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Outcomes of Fetal Macrosomia and Associated Factors: A Case-Control Facility Based Study

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Abstract

Objective: To identify risk factors of perinatal complications among macrosomic babies in a third level health care facility. **Method:** We conducted a case-control institutional based study. Cases (macrosomic babies and mothers with perinatal complications) and controls (pairs free of perinatal complication) of singleton live births were extracted from the maternity registry from January 2017 to December 2019. Matching was done for sex and gestational age after exclusion of genetic cause of macrosomia. The main primary outcome was the risk factors for complications. Logistic regression was used to estimate the odds ratio and the magnitude of association between the primary endpoint and the different covariates of the study. **Results:** Out of 362 couples included, we had 186 cases and 176 controls. The main perinatal complications were the delivery by caesarean section (26.5%) and lesions of the genital canal, 20.2%. There were no maternal deaths. Among newborns, metabolic complications (19.6%) were a leading cause of harmful outcomes before respiratory complications (12.4%), dystocic presentations (6.3%) or traumatic injuries (1.7%). The neonatal case fatality rate was 2.8%. Maternal age ≥30 years ($p = 0.024$); non-screening for gestational diabetes ($p = 0.027$); history of caesarean section ($p = 0.041$); weight gain ≥16 kg ($p < 0.001$); maternal HIV ($p = 0.047$); birth weight ≥4500 g ($p = 0.015$) and birth height ≥52.7 ± 1.7 cm ($p = 0.026$) were risk factors for perinatal adverse outcomes. **Conclusion:** The delivery of a macrosomic baby remains problematic in this setting, and emphasizes the need to improve routine screening of gestational diabetes within a quality of prenatal follow-up through a multidisciplinary perinatal team involving obstetricians, endocrinologists and neonatal pediatricians.

Keywords

Fetal Macrosomia, Gestational Diabetes, Maternal Obesity, Birth Weight, Fetal Growth

1. Introduction

Fetal macrosomia (FM) is an impairment of fetal growth in excess mainly due to hyperinsulinemia. It is defined by a birth weight (BW) above 4000 g or 4500 g irrespective of gestational age or a BW above 90 or 95th percentile on growth charts according to the term at delivery. These babies are described as large for gestational age (LGA) in comparison to those appropriate or small for gestational age [1] [2]. The main causes of fetal macrosomia are grouped into 3 main categories which are diabetes during pregnancy, excess weight gain during pregnancy and obesity [1] [2] [3]. Fetal macrosomia can lead to life-threatening complications for both mothers and babies. Among mothers, it is common to identify a high rate of caesarean delivery, obstetrical maneuvers, tearing of the perineum, postpartum haemorrhage and the dreaded shoulder dystocia. Among babies, traumatic deliveries can result in brachial plexus palsy, fractures, neonatal asphyxia, and many metabolic complications such as hypoglycemia, hypocalcemia, hyperbilirubinemia [4] [5]. Overall FM can affect 20% of live births worldwide, regarding the threshold retained for its definition. In Cameroun, this prevalence rates has been reported from 5% - 31% notably when included the prevalence of diabetes mellitus in pregnancy [5] [6]. Beyond the perinatal period, neonatal macrosomia is a determinant of diseases in adolescence and adulthood, notably obesity, hypertension and metabolic syndrome [7]. To improve the prevention of FM, several interventions are carried out among others: improving timely screening of gestational diabetes, adopting local guidelines for management of delivery of macrosomic babies and prenatal education [8] [9]. Within a context of resource-limited settings, we conducted this institutional facility based study to analyze risk factors associated to complications amongst macrosomic babies. The results of the study can be used to update local guidelines on prevention of FM including management of delivery of babies LGA in our particular setting.

2. Methods

2.1. Study Objective, Design Setting and Population Study

We performed a case-control study, with presence/absence of a perinatal complication, among babies with macrosomia as primary outcome. The sample size (calculated for pregnant women only) was determined assuming a frequency of macrosomia equals to 7.5%, a confidence level of 95%, a relative precision of 50% and an expected Odd Ratio of 2. Given all these, the minimum sample size was estimated at 170 for each group (presence vs absence of perinatal complica-

tion) giving a required total of 340 patients. The study took place at the maternity of Essos hospital center (EHC). EHC is a third level facility in Yaoundé, hosting a maternity of 2500 to 3000 annual deliveries. The studied population comprised all macrosomic babies and their mothers. For the proposal of the study, macrosomia was defined as a BW of 4000 g or above. Cases were macrosomic mothers and babies-pairs with complications and control were mothers and macrosomic babies' pairs without complications. Singleton In-Born cases and controls were matched for sex and gestational age after exclusion of genetic cause of macrosomia.

2.2. Study Period

The study included all the singleton live births from January 2016 to December 2019.

2.3. Procedure-Variables

Cases and controls after being extracted from perinatal registers (maternity and neonatology department) were matched for sex and age. The variables collected were qualitative and quantitative under the following categories:

1) **socidemographic:** maternal age, occupation, marital status, ethnicity, religion, education

2) **clinical and obstetrical:** parity, gestational term, fetal presentation weight gain during pregnancy, past story of mellitus diabetes, duration of the labour, previous macrosomic baby, mode of delivery, maternal perinatal complications.

3) **neonatal variables:** Apgar score, weight, height, head circumference and perinatal complications.

2.4. Primary Endpoint and Statistical Analysis

The main primary outcome was the risk factors for complications. Cspro software version 7.3 was used for data entry, while R software version 3.6.2 was used for all data analysis. Chi 2/Exact Fisher test was applied where applicable for testing the association between the primary endpoint and other qualitative variables. While the Anova/Kruskall Wallis test was used when applicable to test the association between the primary endpoint with quantitative variables. Logistic regression was used to estimate the odds ratio, to measure the magnitude of association between the primary endpoint and different covariates of the study.

Ethical considerations

Administrative authorisation was issued and ethical clearance for the study obtained from the Institutional Review Board (IRB) of the Essos Health Centre (Reference: N°2020/08/CE-CHE). All data were kept in strict confidentiality by using specific identifiers and restricted access.

3. Results

POPULATION STUDY AND CHARACTERISTICS OF CASES AND

CONTROLS

A total of 362 macrosomic babies and their mothers were included, consisting of 186 cases and 176 controls.

Descriptive analyzes showed that the mothers in the case group were older (31.3 ± 5.3 years vs 29.1 ± 5.3 years; p = 0.012) for controls (Table 1). Compliance with the eight CPN model was found more in the controls (47.7% vs 19.4%; p = 0.002). Non-screening for gestational diabetes was more common in cases (26.9% vs 4.3%; p < 0.001). Weight gain during pregnancy was lower in controls (16.02 ± 4.01 kg vs 18.75 ± 3.25; p < 0.001). The case group had more mothers with a history of caesarean section for fetal macrosomia (8.1% vs 0.6%; p = 0.007). Fetal birth weight ≥4500 g was found more in the case group (17.7% vs 1.7%; p < 0.001). The mean birth height of the cases was greater than that of the controls (52.7 cm ± 1.7 cm vs 51.8 cm ± 1.5 cm) (see Table 2 and Table 3).

Table 1. Distribution of socio-demographic characteristics of mothers according to perinatal complications and non-complications of macrosomia and the respective unadjusted OR.

		Macrosomia without Complication N = 176, 48.6%	Macrosome with at least 1 complication N = 186, 51.4%	Undajusted OR (95CI, p)
Marital status	Single	77 (43.8)	85 (45.7)	-
	Married	99 (56.2)	101 (54.3)	0.92 (0.61 - 1.40, p = 0.709)
Education	None	1 (0.6)	10 (5.4)	-
	Primary	13 (7.4)	17 (9.1)	0.13 (0.01 - 0.82, p = 0.067)
	Secondary	52 (29.5)	77 (41.4)	0.15 (0.01 - 0.81, p = 0.073)
	Higher	110 (62.5)	82 (44.1)	0.07 (0.00 - 0.40, p = 0.014)
Occupation	White coolar	29 (16.5)	24 (12.9)	-
	Private	50 (28.4)	60 (32.3)	1.45 (0.75 - 2.82, p = 0.269)
	Informal	53 (30.1)	76 (40.9)	1.73 (0.91 - 3.32, p = 0.095)
	Student	44 (25.0)	26 (14.0)	0.71 (0.34 - 1.48, p = 0.363)
Maternal Age years	<25	30 (17.0)	15 (8.1)	-
	25 - 30	56 (31.8)	55 (29.6)	1.96 (0.97 - 4.13, p = 0.067)
	30 - 35	51 (29.0)	64 (34.4)	2.51 (1.24 - 5.27, p = 0.012)
	35 - 40	33 (18.8)	38 (20.4)	2.30 (1.07 - 5.09, p = 0.035)
	40 et plus	6 (3.4)	14 (7.5)	4.67 (1.55 - 15.54, p = 0.008)
Age	Mean (SD)	29.9 (5.3)	31.3 (5.2)	1.05 (1.01 - 1.10, p = 0.012)

OR: Odd Ratio; CI: Confidence Interval.

Table 2. Distribution of the characteristics of the prenatal follow-up of macrosomic mother-child couples in Essos Hospital Centre according to the presence or absence of perinatal complications and the respective unadjusted ORs.

		Couples without Complication N = 176, 48.6%	Couples with complication N = 186, 51.4%	Unadjusted OR (95CI, p)
Third trimester ultrasound	Yes	171 (97.2)	153 (82.3)	-
	No	**5 (2.8)**	**33 (17.7)**	**7.38 (3.06 - 21.97, p < 0.001)**
Screening for gestational diabetes	Yes	170 (96.6)	136 (73.1)	-
	No	**6 (3.4)**	**50 (26.9)**	**10.42 (4.67 - 27.78, p < 0.001)**
Number of antenatal visits	0 - 1	1 (0.6)	12 (6.5)	-
	2 - 3	32 (18.2)	93 (50.0)	0.24 (0.01 - 1.30, p = 0.181)
	4 - 7	**59 (33.5)**	**45 (24.2)**	**0.06 (0.00 - 0.34, p = 0.009)**
	8 et plus	**84 (47.7)**	**36 (19.4)**	**0.04 (0.00 - 0.19, p = 0.002)**
Body Mass Index(BMI)	Thinness	6 (3.4)	4 (2.2)	-
	Normal	76 (43.2)	58 (31.2)	1.14 (0.31 - 4.65, p = 0.840)
	Overweight	85 (48.3)	99 (53.2)	1.75 (0.48 - 7.03, p = 0.399)
Weight gain during pregnancy (kg)	**Mean (SD)**	**16.02 (40.1)**	**18.75 (32.5)**	**1.03 (1.02 - 1.04, p<0.001)**
	≤16 kg	89 (50.6)	38 (20.4)	-
	>16 kg	**87 (49.4)**	**148 (79.6)**	**3.98 (2.52 - 6.38, p < 0.001)**
Fundal height (cm)	**Mean (SD)**	**36.3 (1.3)**	**37.0 (3.1)**	**1.25 (1.09 - 1.44, p = 0.002)**

OR: Odd Ratio; SD: Standard deviation; CI: Confidence Interval.

Table 3. Distribution of EHC macrosomic mother-child pairs according to paraclinical and fetal anthropometric parameters and unadjusted OR.

		Control N = 176, 48.6%	Cases N = 186, 51.4%	Unadjusted OR (95CI, p)
Mean estimated fetal weight on 3rd trimester ultrasound (g)	**Mean (SD)**	**3946.6 (291.1)**	**4141.2 (437.3)**	**1.01 (1.02 - 1.03, p < 0.001)**
Gestational Age	< 37 SA	3 (1.7)	3 (1.6)	-
	37 SA-41SA6J	170 (96.6)	176 (94.6)	1.04 (0.19 - 5.66, p = 0.966)
	42 SA et plus	3 (1.7)	7 (3.8)	2.33 (0.28 - 21.10, p = 0.428)
Gender	Male	114 (64.8)	118 (63.4)	-
	Female	62 (35.2)	68 (36.6)	1.06 (0.69 - 1.63, p = 0.792)
Birth Weight(g)	4000 - 4500	173 (98.3)	153 (82.3)	-
	≥4500	**3 (1.7)**	**33 (17.7)**	**12.44 (4.35 - 52.43, p < 0.001)**
Head Circumference Mean (cm)	**Mean (SD)**	**36.0 (0.8)**	**36.3 (1.1)**	**1.35 (1.09 - 1.70, p = 0.008)**
Mean Height (cm)	**Mean (SD)**	**51.8 (1.5)**	**52.7 (1.7)**	**1.43 (1.25 - 1.66, p < 0.001)**

Bold: Significant associated covariates (p < 0.05); OR: Odd Ratio; SD: Standard Deviation.

3.1. Complications of FM

The main complications found in the mothers were delivery by caesarean section, more often emergency than elective (26.5%), lesions of the genital canal (20.2%), followed by instrumental delivery in 10.5% of cases, postpartum hemorrhage occurred in 7.2% of cases. There were no maternal deaths. Amongst newborns, metabolic complications (19.6%) were more frequent than respiratory complications (12.4%), dystocic presentations (6.3%) or traumatic injuries (1.7%) (see Table 4). The neonatal case fatality rate was 2.8%.

Table 4. Maternal morbidity and mortality of macrosomic mother-child couples in EHC.

Maternal' complications	N = 362	%
• Instrumental delivery	38	10.5
• Emergency cesarean	71	19.6
• Elective C-section	25	6.9
• Genital laceration	73	20.2
• Gestaional Diabete	21	5.8
• Post partum fever	11	3.0
• Eclampsia ou pré éclampsia	31	8.6
• Post partum hemmorage	26	7.2
• Maternal deaths	0	0
Newborn Complications		
Respiratory distress		
• Mild and moderate respiratory distress	37	10.2
• Severe respiratory distress	8	2.2
Total	45	12.4
Other Complications		
• Anemia	1	0.3
• Hypocalcémia	17	4.7
• Hypoglycémia	34	9.4
• Newborn jaundice	19	5.2
Total	71	19.6
Traumatic Complications:		
• Fracture of the humerus	1	0.3
• Collarbone fracture	2	0.6
• Obstetric brachial plexus palsy	3	0.8
Total	6	1.7

3.2. Factors Associated to Complications of Fetal Macrosomia

The maternal risk factors for perinatal complications amongst mothers of babies born with macrosomia were: maternal age ≥30 years (OR: 3.31, 95% CI 1.19 - 9.57, p = 0.024); non-screening for gestational diabetes (OR: 3.77; 95 CI 1.22 - 13.16, p = 0.027); history of caesarean section (OR: 3.47; 95 CI 1.07 - 11.95, p = 0.041); weight gain ≥16 kg (OR = 3.38; 95 IC 1.80 - 6.54, p < 0.001) and maternal HIV (OR: 6.23; 95 IC 1.18 - 49.42, p = 0.047).

The fetal risk factors for perinatal complications in macrosomic mother-child couples were: birth weight ≥4500 g (OR: 7.12; 95 IC 1.61 - 40.52, p = 0.015) and birth height ≥52.5 ± 1.7 cm (1.26; 95 CI 1.03 - 1.56, p = 0.026). In addition, multiparity (OR: 0.09, 95% CI 0.03 - 0.23, p < 0.001) and great multiparity (OR: 0.30; 95% CI 0.10 - 0.81, p = 0.019) were protective factors (see **Table 5**).

4. Discussion

One of the particularities of this study is that it compares the factors associated with complications in babies weighting 4000 g or above. This is contrary to previous studies comparing babies with macrosomia to those weighting less than 4000 g [10] [11] [12]. Our work seems to document that within our population, complications are more frequent in case of poor prenatal follow-up and as such reinforces the recommendations for good antenatal follow-up advocated by the World Health Organization [13]. This good prenatal follow-up includes, among other things, screening for gestational diabetes, the absence of which increases the risk of macrosomia, thus confirming data from previous studies. However, in our context, the timing of this remains worrying and the consensus of experts seems to recommend a blood glucose test for all women from the first prenatal consultation and a new measurement between 24 and 28 weeks for those at risk and even earlier [14] [15]. Unsurprisingly, our study confirms the deleterious effect of excessive weight gain on the risk of macrosomia as well as the existence of obesity prior pregnancy. In our study, excessive weight gain beyond 16 kg requires sustained attention. However, this result must be tempered, as it was not correlated with pre-pregnancy weight [16] [17]. The risk of complications seems to increase with the age of the mothers as well as with the existence of a past story of caesarean section. These data are consistent with those found in similar populations of sub-Saharan Africa [12] [18] [19] [20].

What is striking in this study is the high rate of emergency and non-elective caesarean section testifying of the late detection of macrosomia, probably during labor. This reinforces the need for good clinical follow-up by regular measurement of symphysis fundal height associated to abdominal circumference [21]. In addition, the absence of influence of third term ultrasonography to predict macrosomia in our study is consistent with previous reports in the literature and emphasizes the need to use a multiparametric ultrasound model including umbilical vein flow for optimal performance and accuracy to diagnose macrosomia [22] [23]. Finally, in newborns, the parameters most associated with complications

Table 5. Multivariate analysis of maternal factors associated with perinatal complications in fetal macrosomia (adjusted ORs).

		Adjusted Odd Ratio (95CI, p)
Education	None	-
	Primary/Secondary	0.20 (0.01 - 1.66, p = 0.190)
	Higher	0.15 (0.01 - 1.21, p = 0.117)
Maternal age (years)	17 - 24	-
	25 - 29	2.28 (0.85 - 6.38, p = 0.108)
	30 - 40	**3.31 (1.19 - 9.57, p = 0.024)**
	≥40	**11.25 (2.23 - 63.76, p = 0.004)**
Third trimester ultrasound	Yes	-
	No	1.18 (0.34 - 4.57, p = 0.804)
Screening of gestational diabetes	Yes	-
	No	**3.77 (1.22 - 13.16, p = 0.027)**
Number of antenatal visits	0 - 1	-
	2 - 3	0.39 (0.01 - 5.10, p = 0.527)
	4 - 7	0.11 (0.00 - 1.54, p = 0.145)
	≥8	**0.06 (0.00 - 0.82, p = 0.050)**
Previous C-section	No	-
	Yes	**3.47 (1.07 - 11.95, p = 0.041)**
Previous macrosomic baby	**Yes**	**19.24 (2.74 - 396.73, p = 0.011)**
Fundal Height (cm)	37.0 (3.1)	0.87 (0.29 - 1.22, p = 0.569)
Weight Gain	≤16 kg	-
	>16 kg	**3.38 (1.80 - 6.54, p < 0.001)**
HIV	No	-
	Yes	**6.23 (1.18 - 49.42, p = 0.047)**
Parity	Primiparous	-
	Pauciparous	0.53 (0.23 - 1.18, p = 0.121)
	multiparous	**0.09 (0.03 - 0.23, p < 0.001)**
	Great multiparous	**0.30 (0.10 - 0.81, p = 0.019)**
Birth Weight (g)	4000 - 4500	-
	4500 et plus	**7.12 (1.61 - 40.52, p = 0.015)**
Foetal Height (cm)	**52.7 (1.7)**	**1.26 (1.03 - 1.56, p = 0.026)**

Bold: Significant associated covariates ($p < 0.05$); OR: Odd Ratio.

within this population of over 4000 g were those with over 4500 g and over 52.7 cm of height. Such thresholds have previously been described for weight [24], but data on height are wandering thus require more attention [25]. At last, the HIV factor found in this study should without doubt be linked to the therapies taken by HIV infected women; some of those drugs may induce metabolic effects, in particular disturbing the metabolism of carbohydrates and lipids. This could therefore suggest to reinforce metabolic monitoring of HIV infected pregnant women under antiretroviral therapy [26].

5. Conclusion

In conclusion, this study has identified the main risks associated with the complications of fetal macrosomia in our context. In terms of prevention, the data observed suggest strengthening prenatal monitoring of all pregnancies but also setting up a gestational screening program for diabetes; any excessive weight gain, especially over 16 kg, requires special attention. Although 3rd trimester ultrasound is not predictive of complications, the importance of fundal height measurement remains crucial. In short, it would be urgent, taking into account the data of this work, to revisit the recommendations for the management of childbirth in case of suspected fetal macrosomia, around the questions of induction of labor, elective caesarean section versus vaginal delivery, particularly at the threshold of 4500 g of presumed weight and an estimated fetal size of more than 52.7 cm.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Araujo Júnior, E., Peixoto, A.B., Zamarian, A.C.P., Elito Júnior, J. and Tonni, G. (2017) Macrosomia. *Best Practice & Research Clinical Obstetrics & Gynaecology*, **67**, 83-96. https://doi.org/10.1016/j.bpobgyn.2016.08.003

[2] Beta, J., Khan, N., Khalil, A., Fiolna, M., Ramadan, G. and Akolekar, R. (2019) Maternal and Neonatal Complications of Fetal Macrosomia: Systematic Review and Meta-Analysis. *Ultrasound in Obstetrics & Gynecology*, **54**, 308-318. https://doi.org/10.1002/uog.20279

[3] Koyanagi, A., Zhang, J., Dagvadorj, A., Hirayama, F., Shibuya, K., Souza, J.P., *et al.* (2013) Macrosomia in 23 Developing Countries: An Analysis of a Multicountry, Facility-Based, Cross-Sectional Survey. *The Lancet*, **381**, 476-483. https://doi.org/10.1016/S0140-6736(12)61605-5

[4] Biratu, A.K., Wakgari, N. and Jikamo, B. (2018) Magnitude of Fetal Macrosomia

and Its Associated Factors at Public Health Institutions of Hawassa City, Southern Ethiopia. *BMC Research Notes*, **11**, Article No. 888.
https://doi.org/10.1186/s13104-018-4005-2

[5] Djomhou, M., Sobngwi, E., Noubiap, J.J.N., Essouma, M., Nana, P. and Fomulu, N.J. (2016) Maternal Hyperglycemia during Labor and Related Immediate Post-Partum Maternal and Perinatal Outcomes at the Yaoundé Central Hospital, Cameroon. *Journal of Health, Population and Nutrition*, **35**, Article No. 28.
https://doi.org/10.1186/s41043-016-0065-x

[6] Nkwabong, E. (2014) Maternal and Neonatal Complications of Macrosomia. *Tropical Doctor*, **44**, 201-204. https://doi.org/10.1177/0049475514539479

[7] Wang, Y., Gao, E., Wu, J., Zhou, J., Yang, Q., Walker, M.C., Mbikay, M., Sigal, R.J., Nair, R.C. and Wen, S.W. (2009) Fetal Macrosomia and Adolescence Obesity: Results from a Longitudinal Cohort Study. *International Journal of Obesity*, **33**, 923-928.
https://doi.org/10.1038/ijo.2009.131

[8] Boulvain, M., Irion, O., Dowswell, T. and Thornton, J.G. (2016) Induction of Labour at or Near Term for Suspected Fetal Macrosomia. *Cochrane Database of Systematic Reviews*, **2016**, CD000938.
https://doi.org/10.1002/14651858.CD000938.pub2

[9] Quaresima, P., Visconti, F., Chiefari, E., Mirabelli, M., Borelli, M., Caroleo, P., *et al.* (2020) Appropriate Timing of Gestational Diabetes Mellitus Diagnosis in Medium- and Low-Risk Women: Effectiveness of the Italian NHS Recommendations in Preventing Fetal Macrosomia. *Journal of Diabetes Research*, **2020**, Article No. 5393952.
https://doi.org/10.1155/2020/5393952

[10] Ahounkeng, N.P., Mboudou, E.T., Adjoby, C.R., Rakotomalala, N.Z., Foumane, P., Dohbit, S.J., *et al.* (2014) Impact of Excessive Weight Gain during Pregnancy on Maternal and Fetal Outcome at the Yaoundé Women's and Children's Hospital (Cameroon). *Médecine et Santé Tropicales*, **24**, 63-67.
https://doi.org/10.1684/mst.2014.0290

[11] Luhete, P.K., Mukuku, O., Kiopin, P.M., Tambwe, A.M. and Kayamba, P.K.M. (2016) Fetal Macrosomia in Lubumbashi: Risk Factors and Maternal and Perinatal Prognosis. *The Pan African Medical Journal*, **23**, Article 166.
https://doi.org/10.11604/pamj.2016.23.166.7362

[12] Lei, F., Zhang, L., Shen, Y., Zhao, Y., Kang, Y., Qu, P., *et al.* (2020) Association between Parity and Macrosomia in Shaanxi Province of Northwest China. *Italian Journal of Pediatrics,* **46**, Article No. 24. https://doi.org/10.1186/s13052-020-0784-x

[13] Said, A.S., Manji, K.P. (2016) Risk Factors and Outcomes of Fetal Macrosomia in a Tertiary Centre in Tanzania: A Case-Control Study. *BMC Pregnancy Childbirth*, **16**, Article No. 243. https://doi.org/10.1186/s12884-016-1044-3

[14] WHO (2016) WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience. World Health Organization, Geneva.

[15] Ntsama Menanga Patricia. (2022) Screening of Gestational Diabetes in Cameroon, View Point. Oral Communication, 3rd Scientific Days of the Cameroon Society of Perinatal Medicine, Yaounde.

[16] Chiefari, E., Quaresima, P., Visconti, F., Mirabelli, M. and Brunetti, A. (2020) Gestational Diabetes and Fetal Overgrowth: Time to Rethink Screening Guidelines. *The Lancet Diabetes & Endocrinology*, **8**, 561-562.
https://doi.org/10.1016/S2213-8587(20)30189-3

[17] Breckenkamp, J., Razum, O., Henrich, W., Borde, T. and David, M. (2019) Effects of Maternal Obesity, Excessive Gestational Weight Gain and Fetal Macrosomia on the

Frequency of Cesarean Deliveries among Migrant and Non-Migrant Women—A Prospective Study. *Journal of Perinatal Medicine*, **47**, 402-408. https://doi.org/10.1515/jpm-2018-0399

[18] Tela, F.G., Bezabih, A.M., Adhanu, A.K. and Tekola, K.B. (2019) Fetal Macrosomia and Its Associated Factors among Singleton Live-Births in Private Clinics in Mekelle City, Tigray, Ethiopia. *BMC Pregnancy and Childbirth*, **19**, Article No. 219. https://doi.org/10.1186/s12884-019-2379-3

[19] Turkmen, S., Johansson, S. and Dahmoun, M. (2018) Foetal Macrosomia and Foetal-Maternal Outcomes at Birth. *Journal of Pregnancy*, **2018**, Article No. 4790136. https://doi.org/10.1155/2018/4790136

[20] Ezegwui, H.U., Ikeako, L.C. and Egbuji, C. (2011) Fetal Macrosomia: Obstetric Outcome of 311 Cases in UNTH, Enugu, Nigeria. *Nigerian Journal of Clinical Practice*, **14**, 322-326. https://doi.org/10.4103/1119-3077.86777

[21] Chen, Z.G., Xu, Y.T., Ji, L.L., Zhang, X.L., Chen, X.X., Liu, R., Wu, C., Wang, Y.L., Hu, H.Y. and Wang, L. (2020) The Combination of Symphysis-Fundal Height and Abdominal Circumference as a Novel Predictor of Macrosomia in GDM and Normal Pregnancy. *BMC Pregnancy and Childbirth*, **20**, Article No. 461. https://doi.org/10.1186/s12884-020-03157-7

[22] Pretscher, J., Kehl, S., Stelzl, P., Stumpfe, F.M., Mayr, A., Schmid, M., Staerk, C., Schild, R., Beckmann, M.W. and Faschingbauer, F. (2020) Influence of Sonographic Fetal Weight Estimation Inaccuracies in Macrosomia on Perinatal Outcome. *Ultraschall in der Medizin-European Journal of Ultrasound*, **80**, e86. https://doi.org/10.1055/s-0040-1717196

[23] Rizzo, G., Mappa, I., Bitsadze, V., Khizroeva, J., Makatsarya, A. and D'Antonio, F. (2021) The Added Value of Umbilical Vein Flow in Predicting Fetal Macrosomia at 36 Weeks of Gestation: A Prospective Cohort Study. *Acta Obstetricia et Gynecologica Scandinavica*, **100**, 900-907. https://doi.org/10.1111/aogs.14047

[24] Deruelle, P., Houfflin-Debarge, V., Vaast, P., Delville, N., Hélou, N. and Subtil, D. (2004) Maternal and Fetal Consequences of Increased Gestationnal Weight Gain in Women of Normal Prepregnant Weight. *Gynécologie Obstétrique & Fertilité*, **32**, 398-403. https://doi.org/10.1016/j.gyobfe.2004.02.018

[25] Valere, M.V., Etienne, B., Ndamba, E. and Marie, K.J. (2018) Macrosomic Newborn Anthropometric Parameters and the Mode of Delivery. *Gynecology & Obstetrics*, **8**, Article 1000490. https://doi.org/10.4172/2161-0932.1000490

[26] Asif, S., Baxevanidi, E., Hill, A., Venter, W.D.F., Fairlie, L., Masenya, M., Serenata, C., Sokhela, S. and Chandiwana, N. (2021) The Predicted Risk of Adverse Pregnancy Outcomes as a Result of Treatment-Associated Obesity in a Hypothetical Population Receiving Tenofovir Alafenamide/Emtricitabine/Dolutegravir, Tenofovir Disoproxilfumarate/Emtricitabine/Dolutegravir or Tenofovir Disoproxilfumarate/Emtricitabine/Efavirenz. *AIDS*, **35**, S117-S125. https://doi.org/10.1097/QAD.0000000000003020