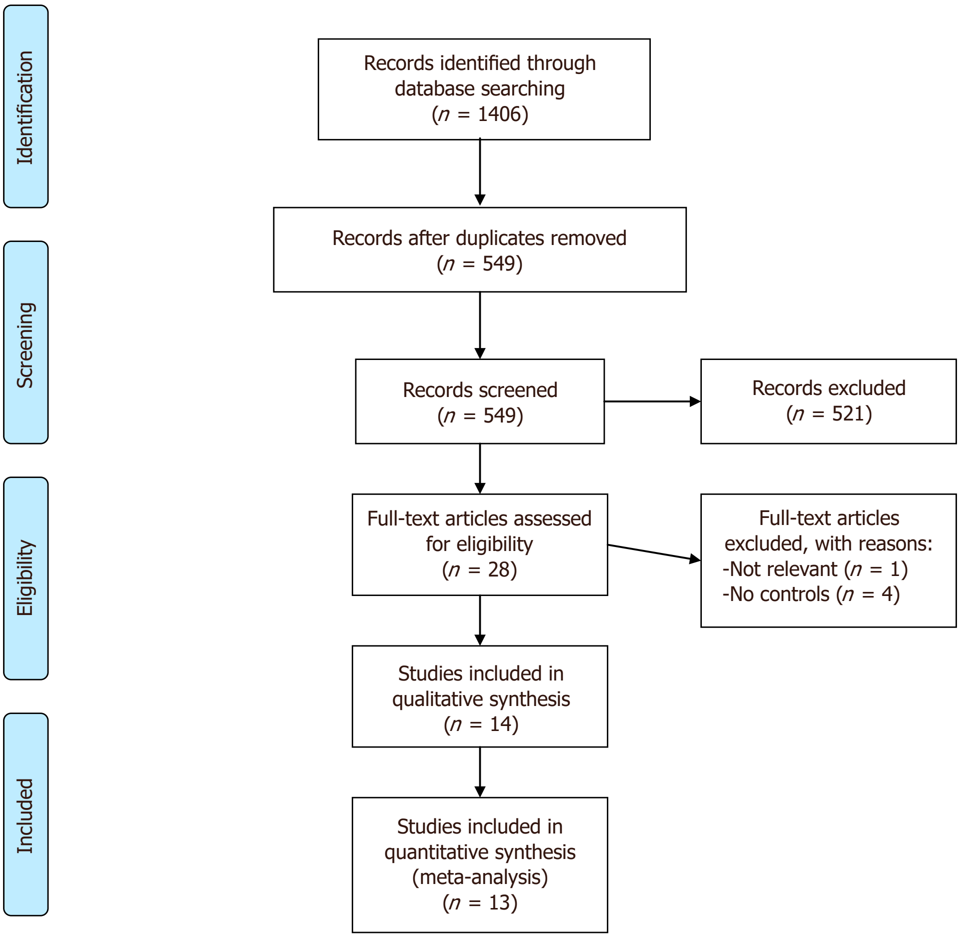

Figure 1. PRISMA flow diagram

Cohort studies that reported on fetal and/or maternal outcomes in terms of the comparison of women who are obese that underwent bariatric surgery to women affected by obesity who did not have bariatric surgery were included with obese being defined as a BMI ≥ 30. For our purposes, bariatric surgery included any weight loss surgery. Papers selected were published in English or able to be translated into English. Papers were also selected based on the ability to directly compare data as presented. Studies were excluded if they did not have a control population or included non-obese women in the study.

The Newcastle-Ottawa scale was used by two assessors to evaluate the quality of the studies based on selection, comparability and outcome. Only studies found to have a 9 or greater points (from a maximum of 10 points) were selected for analysis [Figure 1].

The results are expressed as standard difference in means with standard error. Statistical analysis was done using fixed-effects meta-analysis to compare the mean value of the two groups (Comprehensive Meta-Analysis Version 3.3.070 software; Biostat Inc., Englewood, NJ).

RESULTS

Search results

The electronic search from 2007 to 2016 yielded a total of 549 individual titles, of which 28 were found to be potentially relevant based on abstract. After a full text review of the 28 studies, a total of 13 were determined by the Newcastle-Ottawa scale to be relevant[13-25].

Table 1. Selected studies

Author	Year	Country	Size
Lapolla *et al*.[13]	2010	USA	120/83
Abenhaim *et al*.[14]	2016	USA	221,580/9587
Adams *et al*.[15]	2015	USA	10,447/2666
Amsalem *et al*.[16]	2014	Israel	109/109
Aricha-Tamir *et al*.[17]	2012	Israel	144/144
Berlac *et al*.[18]	2014	Denmark	826/415
Ducarme *et al*.[19]	2007	France	414/13
Johannsson *et al*.[20]	2015	Sweden	2356/596
Kjaer *et al*.[21]	2013	Sweden	1277/339
Parker *et al*.[22]	2016	USA	185,120/1585
Patel *et al*.[23]	2008	USA	43/26
Santulli *et al*.[24]	2010	France	120/24
Stephanson *et al*.[25]	2016	Sweden	447/163

Of the 13 studies, 5 were from the USA, 3 were from Sweden, 2 were from France, 2 were from Israel, and 1 was from Denmark. All studies included obese controls as well as post-surgical women who are obese and were published within the last 10 years [Table 1].

Primary outcomes

The primary outcome of cesarean section rates included 10 papers[13,14,16-19,21-24] and had 230,994 women in the control population and 5571 women in the post-surgical population. As compared to the control population, there was a decrease in the rates of cesarean sections found among the post-surgical population [odds ratio (OR) 0.623, 95% confidence interval (CI) 0.600-0.646, $P = 0.000$] [Figure 2].

Secondary outcomes

The secondary outcomes evaluated included: pregnancy-induced hypertension (PIH), gestational diabetes (GD), intra-uterine growth restriction (IUGR), SGA, LGA, macrosomia, assisted delivery, and premature delivery.

The PIH review included 8 papers[13,14,16,18,19,22-24] and had 89,952 women in the control population and 3094 women in the post-surgical population. As compared to the control population, there was an increase in the rates of PIH in the post-surgical population (OR 1.113, 95% CI 1.067-1.161, $P = 0.000$) [Figure 3].

The GD review included 9 papers[13,14,16,18-23] and had 57,939 women in the control population and 1217 women in the post-surgical population. As compared to the control population, there was no difference in the rates of gestational diabetes in the two groups of patients (OR 1.046, 95% CI 0.984-1.112, $P = 0.145$) [Figure 4].

The IUGR review included 5 papers[14,16,22-24] and had 8357 women in the control population and 452 women in the post-surgical population. As compared to the control population, there was an increase in the rates of IUGR in the post-surgical population (OR 2.099, 95% CI, 1.904-2.315, $P = 0.000$) [Figure 5].

The SGA neonates review included 6 papers[13,15,19-21,23] and had 816 women in the control population and 428 women in the post-surgical population. As compared to the control population, there was an increase in the rates of Small for Gestational Age neonates in the post-surgical population (OR 2.305, 95% CI 2.036-2.611, $P = 0.000$) [Figure 6].

The LGA review included 5 papers[13,15,20-22] and had 15,869 women in the control population and 412 women in the post-surgical population. As compared to the control population, there was a reduction in the rates of LGA babies found in the post-surgical population (OR 0.491, 95% CI 0.441-0.547, $P = 0.000$) [Figure 7].

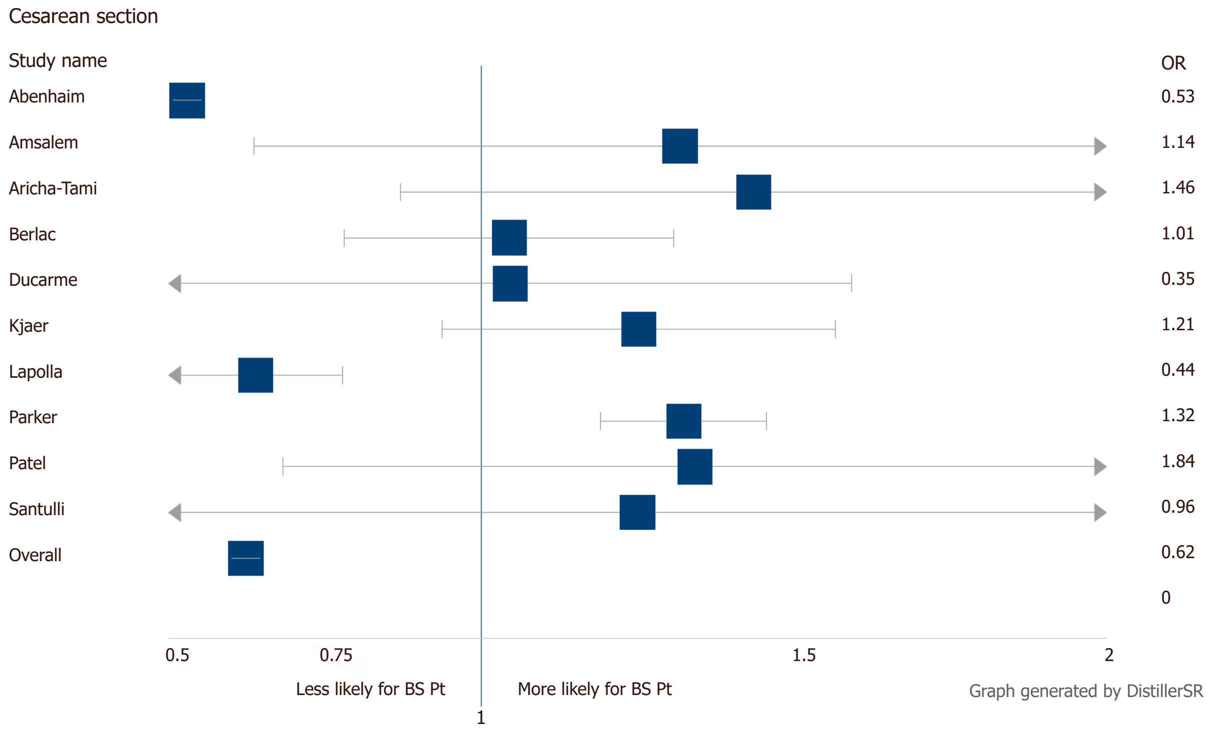

Figure 2. Incidence of cesarean section

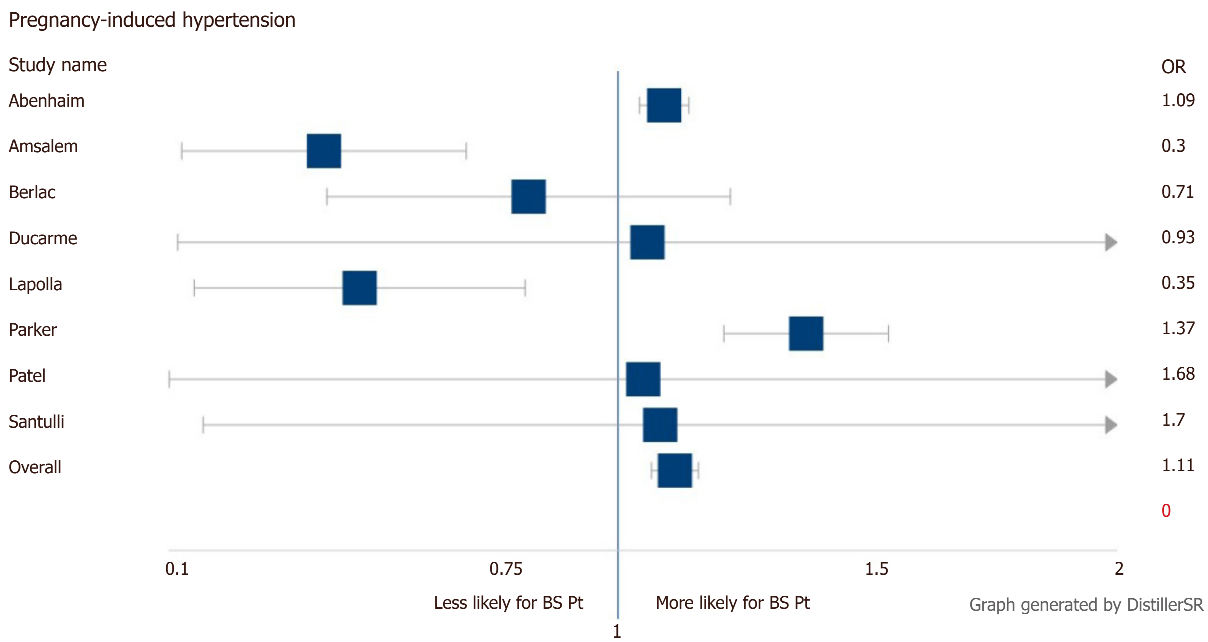

Figure 3. Pregnancy induced hypertension

The macrosomia review included 8 papers[13-17,19,20,23] and had 17,209 women in the control population and 312 women in the post-surgical population. As compared to the control population, there was a reduction in the rates of macrosomia found among the post-surgical population (OR 0.251, 95% CI 0.223-0.281, P = 0.000) [Figure 8].

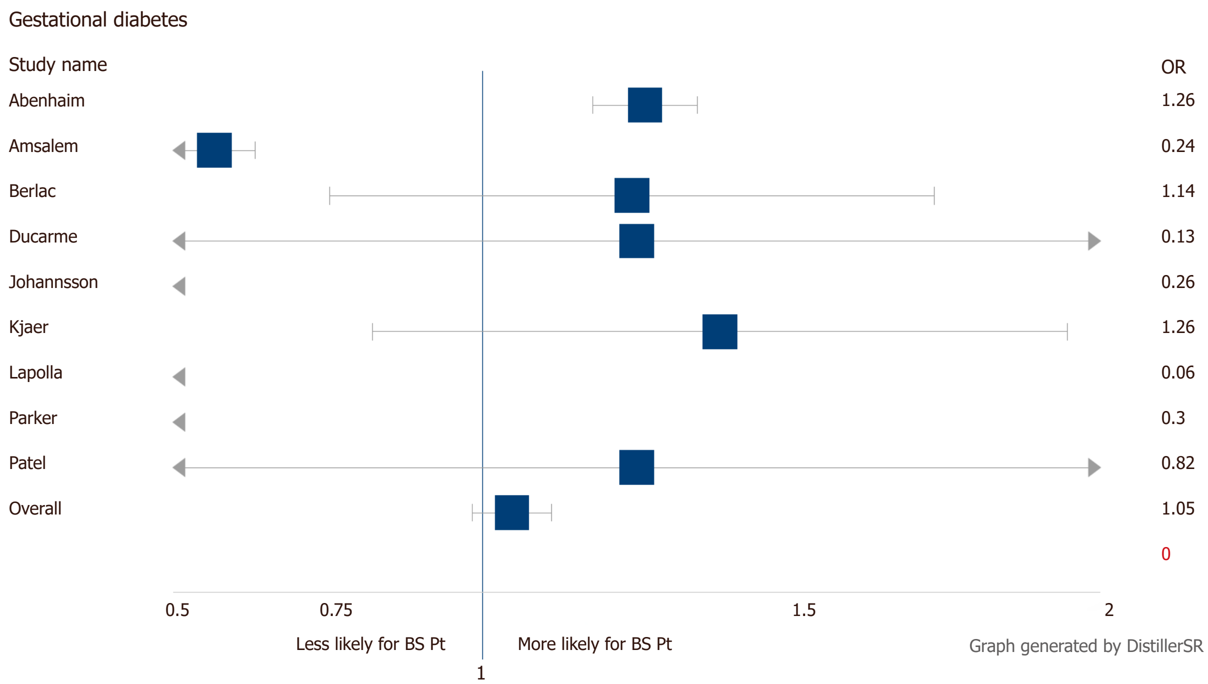

Figure 4. Gestational diabetes

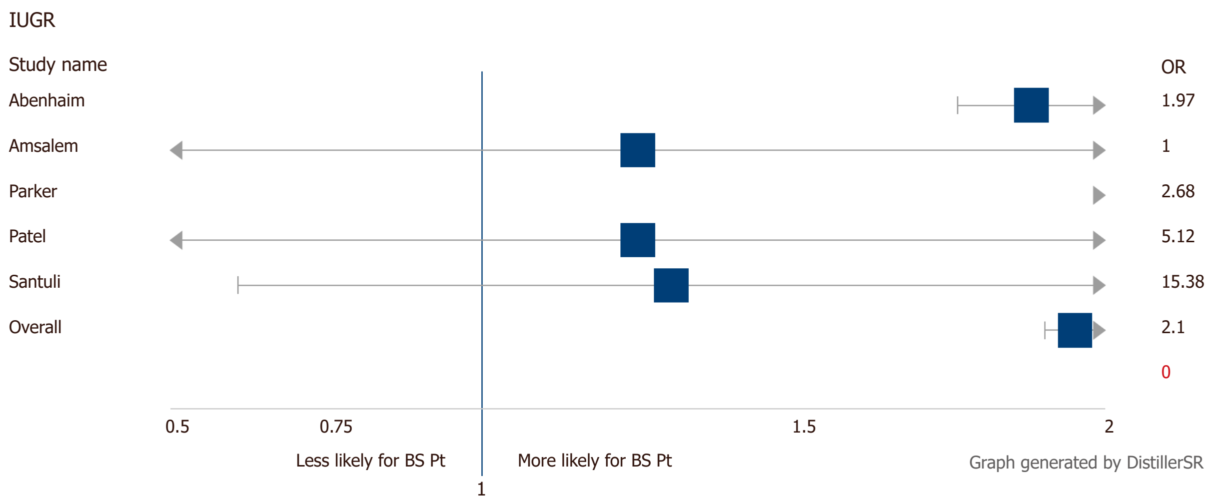

Figure 5. Intra-uterine growth restriction

The assisted delivery review included 7 papers[14,17-19,22-24] and had 16,574 women in the control population and 298 women in the post-surgical population. As compared to the control population, there was a reduction in the rates of assisted deliveries in the post-surgical population (OR 0.807, 95% CI 0.717-0.917, P = 0.000) [Figure 9].

The premature delivery review included 9 papers[13,14,16,19-21,23-25] and had 19,963 women in the control population and 1051 women in the post-surgical population. As compared to the control population, there was no difference in the rates of Premature Delivery found in the post-surgical population (OR 0.982, 95% CI 0.918-1.050, P = 0.591) [Figure 10].

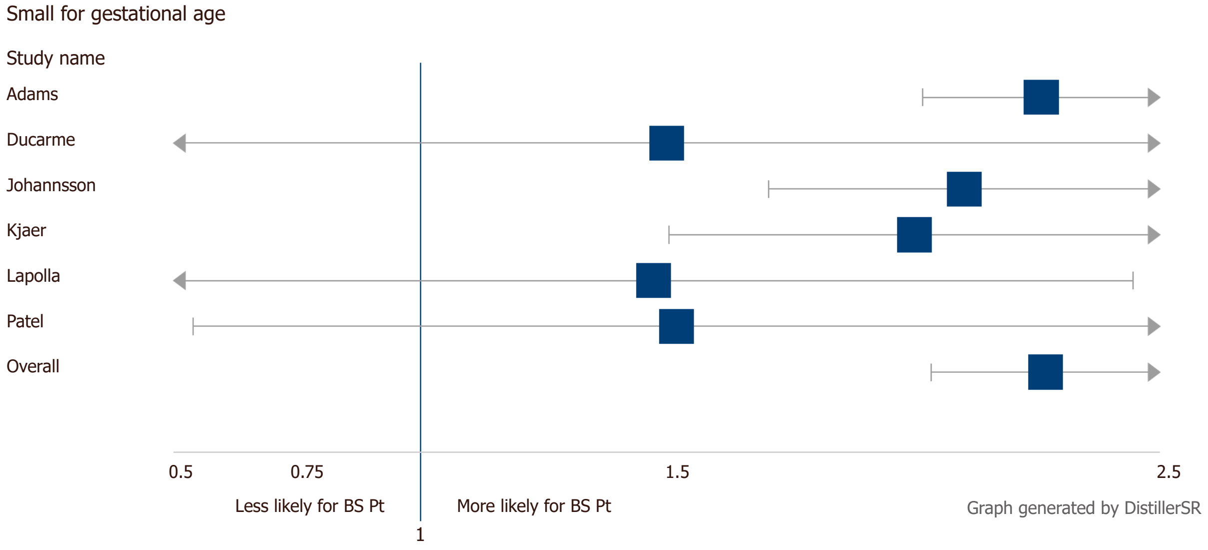

Figure 6. Small for gestational age

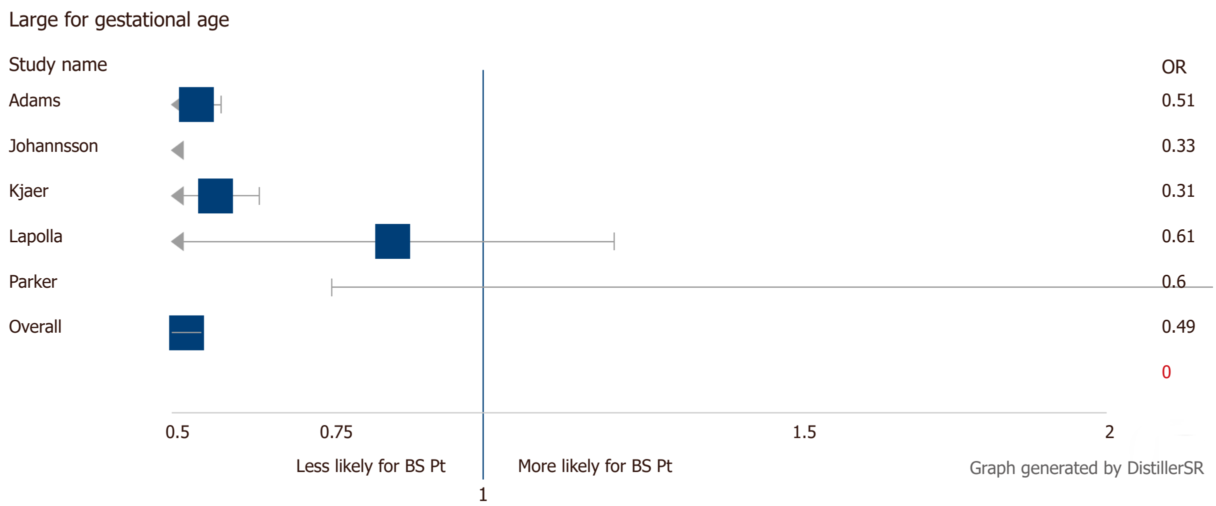

Figure 7. Large for gestational age

DISCUSSION

Main findings

Our findings in this meta-analysis are that women affected by obesity who undergo bariatric surgery have a decreased incidence of cesarean section, assisted delivery, LGA and macrosomic neonates as compared to obese controls. In addition, there was an increased incidence of pregnancy-induced hypertension and SGA and IUGR neonates in the post-surgical candidates. There was no difference in the incidence of gestational diabetes or premature delivery in these two groups.

Cesarean section

Previous systematic reviews have shown inconsistent results in cesarean section rates after bariatric surgery[10-12]. Vrebosch *et al.*[10] found a lower incidence of C-sections while both Galazis *et al.*[11] and Yi *et al.*[12] found no difference.

In the 10 studies used for this review, there was a large variation in their results[13,14,16-19,21-24]. One study found surgery as an independent risk factor[22] while two studies found a decreased rate of C-sections among the

 Young et al. Mini-invasive Surg 2018;2:16 I http://dx.doi.org/10.20517/2574-1225.2017.50

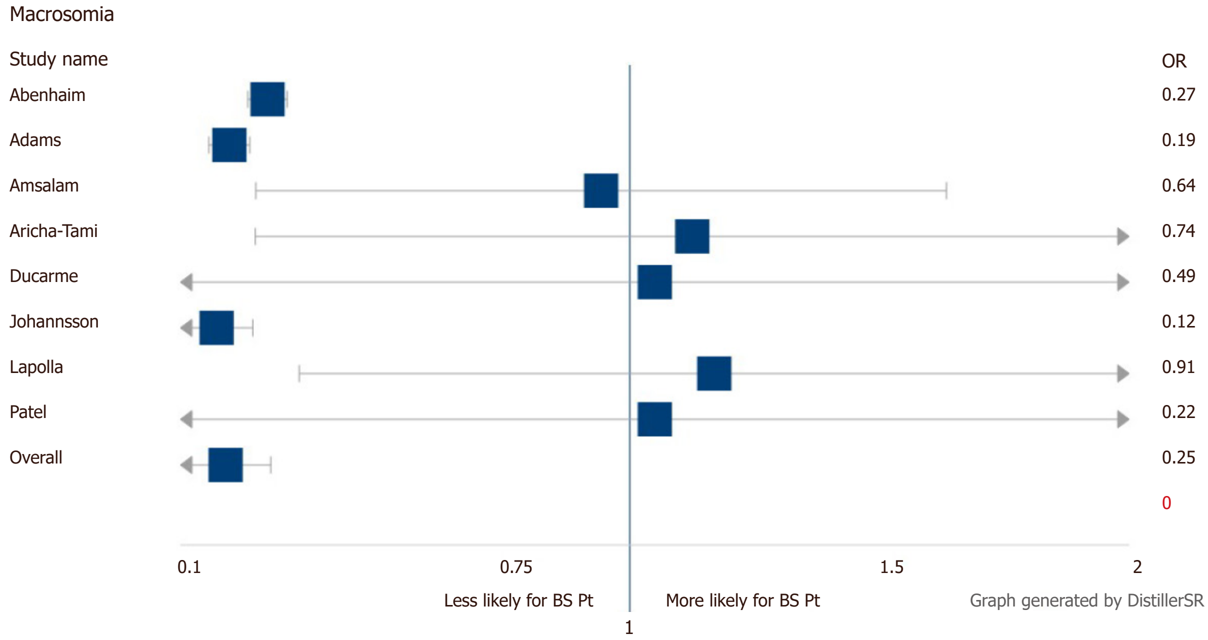

Figure 8. Macrosomia

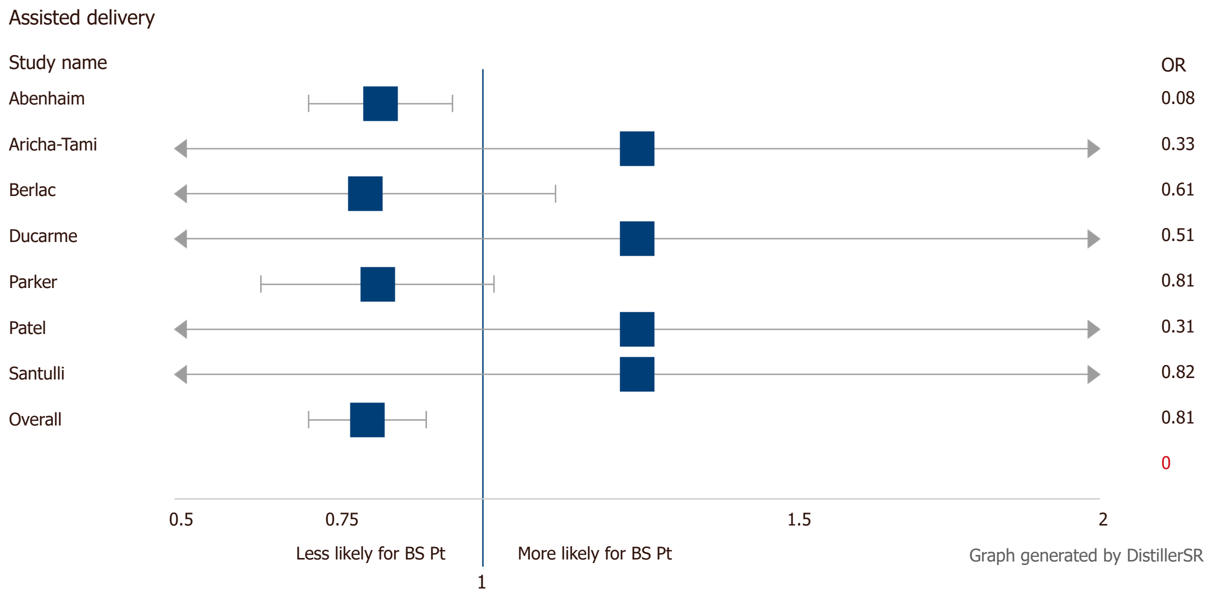

Figure 9. Assisted delivery

event group[13,14]. The remaining seven studies did not find a difference between the two groups. However, bariatric surgery reduces leptin, a hormone increased in maternal obesity that is noted to have a tocolytic effect on the myometrium theorized to prolong labor and increase the likelihood of cesarean. Therefore, post-bariatric women who are obese may produce less leptin resulting in better contractility compared to the obese control.

Our analysis found there was a decreased incidence of cesarean sections in the bariatric surgical women affected by obesity, as compared to the obese controls. We conclude that bariatric surgery lowers the rate of cesarean deliveries.

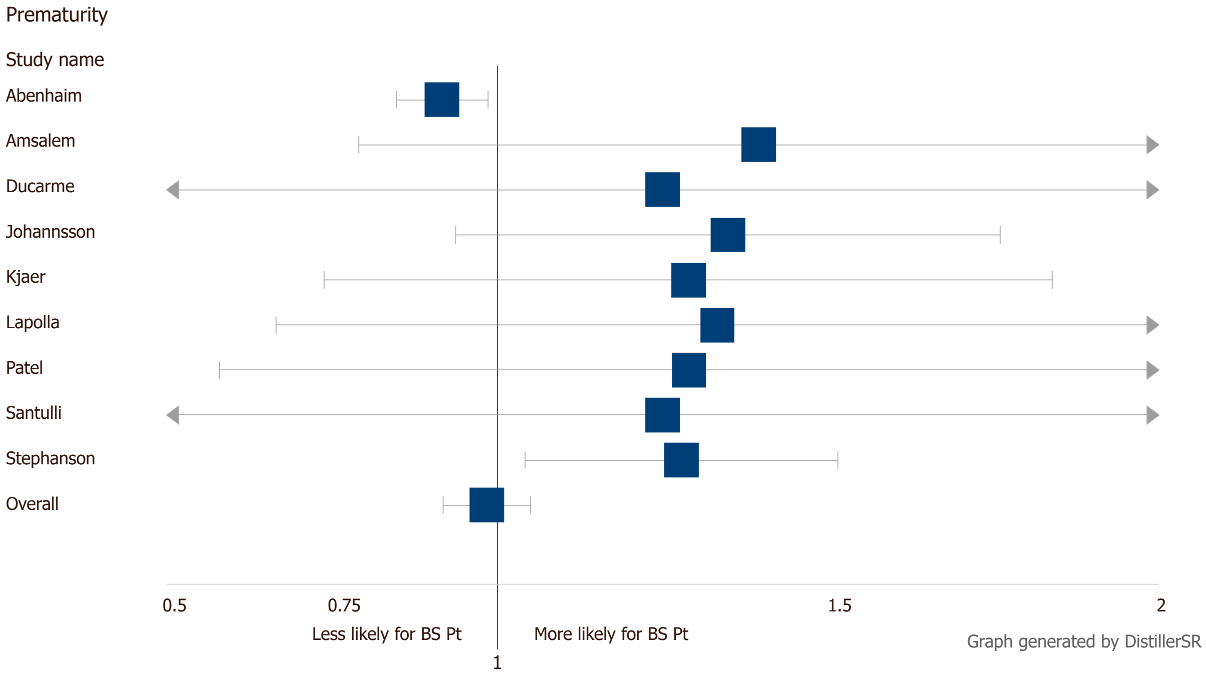

Figure 10. Premature delivery

PIH

There was variation among the 8 studies used in this analysis[13,14,16,18,19,22-24]. While the majority of the studies showed no difference in the two groups, Parker *et al.*[22] showed an increase in PIH. Parker *et al.*[22] theorized this is likely due to the fact that the average bariatric candidate is white and older which pre-disposes them to hypertension.

GD

Prior systematic reviews have shown either a decrease or no change in the rates of GD among the bariatric surgery patient[10-12]. The 9 studies used in this review are no exception[13,14,16,18-23]. While there were 4 papers showing a decrease in the rates of GD[13,16,20,22], the majority did not show a difference. It has been theorized that there is a reduction in the rates of GD after bariatric surgery due to absorption or metabolic changes[24]. However, our data did not show a difference in the rates of GD between the two groups. This is likely due to the metabolic changes associated with prolonged obesity and is not related to surgery.

IUGR

Five studies were included in our review of IUGR rates in respect to bariatric surgery[14,16,22-24]. Individually, they found either no difference or an increased rate of IUGR among the bariatric surgical patient as compared to their control. In analyzing the five studies together, we concluded there was an increased rate of IUGR in association with bariatric surgery.

The explanation for this finding remains unknown. It has been theorized that malabsorption and nutritional deficiencies during the pregnancy may lead to the growth restriction; however fetal growth restriction has many etiologies including aneuploidy, infection, and congenital malformations[23]. Both malabsorption and nutritional deficiencies are more often associated with gastric bypass procedures rather than the banding procedure. A sub analysis to compare the two procedures was not able to be performed as two of the studies only included the Roux-en-Y bypass[23,24] while the other three did not specify the surgical procedure performed. Further studies would need to be performed to determine the IUGR rates in bypass versus banding patients.

SGA

The 6 studies included in this section found either no difference or an increased risk of SGA neonates among bariatric surgery patients[13,15,19-21,23] while our data suggests an increased risk of SGA among the bariatric surgery woman as compared to the controls. However, this is potentially due to the same reasons as listed above for IUGR.

Of the six studies reviewed, only two specified the banding procedure for their surgical subjects[13,19]. A sub analysis of this data showed no difference in the surgical patient versus the control when banding is performed, thus giving us indeterminate results for this category. Further studies would need to be to determine the SGA rates in bypass versus banding patients.

LGA and macrosomia

A total of 5 studies included data on LGA[13,15,20-22] and 8 studies included data on macrosomia rates[13-17,19,20,23]. While there were a few select papers that showed no difference, the majority of the studies reviewed showed a significant decrease in the rates of both LGA and macrosomic neonates in the bariatric surgery patient. Women who gain less weight during the pregnancy, on average, have a decreased chance of delivering a LGA or macrosomic neonate[15].

Our analysis found there was a decreased incidence of both LGA and macrosomia in the bariatric surgical women who are obese, as compared to the obese controls. We conclude that bariatric surgery lowers the rates of LGA and macrosomic neonates.

Assisted delivery

The majority of the 7 papers included in this section showed no difference for bariatric surgery patients[14,17-19,22-24]. However, when we ran the data combined we found a decreased rate in assisted delivery as compared to the obese control group. This is likely due to a decrease in the size of the neonate in the bariatric surgery patient.

Premature delivery

None of the 9 studies included showed a difference in the rates of premature delivery of the neonate[13,14,16,19-21,23-25] and our data supports this conclusion. We did not find any significant difference in the bariatric surgery patient and thus cannot associate surgery to the incidence of early delivery rates.

Strengths and weaknesses

This is the most recent systematic review on the subject of bariatric surgery and maternal and neonatal outcomes. This was done on a large data size including a total of 439,561 subjects. We used a total of 13 studies in order to give a comprehensive and unbiased review of the current material. Time between surgery and pregnancy was not able to be included as only four of the articles included this variable. In the future, the inclusion of miscarriage rates associated with bariatric surgery and a more extensive review of maternal complications compared with time between surgery and pregnancy would further evaluate the fetal and maternal outcomes in post-bariatric surgical patients.

However, there are always limitations to every review. We only included papers that were published in English or were able to be translated into English. In addition, not all of the studies separated the various types of surgery so we could only review bariatric surgery as a whole. Finally, while we used the BMI range of “obese” there was some variation in the obese range between the controls and bariatric surgery patients.

DECLARATIONS

Authors’ contributions

Primary author: Young B
Secondary author: Drew S

Supervisor: Ibikunle C
Primary supervisor: Sanni A

Availability of data and materials
Data are available on request.

Financial support and sponsorship
None.

Conflicts of interest
All authors declare that there are no conflicts of interest.

Ethical approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

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