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OBSTETRICS & GYNECOLOGY | RESEARCH ARTICLE

Prevalence and associated factors of fetal macrosomia in a rural community in Ghana

Kweku Bedu-Addo[1]*, Richard K.D. Ephraim[2], Comfort Tanoe-Blay[2], Linda Ahenkorah-Fondjo[3], Kwame Osei-Darkwah[2], Mabel Ephraim[4], Kate A. Kontoh[5] and Albert Abaka-Yawson[6]

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*Corresponding author: Kweku Bedu-Addo, Department of Physiology, Kwame Nkrumah University of Science and Technology, Ghana
E-mail: kwebuba@yahoo.com

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Abstract: Foetal macrosomia is known to contribute to various perinatal and maternal complications. Additionally, it has been proven to be a primary determinant of the survival of a newborn baby. We sought to determine the prevalence and associated factors of fetal macrosomia in Eikwe, a rural community in the Western part of Ghana. This hospital-based cross-sectional survey conducted from January 2017 to May 2017 engaged 200 women with singleton pregnancies at the maternity/labor unit of the St Martins de pores Hospital. Questionnaires were administered to establish socio-economic and demographic characteristics of respondents while obstetric data were retrieved from participants' medical records/files. Maternal factors associated with macrosomia were examined using multiple logistic regressions. Of the 200 participants, the prevalence of fetal macrosomia was 6.5% [95% CI: 3.50%–10.86%]. Majority of the participants' ages ranged between 21–25 (28.5%) and 26–30 (26.30%) years. Most of the participants were multigravida 99 (49.5%) and multipara 76 (38.0%) respectively. Aspiration of the meconium ($p < 0.001$) and poor Apgar score at the first minute were significantly associated ($p = 0.011$) with fetal macrosomia. Obesity 7 (53.8%) [11.91 (1.91–63.08), $p = 0.019$] and history of fetal macrosomia 9 (69.2%) [172.5 (29.37–1088.63), $p < 0.001$] were significantly associated with macrosomia. The prevalence of fetal macrosomia was 6.5% [95% CI: 3.50%–10.86%]; the previous history of fetal macrosomia and obesity were the main predictors of macrosomia. Moreover, poor Apgar score and aspiration of the meconium were the complications associated with fetal macrosomia.

ABOUT THE AUTHOR

Dr. Kweku Bedu-Addo is a Senior Lecturer in Physiology at the Kwame Nkrumah University of Science and Technology. His specialty is Reproductive Physiology and currently Epidemiological Transition Study. His research interests include the effects of chemicals, drugs, and the environment on the reproductive processes in humans and animals and more recently the influence of novel risk factors, the gut microbiota and short chain fatty acids (SCFAs) on obesity, adiposity and weight change in an international established cohort spanning the epidemiologic transition. He has a PhD from The University of Birmingham, UK. The authors of this paper have conducted research in various Public Health, Reproductive Health and Chemical Pathology.

PUBLIC INTEREST STATEMENT

Fetal weight exceeding 4.0 kg poses various complications to both the expectant mother and the developing baby. This fetal overweight has been suggested to be due to socio-economic and gynecological factors of expectant mothers. Unfortunately, data on this phenomenon especially among rural dwellers are largely unavailable. In response to this, the research team conducted this study to investigate the prevalence of fetal overweight and the contributing factors.

Subjects: Medicine; Nursing; Allied Health; Midwifery;

Keywords: fetal macrosomia; maternal; rural; newborn; determinants

1. Background

The American College of Obstetricians and Gynecologists (ACOG) defined macrosomia as birthweight over 4,000 g irrespective of gestational age or greater than the 90th percentile for gestational age after correcting for neonatal sex and ethnicity (Ng et al., 2010). These births affect 3-15% of all pregnancies (Asplund et al., 2008). Macrosomia is well known to be associated with numerous perinatal and maternal complications (Abolfazl et al., 2008; Kerényi et al., 2009; Ng et al., 2010).

Uncontrolled diabetes mellitus in pregnancy, pre-gravid, maternal obesity, excessive gestational weight gain as well as maternal overnutrition have been associated with fetal macrosomia. Other risk factors of macrosomia include male fetal sex, high parity, maternal height and post-term pregnancy (Koyanagi et al., 2013).

Fetal macrosomia which is found in all parts of the world is expected to be higher in affluent countries where their nutritional levels are higher (Inegbenebor, 2013). The prevalence of fetal macrosomia in the developed countries has specifically increased by 15-20% recently; an increase largely attributed to increasing maternal obesity and diabetes (Koyanagi et al., 2013). In Africa, a prevalence of 7.5%, 8.4% and 14.9% has been recorded in Nigeria, Uganda and Algeria, respectively (Koyanagi et al., 2013).

In Ghana, similar studies have been a mix of urban and peri-urban (Abubakari et al., 2015; Addo, 2010; Agbozo et al., 2016). However, data on macrosomia specifically in the rural settings are largely unknown. Hence, this study sought to determine the prevalence and associated factors of fetal macrosomia in Eikwe, a rural area in Ellembelle District in the Western part of Ghana. This study, therefore, provides local data which would help the primary health-care provider to adequately plan ways to reduce this problem.

2. Methodology

2.1. Study design/area

The study was a hospital-based cross-sectional survey conducted from January 2017 to May 2017 at the maternity/labor unit of the St Martins de pores Hospital Eikwe in the Ellembelle District. The Ellembelle District which is one of the 17 districts in the Western Region of Ghana is located on the southern end of the region. The district lies within the wet semi-equatorial climate zone of the West African subregion. Eikwe is one of the smallest villages in the district, with a population of about 2000. It is situated along the shores of the Atlantic Ocean. The main occupation is fishing and subsistence farming.

2.2. Study population/sample size

The study recruited 200 women with singleton pregnancies who attempted vaginal delivery and delivered newborns at the St Martins de pores hospital. Cochran's sample size formula was used to determine the total participants to be enrolled. Using a foetal macrosomia prevalence of 10.5% reported by Abubakari et al. with a 5% margin error, 95% confidence interval, a sample size of 150 was obtained. The sample size was calculated as shown below:

$$N = \frac{Z^2 P(1-P)}{D^2}$$

where

N represents the estimated sample size,

Z represents the constant for 95% confidence interval given as 1.96,

P represents the average prevalence of foetal macrosomia of 10.5% obtained from a study conducted in Northern Ghana,

D represents the percentage margin of error taken as 5%.

$$N = \frac{1.96^2 * 0.11 * 0.89}{0.05^2}$$

N = 150

The sample size was further increased to 200 participants to increase the statistical power of the study.

2.3. Inclusion and exclusion criteria

Women with singleton pregnancies who attempted vaginal delivery and delivered newborn were enrolled. We excluded women with multiple pregnancies, babies with low birth weight (birth weight less/or equal to 2.50 kg), elective cesarean sections (cesarean deliveries scheduled 8 hours or more before delivery) and babies delivered preterm.

2.4. Ethical consideration

The study was approved by the Institutional Review Board of the University of Cape-Coast (IRB-UCC) and the authorities of St Martins de pores Hospital. Informed written and verbal consent was sought from the study participants before inclusion in the study. The study objectives and procedure, as well as possible risks and benefits associated with participating in the study, were explained to the study participants in English and the local language. Research was carried out only on those who agree to participate and satisfy the inclusion criteria. Study participants who did not seem to understand the study upon several explanations were excluded from the study. Additionally, data obtained were anonymized and kept confidential before analysis by the use of questionnaire identification numbers rather than names.

2.5. Collection of data

Fetal macrosomia was defined as birth weight greater than or equal to 4 kg (Abubakari et al., 2015). A well-structured closed-ended questionnaire was used to obtain socio-demographic data (age, educational status, weight, height and body mass index) of the participants. Besides, obstetric data (gestational age, parity, gravidity, previous history of macrosomia, onset of delivery (spontaneous or induced), route of delivery-vaginally (spontaneous or vacuum extraction/forceps delivery) or caesarean section, shoulder dystocia, genital laceration (classified as first, second, third and fourth degree), birth injury, sex of baby, Apgar scores and perinatal mortality) of the participants were retrieved from their medical records. Additionally, asphyxia was classified as mild (Apgar score of 6), moderate (Apgar score of 4.5), severe score (Apgar score 1–3) at the first and fifth minutes. Data on postpartum hemorrhage, neonatal death and weight of baby were also recorded.

2.6. Data analysis

Data were analyzed with SPSS version 16 (SPSS Inc. Chicago). Descriptive statistics were computed with standard methods. Chi-square test was used to compare the association between categorical variables. Bivariate analysis was determined using *t*-test and multivariate analysis was also determined using ANOVA and $P < 0.05$ was interpreted as statistically significant.

3. Results

Majority of the participants had ages ranging between 21–25 (28.5%) and 26–30 (26.30%) years whereas only 0.5% of the participants were age range 41–45 years. Most of the participants had

Table 1. Demographic characteristics of participants

Variables	Total (N = 200) N (%)
Age group	
15–20	34 (17.0)
21–25	57 (28.5)
26–30	56 (28.0)
31–35	31 (15.5)
36–40	21 (10.5)
41–45	1 (0.5)
Educational level	
None	42 (21.0)
Basic	107 (53.5)
Secondary	38 (19.0)
Tertiary	13 (6.5)
Gravidity	
Prima gravid	55 (27.5)
Multigravida	99 (49.5)
Grand multigravida	46 (23.0)
Parity	
Nullipara	65 (32.5)
Primipara	34 (17.1)
Multipara	76 (38.0)
Grand multipara	25 (12.5)
BMI (Kg/m^2)	25.96 ± 4.03
BMI n (%)	
Normal	94 (47.0)
Overweight	77 (38.5)
Obese	29 (14.5)
History of previous fetal macrosomia	
Yes	11 (5.5)
No	189 (94.5)

basic education, 107 (53.5%). Most of the participants were multigravida, 99 (49.5%), and multipara, 76 (38.0%) respectively. Also, a greater proportion of the participants had normal weight 94 (47.0%) and only 11 (5.5%) of the participants had the previous history of fetal macrosomia (Table 1).

The prevalence of fetal macrosomia among the participants was 13 (6.5%) (Figure 1).

From Table 2, 7.7% of the participants who delivered macrosomic babies had prolonged delivery, 61.5% had spontaneous vaginal delivery, 8.3% had second-degree laceration, 4 (30.8%) had perineal trauma, 15.4% had postpartum hemorrhage and 7.7% was transfused with one unit of blood.

Fetal complications associated with fetal macrosomia are summarized in Table 3. Aspiration of meconium ($p < 0.001$) and poor Apgar score at the first minute ($p = 0.011$) were significantly associated with fetal macrosomia.

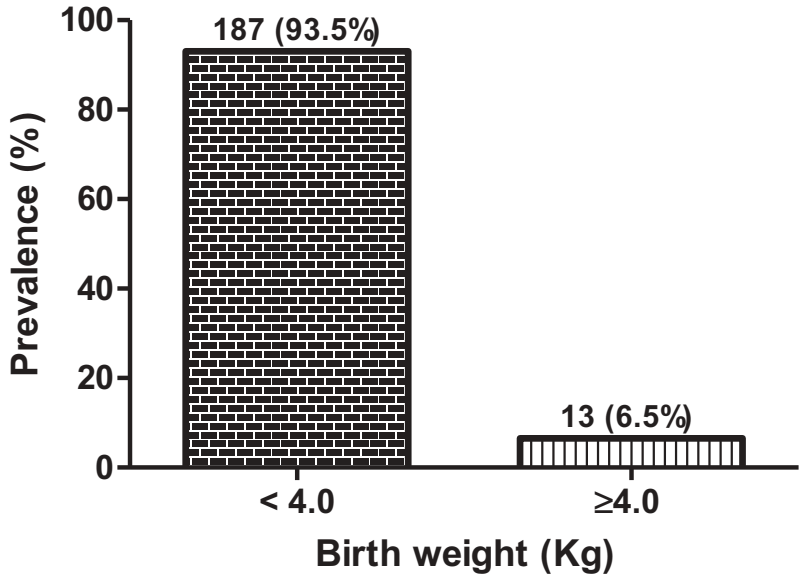

Figure 1. Prevalence of macrosomia (birth weight ≥ 4.0 kg).

Table 4 shows the maternal determinants associated with fetal macrosomia. After adjusting for potential confounders using multivariate logistic regression analysis, obesity 7 (53.8%) [11.91 (1.91–63.08), p = 0.019] and history of fetal macrosomia 9 (69.2%) [172.5 (29.37–1088.63), p < 0.001] were significantly associated with macrosomia.

4. Discussion

Fetal macrosomia is an undesirable condition that can lead to devastating complications to both the mother and the fetus. This study examined the prevalence and determinants of fetal macrosomia as well as the maternal and perinatal outcomes. From our findings, the prevalence of fetal macrosomia was 6.5% [95% CI: 3.50%-10.86%] and maternal obesity and previous history of macrosomia were significant determinants. This observation is similar to the findings of Koyanagi et al. (2013) and Odar et al. (2004) in Uganda who reported prevalence rates of 7.5% and 8.4%, respectively. The prevalence was also higher than that of Adesina and Olayemi (2003) in Ibadan as well as Kamanu et al. (2009) in Abia State both in Nigeria, who reported the prevalence of fetal macrosomia to be 3.5% and 2.5%, respectively. The variation in the prevalence may be due to differences in the definition of fetal macrosomia. Our study used a cutoff point of ≤4.00 kg, while the latter studies used a cutoff point of birth weight ≤4.50 kg. The prevalence of macrosomia in this study, however, was lower than the 10.9% prevalence reported in a retrospective study by Abubakari et al., (2015) and the 10.94% reported by Addo (2010) in the Northern and Ashanti regions of Ghana, respectively. This discrepancy may be as a result of the larger sample size used and the longer duration of their research. It may also be due to differences in geographical and socioeconomic factors of the study population.

Obesity was found to be significantly associated with macrosomia in the study. This finding is consistent with similar studies conducted by Olokor et al. (2015) in Nigeria as well as Addo (2010) in Ghana which reported that maternal obesity was a risk factor for fetal macrosomia in an index pregnancy. Additionally, Mai and Abbassia (2014) in a retrospective study in Algeria observed that maternal obesity increased the risk of fetal macrosomia by fourfolds. Their study further pointed out that 30% to 40% of all children with a birth weight over 4000 g had obese mothers whilst a cohort study by Najafian and Cheraghi (2012) suggested it could be as high as 75% of children.

Again, though some studies have reported maternal weight gain at term as a significant predictor (Adesina & Olayemi, 2003; Kamanu et al., 2009), this present study found no significant

Table 2. Obstetric complications of fetal macrosomia

Characteristics	Birth weight		P-value
	<4.0 kg	≥4.0 kg	
	(n = 187)	(n = 13)	
Duration of labour (hours)			0.308
≤8	158 (84.5)	10 (76.9)	
9–12	26 (13.9)	2 (15.4)	
>12	3 (1.6)	1 (7.7)	
Mode of delivery			0.828
Spontaneous vaginal delivery	132 (71.0)	8 (61.5)	
Vacuum extraction from the vagina	2 (1.1)	0 (0.0)	
Forceps vaginal delivery	1 (0.5)	0 (0.0)	
Caesarean section	51 (27.4)	5 (38.5)	
Degree of genital laceration			0.114
None	151 (80.7)	11 (83.3)	
First degree	34 (18.2)	1 (8.3)	
Second degree	2 (1.1)	1 (8.3)	
Postpartum hemorrhage			0.405
Yes	16 (8.6)	2 (15.4)	
No	171 (91.4)	11 (84.6)	
Received blood transfusion			0.482
Yes	7 (3.7)	1 (7.7)	
No	180 (96.3)	12 (92.3)	
Number of units transfused			0.742
None	180 (96.3)	12 (92.3)	
1	5 (2.7)	1 (7.7)	
2	2 (1.1)	0 (0.0)	
Perineal trauma			0.491
Yes	42 (22.5)	4 (30.8)	
No	145 (77.5)	9 (69.2)	

difference in the maternal overweight in pregnancy and macrosomia. This owes to the fact that the determination of pre-pregnancy weight in the study was difficult since there were no pre-conception clinics. While some of the participants registered late for antenatal care, others were not registered especially in the first trimester. Hence, the effect of weight gain in pregnancy on fetal weight could not be properly determined in this study. This may account for the observed difference.

This study observed that 69.2% of the macrosomic deliveries were from participants with the previous history of macrosomia. This result is consistent with the assertion by the American College of Obstetricians and Gynecologists (ACOG) as well as findings of a retrospective study conducted in Algeria by Mai and Abbassia (2014) which suggests that the history of macrosomia is a major

Table 3. Fetal complications associated with macrosomia

Characteristics	Birth weight		P-value
	<4.0 kg	≥4.0 kg	
Gender			0.460
Male	110 (58.8)	9 (69.2)	
Female	77 (41.2)	4 (30.8)	
Apgar score at 1 min			**0.011**
<7	24 (12.8)	5 (38.5)	
≥7	163 (87.2)	8 (61.5)	
Apgar score at 5 min			0.790
<7	11 (5.8)	1 (7.7)	
≥7	176 (94.1)	12 (92.3)	
Perinatal mortality			0.645
Yes	3 (1.6)	0 (0.0)	
No	184 (98.4)	13 (100)	
Asphyxia at first and fifth minute			0.143
None	164 (87.7)	10 (76.9)	
Mild	13 (7.0)	2 (15.4)	
Moderate	2 (1.1)	1 (7.7)	
Severe	8 (4.3)	0 (0.0)	
Aspiration of the meconium			**<0.0001**
Yes	18 (9.6)	6 (46.2)	
No	169 (90.4)	7 (53.8)	

Bold indicates p-values less than 0.05

determinant of foetal macrosomia. A related study conducted by Mahony et al. (2006) reported rather contradictory findings.

Further, this current study found the aspiration of meconium and poor Apgar score at the fifth minutes to be significantly associated with macrosomia. According to Boulet et al. (2003), the risk of aspiration of meconium increases with increasing birth weight and as such, it is significantly associated with fetal macrosomia, a finding consistent with the present study. However, other studies found no statistically significant association between aspiration of the meconium and macrosomia (Oral et al., 2001).

Poor Apgar score has been reported to be significantly associated with macrosomia (Boulet et al., 2003). Reports by Raio et al. (2003) revealed that the risk of low Apgar score is eight times higher in macrosomic babies when the delivery is a complication with shoulder dystocia. This contradicts this present study which found no correlation between macrosomia and shoulder dystocia.

5. Conclusion

The prevalence of fetal macrosomia was 6.5% [95%CI: 3.50%–10.86%]. Previous history of fetal macrosomia and obesity were the significant predisposing factor to macrosomia. Poor Apgar score and aspiration of the meconium were the complications associated with fetal macrosomia. Health promotion and education should be done in the rural areas to minimize/prevent fetal macrosomia. Also, pregnant women should be encouraged and educated on the need to attend antenatal to help in early diagnosis of fetal macrosomia with the aid of ultrasound scan.

Table 4. Logistic regression analysis of foetal macrosomia across maternal characteristics

Variable	Macrosomia (birth weight ≥ 4.0 kg) (n = 13)	COR (95% CI)	P-value	AOR (95% CI)	P-value
Age group n (%)					
15–20*	0 (0.0)	1			
21–25	1 (7.7)	0.18(0.01–2.08)	0.169		
26–30	9 (69.2)	1.92(0.38–9.67)	0.432		
31–35	1 (7.7)	3.33(0.03–3.93)	0.383		
36–0	2 (15.4)	-			
Educational level					
None*	8 (61.5)	1		1	
Basic	2 (15.4)	0.08 (0.02–0.40)	**0.002**	0.19 (0.10–0.54)	0.051
Secondary	1 (7.7)	0.12 (0.14–0.97)	**0.046**	0.75 (0.52–1.48)	0.078
Tertiary	2 (15.4)	0.77 (0.14–4.20)	0.765	1.21 (0.95–5.43)	0.872
Gravidity					
Primigravida*	0 (0.0)	1		1	
Multigravida	6 (46.2)	0.36(0.11–1.14)	0.082	0.42(0.23–1.55)	0.153
Grand multigravida	7 (53.8)	-		-	
Parity					
Nullipara*	0 (0.0)	1			
Primipara	1 (7.7)	0.22(0.02–2.28)	0.205		
Multiparous	9 (69.2)	0.99 (0.25–3.97)	0.983		
Grand multipara	3 (23.1)	-			
BMI n (%)					
Normal*	2 (15.4)	1		1	
Overweight	4 (30.8)	2.52 (0.45–14.15)	0.294	1.89 (0.32–12.13)	0.457
Obese	7 (53.8)	14.64 (2.84–75.37)	**0.001**	11.91 (1.91–63.08)	**0.019**
History of previous fetal macrosomia					
Yes	9 (69.2)	208.13 (33.57–1290.27)	**<0.001**	172.5 (29.37–1088.63)	**<0.001**
No*	4 (30.8)	1		1	

*reference group; AOR: Adjusted Odds Ratio COR: Crude Odds Ratio. Bold indicates p-values less than 0.05

6. Limitations

The study did not consider the socioeconomic status of participants, such as income, living standards, nutritional status among others, which could be key determinants of fetal macrosomia.

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Author details
Kweku Bedu-Addo[1]
E-mail: kwebuba@yahoo.com
Richard K.D. Ephraim[2]
E-mail: rephraim@ucc.edu.gh
Comfort Tanoe-Blay[2]
E-mail: cblay70@gmail.com
Linda Ahenkorah-Fondjo[3]
E-mail: dammylee@yahoo.com
Kwame Osei-Darkwah[2]
E-mail: darkwahosei80@gmail.com

Mabel Ephraim[4]
E-mail: yaakyem@yahoo.com
Kate A. Kontoh[5]
E-mail: dammylea@yahoo.com
Albert Abaka-Yawson[6]
E-mail: aabakayawson@uhas.edu.gh
[1] Department of Physiology, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Ghana.
[2] Department of Medical Laboratory Science, School of Allied Health Sciences, University of Cape Coast, Ghana.
[3] Department of Molecular Medicine, School of Medical Sciences, Kwame Nkrumah University of Science and Technology, Ghana.
[4] Kumasi Nursing and Midwifery Training School, Kumasi, Ghana.
[5] Cape Coast Teaching Hospital, Cape Coast, Ghana.
[6] Department of Medical Laboratory Science, School of Allied Health Sciences, University of Health and Allied Sciences, Ho, Ghana.

Author contributions

RKDE, KBA and CTB conceived of the study and participated in its design and coordination. CTB, RKDE and LAF were involved in the recruitment of participants, data collection and analysis. RKDE, KOD, KBA, MA, CTB and AAY drafted the manuscript. RKDE, LAF, MA and AAY provided analytic and statistical support. All authors read and approved the final manuscript.

Competing Interests

The authors declare that there are no competing interests.

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