

Predictors of fetal macrosomia in Iringa, Tanzania: a case-control study

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Abstract

Introduction: It is challenging to predict fetal macrosomia before delivery. This study aimed at assessing predictors of fetal macrosomia at Iringa Regional Referral Hospital in Tanzania from June to December 2020.

Method: An unmatched case-control study with 216 participants of whom 72 were cases - women who delivered babies weighing $\geq 4000\text{g}$ - and 144 were controls - women who delivered babies weighing 2500g to 3499g. The purposive sampling technique described below was employed to recruit both controls and cases. SPSS version 25 software program was used for data entry and analysis.

Results: Of the 216 participants, 116 (53.7%) were aged between 25 – 34 years (standard deviation 6.0). The majority of 132 (61.1%) delivered at a gestational age of 37 – 39 weeks + 6 days of whom 17 (23.6%) were cases and 115 (79.86%) were controls. The predictors of fetal macrosomia were advanced gestation age (AOR=8.10, 95% CI 3.66-17.91, $p < 0.0001$) and diabetes mellitus during pregnancy (AOR =14.94, 95% CI 1.60 -39.91, $p = 0.0178$).

Conclusion: Women with higher gestational age and gestational diabetes mellitus are at an increased risk of delivering a baby with macrosomia at Iringa Regional Referral Hospital. An early plan for the mode of delivery, such as labour induction, will aid the prevention of advanced gestational age. Ensuring a healthy diet and physical exercises in our communities will help to reduce diabetes mellitus and hence fetal macrosomia.

Keywords: Macrosomia, Predictors, Tanzania

Introduction

Fetal macrosomia is widely defined as a birth weight of $\geq 4000\text{g}$ or birth weight greater than the 90th percentile at birth.^[1] The worldwide prevalence of fetal macrosomia is 0.5% to 15% of all pregnancies.^[2] The prevalence in developed countries ranges from 15 – 20 % due to excess nutritional intake, obesity, and diabetes mellitus.^[1] In Africa, the prevalence ranges from 2% to 9% and the reasons include multiparity and variations in maternal weight gain during pregnancy.^[1,3-5]

The predictors of fetal macrosomia studied to date include a previous history of delivering a macrosomic baby, multiparity, male fetus, uncontrolled diabetes mellitus, gestational diabetes, gestational age, maternal weight gain during pregnancy, parental height, post-term pregnancy, and ethnicity.^[2,6] Fetal macrosomia has been linked to adverse maternal and fetal outcomes such as postpartum haemorrhage, the leading cause of maternal mortality, and neonatal death.^[3,7] The gold standard for diagnosing fetal macrosomia is magnetic resonant imaging (MRI) which is rarely available at many facilities in developing countries.^[6] Clinical examination and obstetric ultrasound are less accurate compared to MRI.^[6,8] This study aimed to assess the predictors of fetal macrosomia in Iringa, Tanzania.

Method

A hospital-based unmatched case-control study was designed involving term pregnant women with a singleton birth at the Department of Obstetrics and Gynaecology at Iringa Regional Referral Hospital from June to December 2020. A total of 216 women were included of whom the 72 who delivered babies weighing $\geq 4000\text{g}$ were considered as cases and the 144 women who delivered babies weighing 2500g to 3499g were taken as controls. The reasons for selecting these weight groups is:

1. Cases (macrosomic group) - women who delivered babies of birthweight of 4000g and above. This agrees with the globally standard accepted definition of fetal macrosomia.
2. Controls (normal weight babies) - women who delivered babies of 2500g to 3499g, the cut-off lower limit was 2500g because below 2500g is a 'low

birth weight' and in Tanzania, 3500g and above are considered as big babies /macrosomia.

We used a modified [World Health Organization criteria](#) to diagnose diabetes mellitus during pregnancy. A 2-hour 75g oral glucose tolerance test (OGTT) was used. Study participants who were known to be diabetic were not included in the test. Participants were required to fast for a minimum of 8 hours before the test, the fasting blood glucose was obtained. After 2 hours of taking the oral glucose, blood glucose was measured. All women with a fasting plasma glucose level of $\geq 7.0\text{mmol/l}$ (126mg/dl) or a 2-hour plasma glucose of $\geq 11.1\text{mmol/l}$ (200mg/dl) were considered as women with diabetes during pregnancy

Data were analyzed using SPSS, version 25.0 (IBM Inc., Chicago). Ethical clearance was obtained from the University of Dodoma Directorate of Research and Publication and informed consent was obtained from the participants.

Table 1. Social demographic characteristics of the participants (N=216)

Variable	Total n=216 n (%)	Cases n=72 n (%)	Control n=144 n (%)
Child characteristics			
Sex			
Male	124 (57.4)	45 (62.5)	79 (54.9)
Female	92 (42.6)	27 (37.5)	65 (45.1)
Maternal characteristics			
Maternal age (years)			
15 – 24	64 (29.6)	11 (15.3)	53 (36.8)
25-34	116 (53.7)	44 (61.1)	72 (50.0)
35+	36 (16.7)	17 (23.6)	19 (13.2)
Residence			
Rural	94 (43.5)	30 (41.7)	64 (44.4)
Urban	122 (56.5)	42 (58.3)	80 (55.6)
Parity			
1	73 (33.8)	15 (20.8)	58 (40.3)
2	66 (30.6)	19 (26.4)	47 (32.6)
3	44 (20.4)	18 (25.0)	26 (18.1)
4+	33 (15.3)	20 (27.8)	13 (9.0)
Gestation age (weeks)			
37 – 39 weeks +6 days	132 (61.1)	17 (23.6)	115 (79.9)
40 – 41weeks +6 days	68 (31.5)	45 (62.5)	23 (16.0)
42+	16 (7.1)	10 (13.9)	6 (4.2)
Level of education			
No formal education	34 (15.7)	12 (16.7)	22 (15.3)
Primary	106 (49.1)	28 (38.9)	48 (33.3)
Secondary and above	76 (35.2)	32 (44.4)	74 (51.4)

Table 2. Predictors of fetal macrosomia (N=216)

Variable	Macrosomia		X ²	p-value
	Case n=72	Control n=144		
Child's characteristics				
Sex			1.1455	0.285
Male	45 (62.5)	79 (54.9)		
Female	27 (37.5)	65 (45.1)		
Maternal factors				
Age - years			11.7363	0.003
15 – 24	11 (15.3)	53 (36.8)		
25-34	44 (61.1)	72 (50.0)		
≥35	17 (23.6)	19 (13.2)		
Residence			0.1507	0.698
Rural	30 (41.7)	64 (44.4)		
Urban	42 (58.3)	80 (55.6)		
Gestation age - days			63.9846	<0.0001
37 – 39	17 (23.6)	115 (79.9)		
40 - 41(+6 days)	45 (62.5)	23 (16.0)		
42+	10 (13.9)	6 (4.2)		
Maternal Body Mass Index (kg/m2)			0.8827	0.643
18.5- 24.9	27 (37.5)	51 (35.4)		
25.0-29.90	27 (37.5)	59 (41.0)		
≥ 30.0	18 (25.0)	30 (20.8)		
Previous history of delivering a macrosomic baby			30.4912	<0.0001
Yes	35 (48.6)	20 (13.9)		
No	37 (51.4)	124 (86.1)		
Diabetes Mellitus				<0.0001*
Non diabetic	62 (86.1)	143 (99.3)		
Diabetic	10 (13.9)	1 (0.7)		
Parity			18.1653	<0.0001
1	15 (28.4)	58 (40.3)		
2	19 (26.4)	47 (32.6)		
3	18 (25.0)	26 (18.1)		
4+	20 (27.8)	13 (9.0)		
Weight gain during pregnancy (kg)			0.7648	0.382
≤11	38 (52.8)	85 (59.0)		
>11	34 (47.2)	59 (41.0)		

p-value with * indicates p-value calculated by the Fisher exact test

Results

There were 79 (54.9%) male babies and 65 (45.1%) female babies. The mean age of the 216 mothers was 28.5 years (standard deviation 6.0 years); 116 (53.7%) of participants were aged between 25 – 34 years of whom 44 (61.1%) were cases and 72 (5%) were controls. Seventy-eight (33.8%) were primiparous of whom 15 (20.83%) were cases and 58 (40.28) were controls. Table 1.

The predictors of fetal macrosomia

This study found that, among the maternal factors, gestation age ≥ 40 weeks (p-value = < 0.0001), a previous history of macrosomic baby (p-value = < 0.0001), diabetes mellitus in pregnancy, higher parity (p-value = < 0.0001) and higher maternal age (p-value = 0.0028) were predictors of fetal macrosomia on cross tabulation as shown in Table 2.

In this study, women with advanced gestation age (≥ 40 weeks) were eight times more likely to give birth to a macrosomic baby compared to women who delivered at a gestation age of 37 to 39 weeks (AOR=8.10, 95% CI=3.66-17.91, $p < 0.0001$). Women with diabetes mellitus were 14 times more likely to give birth to a

macrosomic baby compared to women without diabetes mellitus (AOR=14.94, 95% CI=1.60-39.91, $p = 0.0178$) as shown in Table 3.

Discussion

In Taiwan and Indonesia, fetal macrosomia has been associated with maternal overweight and obesity.^[10,11] This is contrary to the finding in this study in which body mass index did not predict fetal macrosomia. Although not statistically significant, excessive weight gain before and during pregnancy has been linked to decreasing insulin sensitivity which facilitates the transfer of glucose via the placenta to the growing fetus hence leading to increasing fetal size.^[11,12] These two studies were cohort studies conducted for a longer duration and with a larger sample size compared to our study. This may explain why BMI was significantly associated in their study and not in ours.

The predictors of fetal macrosomia in Malaysia included increasing maternal age, increasing BMI, increasing weight gain during pregnancy, higher parity, and diabetes mellitus during pregnancy.^[14] In this study advanced maternal age, maternal BMI, maternal weight gain

Table 3. Logistic regression of factors associated with fetal macrosomia (N=216)

Variable	OR	95% CI OR		p-value	AOR	95% CI AOR		p-value
						Lower	Upper	
Maternal Age (years)								
15-24	Ref.							
25-34	2.94	1.39	6.23	0.0048	1.75	0.65	4.71	0.2666
≥ 35	4.31	1.72	10.84	0.0019	1.04	0.26	4.234	0.9584
Gestation age								
37 – 39	Ref.							
40 - 41(+6 days)	13.24	6.47	27.07	< 0.0001	8.10	3.66	17.91	< 0.0001
≥ 42	11.28	3.63	35.01	< 0.0001	8.67	2.53	29.74	0.0006
Parity								
1	Ref.							
2	1.56	0.72	3.41	0.2608	1.02	0.38	2.75	0.9713
3	2.68	1.17	6.12	0.0196	1.47	0.47	4.60	0.5072
4+	5.95	2.42	14.63	0.0001	1.78	0.46	6.94	0.4068
History of delivery of a macrosomic baby								
No	Ref.							
Yes	5.87	3.03	11.36	< 0.0001	2.34	0.90	6.09	0.0815
Diabetes mellitus								
Non-diabetic	Ref.							
Diabetic	0.04	0.01	0.35	0.0031	14.94	1.60	39.91	0.0178

during pregnancy, and higher parity were not associated with fetal macrosomia although diabetes mellitus during pregnancy was strongly associated. Ours was a case-control study with only 216 participants while in Malaysia it was a cross-sectional study with 2332 participants, a difference that may explain why findings differ. Diabetes mellitus during pregnancy leads to increasing fetal adiposity hence an increase in fetal weight leading into macrosomia.^[14]

Advanced gestation age was the commonest predictor of fetal macrosomia in this study and is similar to findings in Sydney in which it was estimated that a fetus gains 176.5g per week; this may explain why advanced gestation age predisposes a woman to deliver a macrosomic baby.^[15]

In Tanzania and Ethiopia, the predictors of fetal macrosomia were a maternal weight above 80kg, multiparity, diabetes mellitus during pregnancy, and maternal pre-pregnancy BMI and pregnancy weight gain respectively while maternal age and previous history of delivering a macrosomic baby were found in both studies.^[5,9] These findings are at variance with those in our study where only higher gestation age and gestational diabetes mellitus during pregnancy were significantly associated with fetal macrosomia.

Efforts to prevent diabetes mellitus which may result in fetal macrosomia should be one of the community interventions. Diabetes mellitus can be prevented by first ensuring a healthy balanced diet in our communities and also by educating families on physical exercises. It is best for women with advanced gestation age who are at risk of fetal macrosomia to seek care early and the mode of delivery determined. Early labour induction or a possible Caesarean Section play an important role in preventing dangerous obstetric outcomes of fetal macrosomia.

Conclusion

Women with higher gestational age and gestational diabetes mellitus are at an increased risk of delivering a baby with macrosomia at Iringa Regional Referral Hospital. An early plan for the mode of delivery, such as labour induction, will aid the prevention of advanced gestational age. Ensuring a healthy diet and physical exercises in our communities will help to reduce diabetes mellitus and hence fetal macrosomia.

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