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Evaluation of neonatal and obstetric outcomes according to increased or decreased body mass index of the pregnant woman

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ABSTRACT

Aims: The present study aims to evaluate the neonatal obstetric outcomes from the increased or decreased body mass index of the pregnant woman.
Methods: The collection was between November 2016 and March 2017 in a public maternity hospital in the south of Brazil. Different categories of pregnant women were included according to their respective body mass indexes.
Results: The primary endpoint analyzed was maternal overweight and neonatal outcomes. A multinomial logistic regression model was constructed and adjusted for confounding factors, established confidence interval (CI) of 95%. There were 1464 pregnant women, 69 (4.7%) underweight, 771 (52.7%) normal weight, 397 (27.1%) overweight and 227 (15.5%) obese women. The categories differed according to maternal age, marital status, gestation number (primigravida and multigesta) and abortion number for primigravidae ($p < 0.01$). Compared to normal-weight pregnant women, the cesarean delivery method presented a better chance for obese pregnant women, being (OR = 1,86, 95% CI 1.32–2.62) and those with a low birth weight, (OR = 2.3, 95% CI 1.67–3.15)
Conclusions: The occurrence of macrosomic newborns in overweight pregnant women was 1.82 times (95% CI 1.08–3.06) and giving birth to a large baby for gestational age was 2.18 times (95% CI 1,46-3,24) and in obese mothers, 16.8 times (95% CI 2.22–123.34). Increasing BMI above normal patterns suggests an association with increased neonatal weight.

1. Introduction

Development of overweight, especially in adults, has shown a rapid intensification over the last decade and has become one of the great challenges for public health. By 2014, 11% of men and 15% of women of world wide adult population were obese (Enes and Slater, 2010; World Health Organization, 2017).

Considering the conditions inherent to pregnancy, obesity has been catalogued as a disturbing alteration in the scientific literature after several prognoses already established in previous research, as well as the probable afflictions for the mother and her baby (Sebire et al., 2001; Bautista-Castaño et al., 2013). In Brazil, it has become a daunting problem to confront. The wide range of fundamentals and factors, and methodological difficulties make it hard to determine the main causes, and therefore, to understand and to conduct the most effective means to manage ideal weight gain during pregnancy (Nucci et al., 2007).

Regarding the parameters used in researches, some authors suggest the body mass index according to the World Health Organization, while other researchers present the weight gain of pregnant woman in relation to what would be appropriate, compatible with the Institute of Medicine standards (Yu et al., 2006; Silva et al., 2013a). However, concerning pregnancy, the subject is relatively recent in literature, and although several studies have demonstrated the association between inadequate maternal weight and perinatal outcomes, few studies have addressed dimensions and their consequences.

Recent studies have shown that weight gain and excessive body

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mass index in pregnancy suggest greater risks for both mother and newborn. For pregnant women, several researches indicate increased risk of acquiring gestational diabetes mellitus, preeclampsia, placental infections and a higher frequency of cesarean sections (Aliyu et al., 2010; Salihu et al., 2009; Bogaerts et al., 2013).

For neonatal outcomes, compared to healthy mothers, there are greater risks of large for gestational age neonates, macrosomia and hospitalization in the intensive care unit. (Jarvie and Ramsay, 2010; Adamo et al., 2013; Kim et al., 2016). Thus, the present study aims to evaluate neonatal obstetric outcomes from increased or decreased body mass index of the gestating mother.

2. Method

This research obtained data through the analysis at the first consultation and of medical records of pregnant women diagnosed with obesity; information was collected from maternal hospital screening and medical records of their children in a retrospective cohort study. Pregnant women over 18 years of age were included in the sample, and body mass index (kg/m^2) was classified according to World Health Organization (Who) criteria.

In this study, the comparative proposal contains different body mass index categories aiming to identify the parameters of overweight and obese mothers: a group of pregnant mothers with low (< 18.5) and normal body mass index (18.5–24, 9 kg/m^2). The latter in comparison with the pregnant women classified as overweight (25–29.9 kg/m^2) and obese ($\geq 30\ kg/m^2$). In this way, the study analyzed the maternal and neonatal outcomes according to the different categories of BMI of the pregnant women.

It is worth mentioning that the pregnant women would only be selected if they presented pre-gestational BMI in the health portfolio and they would be measured at the first.

2.1. Gestational visit and in the third trimester

There appears to be divergence in nutritional assessment and disparity between low weight, overweight and obesity frequencies when compared to pregnant women according to the criteria of Rosso, Atalah et al. or CLAP. (Silva et al., 2017). Thus, the WHO criteria were used as parameters in the present study.

The collection period was between November 2016 and March 2017 at a public maternity hospital in the south of Brazil. Pregnant women were seen at the outpatient unit of a maternity hospital in Joinville/SC.

The development of this research was according to regulations of 466/12 Resolution of National Health Council and the Helsinki agreement. The confidentiality of patients and their children was preserved. Brazilian Platform approved this study and its implementation under the number CAAE: 51241915.6.0000.5363, and by the Research Ethics Committee number 5363. All participants signed a Term of Free and Informed Consent at the first consultation. There is no conflict of interest in this study.

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Certain characteristics of gestating women regarding maternal body mass index and consecutive neonatal outcomes were incorporated. The paper considered the following maternal variables: maternal age, ethnicity, marital status, schooling, gestation number (parity), abortion, number of prenatal consultations.

For neonatal outcomes, this study selected the following characteristics: cesarean section, prematurity, newborn weight classification - children small for gestational age (below the 10th percentile of weight), appropriate for gestational age (between the 10th percentile and the 90th percentile of weight) and large for gestational age (above percentile 90) (Battaglia and Lubchenco, 1967). Macrosomic neonates, weighing more than 4,000 g, were included too. Concomitantly, the Apgar score, neonatal intensive care unit admission and neonatal death were evaluated.

Data analysis was through Microsoft Excel version 2016 and later analyzed through the software Statistical Package for the Social Science version 21.0. The quantitative variables are presented through means and standard deviations and the qualitative variables through absolute and relative frequencies. We applied the Analysis of Variance test for the scalar variables and the chi-square test (4×2) for the categorical ones. To quantify the influence of gestational body mass index on neonatal outcomes, multinomial logistic regression models were constructed, with all basal characteristics included in the mathematical model as cofactors. In all analytical models, we considered significant p-values lower than 0.05. The first BMI record was collected at the first visit to the maternal screening registry and subsequent information in the hospital records.

3. Results

Among the 1780 pregnant women interviewed, 1464 presented the required criteria for this study, 69 (4.7%) were underweight, 771 (52.7%) had normal weight, 397 (27.1%) were overweight and 227 (15.5%) were obese.

Table 1 presents the characteristics of mothers related to gestational body mass index. Maternal age was a characteristic that indicated difference between the groups ($P < 0.05$). The data related to the number of pregnancies identifying the primigravida and multigravida mother showed significant values in the comparative proposal as well. Likewise the highest number of abortions for primigravida overweight and obese. The other variables did not show any significant differences ($p > 0.05$).

Table 2 compares the odds of neonatal outcomes according to each patient's body mass index category. Cesarean birth indicated divergent values for underweight and obese pregnant women ($p < 0.01$).

Comparisons regarding the chances of occurrence of macrosomic newborns showed ($p < 0.05$) in pregnant women with overweight body mass index (OR = 1.82, 95% CI 1.08–3.06). However, the occurrence of large for gestational age infants was higher among both overweight and obese women (OR = 2.18, 95% CI 1.46–3.24), and (OR = 16.86 CI95% 2.22–123.34) respectively. Comparisons about chances of occurrence of small for gestational age newborn, low Apgar in the first and fifth minutes, hospitalization in neonatal intensive care unit and death were not significant, and are presented in more detail in Table 2.

4. Discussion

The study showed the impact of increased or decreased weight during pregnancy on gestational and neonatal outcomes. Compared to normal-weight pregnant women, obese and underweight pregnant women presented a greater chance of cesarean delivery method ($p < 0.01$). Consecutively, it also showed an increase in macrosomic newborns in overweight pregnant women and, a greater occurrence of large for gestational age infants for both overweight and obese pregnant women ($p < 0.01$).

Among other results, the present study pointed to single mothers with differences between groups according to their respective body mass index ($p < 0.05$). The literature consulted demonstrated a higher percentage of excessive weight gain in married pregnant women (Kac and Velásquez-Meléndez, 2005).

Researchers have identified that inappropriate changes in gestational weight are relevant to the results. One study compared the results to gestational weight gain (GWG) according to the guidelines of the Institute of Medicine (IOM). The research indicated that weight gain or above normal is associated with higher maternal-fetal risks, among others, in the baby's weight (Goldstein et al., 2017).

Regarding the ethnicity variable, it is worth noting that researches

Table 1
Population characteristics according to gestational body mass index.

	Global (N = 1464)	BMI Gestational - Classification				P
		Underweight (N = 69)	Normal (N = 771)	Overweight (N = 397)	Obesity (N = 227)	
Maternal Age	26,0 ± 6,7	22,8 ± 7,2	25,4 ± 6,5	26,7 ± 6,5	27,8 ± 7,1	< 0,01 *
Ethnicity						
White	1255 (85,6)	59 (85,5)	662 (85,9)	344 (86,6)	169 (83,3)	0,76 **
Black	69 (4,7)	4 (5,8)	33 (4,3)	19 (4,8)	13 (5,7)	0,79 **
Other	138 (9,4)	6 (8,7)	74 (9,6)	34 (8,6)	24 (10,6)	0,85 **
Marital Status						
Single	222 (15,1)	14 (20,3)	128 (16,6)	58 (14,6)	21 (9,3)	0,03 **
Married	1206 (82,3)	54 (78,3)	623 (80,8)	330 (83,1)	199 (87,7)	0,09 **
Other	35 (2,4)	1 (1,4)	18 (2,3)	9 (2,3)	7 (3,1)	0,85 **
Schooling						
Illiterate	222 (15,1)	11 (15,9)	106 (13,7)	64 (16,1)	41 (18,1)	0,41 **
Elementary School	478 (32,6)	30 (43,5)	235 (30,5)	131 (33,0)	81 (35,7)	0,10 **
High School	655 (44,7)	23 (33,3)	361 (46,8)	177 (44,6)	94 (41,4)	0,09 **
Higher education	106 (7,2)	5 (7,2)	65 (8,4)	25 (6,3)	11 (4,8)	0,24 **
Number of Gestations	2,2 ± 1,4	1,7 ± 1,2	2,1 ± 1,2	2,3 ± 1,5	2,6 ± 1,5	< 0,01 *
Parity						
0	543 (37,0)	41 (59,4)	313 (40,6)	127 (32,0)	62 (27,3)	< 0,01 **
1	441 (30,1)	19 (27,5)	234 (30,4)	127 (32,0)	60 (26,4)	0,48 **
2 +	479 (32,7)	9 (13,0)	640 (83,0)	142 (35,8)	105 (46,3)	< 0,01 **
Abortions						
0	1205 (82,2)	64 (92,8)	640 (83,0)	332 (81,1)	178 (78,4)	< 0,01 **
1	185 (12,6)	4 (5,8)	90 (11,7)	51 (12,8)	40 (17,6)	0,04 **
2+	52 (3,5)	1 (1,4)	20 (2,6)	22 (5,5)	9 (4,0)	0,06 **
Pre-natal appointment						
< 6	1444 (98,5)	1 (1,5)	10 (1,2)	1 (0,2)	4 (1,8)	0,27 **
≥6	16 (1,1)	68 (98,5)	759 (98,4)	396 (99,8)	223 (98,2)	

Abreviations: BMI, Body mass index. **Statistics** * Varience Analysis (ANOVA); ** chi-quadrado (3 × 2).

in south Brazil present a higher percentage of Caucasian pregnant women (Silva et al., 2014; Fonseca et al., 2014). Therefore, different authors reported Caucasian ethnicity with greater propensity to high Body Mass Index during pregnancy than others (Silva et al., 2014; Fonseca et al., 2014). Concerning maternal education, literature points out the degree of instruction of the mother as an important factor concerning high Body Mass Index and/or considered one of the preventive factors in maternal and perinatal intercurrences (Konno et al., 2007; Teixeira et al., 2016; Vieira et al., 2016). However, these equivalences: ethnicity and maternal level of education were not evident in our results (P > 0.05).

When studying the number of pregnancies, it is worth mentioning that multigravida women presented a consistent perspective regarding greater weight increase and greater chances of neonatal complications (Apgar score at the first minute and macrosomia) (Kac and Velásquez-Meléndez, 2005; Silva et al., 2009, 2013b). In the present research, both primigravida and multigravida mothers presented a difference in the comparative proposal related to the mothers' weight (p < 0.05).

The analysis corresponding to the number of prenatal appointments related to the Body Mass Index of the respective groups, both pregnant women with less than six prenatal consultations and pregnant women with six or more visits to the doctor had no differences (p > 0.05). However, researchers evidenced the lower number of medical care during pregnancy as an adjunct factor for occurrence of large for gestational age newborns (Silva et al., 2009). Hence, although the variable number of consultations did not indicate a difference between the groups, in this study it can be considered a confounding factor concerning large for gestational age newborn outcomes in overweight mothers.

About the newborn characteristics according to gestational body mass index, the different factors or pathologies that may potentially affect labor are already well known (Silva et al., 2013b). However, obesity is a relevant and independent factor (Kac and Velásquez-Meléndez, 2005). Several studies point out cesarean section as one of the main outcomes when the patient has a high body mass index (Adamo et al., 2013; Lamminpaa et al., 2016; Stamilio and Scifres, 2014; Melo et al., 2016). In another study, the odds were (OR = 1.36 (95% CI 1.14–1.63) and (OR = 1.84 CI95% 1.53–2.22) for overweight and obese pregnant women, respectively (Bautista-Castaño et al., 2013).

Similarly, the current paper statistics indicate increased chances of cesarean section in obese pregnant women (OR = 1.86, 95% CI 1.32–2.62) as well as in pregnant underweight mothers (OR = 2.30, 95% CI, 67–3.15). Pregnant women with higher BMI (overweight and obesity) presented higher chances of complications at delivery (cesarean section and large bleeding) and maternal intercurrences (gestational diabetes and hypertensive syndrome) (Silva et al., 2014).

Although there is an association between increased weight in the newborn and the hyperglycemic history of the mother (Melo et al., 2016; King and Casanueva, 2007), different authors in later studies have shown a propensity for macrosomic and large for gestational age newborns in mothers with a body mass index above normal standards (Kim et al., 2016; Fonseca et al., 2014; Kominiarek et al., 2010; Vernini et al., 2016).

The comparative analysis of Apgar score revealed (P > 0.05). Nevertheless, this result contradicts the ones in the referred literature, in which as the mother's body mass index increases from adequate to excess weight, the baby's Apgar tend to decrease (Bautista-Castaño et al., 2013; Silva et al., 2014). Admission to the Neonatal Intensive Care Unit was not considered a significant outcome in relation to the different groups evaluated.

Even though researches show the harmful effects of obesity during pregnancy, such as infection rates and chances of early neonatal mortality, the mechanisms and the possible effects corresponding to placental transfer of maternal adiposity are parameters yet to be uncovered (Crume et al., 2015; Hermond and Robbins, 2016; Coyne et al., 2016). It was not identified a chance of increased Neonatal death rate between categories for both underweight and overweight women in this study.

This retrospective cohort did not consider the maternal outcomes and the data is not yet fully consolidated on the different social, economic and educational determinants that can influence perinatal

Table 2
Newborn characteristics according do the gestational BMI classification.

Outcome	Group (BMI)	N (%)	OR Adjusted * (CR 95%)	p
Cesarian Section	Underweight	25 (36,2)	2,30 (1,67–3,15)	< 0,01
	Normal	227 (29,4)	–	…
	Overweight	135 (34,0)	1,53 (0,86–2,72)	0,14
	Obesity	112 (49,3)	1,86 (1,32–2,62)	< 0,01
Preterm Birth	Underweight	11 (15,9)	0,78 (0,45–1,35)	0,38
	Normal	75 (9,7)	–	…
	Overweight	35 (8,8)	0,43 (0,18–1,01)	0,05
	Obesity	19 (8,4)	0,94 (0,51–1,72)	0,85
Macrosomy	Underweight	0 (0,0)	…	…
	Overweight	36 (9,1)	1,82 (1,08–3,06)	0,02
	Obesity	25 (11,5)	1,24 (0,72–2,15)	0,42
Small For Gestational Age	Underweight	8 (11,6)	0,61 (0,31–1,20)	0,15
	Normal	58 (7,5)	–	…
	Overweight	31 (7,8)	0,41 (0,15–1,11)	0,08
	Obesity	11 (4,8)	0,59 (0,29–1,21)	0,15
Large For Gestational Age	Underweight	1 (1,4)	1,51 (0,99–2,30)	0,05
	Normal	91 (7,8)	–	…
	Overweight	64 (16,1)	2,18 (1,46–3,24)	< 0,01
	Obesity	53 (23,3)	16,57 (2,22–123,34)	< 0,01
Apgar 1 Low	Underweight	4 (5,8)	0,78 (0,27–2,26)	0,65
	Normal	17 (2,2)	–	…
	Overweight	10 (2,5)	0,27 (0,06–1,16)	0,07
	Obesity	5 (2,2)	0,74 (0,24–2,27)	0,60
Apgar-5 Low	Underweight	1 (1,4)	4,48 (0,38–51,74)	0,23
	Normal	1 (0,1)	–	…
	Overweight	3 (0,8)	0,35 (0,02–5,10)	0,44
	Obesity	3 (1,3)	1,64 (0,24–10,97)	0,60
NICU Admission	Underweight	7 (10,1)	1,00 (0,52–1,91)	0,98
	Normal	47 (6,1)	–	…
	Overweight	22 (5,5)	0,59 (0,22–1,61)	0,31
	Obesity	14 (6,2)	1,08 (0,53–2,20)	0,81
Neonatal Death	Underweight	4 (5,8)	0,18 (0,01–9.85)	0,40
	Normal	110 (14,3)	–	…
	Overweight	73 (18,4)	–	…
	Obesity	48 (21,1)	0,13 (0,01–15,20)	0,40

Abreviations: BMI, body mass index; OR, Odds ratio; CR, Confidence Range. Statistics: Multinomial logistic regression (adjusted for maternal age, ethnicity, marital status, schooling, number of pregnancies, parity, number of abortions, prenatal appointments).

intercurrences. Notwithstanding, the number of pregnant women assessed and considerations about confounding factors aim to solve these issues. Other studies considering different variables are necessary to strengthen the results.

5. Conclusion

The present paper concludes that the cesarean delivery method presented 1.86 times higher odd for obese mothers, and even higher for those with low body mass index mothers (OR = 2.3 times), compared to normal body mass index mother. The odds ratio of macrosomic babies occurrence was 1.82 times higher in overweight pregnant women. Giving birth to large for gestational age baby was 2.18 times higher in overweight mothers, and 16.8 times higher in obese mothers in comparison to normal body mass index pregnant women. Increasing BMI above normal patterns suggests an association with increased neonatal weight.

Conflicts of interest

None.

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