Maternal obesity in high-risk pregnancies and postpartum infectious complications

Letícia Vieira de Paiva[1], Roseli Mieko Yamamoto Nomura[2], Maria Carolina Gonçalves Dias[3], Marcelo Zugaib[4]

[1]Nutritionist, Postgraduate Program Student, USP, São Paulo, SP, Brazil
[2]Associate Professor, Universidade de São Paulo (USP), São Paulo, SP, Brazil
[3]MSc in Applied Human Nutrition, USP; Nutritionist, Central Institute, Clinical Hospital, Medical School, USP, São Paulo, SP, Brazil
[4]Full Professor, Medical School, USP, São Paulo, SP, Brazil

Summary

Objective: To analyze the association between maternal obesity and postnatal infectious complications in high-risk pregnancies. **Methods:** Prospective study from August 2009 through August 2010 with the following inclusion criteria: women up to the 5th postpartum day; age ≥ 18 years; high-risk pregnancy; singleton pregnancy with live fetus at labor onset; delivery at the institution; maternal weight measured on day of delivery. The nutritional status in late pregnancy was assessed by the body mass index (BMI), with the application of the Atalah et al. curve. Patients were graded as underweight, adequate weight, overweight, or obese. Postpartum complications investigated during the hospital stay and 30 days post-discharge were: surgical wound infection and/or secretion, urinary infection, postpartum infection, fever, hospitalization, antibiotic use, and composite morbidity (at least one of the complications mentioned). **Results:** 374 puerperal women were included, graded according to the final BMI as: underweight (n = 54, 14.4%); adequate weight (n = 126, 33.7%); overweight (n = 105, 28.1%); and obese (n = 89, 23.8%). Maternal obesity was shown to have a significant association with the following postpartum complications: surgical wound infection (16.7%, p = 0.042), urinary infection (9.0%, p = 0.004), antibiotic use (12.3%, p < 0.001), and composite morbidity (25.6%, p = 0.016). By applying the logistic regression model, obesity in late pregnancy was found to be an independent variable regardless of the composite morbidity predicted (OR: 2.09; 95% CI: 1.15-3.80, p = 0.015). **Conclusion:** Maternal obesity during late pregnancy in high-risk patients is independently associated with postpartum infectious complications, which demonstrates the need for a closer follow-up of maternal weight gain in these pregnancies.

Keywords: Nutritional status; obesity; pregnancy; postpartum period; high-risk pregnancy; puerperal infection.

Study conducted at the Discipline of Obstetrics, Department of Obstetrics and Gynecology, Medical School, Universidade de São Paulo, São Paulo, and at the Nutrition and Dietetics Division, Nutrology Group, Clinical Hospital, Medical School, Universidade de São Paulo, São Paulo, SP, Brazil

Submitted on: 09/21/2011
Approved on: 02/19/2012

Financial support:
Master's scholarship to the student Letícia Vieira de Paiva granted by Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)

Correspondence to:
Roseli Mieko Yamamoto Nomura
Av. Dr. Eneas de Carvalho Aguiar, 255
10º andar, sala 10037
São Paulo – SP, Brazil
CEP: 05403-000
roseli.nomura@hotmail.com

Conflicts of interest: None.

Introduction

Nutritional status results from the balance between nutrient intake and energy expenditure in the body to meet daily needs. The nutritional status investigation is based on the measurement of physical parameters and on the overall body composition. The parameters adopted for nutritional surveillance in pregnant women are: body mass index (BMI) and gestational weight gain. Weight and height measurements are the most often used, and BMI is the key indicator for maternal nutritional status diagnosis[1,2]. This index allows for the identification of pregnant women at nutritional risk, mainly regarding maternal obesity; in this condition, a nutritional guidance aiming to promote maternal health is recommended in order to provide a better condition for delivery and appropriate neonate weight[2].

In obese pregnant women, postpartum complications are frequent, mainly infectious complications. A number of studies show that, regardless of the delivery route, endometritis, wound infection, episiotomy tears, postpartum bleeding, and prolonged surgery time are more frequent[3-5]. These aspects are worrying, as excess weight in Brazil represents the most prevalent nutritional problem, found in 25% to 30% of pregnancies[6-8]. The obesity incidence is growing among women of childbearing age, according to the Institute of Medicine (IOM) – a government agency that is part of the U.S. National Academy of Science[9]. In addition, obesity in itself raises the pregnancy risk due to the acknowledged association with preeclampsia, diabetes mellitus, fetal macrostomia, venous thromboembolism[10-11], increased C-section incidence[12-14], dystocias, and postpartum complications[15], influencing pregnancy outcomes[16-17]. However, the postpartum infectious outcomes in obese women with other comorbidities are not known. To fill this gap, the present study was conducted in high-risk pregnancies aiming to find the influence of maternal nutritional status during late pregnancy on the occurrence of postpartum complications.

Methods

This prospective observational study was performed from August 2009 through August 2010. The investigation protocol and the informed consent were approved by the Institutional Ethics Committee under the No. 1233/07.

Were invited to participate in the study 472 women whose delivery was conducted in the University Hospital, a tertiary center. The following inclusion criteria were adopted: women up to the 5th postpartum day whose pregnancy was considered as high-risk; maternal age ≥ 18 years; singleton pregnancy with live fetus at labor onset; delivery at the institution; maternal weight measured on the day of delivery; and agreement to participate in the study. Those who had any complicating clinical or obstetric event were considered as high-risk pregnancies. The exclusion criteria adopted were: no telephone contact obtained after hospital discharge, and impaired ability to understand the interview.

Data were collected in an interview by the investigator with a previously designed protocol containing: patient's data, hospitalization data, habits/addictions, obstetric events, clinical diagnoses, and delivery/neonate data. The following data regarding clinical and/or obstetric events were collected from the patient's charts: delivery type (vaginal, forceps-assisted, C-section) and postpartum complications (surgical wound infection and/or secretion, urinary infection, postpartum infection, fever, hospitalization, mastitis, need for antibiotic therapy). Postpartum complications that occurred up to the 30th postpartum day were also tracked with telephone interviews by the investigator, after hospital discharge. The occurrence of one or more postpartum maternal complications was considered composite morbidity.

The maternal nutritional status in late pregnancy was assessed by the body mass index (BMI) based on the patient's height and weight, both measured on the day of delivery. BMI range values per gestational week from the Atalah et al.[18] curve were used to grade the maternal nutritional status: underweight, adequate weight, overweight, obese.

Gestational age was calculated from the first day of the last menstrual period (LMP) when it was consistent with the gestational age estimated by an ultrasonography performed in the 20th gestational week at the latest. In cases when this concordance was not observed, gestational age was calculated from the first ultrasonography data. The neonate weight in grams, measured at the delivery room, was compared with the Alexander et al.[19] normality curve as follows: those with a weight lower than the 10th percentile in the matching range were considered small for gestational age (SGA); those between the 10th and the 90th percentiles were considered adequate for gestational age (AGA), and those with a percentile higher than the 90th percentile were large for gestational age (LGA).

The software Medcalc version 11.5.1.0 was used to calculate the sample size. As no prior studies with high-risk pregnant women are available, the postpartum infectious complications ratios from the study by Bianco et al.[3] were used in obese and non-obese women. By considering a type I (alpha) error 0.05 and a type II (beta) error 0.10, the sample size required for the current investigation was calculated as 340 cases. In this study, 408 puerperal women were included; however, three patients had an impaired ability to understand the interview and 31 patients were lost to telephone contact after delivery. Thus, the overall study population consisted of 374 puerperal women classified by BMI as follows: underweight (n = 54, 14.4%); adequate weight (n = 126, 33.7%); overweight

(n = 105, 28.1%); or obesity (n = 89, 23,8%). The population characteristics in the analyzed groups are shown in Table 1.

The results were analyzed with the software Medcalc (Medcalc software bvba, version 11.5.1.0). Categorical variables were descriptively analyzed, and absolute and relative frequencies were calculated. The results were expressed as means and standard-deviations in order to analyze continuous variables. The chi-squared test was applied to compare ratios, with the Fisher's exact test being used when relevant. The ANOVA test was used to compare the means among groups for variables with a normal distribution, and the Kruskal-Wallis test was used for variables with non-normal distribution. The multiple logistic regression model was used to identify independent variables associated with the outcome. A p-value of 0.05 (alpha = 5%) was adopted as the significance level. Thus, descriptive levels (p) lower than that value were considered significant ($p < 0.05$).

Results

The analysis of factors associated with maternal nutritional status in late pregnancy (Table 1) demonstrated a significantly higher ratio of nulliparous women in the underweight and adequate weight group (p = 0.004) and a significantly higher frequency of a previous C-section in the obese group (p = 0.035). Regarding the occurrence of clinical events, a higher frequency of arterial hypertension

Table 1 – Maternal characteristics in high-risk pregnancies according to the nutritional status classification at the end of pregnancy

	Final maternal nutritional status			
Characteristics	U/A (n = 180)	Ov (n = 105)	Ob (n = 89)	p
Mean age (SD)	29.2 (6.7)	29.9 (5.8)	30.0 (6.2)	0.559
Whites, n (%)	85 (47.2)	47 (45.6)	53 (59.5)	0.282
Nulliparous, n (%)	80 (44.4)	32 (30.5)	23 (25.8)	0.004
Previous C-section, n (%)	48 (26.7)	38 (36.2)	37 (41.6)	0.035
Smoking, n (%)	30 (16.7)	17 (16.2)	7 (7.9)	0.129
Clinical and/or obstetric events, n (%)				
HBP	37 (20.5)	38 (36.2)	55 (61.8)	< 0.001
Diabetes	17 (9.4)	24 (22.8)	18 (20.2)	0.005
Heart disease	39 (21.7)	13 (12.4)	8 (8.9)	0.014
FGR	35 (19.4)	14 (13.3)	6 (6.7)	0.019
Infections	20 (11.1)	9 (8.6)	6 (6.7)	0.485
PROM	26 (14.4)	8 (7.6)	7 (7.9)	0.116
Vascular collagen diseases	12 (6.7)	6 (5.7)	5 (5.6)	0.923
Fetal MF	17 (9.4)	5 (4.8)	4 (4.5)	0.188
Others	17 (9.4)	16 (15.2)	7 (7.9)	0.191
Delivery routes, n (%)				
C-section	123 (68.3)	80 (76.2)	70 (78.6)	
Vaginal	37 (20.5)	20 (19.0)	14 (15.7)	0.201
Forceps-assisted	20 (11.1)	5 (4.8)	5 (5.6)	
Mean GA at delivery (SD)	37.2 (2.8)	37.6 (2.5)	37.5 (2.9)	0.210
Mean birth weight (SD)	2676 (706)	2902 (691)	3070 (803)	< 0.001
BW classification, n (%)				
SGA	56 (31.1)	24 (22.8)	11 (12.3)	
AGA	121 (67.2)	78 (74.3)	71 (79.8)	0.002
LGA	3 (1.7)	3 (2.8)	7 (7.9)	

U/A, underweight or adequate weight; Ov, overweight; Ob, obesity; SD, standart deviation; HBP, high blood pressure; FGR, fetal growth restriction; PROM, premature rupture of membranes; fetal MF, fetal malformation; GA, gestational age; BW, birth weight; SGA, small for gestational age; AGA, adequate for gestational age; LGA, large for gestational age.

in the obese group, and of diabetes in overweight and obese groups was found (p < 0.001 and p = 0.005, respectively). As for heart disease and restricted fetal growth restriction, these events had a higher frequency in the underweight and adequate weight group (p = 0.014 and p = 0.019, respectively). This group also presented a significantly lower (p < 0.001) mean birth weight than the other groups. A higher number of SGA neonates and a lower number of AGA neonates (p = 0.002, Table 1) were observed.

By investigating postpartum maternal complications (Table 2), obesity late in the pregnancy was observed to be significantly associated with the following results: surgical wound infection (p = 0.042), urinary infection (p = 0.004), antibiotic therapy need (p < 0.001), and composite morbidity (p = 0.016).

Aiming to find the factors independently associated with the occurrence of composite maternal morbidity, a logistic regression model with backward elimination of factors was used. The confounding variables included in the model were: classification of the final maternal nutritional status, high blood pressure, diabetes, birth weight classification, and type of delivery. Maternal obesity in late pregnancy was independently associated with postpartum composite morbidity, with an odds ratio (OR) of 2.09 (95% CI 1.15-3.80, p = 0.015, Table 3).

Discussion

This study found that obesity in late high-risk pregnancies is an independent factor for postpartum complications. This association has been indicated in population studies[3-5,20], but no studies focused on high-risk pregnant women are available, cases in which comorbidities and other factors can contribute to the occurrence of these outcomes.

In the present study, maternal obesity showed an association with clinical events, such as hypertension, diabetes, and heart disease by the nutritional status classification. Even though these diseases may interfere with the occurrence of delivery complications, the results demonstrated that obesity is the relevant and independent factor. In this university hospital with a high C-section rate[21], it is essential to minimize factors contributing to complications.

The increased C-section rates in Brazil are an important aspect in the management of high-risk pregnancies. Any factor favoring a higher postoperative morbidity should be weighed when the delivery route is selected. Sebire et al.[5], in a retrospective cohort population study, reported a rate of 10.9% maternal obesity, assessed by the pregestational BMI, with an increased risk for events such as postpartum bleeding (OR: 1.39; 95% CI: 1.32-1.46), genital tract infection (OR: 1.30; 95% CI: 1.07-1.56), urinary infection (OR: 1.39; 95% CI: 1.18-1.63), and abdominal wall infection (OR: 2.24; 95% CI: 1.91-2.64). No study in high-risk pregnant women addressing the influence of maternal weight on delivery complications is available. In addition to several comorbidities that could be associated, obesity is revealed as an important factor in determining these complications. The present cases assessed for final BMI in high-risk pregnancies have also shown an association between obesity and postpartum infectious complications, demonstrating the need for improved preconceptional guidance in order that women conceive in better nutritional conditions, as well as the adoption of preventive measures so that the nutritional classification does not change during the course of the pregnancy.

Another relevant aspect refers to women who move from eutrophy to overweight or obesity. Excess maternal weight gain should alert to delivery and postpartum complications,

Table 2 – Postpartum complications in high-risk pregnancies according to the nutritional status classification at the end of pregnancy

	Final maternal nutritional status			
Postpartum complication	U/A (n = 181)	Ov (n = 103)	Ob (n = 90)	p
Wound infection (%)	14 (7.8)	8 (7.6)	15 (16.8)	0.042
Wound secretion	5 (2.8)	0 (0)	5 (5.6)	0.054
Urinary infection	4 (2.2)	1 (1)	8 (9.0)	0.004
Postpartum infection	2 (1.1)	1 (1)	0 (0)	0.617
Fever	13 (7.2)	4 (3.8)	11 (12.3)	0.077
Hospitalization	3 (1.7)	1 (1)	3 (3.4)	0.446
Mastitis	4 (2.2)	1 (1)	0 (0)	0.302
Antibiotic therapy need	7 (3.9)	0 (0)	11 (12.3)	< 0.001
Composite morbidity	26 (14.4)	12 (11.4)	23 (25.8)	0.016

U/A, underweight or adequate weight; Ov, overweight; Ob, obesity.

Table 3 – Multiple logistic regression with backward elimination of independent factors associated with postpartum maternal morbidity

Variable	Odds ratio	95% confidence interval	p
Obesity	2.09	1.15 - 3.80	0.015
Vaginal delivery	0.43	0.17 - 1.04	0.061
LGA neonate	2.78	0.85 - 9.06	0.090

LGA, large for gestational age.

especially when women reach the range characterizing obesity. Controlling the weight gain is important both for maternal and fetal health, and for the delivery outcome[7,22]. Seligman et al.[23], in a national study with pregnant women from the general population, found that pregestational obesity and excess weight gain independently increase the risk of a C-section and adverse outcomes at the delivery; however, they did not analyze maternal BMI at the end of the pregnancy.

Mantakas et al.[20] observed that a higher BMI implicates a higher risk for postpartum infection in pregnant women undergoing C-sections (OR: 2.41; 95% CI: 0.86-9.88). The present study did not show any association between maternal obesity and delivery route, as C-sections were prevalent in all analyzed groups. This likely occurred because the study specifically addresses high-risk pregnant women, in whom clinical comorbidities increase C-section rates. However, in multivariate analysis, vaginal delivery remained in the logistic regression model and it is suggested to exert a protective effect on composite morbidity, although statistical significance was not reached.

Maternal obesity in itself predisposes women to gestational complications and increases the need for obstetric intervention. Weiss et al.[24] observed a higher chance of pregnancy-induced hypertension in obese women compared with overweight and underweight groups (OR: 2.2, 95% CI: 2.1-2.6; OR: 1.5, 95% CI: 1.4-1.7; OR: 0.7, 95% CI: 0.6-0.8) respectively.

The proportion of obesity in high-risk pregnant women was 24% and composite morbidity, meaning the occurrence of at least on morbid event investigated, was found in approximately 25% of them. Any postoperative morbidity impairs maternal well-being and may damage the relationship between the mother and her newborn child. At times, the need to use antibiotics can lead to concerns about breastfeeding until the complication affecting the mother is resolved.

Fetal complications most commonly associated with maternal obesity are fetal death, genetic diseases, and macrostomia[12,22,25,26]. The present study also found a higher mean birth weight and a higher LGA rate in pregnant women classified as obese after the final BMI. However, despite the fact that the variable LGA neonate remained in the logistic regression final model, it did not reach statistical significance for the composite maternal morbidity.

This study is limited by the impossibility to obtain follow-up data of weight gain over the pregnancy to compare different maternal outcomes and delivery complications. The study of subgroups with specific comorbidities can identify other factors associated with postpartum complications in further studies. In addition, the information on postpartum complications was obtained by phone calls and cases were excluded due to loss of contact, which could have contributed to some bias.

Conclusion

In conclusion, this study demonstrated that, in high-risk pregnancies, final maternal obesity is independently associated with postpartum infectious complication occurrence, such as surgical wound infection, urinary infection, antibiotic therapy need, as well as composite morbidity. This demonstrates that more effective maternal weight gain follow-up is needed to minimize postpartum complications.

Acknowledgements

The authors are grateful to the Fundação de Amparo à Pesquisa do Estado de São Paulo [Research Support Foundation of the State of São Paulo] (FAPESP) for the funding support received (master's scholarship).

References

1. World Health Organization. Division of noncommunicable disease. Programme of nutrition family and reprodutive health. Obesity: preventing and managing the global epidemic: report of a WHO consultation on obesity. Geneva: WHO; 1998.
2. Brasil. Ministério da Saúde. Manual técnico pré-natal e puerpério. Atenção qualificada e humanizada. Brasília (DF); 2005.
3. Bianco AT, Smilen SW, Davis Y, Lopez S, Lapinski R, Lockwood CJ. Pregnancy outcome and weight gain recommendations for the morbidly obese women. Obstet Gynecol. 1998;91(1):97-102.
4. Perlow JH, Morgan MA. Massive maternal obesity and perioperative cesarean morbidity. Am J Obstet Gynecol. 1994;170(2):560-5.
5. Sebire NJ, Jolly M, Harris JP, Wadsworth J, Joffe M, Beard RW, et al. Maternal obesity and pregnacy outcome: a study of 287,213 pregnacies in London. Int J Obes Relat Metab Disord. 2001;25(8):1175-82.
6. Nucci LB, Schmidt MI, Duncan BB, Fuchs SC, Fleck ET, Britto MS. Nutritional status of pregnant women: prevalence and associated pregnancy outcomes. Rev Saúde Pública. 2001;35(6):502-7.
7. Stulbach TE, Benício MHD, Andreazza R, Kono S. Determinantes do ganho ponderal escessivo durante a gestação em serviço público de pré-natal de baixo risco. Rev Bras Epidemiol. 2007;10(1):99-108.
8. Vítolo MR, Bueno MSF, Gama CM. Impacto de um programa de orientação dietética sobre a velocidade de ganho de peso de gestantes atendidas em unidades de saúde. Rev Bras Ginecol Obstet. 2011;33(1):13-9.
9. IOM (Institute of Medicine), NRC (National Research Council). Weight gain during pregnancy: reexamining the guidelines. Washington (DC): The National Academies Press; 2009.

10. Jarvie E, Ramsey JE. Obstetric management of obesity in pregnancy. Semin Fetal Neonatal Med. 2010;15(2):83-8.
11. Gunatilake RP, Perlow JH. Obesity and pregnancy: clinical management of the obese gravida. Am J Obstet Gynecol. 2011;204(2):106-19.
12. Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of body mass index on pregnancy outcomes in nulliparous women delivering singleton babies. BMC Public Health. 2007;7:168.
13. Chu SY, Kim SY, Schmid CH, Dietz PM, Callaghan WM, Lau J, et al. Maternal obesity and risk of cesarean delivery: a meta-analysis. Obes Rev. 2007;8(5):385-94.
14. Dodd JM, Crowther CA, Robinson JS. Dietary and lifestyle interventions to limit weight gain during pregnancy for obese or overweight women: a systematic review. Acta Obstet Gynecol Scand. 2008;87(7):702-6.
15. Huda SS, Brodie LE, Sattar N. Obesity in pregnancy: prevalence and metabolic consequences. Semin Fetal Neonatal Med. 2010;15(2):70-6.
16. Fazio Ede S, Nomura RM, Dias MC, Zugaib M. Consumo dietético de gestantes e ganho ponderal materno após aconselhamento nutricional. Rev Bras Ginecol Obstet. 2011;33(2):87-92.
17. Dias MC, Fazio Ede S, de Oliveira FC, Nomura RM, Faintuch J, Zugaib M. Body weight changes and outcome of pregnancy after gastroplasty for morbid obesity. Clin Nutr. 2009;28(2):169-72.
18. Atalah SE, Castilho CL, Castro SR, Aldea PA. Propuesta de um nuevo estándar de evalución nutricional em embarazadas. Rev Med Chile. 1997;125(12):1429-36.
19. Alexander GR, Himes JH, Kaufman RB, Mor J, Kogan M. A United States national reference for fetal growth. Obstet Gynecol. 1996;87(1):163-8.
20. Mantakas A, Farrel T. The influence of increasing BMI in nulliparous women on pregnancy outcome. Eur J Obstet Gynecol Reprod Biol. 2010;153(1):43-6.
21. Nomura RM, Alves EA, Zugaib M. Complicações maternas associadas ao tipo de parto em hospital universitário. Rev Saúde Pública. 2004;38(1):9-15.
22. Sirimi N, Goulis DG. Obesity in pregnancy. Hormones (Athens). 2010;9(4):299-306.
23. Seligman LC, Duncan BB, Branchtein L, Gaio DSM, Mengue SS, Schmidt MI. Obesity and gestational weight gain: cesarean delivery and labor complications. Rev Saúde Pública. 2006;40(3):457-65.
24. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate: a population-based screening study. Am J Obstet Gynecol. 2004;190(4):1091-7.
25. Gluckman PD, Hanson MA, Cooper C, Thornburg KL. Effect of *in utero* and early-life conditions on adult health and disease. N Engl J Med. 2008;359(1):61-73.
26. HAPO Study Cooperative research Group. Hyperglycaemia and adverse pregnancy outcome (HAPO) study: associations with maternal body mass index. Int J Obstet Gynecol. 2010;117(5):575-84.