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ORIGINAL ARTICLE

Risk Factors for Macrosomia

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Abstract

Objective To identify risk factors for macrosomic babies.
Methods This cross-sectional analytical study was carried out in the University Teaching Hospital and the Central Hospital of Yaoundé (Cameroon) from October 1st, 2012 to March 31st, 2013. Women who gave birth to ≥4,000 or 3,000–3,499 g babies were recruited. Variables recorded were fetal sex and birth weight, gestational age, maternal age, parity, mother's body mass index (BMI), weight gain during pregnancy, previous macrosomia, and father's BMI. Fisher exact test and student *t*-test were used for comparison. Level of significance was $P < 0.05$.
Results Main risk factors for macrosomia are delivery of a previous macrosomic baby (OR 13.1), maternal weight gain ≥16 kg (OR 10.2), parity ≥3 (OR 4.8), father's BMI ≥30 (OR 3.7), male sex (OR 2.2), and post-term (OR 1.9).
Conclusion Father's obesity should be added among the known risk factors for macrosomia.

Keywords Macrosomia · Risk factors · Cameroon

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Introduction

Macrosomia characterizes birth weight ≥4,000 g or above the 90th percentile [1, 2]. But for some authors, only birth weight ≥4,500 g indicates macrosomia [3, 4]. Prevalence of macrosomia defined as birth weight ≥4,000 g varies in sub-Saharan countries between 1.9 % in Ethiopia and

14.6 % in Nigeria [5]. In Cameroon, its prevalence in 1995 was 6.4 % [6]. Risk factors for macrosomia are not all known. They include maternal obesity or overweight, diabetes or gestational diabetes, excessive weight gain during pregnancy, post-term pregnancy, and male sex [7]. Prenatal diagnosis of macrosomia might call for close attention during labor and delivery. Unfortunately, macrosomia is not always predictable even clinically or through ultrasound scan [2, 4]. Maternal complications include dysfunctional uterine contractions, prolonged labor, increased risk of cesarean section, uterine rupture, spontaneous symphysiotomy, obstetrical neuropathy, and lower genital tract lacerations [7, 8]. Fetal and neonatal complications include shoulder dystocia, Erb's palsy, fracture of the clavicle or humerus, neonatal asphyxia, hypocalcemia, hypoglycemia, hypomagnesemia, hyperbilirubinemia, increased risk of neonatal infection (due to prolonged labor), and sometimes perinatal death [7, 9, 10]. These complications explain the increased risk of maternal and neonatal morbidities associated with macrosomic babies. No recent study has evaluated the risk factors for macrosomia in our setting. Knowing risk factors for macrosomia in our environment might help us reducing its prevalence during antenatal care, consequently reducing the prevalence of the many complications above mentioned. The aim of this study therefore was to identify risk factors for macrosomia in our country.

Materials and Methods

This cross-sectional analytical study was conducted in the maternities of the University Teaching Hospital and the Central Hospital of Yaoundé (Cameroon) from October 1st, 2012 to March 31st, 2013. Women who just gave birth to neonates weighing ≥4,000 g and controls (the woman who delivered—just after the delivery of the case—a neonate with birth weight between 3,000 inclusive and 3,500 g exclusive) were recruited. This range for control was chosen, because it is the range with lesser birth trauma risk such as shoulder dystocia compared to 3,500–3,999 g [11]. Data collected on a pretested questionnaire included in both groups fetal sex and birth weight, gestational age at delivery (confirmed by an ultrasound scan performed before 20 weeks gestation), maternal age at delivery, parity, pre-gestational body mass index (BMI), weight gain during pregnancy (difference between the weight just before delivery and the weight just before she realized that she was pregnant), past history of macrosomia, and father's BMI (calculated when the father came to hospital to visit his wife). Sample size was calculated using the following formula: $N = 2 \times (Z\alpha + Z\beta/P_0 - P_1)^2 \times P \times (1 - \mathrm{P})$ where $Z\alpha = 1.65$, $Z\beta = 1.65$, P_0 the cesarean section rate among women with a macrosomic baby (35 %), P_1 the cesarean section rate among controls (15 %), and P is $(P_0 + P_1)/2$. According to this formula, 103 women at least were needed in each group. An informed consent was obtained from each woman and her husband. This study was approved by the two institutional ethics committees. Data were analyzed using SPSS 18.0. Fisher exact test was used to compare categorical variables and student t-test to compare continuous variables. We used odds ratios with their 95 % confidence interval to present the comparison between the two groups. P value <0.05 was considered statistically significant. Results are presented as mean ± standard deviation (SD) for quantitative data and frequencies for qualitative data.

Results

During the study period, 116 mothers who delivered macrosomic babies and 116 controls were analyzed.

Birth weights varied between 4,000 and 4,850 g with a mean of 4,280.6 ± 165.2 g in the macrosomic group as against a range from 3,020 to 3,480 g with a mean of 3,254.5 ± 85.6 g in the control group ($P < 0.0001$). Male newborns were observed in 70 cases (60.3 %) in the macrosomic group as against 47 (40.5 %) in the control group (Odds Ratio (OR) 2.2, 95 % CI 1.3–3.7, $P = 0.0037$).

Maternal ages varied between 17 and 40 years with a mean of 29.4 ± 5.3 years in the macrosomic group as against a range from 17 to 41 years with a mean of 26.4 ± 5.3 years in the control group ($P < 0.0001$) (Table 1). Women aged ≥30 years ($n = 85$) delivered more macrosomic babies (48 or 56.4 %) than women ($n = 147$) of <30 years (68 or 46.2 %). OR for macrosomia was 1.5 (95 % CI 0.88–2.58) when maternal age ≥30 was compared to <30 years.

Mean parity was 3.3 ± 1.3 and varied between 1 and 7 in the macrosomic group as against a mean of 2.2 ± 1.3

Table 1 Distribution of maternal age

Maternal age (years)	Case group (BW ≥ 4,000 g) N (%)	Control group (BW 3,000–3,499 g) N (%)
<20	6 (5.2)	10 (8.6)
20 to <25	23 (19.8)	28 (24.1)
25 to <30	39 (33.6)	41 (35.3)
30 to <35	33 (28.4)	29 (25)
35 to <40	12 (10.3)	6 (5.2)
≥40	3 (2.6)	2 (1.7)
Total	116 (100)	116 (100)

BW birth weight

Table 2 Distribution of women according to their parity

Parity	Case group (BW ≥ 4,000 g) *N* (%)	Control group (BW 3,000–3,499 g) *N* (%)
1	6 (5.2)	13 (11.2)
2	18 (15.5)	38 (32.7)
3	24 (20.7)	45 (38.8)
4	40 (34.5)	12 (10.3)
5	20 (17.2)	5 (4.3)
≥6	8 (6.9)	3 (2.6)
Total	116 (100)	116 (100)

BW birth weight

with a range from 1 to 6 in the control group ($P < 0.0001$) (Table 2). Women of parity ≥3 ($n = 143$) delivered more macrosomic babies (92 or 64.3 %) than women ($n = 89$) of parity <3 (24 or 26.9 %). OR for macrosomia was 4.8 (95 % CI 2.7–8.7) when parity ≥3 was compared to <3.

Maternal pre-gestational BMI ranged from 19.6 to 36.1 kg/m^2 with a mean of 26.1 ± 4.2 kg/m^2 in the macrosomic group as against a range from 18.5 to 31.3 kg/m^2 with a mean of 24.9 ± 3.1 kg/m^2 in the control group ($P = 0.014$). Women with pre-gestational BMI ≥25 (n = 118) had more macrosomic babies (62 or 52.5 %) than women ($n = 114$) with pre-gestational BMI <25 (54 or 47.3 %). OR for macrosomia was 1.2 (95 % CI 0.7–2.06) when maternal pre-gestational BMI ≥25 was compared to <25.

Father's BMI varied between 19.1 and 41.4 kg/m^2 with a mean of 27.7 ± 4.0 kg/m^2 in the macrosomic group as against a range from 17.8 to 40.0 kg/m^2 with a mean of 25.0 ± 4.3 kg/m^2 in the control group ($P < 0.0001$) (Table 3). Women whose husband BMI ≥30 ($n = 61$) gave more birth to macrosomic babies (39 or 63.9 %) than women ($n = 80$) whose husband BMI <25 (27 or 33.7 %). OR for macrosomia was 3.7 (95 % CI 1.7–6.9) when father's BMI ≥30 was compared to <25.

Table 3 Distribution of father's body mass index

BMI (Kg/m^2)	Case group (BW ≥4,000 g) *N* (%)	Control group (BW 3,000–3,499 g) *N* (%)
<20	2	9
20–25	25	44
25–30	50	41
30–35	23	16
35–40	12	5
≥40	4	1
Total	116	116

BMI body mass index, *BW* birth weight

Maternal weight gain during pregnancy ranged from 5.5 to 25 kg with a mean of 16.2 ± 4.2 kg in the macrosomic group as against a range from 5 to 19 kg with a mean of 12.3 ± 2.4 kg in the control group ($P < 0.0001$). Women with gestational weight gain ≥16 kg ($n = 58$) delivered more macrosomic babies (50 or 86.2 %) than women ($n = 174$) with gestational weight gain <16 (66 or 37.9 %). Weight gain ≥16 kg during pregnancy was associated with an OR of 10.2 (95 % CI 4.5–22.9) for macrosomia when compared to weight gain <16 kg.

Past history of macrosomia was observed in 30 cases (25.9 %) in the macrosomic group and in three cases (2.6 %) in the control group (OR 13.1, 95 % CI 3.8–44.4, $P < 0.0001$).

Gestational ages varied between 38 and 44 weeks with a mean of 40.3 ± 1.2 in the macrosomic group as against a range from 37 to 43 with a mean of 38.8 ± 1.0 in the control group ($P < 0.0001$). Post-term pregnancies were observed in 13 cases (11.2 %) in the macrosomic group and only in seven cases (6.0 %) in the control group (OR 1.9, 95 % CI 0.7–5.1, $P = 0.24$).

Discussion

The mean birth weight among our controls was lower than that found among the macrosomic babies with a statistically significant difference. This is due to the fact that our reference group was mothers who delivered babies of normal weight. Some studies have compared birth weights ≥4,000 g to those of 3,000 to 3,999 g [12]. Comparing for instance, a baby of 4,005 g to another of 3,995 g might not be justified enough, because we might be comparing similar babies giving that a baby that has urinated or that has passed meconium before or just after delivery may move from 4,005 to less than 4,000 g.

Macrosomia was more encountered among male sex than among female sex (OR 2.2, 95 % CI 1.3–3.7). Some authors also found that male sex was more involved in macrosomia than female sex [3]. Women ≥30 years had increased risk for delivering macrosomic babies than those <30 years (OR 1.5, 95 % CI 0.8–2.5). This has already being shown by some authors who noticed that women aged 30 or more were at increased risk [6, 13].

Our study has shown that multiparity has an influence on the occurrence of macrosomia. In fact, women of parity ≥3 were more prone to macrosomic babies than those of parity <3 (OR 4.8, 95 % CI 2.7–8.7). This might be due to the fact that in the same woman, birth weight increases with parity. Abena et al. in their series observed that parity was a risk factor when it was >5 [6].

Regarding pre-gestational BMI, we observed that women with BMI ≥25 had slightly increased risk for

delivering macrosomic babies (OR 1.2, 95 % CI 0.7–2.6). This is in accordance with the findings of Bergmann et al. [13] who noticed that women with pre-gestational BMI $\geq$26 kg/m^2 were at increased risk for delivering macrosomic babies, while Kamanu et al. [14] found a pre-gestational BMI value of $\geq$28 kg/m^2 as cut-off point for the risk for delivering macrosomic babies.

Moreover, father's BMI $\geq$30 was found in our study to have an influence in the occurrence of macrosomia (OR 3.7, 95 % CI 1.7–6.9). This may show that father's genetic factors might also be involved in the occurrence of macrosomia. More studies with larger samples should be carried out to confirm these findings.

Women with previous macrosomic babies had increased risk for delivering a macrosomic baby than controls (OR 13.1, 95 % CI 3.8–22.8). This is in accordance with the findings of Kamanu et al. [14] who noticed that past history of delivery of a macrosomic baby was a significant risk factor for the delivery of macrosomic baby in subsequent pregnancies.

Maternal weight gain above 16 kg during pregnancy was a risk factor in our study (OR 10.2, 95 % CI 4.5–22.9). This has already been observed by some authors [3, 6, 13]. This means that increased nutritional input during pregnancy might also be a risk factor for macrosomia. In our study, gestational age at delivery had an influence on the occurrence of macrosomia, since post-term was associated with an OR of 1.9 (95 % CI 0.7–5.1). Some researchers noticed too post-term as a risk factor [6, 13].

Conclusion

Father's BMI $\geq$30 kg/m^2 should be added among the already known risk factors for macrosomia confirmed in this study (previous delivery of a macrosomic baby, maternal weight gain during pregnancy $\geq$16 kg, parity $\geq$3, male sex, and post-term). Henceforth, to reduce the risk of delivering macrosomic babies, mothers should try to gain less than 16 kg bodyweight during pregnancies, and obstetricians should avoid post-term especially when the other risk factors above mentioned are present.

Conflict of interest The authors have none to declare.

Ethical Statement This study entitled "Risk factors for macrosomia" received approval from the two institutional ethics committees.

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