

Post Bariatric Surgery Pregnancy (Pbsp): An Obstetrician Perspective

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Abstract

Bariatric surgery (BS) has increasingly been offered to obese woman. It is quite common in developing world but slowly the increased affordability and access to health care in developing countries could witness an increase in bariatric surgeries. The affluent society has higher bariatric surgeries in offering and along with slightly higher age of marriage it is not uncommon to encounter post bariatric surgery pregnancies. Nutritional deficiencies like Vitamin B12, Folate, Calcium, Protein and fat-soluble vitamins are increased after bariatric surgery. Its high time that we focus on current recommendations for nutritional supplementation after bariatric surgery as the dictum goes, 'Prevention is better than cure'.

Keywords: post bariatric surgery pregnancy; nutritional requirement

Introduction

Pregnancy is an altered physiological state, conditions like hyperemesis, gastro oesophageal reflux disease increase during pregnancy alongside if the patient is post bariatric surgery these complaints could have additive effect on nutritional status of woman [1]. Obesity is defined as an increase in Body Mass Index (BMI) more than 30 kg/m². Bariatric surgery has no doubt emerged as an effective cost effective treatment of obesity in recent years [2] and large number of woman are opting for bariatric surgery [3, 4]. The control on obesity improved fertility rates but at the same time post bariatric surgery complications are also on rise [5]. Bariatric surgery [6] can be: restrictive or malabsorptive procedures or a combination of both. Roux-en-Y gastric bypass (RYGB), the sleeve gastrectomy and the adjustable gastric band are most commonly employed surgical techniques.

The million-dollar question is the management of pregnancy in woman who has undergone bariatric surgery but unfortunately there is paucity of literature on this issue and lack of international consensus. The American college of obstetrics and Gynecologists along with the European association has recommended delaying pregnancy for at least 1 to 1.5 years after bariatric surgery [7, 8].

We present a pellucid gist of various recommendations for post bariatric surgery pregnant woman (PBSPW) (Table -1)

- The first step is to create awareness among woman and obstetricians / gynecologists regarding additional nutritional supplements in pregnant woman after bariatric surgery.
- Women who become pregnant following bariatric surgery should have nutritional surveillance and laboratory screening for deficiencies every trimester [9].
- PBSPW are advised to adopt a regular eating pattern. The eating pattern should include three small, balanced meals per day. Just like pregnancy in non obese woman a PBSPW should take a balanced diet that includes appropriate quantity of carbohydrates, protein, vitamins, fruits and vegetables.
- Those women who suffer from hyperemesis should eat frequent small meals.
- A reference nutrient intake of 0.75 g of protein per kg of body weight plus an additional 6 g/day in pregnancy is recommended [10].



hemorrhage, the most common nutritional deficiency post bariatric surgery is Iron deficiency anemia [11]. American college of obstetrics and gynecology {ACOG} recommends 27 mg/ day of elemental ferrous iron supplementation and 40 mg/day elemental iron in post bariatric surgery pregnancies [12]. Iron supplementation in post bariatric surgery pregnancy should not be done without monitoring of routine CBC, iron, ferritin levels at every trimester [7].

- A preoperative and annual screening for vitamin B12 followed by supplementation of 1000 microgram/ day orally or 500 microgram/ week intranasal route or 1000 microgram/ week intramuscularly hydroxyl cobalamin for 3 months is recommended [13,14].
- General screening at each trimester and supplementation is recommended at usual doses for folic acid (14). The dose of folic acid is 400 micrograms/ day from preconception period till 12 weeks of pregnancy [15]. Post bariatric surgery an additional 5mg/day of folic acid is recommended.
- For post bariatric surgery pregnancies it's supplementation in beta carotene form in daily dose not exceeding 5000 IU is recommended [16, 17, and 18].
- Vitamin C, B9 and trace elements like Selenium have an important role in enzymatic reactions but no adverse effect on pregnancy have been observed in literature studies (19) but supplementation of vitamins is recommended following bariatric surgery in pregnant woman [16,17,20].
- Calcium supplementation in pregnancy and lactation are recommended in doses 700 mg/day [21]. In PBSP calcium supplementation of 1500mg/ day [22] is suggested. Calcium citrate is preferred over all formulations as it has better absorption at reduced gastric PH [23].
- Vitamin D levels post RYGB have been found to be < 29 ng/ml inspite of supplementation however minimal adverse effects have been seen in literature studies [24] Vitamin D deficiency poses risk of IUGR and Preeclampsia [25], its supplementation in dose of 800 IU/day [26] is suggested as well as screening once in every trimester [27].
- Oral Magnesium supplements help in preventing calf cramps and muscular contractions of uterus [28, 29]. In pregnancy daily dietary supplementation of 310 mg is recommended where as in PBSP it is 200-1000mg [30].
- Zinc also contributes to copper deficiency therefore it is recommended that 1 mg of copper be given per 8-15 mg of Zinc substitution [31].
- Maternal or fetal adverse events in pregnancy due to iron, calcium, magnesium or iodine deficiency after bariatric surgery have not been reported in pregnant woman [32].
- During pregnancy retinol equivalent of 1100 ug (i.e 3666 IU) per day starting from fourth month of gestation until the end of pregnancy is recommended for vitamin A supplementation [33]. The upper tolerable limit for vitamin A by EFSA (European food safety agency) is stated at 3000 ug/ day retinal equivalent. Beta carotene form of vitamin A is recommended over retinol during pregnancy [31].
- EFSA recommends daily intake of 11 mg of vitamin E with no additional requirements during pregnancy or lactation [34].
- EFSA could not define upper tolerable limit for vitamin K supplementation [35] therefore daily intake of 70 ug phyloquinone is recommended. Vitamin K shows poor

absorption after bariatric surgery and there are cases of intracranial bleeding also seen post bariatric surgery with low vitamin K levels [36]. Therefore, either direct measurement of Vitamin K or Prothrombin time estimation should be done.

- It is always advisable to take small meals in divided daily intake say 6 meals to prevent dumping episodes. Liquid intake following meals should be postponed for 30minutes and lying down for 30 minutes to reduce vasomotor symptoms [37].
- Late dumping occurs after 1-3 hours of carbohydrate intake which is primarily mediated by incretin. It causes reactive hypoglycemia causing diaphoresis, tremors and palpitations [38]. Limited pharmacotherapy interventions are available for pregnant woman. Pectin and guar gum have been tried in some patients with some success in studies from literature [37].
- Oral glucose tolerance test is done in pregnant woman but for those with history of bariatric surgery the interpretation of the test may be difficult and therefore capillary blood monitoring is recommended before and after meals at 24- 28 week s of pregnancy [39].

Table-1 Nutritional requirement PBSP

Iron	100-200 mg[42], 40-65 mg[17], 65 mg[40], 200 mg[16]
Calcium	1500mg[42], 1000-2000 mg[17], 1200-1500mg[43], 1200 mg[40], 1000-1200 mg [16]
Vit D	400IU [40], 1200-2000IU [42], 2000-6000 IU [17] 1000IU [16]
Vit A	Upper limit 5000 IU [17,40]
Vit E	Not available
Vit K	120ug [75]
Vit B12	1000ug/3monthsIM [16,42], 350 Ug oral/ day [17], 1000ug/ week IM [40]
Folic acid	600-800Ug [41], 400ug [43], 800ug [40], 4mg [17], 400 ug [16]
Iodine	250 ug [17], 200ug [43]
Zinc	11mg [40], 20-30 mg [42], 15mg [17]
Magnesium	200-1000 mg [17]

There are numerous challenges in pregnancy after bariatric surgery the most common been malabsorption leading to nutritional deficiencies [45, 46]. We have elaborated the additional nutritional requirements in pregnancy after BS; we shall now focus on other aspects.

Obesity has detrimental effect on endometrial and ovarian function [47, 48]. Impaired intraovarian follicle growth, oocyte maturation leads to hyperandrogenemia and PCOS [49]. Obesity interferes with ovarian ultrasound visualization and oocyte retrieval ultimately leading artificial reproductive technique failure [48]. Artificial reproductive technique failures BS leads to weight loss and increased sexual functioning [50]. BS also increased chances of oocyte retrieval and increased chances of live birth rates [51]. It is therefore recommended in BS guidelines that BS should be considered in infertile anovulatory patients with BMI> 35 Kg/m² and in whom life style modification since past 6 months has not shown any improvement [52].

Gestational diabetes



Oral glucose tolerance (OGTT) is recommended for all pregnant woman between 24 and 28 weeks by 2 hour 75 g oral glucose [53]. Table-2 shows diagnostic thresholds for diabetes in pregnancy.

Fasting plasma glucose	More than or equal to 5.1 mmol/L (92 mg/dl)
1 hour plasma glucose	More than or equal to 10.0mmol/L (180 mg/dl)
2 hour plasma glucose	More than or equal to 8.5mmol/L (153 mg/dl)

Maternal insulin resistance is poorly understood and is likely related to systemic inflammation or immune dysregulation [55]. Metabolic imprinting [56, 57] leads to increased supply of nutrients and growth factors to fetus causing macrosomia, large for gestational age (LGA) and increased tendency for cesarean section [58, 59].

Study by Galazis et al have shown improved gestational diabetes in post bariatric surgery patients [60] but other studies have highlighted an exaggerated post prandial use of plasma glucose concentration[61]. Woman after BS in pregnancy have altered post prandial glucose dynamics[62], which interferes with OGTT interpretation, but no guideline on choice of investigations for plasma glucose estimation in PBSP are currently available[16,48,63]. Capillary blood glucose estimation could be an alternative methodology but not yet approved. Early dumping syndrome may occur with release of hyper osmolar carbohydrate in small intestine causing fall in blood pressure with compensatory tachycardia, flushes and syncope [63] and therefore patients are advised to have small meals and delayed liquid intake after meal for at least 30 minutes [64] as well as lying down after meals.

Maternal complications

Pregnancy induced hypertension (PIH) and pre eclampsia (PE) have increased incidence in obese woman [65, 66, and 67]. BS curtails obesity and therefore woman conceiving after BS have a lower risk for developing hypertensive disorders, the fact has been established from literature studies [68, 69]. PBSP are at risk for developing internal hernia as the gravid uterus lifts up bowel resulting in increased intraabdominal pressure [16, 70].

Fetal complications

Obese woman who are pregnant have higher chances of fetal malformations like neurological defects, anorectal atresia and congenital heart defects, even have increased chances of miscarriage [71]. Maternal obesity predisposes to LGA fetus which poses risk of shoulder dystocia as well as childhood obesity and cardiovascular disease [72, 73].

Another interesting finding that have emerged in post BS pregnancies is the incidence of small for gestational age (SGA) infants. Malabsorptive bariatric surgeries have higher chances of SGA fetus as seen in studies by Chvrot[74], Shenier[75] and Ducarme[76].

SGA further predisposes to increased risk for insulin resistance in latter life, type IIDM and metabolic syndrome. There is emerging evidence of preference for restrictive over malabsorptive BS technique in young woman desirous of childbearing [60].

Breast feeding

The only nutrients that are of concern in post BS pregnant woman breast milk are Vitamin B12 and fat that may cause megaloblastic anemia and delayed growth in exclusively breast-fed infants [77]. However, protective effects of breast feeding outweigh these short comings and there is also lack of consensus regarding vitamins and micronutrients supplementation during lactation period after BS.

Conclusion

Post bariatric surgery pregnancy is not absolutely free of risks and complications to both mother and fetus. A Preconceptional counseling with disclosure of all risks should be under taken by the surgeon and obstetrician together so that patients opting for BS who plan to conceive can make an informed decision. The current guidelines for pregnancy after BS , mode of delivery or nutritional supplementation or breast feeding are not available and shall require more research to formulate an evidenced based recommendations. There is growing need of prospective studies to fulfill our knowledge gaps in near future so that better care could be provided to post bariatric surgery pregnancies.

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References

1. Rand, C.S.; Macgregor, A.M. (1994). Adolescents having obesity surgery: A 6-year follow-up. *South. Med. J.* 87, 1208–1213.
2. Picot, J.; Jones, J.; Colquitt, J.; Gospodarevskaya, E.; Loveman, E.; Baxter, L.; Clegg, A. (2009). The clinical effectiveness and cost-effectiveness of bariatric (weight loss) surgery for obesity: A systematic review and economic evaluation. *Health Technol. Assess.* 13, 1–190, 215–357, iii–iv.
3. Deitel, M.; Stone, E.; Kassam, H.A.; Wilk, E.J.; Sutherland, D.J. (1988). Gynecologic-obstetric changes after loss of massive excess weight following bariatric surgery. *J. Am. Coll. Nutr.* 7, 147–153.
4. Lapolla, A.; Marangon, M.; Dalfrà, M.G.; Segato, G.; De Luca, M.; Fedele, D.; Favretti, F.; Enzi, G.; Busetto, L. Pregnancy Outcome in Morbidly Obese Women Before and After Laparoscopic Gastric Banding. *Obes. Surg.* 2010, 20, 1251–1257.
5. Narayanan, R.P.; Syed, A.A. Pregnancy Following Bariatric Surgery—Medical Complications and Management. *Obes. Surg.* 2016, 26, 2523–2529.
6. Elder KA, Wolfe BM. Bariatric surgery: a review of procedures and outcomes. *Gastroenterology.* 2007; 132(6):2253–71.
7. American College of Obstetricians and Gynecologists. ACOG practice bulletin no. 105: bariatric surgery and



- pregnancy. *Obstet Gynecol.* 2009; 113(6):1405–13.
8. Busetto L, Dicker D, Azran C, Batterham RL, Farpour-Lambert N, Fried M, et al. Practical recommendations of the Obesity management task force of the European Association for the Study of Obesity for the post-Bariatric Surgery medical management. *Obes Facts.* 2018; 10(6):597–632.
 9. Mechanick, J.I.; Youdim, A.; Jones, D.B.; Garvey, W.T.; Hurley, D.L.; McMahon, M.M.; Heinberg, L.J.; Kushner, R.; Adams, T.D.; Shikora, S.; et al. Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient 2013 update. Cosponsored by American Association of Clinical Endocrinologists, the Obesity Society, and the American Society for Metabolic and Bariatric Surgery. *Surg. Obes. Relat. Dis.* 2013, 9, 159–191.
 10. British Nutrition Foundation. *Nutrition Requirements*; British Nutrition Foundation: London, UK, 2016.
 11. Xanthakos, S.A. Nutritional deficiencies in obesity and after bariatric surgery. *Pediatr. Clin. N. Am.* 2009, 56, 1105–1121.
 12. American College of Obstetricians and Gynecologists. ACOG practice bulletin no. 95: anemia in pregnancy. *Obstet Gynecol.* 2008; 112(1):201–7.
 13. Majumder, S.; Soriano, J.; Louie Cruz, A.; Dasanu, C.A. Vitamin B12 deficiency in patients undergoing bariatric surgery: Preventive strategies and key recommendations. *Surg. Obes. Relat. Dis.* 2013, 9, 1013–1019.
 14. Frank, L.L. Thiamin in Clinical Practice. *J. Parenter. Enter. Nutr.* 2015, 39, 503–520.
 15. Norman, R.J.; Noakes, M.; Wu, R.; Davies, M.J.; Moran, L.; Wang, J.X. Improving reproductive performance in overweight/obese women with effective weight management. *Hum. Reprod. Update* 2004, 10, 267–280.
 16. Busetto L, Dicker D, Azran C, Batterham RL, Farpour-Lambert N, Fried M, et al. Practical recommendations of the Obesity management task force of the European Association for the Study of Obesity for the post-Bariatric Surgery medical management. *Obes Facts.* 2018;10(6):597–632.
 17. Kaska L, Kobiela J, Abacjew-Chmylko A, Chmylko L, Wojanowska-Pindel M, Kobiela P, et al. Nutrition and pregnancy after Bariatric Surgery. *ISRN Obes.* 2013; 2013:1–6.
 18. Strobel M, Tinz J, Biesalski H-K. The importance of β -carotene as a source of vitamin a with special regard to pregnant and breastfeeding women. *Eur J Nutr.* 2007; 46(1):1–20.
 19. Gascoin G, Gerard M, Sallé A, Becouarn G, Rouleau S, Sentilhes L, et al. Risk of low birth weight and micronutrient deficiencies in neonates from mothers after gastric bypass: a case control study. *Surg Obes Relat Dis Off J Am Soc Bariatr Surg.* 2017; 13(8):1384–91.
 20. *Bariatric Surgery in the Management of Female Fertility, The Role of (Scientific Impact Paper No. 17).* Royal College of Obstetricians & Gynaecologists. [cited 2020 Mar 5].
 21. British Nutrition Foundation. *Nutrition Requirements*; British Nutrition Foundation: London, UK, 2016.
 22. Landsberger, E.J.; Gurewitsch, E.D. Reproductive implications of bariatric surgery: Pre- and postoperative considerations for extremely obese women of childbearing age. *Curr. Diabetes Rep.* 2007, 7, 281–288.
 23. Kominiarek, M.A. Preparing for and Managing a Pregnancy after Bariatric Surgery. *Semin. Perinatol.* 2011, 35, 356–361.
 24. Medeiros M, Matos AC, Pereira SE, Saboya C, Ramalho A, Vitamin D. Its relation with ionic calcium, parathyroid hormone, maternal and neonatal characteristics in pregnancy after roux-en-Y gastric bypass. *Arch Gynecol Obstet.* 2016; 293(3):539–47.
 25. Mahadevan, S.; Kumaravel, V.; Bharath, R. Calcium and bone disorders in pregnancy. *Indian J. Endocrinol. Metab.* 2012, 16, 358–363.
 26. O’Kane, M.; Pinkney, J.; Aasheim, E.T.; Barth, J.H.; Batterham, R.L.; Welbourn, R. *Bomss Guidelines on Perioperative and Postoperative Biochemical Monitoring and Micronutrient Replacement for Patients Undergoing Bariatric Surgery.*
 27. Nomura RMY, Dias MCG, Igai AMK, Paiva LV, Zugaib M. Anemia during pregnancy after Silastic ring roux-en-Y gastric bypass: influence of time to conception. *Obes Surg.* 2011; 21(4):479–84.
 28. L. H. Allen, “Multiple micronutrients in pregnancy and lactation: an overview,” *American Journal of Clinical Nutrition*, vol. 81, no. 5, pp. 1206S–1212S, 2005.
 29. M. Makrides, D. D. Crosby, E. Bain, and C. A. Crowther, “Magnesium supplementation in pregnancy,” *Cochrane Database of Systematic Reviews*, vol. 4, p. CD000937, 2014.
 30. L. Kaska, J. Kobiela, A. Abacjew-Chmylko et al., “Nutrition and pregnancy after bariatric surgery,” *ISRN Obesity*, vol. 2013, Article ID 492060, 6 pages, 2013.
 31. S. Sherf Dagan, A. Goldenshluger, I. Globus et al., “Nutritional recommendations for adult bariatric surgery patients: clinical practice,” *Advances in Nutrition*, vol. 8, no. 2, pp. 382–394, 2017.
 32. G. Jans, C. Matthys, A. Bogaerts et al., “Maternal micronutrient deficiencies and related adverse neonatal outcomes after bariatric surgery: a systematic review,” *Advances in Nutrition*, vol. 6, no. 4, pp. 420–429, 2015.
 33. Scientific Panel on Dietetic Products Nutrition and Allergies, “Tolerable upper intake levels for vitamins and minerals,” 2006.
 34. EFSA Panel on Dietetic Products Nutrition and Allergies (NDA), “Scientific opinion on dietary reference values for vitamin E as α -tocopherol,” *EFSA Journal*, vol. 13, no. 7,p. 4149, 2015.
 35. EFSA Panel on Dietetic Products Nutrition and Allergies (NDA), “Dietary reference values for vitamin K,” *EFSA Journal*, vol. 15, no. 5, p. 4780, 2017.
 36. A. Eerdeken, A. Debeer, G. Van Hoey et al., “Maternal bariatric surgery: adverse outcomes in neonates,” *European Journal of Pediatrics*, vol. 169, no. 2, pp. 191–196, 2010.
 37. Tack, J.; Arts, J.; Caenepeel, P.; De Wulf, D.; Bisschops, R. Pathophysiology, diagnosis and management of postoperative dumping syndrome. *Nat. Rev. Gastroenterol. Hepatol.* 2009, 6, 583–590.
 38. Narayanan, R.P.; Syed, A.A. Pregnancy Following Bariatric Surgery—Medical Complications and Management. *Obes. Surg.* 2016, 26, 2523–2529.
 39. Adam, S.; Ammori, B.; Soran, H.; Syed, A.A. Pregnancy after bariatric surgery: Screening for gestational diabetes. *BMJ* 2017, 356, j533.
 40. D. W. Quyang, “Fertility and pregnancy after bariatric surgery,” 2017.
 41. ACOG, *Clinical Management Guideline, Bariatric Surgery and Pregnancy*, ACOG, Washington, DC, USA, 2009.
 42. B. Schultes, B. Ernst, and M. /urnheer, “Barietrische chirurgie und schwangerschaft,” *Swiss Medical Forum*–



- Schweizerisches Medizin-Forum, vol. 10, no. 17, pp. 204–307, 2010.
43. I. Gonzalez, A. Lecube, M. A. Rubio, and P. P. Garcia-Luna, “Pregnancy after bariatric surgery: improving outcomes for mother and child,” *International Journal of Women’s Health*, vol. 8, pp. 721–729, 2016.
 44. R. Kushner, S. Cummings, and D. Herron, “Bariatric surgery: postoperative nutritional management,” 2017.
 45. Weng T-C, Chang C-H, Dong Y-H, Chang Y-C, Chuang L-M. Anaemia and related nutrient deficiencies after roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. *BMJ Open*. 2015; 5(7):e006964.
 46. Via MA, Nutritional MJ. Micronutrient Care of Bariatric Surgery Patients: current evidence update. *Curr Obes Rep*. 2017;6(3):286–96.
 47. Bellver J, Melo MAB, Bosch E, Serra V, Remohí J, Pellicer A. Obesity and poor reproductive outcome: the potential role of the endometrium. *Fertil Steril*. 2007; 88(2):446–51.
 48. Fedorcsák P, Dale PO, Storeng R, Ertzeid G, Bjercke S, Oldereid N, et al. Impact of overweight and underweight on assisted reproduction treatment. *Hum Reprod*. 2004; 19(11):2523–8.
 49. Gougeon A. Regulation of ovarian follicular development in primates: facts and hypotheses. *Endocr Rev*. 1996; 17(2):121–55.
 50. Sarwer DB, Spitzer JC, Wadden TA, Mitchell JE, Lancaster K, Courcoulas et al. Changes in sexual functioning and sex hormone levels in women following bariatric surgery. *JAMA Surg*. 2014; 149(1):26–33.
 51. Milone M, Sosa Fernandez LM, Sosa Fernandez LV, Manigrasso M, Elmore U, De Palma GD, et al. Does Bariatric Surgery improve assisted Reproductive technology outcomes in obese infertile women? *Obes Surg*. 2017; 27(8):2106–12.
 52. Balen AH, Morley LC, Misso M, Franks S, Legro RS, Wijayarathne CN, et al. The management of anovulatory infertility in women with polycystic ovary syndrome: an analysis of the evidence to support the development of global WHO guidance. *Hum Reprod Update*. 2016; 22(6):687–708.
 53. McCauley ME, van den Broek N, Dou L, Othman M. Vitamin a supplementation during pregnancy for maternal and newborn outcomes. *Cochrane Database Syst Rev* 2015 ;(10):CD008666.
 54. Weinert LS. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy: comment to the International Association of Diabetes and Pregnancy Study Groups Consensus Panel. *Diabetes Care*. 2010; 33(7):e97 author reply e98.
 55. Lekva T, Norwitz ER, Aukrust P, Ueland T. Impact of systemic inflammation on the progression of gestational diabetes mellitus. *Curr Diab Rep*. 2016; 16(4):26.
 56. Fetita L-S, Sobngwi E, Serradas P, Calvo F, Gautier J-F. Consequences of fetal exposure to maternal diabetes in offspring. *J Clin Endocrinol Metab*. 2006; 91(10):3718–24.
 57. Hillier TA, Pedula KL, Schmidt MM, Mullen JA, Charles M-A, Pettitt DJ. Childhood Obesity and Metabolic imprinting: the ongoing effects of maternal hyperglycemia. *Diabetes Care*. 2007; 30(9):2287–92.
 58. Wendland EM, Torloni MR, Falavigna M, Trujillo J, Dode MA, Campos MA, et al. Gestational diabetes and pregnancy outcomes--a systematic review of the World Health Organization (WHO) and the International Association of Diabetes in pregnancy study groups (IADPSG) diagnostic criteria. *BMC Pregnancy Childbirth*. 2012; 12:23.
 59. Scholl TO, Sowers M, Chen X, Lenders C. Maternal glucose concentration influences fetal growth, gestation, and Pregnancy Complications. *Am J Epidemiol*. 2001; 154(6):514–20.
 60. Galazis N, Docheva N, Simillis C, Nicolaides KH. Maternal and neonatal outcomes in women undergoing bariatric surgery: a systematic review and meta-analysis. *Eur J Obstet Gynecol Reprod Biol*. 2014; 181:45–53.
 61. Goldfine AB, Mun EC, Devine E, Bernier R, Baz-Hecht M, Jones DB, et al. Patients with neuroglycopenia after gastric bypass surgery has exaggerated incretin and insulin secretory responses to a mixed meal. *J Clin Endocrinol Metab*. 2007 Dec;92(12):4678–85.
 62. Feichtinger M, Stopp T, Hofmann S, Springer S, Pils S, Kautzky-Willer A, et al. Altered glucose profiles and risk for hypoglycaemia during oral glucose tolerance testing in pregnancies after gastric bypass surgery. *Diabetologia*. 2017; 60(1):153–7.
 63. Narayanan RP, Syed AA. Pregnancy following Bariatric Surgery—medical complications and management. *Obes Surg*. 2016; 26(10):2523–9.
 64. Rariy CM, Rometo D, Korytkowski M. Post-gastric bypass hypoglycemia. *Curr Diab Rep*. 2016; 16(2):19.
 65. Mbah A, Kornosky J, Kristensen S, August E, Alio A, Marty P, et al. Superobesity and risk for early and late preeclampsia. *BJOG Int J Obstet Gynaecol*. 2010; 117(8):997–1004.
 66. Spradley FT. Metabolic abnormalities and obesity’s impact on the risk for developing preeclampsia. *Am J Physiol - Regul Integr Comp Physiol*. 2017; 312(1):R5–12.
 67. Spradley FT, Palei AC, Granger JP. Increased risk for the development of preeclampsia in obese pregnancies: weighing in on the mechanisms. *Am J Physiol - Regul Integr Comp Physiol*. 2015; 309(11):R1326–43.
 68. Maggard MA, Yermilov I, Li Z, Maglione M, Newberry S, Suttrop M, et al. Pregnancy and fertility following bariatric surgery: a systematic review. *JAMA*. 2008; 300(19):2286–96.
 69. Vrebosch L, Bel S, Vansant G, Guelinckx I, Devlieger R. Maternal and Neonatal outcome after laparoscopic adjustable gastric banding: a systematic review. *Obes Surg*. 2012; 22(10):1568–79.
 70. Vannevel V, Jans G, Bialecka M, Lannoo M, Devlieger R, Van Mieghem T. Internal herniation in pregnancy after gastric bypass: a systematic review. *Obstet Gynecol*. 2016; 127(6):1013–20.
 71. Catalano PM, Shankar K. Obesity and pregnancy: mechanisms of short term and long term adverse consequences for mother and child. *BMJ*. 2017; 356:j1.
 72. Tsur A, Sergienko R, Wiznitzer A, Zlotnik A, Sheiner E. Critical analysis of risk factors for shoulder dystocia. *Arch Gynecol Obstet*. 2012; 285(5):1225–9.
 73. Simeoni U, Barker DJ. Offspring of diabetic pregnancy: long-term outcomes. *Semin Fetal Neonatal Med*. 2009; 14(2):119–24.
 74. Chevrot A, Kayem G, Coupaye M, Lesage N, Msika S, Mandelbrot L. Impact of bariatric surgery on fetal growth restriction: experience of a perinatal and bariatric surgery center. *Am J Obstet Gynecol* 2016;214(5):655.e1–7
 75. Sheiner E, Willis K, Bariatric Surgery YY. Impact on



- pregnancy outcomes. *Curr Diab Rep.* 2013; 13(1):19–26.
76. Ducarme G, Revaux A, Rodrigues A, Aissaoui F, Pharisien I, Uzan M. Obstetric outcome following laparoscopic adjustable gastric banding. *Int J Gynecol Obstet.* 2007; 98(3):244–7.
77. Grange DK, Finlay JL. Nutritional vitamin B12 deficiency in a breastfed infant Following maternal gastric bypass. *Pediatr Hematol Oncol.* 1994; 11(3):311–8.