The Relationship Between the Weight of the Placenta, Body Mass Index and Fetal Birth Weight Among Sudanese Women

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ABSTRACT
Introduction: Accurate estimation of fetal birth weight is essential for the management of labor and delivery. The predictability of fetal weights by clinical assessment and ultrasound is limited. Aim: The study aimed to evaluate the association between fetal birth weight and placental weight and other demographic characteristics. Methods: a total of 369 live born of a singleton term pregnancies (37 to 42 weeks gestations) were included in the study. Immediately after delivery, the placenta was weighed with cord and membranes. A linear regression was used to examine the effect of placental weight and other variables on fetal birth weight. Results: The mean of birth weight was 3122.5±477.8 grams. Placenta weight had a mean of 556.92±112.488 grams. The mean gestational age was 39.0543±.89642 weeks. The association between the placental weight and the birth weight was significant, and we found that for each gram increase in placental weight, birth weight is increased by 2.848g (SE = 0.178, p < 0.01). Similarly, there was a significant association between placental weight and fetal birth weight, and we found that for each kg increase in maternal weight, birth weight is increased by 17.018 g (SE = 5.281, p =0.001). Conclusion: Placenta weight and BMI are independent predictors of fetal birth weight. Keywords: birth weight, gestational age, maternal characteristics, placental weight.

1. INTRODUCTION
Continuous assessment of fetal weight is a pivotal part of antenatal care, especially during management of high-risk pregnancy such as diabetes. This is essential in the management of labor and delivery (1). Fetal birth weight is considered the single most important factors for newborn survival (2). It is essential to accurately assess fetal weight owing to the higher rate of complications that can arise from low and excessive fetal birth weight. Low birth weight is associated with increased risk of perinatal morbidity and mortality as a result of prematurity. For large babies, the potential risk is operative delivery, lacerations, postpartum hemorrhage, shoulder dystocia, brachial plexus injury, bone injuries, and intrapartum asphyxia (3).

There are many methods used to predict fetal birth weight including symphysis-fundal height (SFH), clinical, and ultrasonographic methods (4, 5). The predictive power of all these methods is limited, and in most cases, we used to diagnose macrosomic babies retrospectively. Further studies are important to improve our prediction of fetal weight. The estimation of the placental size and volume using ultrasound has been used to predict fetal birth weight. While several studies were conducted to examine this association, the predictive power remains equivocal and further studies are warranted to investigate this association. In the present study, we examined the association between placental weight, BMI and some demographic and obstetric characteristics and the fetal weight. This will help in making an appropriate decision for the management of the pregnant woman.
2. AIM
The study aimed to evaluate the association between fetal birth weight and placental weight and other demographic characteristics.

3. METHODS
This is a prospective cross-sectional study conducted at Omdurman Maternity Hospital (OMH) in the period from January to June 2019. OMH is a referral hospital for women who are referred from other health services centers and hospitals and women who live in close proximity to the hospital facility.

Sample size
A sample of 600 of women was selected to calculate the proportion of women with no medical or obstetrical complications within 3 percentage points of the true proportion, assuming the true proportion was 80% and that 10% of women would not respond.

Women with singleton pregnancy and willing to participate were enrolled in the study. Women with medical disorders e.g. hypertension, diabetes mellitus, thyroid disease, and renal were excluded from the study. After obtaining verbal informed consent from all participating women, relevant data was gathered using structured questionnaires. Data gathered included socio-demographics, medical and obstetric histories, antenatal attendance and total numbers of visits characteristics. After delivery, data gathered included fetal gestational age, mode of delivery, fetal weight, sex and placental weight. Body mass index was calculated by measuring maternal weight and height, which was expressed as weight (kg)/height (m)². Each Placenta, membranes and the cord were weighed on tabletop beam weighing scale after removing obvious blood clots.

Ethical approval
The study received ethical clearance from Sudanese Specialization Board committee and Omdurman Maternity Hospital (OMH) Ethics review board. All participants provide signed informed consent after explanation of the nature of the study.

Statistical Analysis
SPSS for Windows (version 20.0) was used for data analyses. Studied variables were described as means (M) and standard deviations (SD). Proportions of the studied groups were expressed in percentages (%). The difference of mean (SD) of the birth weight was compared between two groups using a T-test. Linear regression analyses were performed with birth weight as the dependent variable and socio-demographic parameters (age, parity, occupation, and residence), hemoglobin, gestational age, maternal BMI were the independent variables. P < 0.05 was considered statistically significant.

4. RESULTS
A total of 369 live born singleton term pregnancies (37 to 42 weeks gestations) were included in the study, 121 (32.8%) were primiparae, 183 (49.6%), were multiparous and 65 (17.6%) were gradmultiparous women. Of the total, 28 (7.6%) had no formal education, while the majority 201 (54.4%) received intermediate education and 140 (37.9%) had higher education and 125 (33.9%) had rural residency.

Of all cases, 337 (91.3%) had attended the antenatal care and only 101 (27.4) of them had adequate ANC. Cesarean section rate among the study group was 20 (5.4%) and 173 (46.9%) of fetuses were males as shown in Table 1.

The mean maternal age was 28.08±5.681, ranged 16 to 40 years with the mean number of deliveries of 2.50±2.199 deliveries. The mean gestational age, placental weight fetal birth weight, and BMI were 39.0543±.8964 weeks,
with birth weight (Table 3). Fetal macrosomia. Since the concept of the developmental factors can be taken to address those predictors to prevent the predictors of fetal birth weight so that timely intervention for each other.

The birth weight range was 2000–5050 g and the mean (SD) was 3122.4(477.0) g, while the 10th and 90th centile was 2500 and 3600 g, respectively. There was no significant difference in the birth weight between male (n=185, 3139.3 (507.0) g) and female (n=184, 3110.3 (447.0) g, P= 0.561) newborns. The birth weight of newborns born to primiparas (n=121) was significantly lower compared with birth weight of newborns born to multiparous mothers (248) [3010.7 (415.0) g vs. 3177.0 (497.0) g, P= 0.022].

In linear regression, BMI (13.945g, P=0.006) and placental weight (2.98g, P<0.001) were significantly associated with birth weight (Table 3).

5. DISCUSSION

In this study, we tried to evaluate the association between fetal birth weight and different maternal demographic parameters including maternal age, parity, and hemoglobin level, and occupation, age number of antenatal visits, fetal gender, and placental weight. We took all the demographic factors as predictors and tried to see their association with fetal birth weight as the measured outcome.

In linear regression, fetal weight was significantly predicted by placental weight (p=0.000) and BMI (p=0.001). There was no association between fetal weight and maternal age, education, residence, occupation, number of ANC visits, parity, hemoglobin level, gestational age and fetal gender (r>0.05) as shown in Table 3. Therefore placental weight and maternal BMI were significant predictors of fetal weight at birth.

Increased birth weight (macrosomia) where the fetal weight is above 4500 grams is associated with adverse fetal outcome leading to shoulder dystocia ending up in Erb’s palsy, humerus or clavicular fractures and birth asphyxia (5, 6). In short fetal birth weight is associated with adverse obstetrical outcome both in term of maternal and fetal morbidity (7). Long-term consequences of fetal macrosomia include preponderance to obesity, heart disease and diabetes (8). Therefore it is important to investigate the predictors of fetal birth weight so that timely intervention can be taken to address those predictors to prevent the fetal macrosomia. Since the concept of the developmental origin of the disease has been in place and we know that in utero programming of genes is responsible for metabolic diseases in life later on (8). The scientists are struggling to search for predictors of fetal birth weight. In a meta-analysis conducted by Laura et al 214,385 babies were born large for gestational age (fetal weight above 90th centile) and out of these 36,295 were born to obese mothers thereby 22.4% mothers gave birth to large for dates babies. When obesity and macrosomia group (fetal weight above 4000 grams) was compared 15.8% of obese mothers gave birth to babies weighing 4000 grams (9). This meta-analysis included regions of North America and Europe. There was a paucity of literature in studying obesity and fetal weight from Africa, therefore, our study will add further to the scientific publication from our part of the world and results are consistent with the results from advanced countries. This indicates that obesity irrespective of geographic distribution is a strong predictor of fetal weight.

The placenta is the interface between mother and fetus from where all nutrients have to pass through to the fetus as well as metabolic excretions has to revert back to mother. Therefore it plays a major role in fetal growth and development and it can be an independent predictor of fetal condition. Placental weight has been used as a tool to predict placental health and Roseboom et al have reported that placental weight was low in children born in Dutch famine areas and their nutrition was impaired (10). As described by many other studies that maternal factors like weight and nutrition affect fetal growth similarly placental weight can determine the fetal health (11, 12). Placental weight is found to be poor in growth restricted fetuses (13). Changes in maternal diet seen in famine and Ramadan (fasting month for Muslims) has shown a reduced size of placenta along with the reduced fetal size (10, 14). In short maternal factors determine the placental weight and placental weight is a predictor of fetal weight (11). Our results are in line with the STROK study from the Scandinavian population which uses the linear regression model and found placental weight as a predictor of birth weight (11). The present study showed no significant differences in fetal birth weight between male and female, this finding is inconsistent with previous report which can be explained by the relatively small sample size. Also the study showed that primiparous women had a significantly lower birth weight compared to multiparous mothers which is consistent with previous report (15).

6. CONCLUSION

Fetal birth weight depends upon maternal BMI as well as Placental weight. Optimizing maternal obesity and dietary factors to optimize placental weight can help in optimizing fetal birth weight. Future researches are warranted to investigate this association.

Our study has the strength of being conducted in the African region where dietary factors are different from Western regions but supplemented the results of Western regions and America highlighting that obesity is an independent predictor of fetal birth weight. We have the limitation of being conducted in a single hospital facility but given the good power (80%) we conclude that results can be generalized to the whole region.
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