Predictors Of Fetal Macrosomia Among Women Delivering At A Tertiary Hospital In Tanzania: Case Control Study

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Abstract

Purpose: Women who deliver macrosomic or big baby have been observed to sustain adverse maternal and fetal outcomes such as prolonged labor, perineal tears, uterine rupture, postpartum hemorrhage, maternal and neonatal deaths. The study aimed at assessing predictive factors associated with fetal macrosomia at a tertiary hospital in Tanzania.

Methods: This was an analytical quantitative study that used a case-control study design in which cases were women who delivered babies weighing $\geq 4000\text{g}$ while controls were those who delivered babies weighing 2500g to 3500g. Purposive sampling technique was employed to recruit both controls and cases 216 participants. This was an unmatched case control study. A structured questionnaire was used for the data collection. SPSS version 25 software program was used for data entry and analysis.

Results: The identified predictors associated with fetal macrosomia at Iringa Regional Referral hospital were advanced gestation age (AOR=8.16, CI 3.49-19.03, $p<0.0001$), diabetes mellitus during pregnancy (AOR =12.03, CI 1.28 -13.14, $p= 0.0297$) and a previous history of macrosomic baby delivery (AOR = 3.01, CI 1.02 -8.89, $p=0.0467$).

Conclusion: women with advanced gestation age, diabetes mellitus during pregnancy, and a previous history of macrosomic baby delivery are at an increased risk of delivering a macrosomic baby.

Introduction

Fetal macrosomia has been linked to increasing nutritional status and the prevalence differs according to ethnicity [1], [2]. The more maternal weight gain, the more chances of delivering a macrosomic baby [3]. The worldwide prevalence of fetal macrosomia is 0.5 % to 15 % of all pregnancies [4], [5]. Considering developed and developing countries, the prevalence in developed countries ranges from 15–20 % due to increasing nutritional intake, obesity and diabetes mellitus [2]. It is a birth weight of $\geq 4000\text{g}$ or birth weight greater than the 90th percentile at birth [6]. So far the largest recorded birth weight worldwide was in 1894 in Ohio USA which was 10.78 kg[7].

Predicting fetal macrosomia in a clinical setting is a challenge in developing countries. The gold standard for diagnosing fetal macrosomia is magnetic resonant imaging (MRI) which is rarely available at many facilities in developing countries [8]. Clinical examination (Leopard maneuvers) is less accurate and obstetric ultrasound has been observed to be substandard compared to magnetic resonant imaging (MRI) [8], [9]. Nuchal translucency (NT) and biochemical factors like pregnancy-associated plasma protein-A (PAPP-A) and free β -human chorionic gonadotrophin (β -hCG) have also been studied and found to have low predictive value for fetal macrosomia [10]. In Tanzania, there has been an increasing rate of caesarean section that results from fetal macrosomia [11].

Methods

A hospital-based analytical case-control study design involving pregnant women and their newborns at Iringa Regional Referral Hospital from June to December 2020. A sample of 216 was calculated using modified Kesley formula for case control study. Cases were 72, they were those who delivered babies of weight $\geq 4000\text{g}$ while Controls were 144 and they delivered babies of weight 2500g to 3500g.

The weight of the mother was measured by weighing balance with a sensitivity of 100 g and height of the mother was measured using a calibrated height measuring steel attached to the beam balance and recorded to 0.1 cm, mothers were required to maintain an upright position with their feet together, and a horizontal headpiece was lowered onto the women's head. Maternal weight gain was measured by subtracting the early first trimester weight from the last measured weight before delivery. The Reproductive and Child Health card (RCH) was checked to obtain weight of the mother at the first and last antenatal visit. Body Mass Index (BMI) was calculated, weight in kilogram dividing by height in meters squared.

Maternal random/fasting blood glucose (RBG/FBG) was measured by ACCU-Check Active meter by a drop of capillary blood obtained by finger prick. Soon after delivery, participants were categorized as cases or controls. The weight of the newborn was measured soon after delivery using a beam balance accurate to 100 g. This was an unmatched case control study. In a situation where the case never met the inclusion criteria, the next woman who delivered an infant with birth weight of $\geq 4000\text{ g}$ was recruited.

All statistical analysis was performed using SPSS, version 25.0 (IBM Inc., Chicago). Categorical variables were summarized as the frequency with percentages, while continuous variables summarized as means with standard deviations and range. The p-value, OR, and 95% confidence interval were tested. A p-value of < 0.05 was considered to be significant for all statistical tests. Factors with significant odds ratio (OR) were subjected to multinomial logistic regression to determine the adjusted odds ratio (AOR).

Results

A total of 216 participants were involved in this study. Result showed that, majority 116 (53.70%) of respondents were between the age 25–34 years of which 44 (61.11%) were cases and 72 (50%) were controls. Regarding parity, 78 (33.80%) of study participants were primiparous in which 15 (20.83%) were cases and 58 (40.28) were controls. Considering gestation age, majority 17 (23.63%) of cases and 115 (79.86%) of controls delivered at 37–39 weeks of gestation age.

There were 122 (88.41%) of controls and 35 (50.72%) of cases with a previous history of macrosomic baby. 16 (22.22%) of cases and 19 (13.19%) of controls were overweight. 11 (5.09 %) cases and 1 (0.69%) controls were found to be diabetic. 8 (3.7%) of study participants had a weight gain of $\geq 11\text{ kg}$ of which 6 (8.33%) were cases and only 2 (1.39) were controls. As shown in Table 1 below.

Table 1
Socio-demographic characteristics of the study participants (N = 216)

Variable	Total N = 216 N (%)	Cases n = 72 n (%)	Control n = 144 n (%)
Child's Particulars			
Sex			
Male	124 (57.41)	45 (62.50)	79 (54.86)
Female	92 (42.59)	27 (37.50)	65 (54.14)
Maternal Particulars			
Maternal age (Years)			
15–24	64 (29.63)	11 (15.28)	53 (36.81)
25–34	116 (53.70)	44 (61.11)	72 (50.00)
35+	36 (16.67)	17 (23.61)	19 (13.19)
Residence			
Rural	94 (43.52)	30 (41.67)	64 (44.44)
Urban	122 (56.48)	42 (58.33)	80 (55.56)
Parity			
1	73 (33.80)	15 (20.83)	58 (40.28)
2	66 (30.56)	19 (26.39)	47 (32.64)
3	44 (20.37)	18 (25.00)	26 (18.06)
4+	33 (15.28)	20 (27.78)	13 (9.03)
Gestation age			
37–39	132 (61.11)	17 (23.61)	115 (79.86)
40–41(+ 6 days)	68 (31.48)	45 (62.50)	23 (15.97)
42+	16 (7.14)	10 (13.89)	6 (4.17)
Level of education			
No formal education	34 (15.74)	12 (16.67)	22 (15.28)
Primary	106 (49.07)	28 (38.89)	48 (33.33)
Secondary and above	76 (35.19)	32 (44.44)	74 (51.39)

In this study, among the maternal factors, gestation age ≥ 40 weeks, a previous history of macrosomic baby, diabetes mellitus in pregnancy and higher parity were strongly associated with fetal macrosomia ($p\text{-value} = < 0.0001$) as shown in Table 2 below. Other factors associated with fetal macrosomia were advanced maternal age ($p\text{-value} = 0.0028$), weight gain during pregnancy ($p\text{-value} = 0.0178$) and overweight ($p\text{-value} = 0.0896$). Regarding neonatal factors, child's gender ($p\text{-value} = 0.2845$) was not significantly associated with fetal macrosomia.

Table 2
Factors associated with fetal macrosomia (N = 216)

Variable	Macrosomia			
	Case n = 72	Control n = 144	χ ²	P-value
Child's characteristics				
Sex			1.1455 ^a	0.2845
Male	45	79		
Female	27	65		
Maternal factors				
Age			11.7363 ^a	0.0028
15–24	11	53		
25–34	44	72		
35+	17	19		
Residence			0.1507 ^a	0.6979
Rural	30	64		
Urban	42	80		
Gestation age			63.9846 ^a	< .0001
37–39	17	115		
40–41(+ 6 days)	45	23		
42+	10	6		
Maternal Body Mass Index(kg/m2)			2.8811 ^a	0.0896
18.5–24.9	56	125		
25.0-29.90	16	19		
Previous history of delivery Macrosomia			35.6515 ^a	< .0001
Yes	34	16		
No	35	122		
Diabetes Mellitus during pregnancy				< .0001*
Non-diabetic	62	143		

Variable	Macrosomia			
	Case n = 72	Control n = 144	χ^2	P-value
Diabetic	10	1		
Parity			18.1653 ^a	< .0001
1	15	58		
2	19	47		
3	18	26		
4+	20	13		
Weight gain during pregnancy				0.0178*
≤ 11	142	66		
> 11	2	6		

P-Value with * indicate p-value of Fisher exact test

Logistic regression findings showed that those women who were at their gestation age of 40–41 weeks plus 6 days were 8 times more likely to deliver macrosomic babies compared to women who delivered at 37–39 weeks (AOR = 8.16, 95% CI = 3.49–19.03, $p = 0.000$). Diabetic women were 12 times more likely to deliver macrosomic babies compared to non-diabetic women (AOR = 12.03, 95% CI = 1.28–13.14, $p = 0.0297$). Women with a previous history of macrosomic delivery were 3 times more likely to deliver macrosomic babies compared to women with no history of previous macrosomic delivery. (AOR = 3.01, 95% CI = 1.02–8.89, $p = 0.0467$). However other factors such as maternal BMI, parity, weight gain during pregnancy, maternal age and child's gender were not statistically significantly associated with fetal macrosomia as shown in Table 3 below

Table 3
Logistic Regression of Factors associated with fetal macrosomia (N = 216)

Logistic Regression of Factors associated with fetal macrosomia (N = 276)								
Variable	OR	95% CI		P-value	AOR	95% CI		P-value
		OR				AOR		
		Lower	Upper			Lower	Upper	
Maternal Age								
15–24	Ref.							
25–34	2.94	1.39	6.23	0.0048	1.89	0.67	5.35	0.2280
≥ 35	4.31	1.72	10.84	0.0019	0.85	0.19	3.95	0.8401
Gestation age								
37–39	Ref.							
40–41(+ 6 days)	13.24	6.47	27.07	0.000	8.16	3.49	19.03	< .0001
≥ 42	11.28	3.63	35.01	0.000	8.84	2.49	31.43	0.0008
Parity								
1	Ref.							
2	1.56	0.72	3.41	0.2608	0.99	0.35	2.86	0.9891
3	2.68	1.17	6.12	0.0196	1.22	0.36	4.12	0.7498
4+	5.95	2.42	14.63	0.0001	1.73	0.41	7.40	0.4582
BMI								
18.5–24.9	Ref.							
25.0-29.9	3.03	1.23	3.85	0.0428	2.77	0.98	7.85	0.0555
History of delivery Macrosomia								
No	Ref.							
Yes	7.41	3.67	14.96	0.000	3.01	1.02	8.89	0.0467
Diabetes mellitus in pregnancy								
Non-diabetic	Ref.							
Diabetic	0.04	0.01	0.35	0.0031	12.03	1.28	13.14	0.0297

Discussion

In this study, the risk factors for fetal macrosomia are advanced gestation age, previous history of delivering macrosomia and diabetes mellitus during pregnancy. Maternal BMI, parity, weight gain during pregnancy, age of participant and child's gender were not significantly associated with fetal macrosomia.

In Taiwan and Indonesia, fetal macrosomia has been strongly associated with overweight and obesity [12], [13] which is contrary to the finding in this study in which most cases were found to be overweight compared to controls but it was not statistically significant. Overweight and obesity are linked to increased nutritional intake and sedentary life.

In Antioquia, Columbia, a cohort study revealed that pre pregnancy overweight, weight gain during pregnancy and gestational diabetes were the main predisposing factors for fetal macrosomia and are results of increased nutrition intake and sedentary lifestyle [14]. Only diabetes mellitus during pregnancy was a similar finding in this study, weight gain during pregnancy was not significantly associated with fetal macrosomia in this study.

The risk factors for fetal macrosomia in Malaysia include increasing maternal age, increasing body mass index (BMI), increasing weight gain during pregnancy, higher parity and diabetes mellitus during pregnancy [15]. This is contrary to the findings of this study in which advanced maternal age, maternal body mass index, maternal weight gains during pregnancy and higher parity were not associated with fetal macrosomia although diabetes mellitus during pregnancy was strongly associated with macrosomia.

In Cameroon, risk factors identified included a previous history of macrosomic delivery, maternal weight gain above 16 kg, higher parity, male gender and post term pregnancies [16]. Comparing to this study, only previous history of macrosomic delivery and post term pregnancy are similar factors identified in this study while higher parity, male gender and maternal weight gain were not associated with macrosomia in this study. Similarly, macrosomia in Chad and Ghana has been associated with a previous history of delivering macrosomic baby [17], [18]. In Hawassa city, Ethiopia, male gender, advanced gestation age and having a previous history of macrosomia baby delivery were significant factors associated with fetal macrosomia [19] while in this study, advanced gestation age and having a previous history of macrosomic delivery were strong factors associated with fetal macrosomia. Male gender was not associated with fetal macrosomia in this study.

In Mekelle city, Tigray, Ethiopia in which women with a history of a previous macrosomic delivery were 3 times more likely to give birth to a macrosomia baby compared to women with no history [20], in this study women with a previous history of macrosomic delivery were also 3 times more likely to deliver macrosomic baby compared to women with no history of previous macrosomic delivery.

In Ethiopia women who were aged 30 years and above were 2.6 times to delivery macrosomia baby compared to those who were less than 30 years [20]. This is similar to finding of this study in which

participants who aged 25–34 years were 2.94 times more likely to delivery macrosomic baby while those of ≥ 35 years were 4.31 times more likely to delivery macrosomic baby compared to women of 15–24 years. Women with a pregnancy weight gain of 16 kg or above were 11 times more likely to delivery macrosomic babies compared to women who gained less than 16 kg [20]. This is similar to findings in this study in which maternal weight gain during pregnancy was significantly associated with macrosomic delivery.

In Tanzania, a study done at Muhimbili National Hospital, the risk factors for fetal macrosomia were increasing maternal weight above 80 kg, advanced maternal age of 30–39 years, multiparty, diabetes mellitus during pregnancy and a previous history of delivering a macrosomic baby [11]. These finding are similar to this study done at Iringa region in which advanced gestation age, previous history of delivering macrosomia and diabetes mellitus during pregnancy were significantly associated with fetal macrosomia. Increasing maternal weight gain, advanced maternal age and multiparty were not associated with fetal macrosomia.

The above differences and similarities can be attributed to the fact that countries differ in their ethnicity, dietary practices and genetic makeup.

Conclusion

The factors which were associated with fetal macrosomia in the current study were; advanced maternal gestation age ≥ 40 weeks, diabetes mellitus during pregnancy and a previous history of macrosomic baby delivery.

List Of Abbreviations

IRRH	Iringa Regional Referral Hospital
DM	Diabetes Mellitus
NICU	Neonatal Intensive Care Unit
WHO	World Health Organization

Declarations

Conflict of Interest: The authors declare no conflict of interest.

Ethical statement

Before conducting the research, the researcher obtained letters of permission from the University of Dodoma, Directorate of Research, and through the Department of Public Health to undertake the study. The researcher obtained Ethical clearance, and a copy was sent to Iringa Regional Referral Hospital

management for approval. The proposal was discussed at the department and college then submitted for ethical review by the University of Dodoma ethical committee under the director of postgraduates.

Critical observation of the rules and regulations during the process of researching to avoid any physical or emotional harm by considering protocol, a complete description of the aims of the study, informed consent of participants, and confidentiality of the information sources was maintained.

Pregnant women who never consented to participate in the study were assured of receiving the same quality of care as other participants. Advice and reassurance were given to the participants where appropriate, researcher-designed patient's identity numbers instead of real names, which remained anonymous, and any participant was free to withdraw from the study at any time they felt uncomfortable in any way.

Declaration and copyright

I, **Emmanuel Imani Ngadaya**, declare that this research is my own original work and that it has not been presented, published or shared to any other professional for other purposes apart from academic purposes.

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