Journal of Obesity and Therapeutics

Review Article A SCITECHNOL JOURNAL

Maternal Nutritional Status and Related Pregnancy Outcomes Following Bariatric Surgery

Leen Lawand[1], Ghinwa Lawand[2] and Samaa Al Tabbah[3*]

[1]Department of Nutrition and Food Sciences, American University of Beirut, Beirut, Lebanon

[2]Department of Obstetrics and Gynecology, Beirut Arab University, Beirut, Lebanon

[3]Department of Pharmacy, Lebanese American University, Beirut, Lebanon

***Corresponding author:** Samaa Al Tabbah, Department of Pharmacy, Lebanese American University, Beirut, Lebanon, 009613969396; E-mail: samaa.tab@hotmail.com

Received date: 16 January, 2023, Manuscript No. JOT-23-87174;

Editor assigned date: 19 January, 2023, PreQC No. JOT-23-87174 (PQ);

Reviewed date: 02 February, 2023, QC No. JOT-23-87174;

Revised date: 20 April, 2023, Manuscript No. JOT-23-87174 (R);

Published date: 27 April, 2023, DOI: 10.4172/JOT.1000238

Abstract

Objective: Obesity has emerged as a major health concern in recent years, accompanied by an increase in the prevalence of bariatric surgery in women of reproductive age, but certain surgery specific risks may exist. The long term effects of surgery on pregnancy outcomes are still unknown. The aim of this review was to discuss the maternal nutritional status and related pregnancy outcomes following bariatric surgery.

Methods: The cochrane library and pubmed databases were searched for scientific articles between the periods 2015 and 2022. We included studies that discussed maternal nutritional status and related pregnancy outcomes following bariatric surgery. The obtained information was evaluated, compiled, analyzed, interpreted, and conclusions were reached.

Results: In total, 83 papers were reviewed. Bariatric operations can result in nutritional deficiencies in the mother thus increasing maternal morbidity and a higher risk of poor pregnancy outcomes. Moreover, under nutrition in pregnant women due to past bariatric surgery is associated with a range of harmful effects to the developing fetus, as well as for the child in the long term.

Conclusion: Optimal gametogenesis, embryonic development, and fetal health are all dependent on the health of the mother during the preconception as well as the pregnancy periods, which also has an impact on the health of the mother and the child later in life.

Keywords: Obesity; Maternal; Nutritional; Pregnancy; Bariatric; Surgery; Weight

Introduction

Obesity as a major health problem

Obesity has emerged as a major health concern in recent years, accompanied by an increase in the prevalence of bariatric surgery in women of reproductive age [1]. The world health organization defines obesity as having a Body Mass Index (BMI) of 30 kg/m^2 or greater. According to BMI, obese individuals are further divided into three classes: Class I (30 kg/m^2-34.9 kg/m^2), class II (35 kg/m^2-29.9 kg/m^2), and class III or extreme obesity (40 kg/m^2) [2,3]. Increasing weight trends in adults over the past couple decades illustrate the increasing influence obesity is having on women's well-being making it a global health problem [4]. Obesity and its related comorbidities adversely affect fertility, maternal health during pregnancy, maternal obstetric outcomes, fetal outcomes, and the long term health of the offspring. Thus, weight loss prior t0 pregnancy can greatly reduce these risks [5].

Bariatric surgery on the rise

Obesity first line treatment usually involves lifestyle modifications; however, these changes rarely result in long term weight loss. Currently, Bariatric Surgery (BS) in combination with lifestyle modifications is considered the best treatment to fast track weight loss on a long term basis [6]. According to international guidelines, bariatric surgery should be considered in patients whose BMI exceeds 40 kg/m^2, in patients with BMI between 35 kg/m^2 and 40 kg/m^2 with severe comorbidities, or even in patients with coexisting diabetes mellitus [7]. Over 800,000 bariatric surgical procedures were documented from 2014 to 2019 in the 5th edition of the global registry report of the International Federation for the Surgery of Obesity and metabolic disorders (IFSO) [8]. In the Middle East and North Africa (MENA) region, where many countries are Arab in culture, obesity and metabolic disorders are on the rise [9].

Literature Review

Overview of bariatric procedure and major outcomes

Bariatric surgery includes restricted surgery such as Adjustable Gastric Banding (AGB) and Vertical Sleeve Gastrectomy (VSG) as well as malabsorption surgery such as Rouxen Y Gastric Bypass (RYGB). Alternatively, it can be a combination of both [10]. Of these operations, VSG is currently the most frequently performed operation, accounting for 53.6% of the operations. VSG results in similar body weight loss to RYGB and significantly higher than that of gastric banding. Additionally, VSG and RYGB offer similar remission for comorbidities such as type 2 diabetes and hyperlipidemia [11].

Obesity and pregnancy

Obesity during pregnancy is associated with significant morbidity, including fetal macrosomia, hypertensive disorders, and gestational diabetes [12]. Several studies have shown that bariatric operations before pregnancy are associated with a reduced prevalence of macrosomic infants, maternal diabetes, and hypertension relative to the prevalence found among obese women who did not undergo a bariatric operation [13-15]. However, because bariatric operations can

result in nutritional deficiencies in the mother, there has been some concern that surgery may adversely influence fetal development and infant outcomes such as Neonatal Intensive Care Unit (NICU) admissions, Apgar scores, and congenital malformations [16].

Importance of nutrition for the mother and the fetus during pregnancy

During pregnancy, nutritional requirements increase immensely in order to maintain maternal metabolism and to support fetal growth and development [17]. To ensure a safe and healthy pregnancy for both the mother and the baby, nutrition is one of the most important issues that should be discussed with women when planning on getting pregnant because many macronutrients and micronutrients are vital for maternal and fetal health [18]. Any deficiencies or poor dietary intake will have a heavy impact on the baby's health when entering adulthood [19]. A mother's diet should be able to provide an adequate amount of energy to synthesize new tissue and help in fetal growth [20]. Energy restriction and low caloric intake during pregnancy will result in low birth weight infants and cause health complications and growth defects later on for the baby. Energy intake is calculated based on the mother's pre pregnancy weight, BMI and physical activity levels.

When pregnant, protein metabolism is adjusted in order to maintain maternal homeostasis while also accommodating to fetal demands as well as preparing for lactation for breastfeeding. Whole body protein turnover rate also becomes high during that time, so protein synthesis is increased by 15% to 25% in the second and third trimesters respectively, thus making the body use a huge amount of its stored amino acids. Therefore, protein and essential amino acids are necessary macronutrients that should be provided adequately in the mother's diet.

Essential fatty acids omega 6 (linoleic) and omega 3 (linolenic) fatty acids as well as their derivatives, EPA (Eicosapentaenoic Acid), DHA (Docosahexaenoic Acid) and AA (Arachidonic Acid) are key structural components of cell membranes and crucial for tissue formation. It is crucial that the mother's dietary intake should include fatty acids, especially DHA and EPA. DHA helps in the development of the brain and retina of the fetus, while EPA helps in reducing the risk for developing preeclampsia by reducing the synthesis of thromboxane A2, a hormone that stimulates the activation of new platelets, from AA supplementation.

Folate or folic acid, a vitamin B complex, is a coenzyme used in the synthesis of DNA and neurotransmitters, as well as amino acid metabolism, protein synthesis and cell multiplication. This vitamin is vital during embryonic and fetal stages of pregnancy, where there is rapid cell division and tissue growth and also prevents the development of neural tube defects, which are defects of the brain and spine. It is very important to supplement the mother with folic acid during preconception and early pregnancy because the neural tube is formed during the first four weeks of pregnancy. Women of all reproductive ages should start with supplementation at least 1 month before conception until at least 12 weeks of gestation.

The physiological function of vitamin A, a fat soluble vitamin, include vision, growth, bone metabolism, immune function, and gene transcription in addition to antioxidant activities. During pregnancy, additional vitamin A is needed to support fetal growth and tissue maintenance as well as to provide reserves for the fetus and aid in maternal metabolism.

B complex vitamins are vitamins B_1 (thiamine), B_2 (riboflavin), B_3 (niacin), B_6 (pyridoxine) and B_{12} (cyanocobalamin). These water soluble vitamins are essential for the production and release of energy in cells and for the metabolism of protein, fat and carbohydrates. Due to the increase in protein and energy needs during pregnancy, the requirements for these vitamins increase, especially during the third trimester.

Vitamin C is a very essential water-soluble vitamin because it is involved in synthesizing collagen, which is a primary component of connective tissue, and is involved in mobilizing iron from stores as well as enhancing its absorption. Vitamin C participates in several processes that are related to collagen synthesis, synthesis of hormones, synthesis of carnitine, gene transcription, elimination of tyrosine, protection against Reactive Oxygen Species (ROS), and reduction of iron in the gastrointestinal tract vitamins C and E work synergistically to allow the promotion of antioxidant defenses and inhibit the formation of free radicals that cause oxidative stress. In order to utilize their function, they are often supplemented together, however, studies show that when these two vitamins are supplemented together, they increase the risk of Premature Ruptures Of Membranes (PROM), so it is not recommended to supplement both vitamin C and E together during pregnancy.

Calcium is an important mineral needed by the body for bone mineralization. It is used in several biological processes, which include muscle contraction, enzyme and hormone homeostasis, as well as neurotransmitter release and nerve cell function. In pregnancy, calcium demands are increased, especially during the third trimester by the body because calcium is actively transported across the placenta.

Iodine is an essential nutrient needed by the body for regulating growth, development and metabolism through the biosynthesis of thyroid hormones. During pregnancy, Iodine passes through the placenta for fetal thyroid hormone production. Maternal and fetal thyroid hormone production are important for development of fetal brain and nervous system.

Zinc plays a key role in various cellular processes such as differentiation, apoptosis, and proliferation, and is used for vital biochemical and structural processes in the body. It is a key mineral during pregnancy and is very important for cell division and protein growth. It plays a crucial role in healthy embryogenesis.

Iron has an essential physiologic role, as it is involved in oxygen transportation and energy formation. It is a vital nutrient needed during pregnancy. Approximately twice the amount must be provided to the mother to make more blood in order to carry oxygen to the baby. Moreover, this huge supply of iron the body needs also supports the baby in making his own blood.

Health risks associated with malnutrition during pregnancy

Pregnant women who receive inadequate nutrition experience greater maternal morbidity and have a higher risk of poor pregnancy outcomes e.g., premature birth and miscarriage. They also have an increased risk of developing the following conditions: Anemia, infection, lethargy, weakness, and lower productivity. Moreover, under nutrition in pregnant women is associated with a range of harmful effects to the developing fetus, including Intrauterine Growth Retardation (IUGR) and low birth weight. Maternal under-nutrition during Pregnancy, (IUGR) and low birth weight are in turn associated with a range of adverse outcomes for the developing fetus and/or

newborn baby, including an increased risk of: Stillbirth, premature birth, perinatal mortality, birth defects, and underdevelopment of some organs, cretinism, and brain damage. As for the child in the long term, maternal under nutrition causes metabolic and other changes. For example, a fetus that is malnourished adapts by reducing insulin and glucose production. This will increase the risk of chronic nutritional disorders including type 2 diabetes mellitus, metabolic syndrome and obesity.

As for the micronutrient deficiency during pregnancy, there are also numerous maternal and fetal health risks associated with it in particular: Folate, and vitamin B_{12}. Maternal health risks which may arise as a result of deficiency in micro-nutrients include: Anemia and its symptoms, neurological complications (associated with vitamin B_{12} deficiency), blood clotting disorders (associated with vitamin K deficiency), iron deficiency anemia (associated with iron deficiency), miscarriage and stillbirth (associated with Iodine deficiency), pre-eclampsia, premature rupture of membranes, and reterm delivery (associated with zinc and magnesium deficiency).

Consequences of bariatric surgery on pregnancy

Pregnancies after BS, especially malabsorptive procedures, are characterized by nutritional deficiencies such as anemia, low protein and vitamin levels. BS before pregnancy seems to increase the risk for the development of Iron Deficiency Anemia (IDA) during pregnancy. Folic acid deficiency seems to be rare after all BS procedures. Gascoin, et al., compared non-obese pregnant controls with pregnant women after gastric bypass that took 800 µg/day of folic acid and did not observe folic acid deficiency in the bariatric group. Weng, et al., could also find no evidence of folate deficiencies in patients after RYGB. They suggest that folate absorption occurs throughout the entire small intestine and any deficiency caused by inadequate dietary intake can therefore easily be corrected by supplementation. Vitamin B_{12} deficiency seems to occur especially after malabsorptive or combined BS as the secretion of intrinsic factor and gastric acid is decreased and the duodenum, being the main absorption site, is bypassed. In pregnant women after BS, the prevalence of vitamin B_{12} deficiency is reported to be between 48% and 53%, but not in bariatric gravidas who received a vitamin B_{12} supplementation. Several studies have found a vitamin D deficiency in 3% to over 70% of pregnant women, depending on the BS procedure. The altered anatomy of the intestinal tract occurring especially after RYGB could directly interfere with calcium absorption, possibly leading to maternal bone loss, reduced calcium levels in breast milk or deficient fetal bone mineralization. Inadequate vitamin D levels (< 29 ng/ml) were observed in over 70% of pregnant women who underwent RYGB surgery, through all three trimesters of pregnancy and despite a supplementation with 600 IU of vitamin D per day. BS might be associated with protein deficiency as a consequence of the restricted food intake and absorption. A German study in non-pregnant patients after BS provided evidence that 60 g/daily or even higher levels of protein supplements increase body fat mass loss without negative effects on the renal function. There is only little evidence for detrimental effects of maternal protein deficiency on pregnancy outcome, mainly impaired fetal growth; however, pregnant women after BS should be advised to adhere to the general recommendations for post-surgery protein intake and the fetal growth should be assessed regularly. Vitamin A deficiency was reported in 10% to 58% of pregnant women after BS, depending on BS procedure and gestational age. Gascoin, et al., observed also vitamin E deficiency in pregnant women with a history of gastric bypass, but no adverse pregnancy outcome is described. Deficiencies of vitamin C, vitamin B_1 and vitamin B_9 in pregnant women after BS were observed and the offspring of mothers with a BS history displayed lower cord blood levels of several micronutrients such as vitamin A, calcium, zinc and iron, in contrast to a control group. Furthermore, a history of BS is associated with altered glucose metabolism, impacting the diagnosis of hyperglycemia. In addition, pregnant women with a history of gastric bypass might be at risk to develop an internal hernia, potentially leading to severe consequences like bowel necrosis or acute perforation, which might eventually lead to acute C-section. Exceptional cases of maternal and fetal death have also been described. Moreover, BS before pregnancy seems to reduce the risk for developing GDM considerately. Despite the protective effect of BS and subsequent weight loss on the development of GDM, some procedures like RYGB alter glucose kinetics and might also have detrimental effects on pregnancy outcome and GDM diagnostics which have to be observed by obstetricians.

Pregnancy after bariatric surgery: Timing and benefits

The American College of Obstetricians and Gynecologists (ACOG)'s typical guideline for women who want to get pregnant following bariatric surgery is to wait at least 1 to 1.5 years after surgery, which is also recommended by the European Association for the Study of Obesity (EASO). Postoperatively, it is recommended that pregnant women postpone pregnancy to ensure maximum weight loss, weight stabilization, and reduce the risk of macronutrient and micronutrient deficiencies as well as electrolyte imbalances. In a cohort study, it was found that gestational age at delivery, gestational weight increase, and neonatal birthweight were lower in the group that conceived within 12 months of the bariatric surgery than the group that conceived between 12 month and 24 month and late group (>24 months). Moreover, Parent, et al., reported that shorter surgery to birth intervals (less than 2 years) have been associated with prematurity, small for gestational age, and NICU admissions, but there are no data on long term outcomes. On the other hand, Stentebjerg, et al., found that postponing a pregnancy according to this recommendation may result in poor pregnancy outcomes (iron deficiency, excessive gestational weight gain, and caesarean section delivery). Several other studies also did not find a difference between gestational outcomes in relation to the interval between surgery and conception.

Discussion

BS before pregnancy seems to significantly reduce the risk for developing Gestational Diabetes Mellitus (GDM), which is defined as diabetes that occurs in the second or third trimester of pregnancy without having a preexisting type 1 or 2 diabetes. There are several adverse pregnancy outcomes associated with GDM, such as preterm labor, cesarean section, macrosomia, and preeclampsia. Moreover, the rate of gestational diabetes was lower in the VSG group compared to the non-surgery group in a study by Rottensteich, et al.

The risk of hypertensive disorders during pregnancy increases with obesity. Hypertension disorders include pre-gestational chronic hypertension, Pregnancy Induced Hypertension (PIH), and Preeclampsia (PE). As maternal BMI increases, the risk for pregnancy associated hypertension and preeclampsia increases proportionally, ranging between 1.4% and 2.4% in normal weight women and reaching 3.5%–14.5% in obese women. According to Aricha-Tamir, et al., women who underwent BS had a significantly lower incidence of preeclampsia (3% of cases), compared with obese women in the

control group (15% of cases). On the other hand, there were no differences between women who underwent BS and those who did not in the cohort study by Kjaer, et al.; Ibeibele, et al., found that having bariatric surgery before a second pregnancy resulted in a 67% reduction of hypertension during the second pregnancy.

Conclusion

Maternal health during the preconception period is crucial for optimal gametogenesis and for embryonic and fetal development which also affects health in the later lives of both mother and offspring. Whereas BS leads to the reduction of many obesity related pregnancy complications, such as Gestational Diabetes Mellitus (GDM), pregnancy induced hypertension and fetal macrosomia; those procedures pose new risks which might lead to adverse outcomes for mothers, offspring, and children later in life.

Grands and Funding

None.

Authorship Contribution

Leen Lawand, Ghinwa lawand, Samaa Al Tabbah contributed equally to the preparation and write up of the manuscript. Samaa AL Tabbah and Ghinwa Lawand carried out the critical review of the manuscript, Samaa Al Tabbah and Leen Lawand confirmed the final draft for journal submission.

Conflict of Interest

All the authors have no conflict of interest.

Ethical Approval

Not applicable.

References

1. Falcone V, Stopp T, Feichtinger M, Kiss H, Eppel W, et al. (2018) Pregnancy after bariatric surgery: A narrative literature review and discussion of impact on pregnancy management and outcome. BMC Pregnancy Childbirth 18:1-3.
2. Kominiarek MA, Rajan P (2016) Nutrition recommendations in pregnancy and lactation. Med Clin North Am 100:1199-1215.
3. Edison E, Whyte M, van Vlymen J, Jones S, Gatenby P, et al. (2016) Bariatric surgery in obese women of reproductive age improves conditions that underlie fertility and pregnancy outcomes: Retrospective cohort study of UK National Bariatric Surgery Registry (NBSR). Obes Surg 26:2837-2842.
4. Jans G, Matthys C, Bel S, Ameye L, Lannoo M, et al. AURORA: Bariatric surgery registration in women of reproductive age-A multicenter prospective cohort study. BMC Pregnancy Childbirth 16:1-1.
5. Inocian EP, Nolfi DA, Felicilda-Reynaldo RF, Bodrick MM, Aldohayan A, et al. (2021) Bariatric surgery in the Middle East and North Africa: Narrative review with focus on culture specific considerations. Surg Obes Relat Dis 17:1933-1941.
6. Mohan S, Samaan JS, Premkumar A, Samakar K (2022) History of abuse and bariatric surgery outcomes: A systematic review. Surg Endosc 36:4650-4673.
7. Angrisani L, Santonicola A, Iovino P, Vitiello A, Higa K, et al. IFSO worldwide survey 2016: Primary, endoluminal, and revisional procedures. Obes Surg. 28:3783-3794.
8. Santos S, Voerman E, Amiano P, Barros H, Beilin LJ, et al. (2019) Impact of maternal body mass index and gestational weight gain on pregnancy complications: An individual participant data meta-analysis of European, North American and Australian cohorts. Int J Obst Gyna 126:984-995.
9. Snoek KM, Steegers-Theunissen RP, Hazebroek EJ, Willemsen SP, Galjaard S, et al. (2021) The effects of bariatric surgery on periconception maternal health: A systematic review and meta-analysis. Hum Reprod Update 27:1030-1055.
10. Akhter Z, Rankin J, Ceulemans D, Ngongalah L, Ackroyd R, et al. (2019) Pregnancy after bariatric surgery and adverse perinatal outcomes: A systematic review and meta-analysis. PLoS Med 16:e1002866.
11. Al-Nimr RI, Hakeem R, Moreschi JM, Gallo S, McDermid JM, et al. (2019) Effects of bariatric surgery on maternal and infant outcomes of pregnancy-an evidence analysis center systematic review. J Acad Nutr Diet 119:1921-1943.
12. Getahun D, Fassett MJ, Jacobsen SJ, Sacks DA, Murali SB, et al. (2022) Perinatal outcomes after bariatric surgery. Am J Obstet Gynecol 226:121.e1-121.e16.
13. Mousa A, Naqash A, Lim S (2019) Macronutrient and micronutrient intake during pregnancy: An overview of recent evidence. Nutrients 11:443.
14. Marshall NE, Abrams B, Barbour LA, Catalano P, Christian P, et al. (2022) The importance of nutrition in pregnancy and lactation: Lifelong consequences. Am J Obstet Gynecol 226:607-632.
15. Young MF, Ramakrishnan U (2020) Maternal undernutrition before and during pregnancy and offspring health and development. Ann Nutr Metab 76:41-53.
16. Marangoni F, Cetin I, Verduci E, Canzone G, Giovannini M, et al. (2016) Maternal diet and nutrient requirements in pregnancy and breastfeeding. An Italian consensus document. Nutrients 8:629.
17. Most J, St Amant M, Hsia DS, Altazan AD, Thomas DM, et al. (2019) Evidence-based recommendations for energy intake in pregnant women with obesity. J Clin Invest 129:4682-4690.
18. Xiong T, Wu Y, Huang L, Chen X, Zhang Y, et al. (2021) Association between the maternal protein nutrition status during pregnancy and the risk of preterm birth. Matern Child Nutr 17:e13043.
19. Murphy MM, Higgins KA, Bi X, Barraj LM (2021) Adequacy and sources of protein intake among pregnant women in the United States, NHANES 2003-2012. Nutrients 13:795.
20. Saini RK, Keum YS (2018) Omega-3 and omega-6 polyunsaturated fatty acids: Dietary sources, metabolism, and significance-A review. Life Sci 203:255-267.