

Association between maternal undernutrition among Sudanese women and newborn birth weight

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ABSTRACT

Background: Maternal undernutrition is a major health problem in developing countries. It is associated with maternal and perinatal morbidity, such as low birth weight (LBW), as well as mortality. This study aimed to investigate the effect of maternal undernutrition among pregnant women in Sudan on newborn birth weight. **Methods:** This was a cross-sectional study carried in the labor ward of Medani Maternity Hospital in central Sudan between June and December 2019. Data on the mothers' sociodemographic and obstetrics characteristics were collected through a questionnaire. Anthropometric measurements were obtained following standard procedures for both mothers and newborns. Linear logistic regressions were used to assess factors associated with birth weight. **Results:** Three hundred thirty-nine pairs of pregnant women and their newborns were enrolled in the study. Half of the women were primiparas ($n = 170$, 50.1%). The birth weight range was 1,330–4,640 g, and the mean (standard deviation (SD)) was 3,029.4 (613.0) g. The 10th and 90th centiles were 2,450 and 3,790 g, respectively. There was no significant difference in the birth weights of male ($n = 160$, 3,086.2 614.0 g) and female ($n = 179$, 2978.6 611.0 g; $P = 0.107$) newborns. In the linear regression, parity (43.1, $P = 0.045$), mid-upper arm circumference (MUAC) (39.3 cm, $P = 0.001$), gestational age (75.6 weeks, $P = 0.017$), and body mass index (BMI) (0.4 kg/m², $P = 0.006$) were significantly associated with birth weight. There was no significant association between age, employment, a history of miscarriages, antenatal care, sex of the newborn, interpregnancy interval (IPI), and birth weight. **Conclusion:** The main finding was a significant association between parity, gestational age, MUAC, BMI, and birth weight.

Keywords: Birth weight, pregnancy, Sudan, undernutrition

Background

It has been estimated that there are annually over 20 million low birth weight (LBW; <2,500 g) deliveries, with the vast majority of these being in low- and middle-income countries.^[1] LBW is the leading cause of neonatal mortality, and it has implications for childhood neurological, metabolic, and physical development.^[2] As part of its global nutrition targets, the World Health Organization (WHO) has set a goal of a 30% reduction in the incidence of LBW by 2025.^[1] Several factors,

such as a low education level, low income, and occupational, are associated with LBW.^[3,4]

Maternal malnutrition/undernutrition is one of the most important modifiable risk factors for impaired fetal growth. Nutrition plays a fundamental role in the health of a pregnant woman and the growth of the fetus, and poor nutrition can lead to poor neonatal and fetal outcomes.^[5] Maternal undernutrition is a problem in developing countries.^[6] The prevalence of undernutrition among pregnant African women was reported to be 23.5%.^[7] Moreover, it has been estimated that up to 20% of African women of reproductive age are undernourished.^[5,8,9] Maternal undernutrition among pregnant Sudanese women was reported to be 12.5% from a recently published study.^[10]

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Assessing micronutrient deficiencies is technically difficult and costly. Anthropometric measurements can be used to assess malnutrition. Both body mass index (BMI) and mid-upper arm circumference (MUAC) are used for nutritional assessments. MUAC is one of the best tools for measuring the nutritional status of pregnant women.^[11,12] Several studies have assessed the association between birth weight/LBW and maternal undernutrition in African countries.^[13-15] However, there are no published data on the association between maternal undernutrition and newborn birth weights in Sudan. This study aimed to assess if maternal undernutrition is associated with the birth weights of newborns in Sudan.

Materials and Methods

This cross-sectional study was conducted in Medani Maternity Hospital, Sudan between June and September 2019. This study was approved by the research and ethics committee of the Department of Obstetrics and Gynecology, Faculty of Medicine, University of Gezira. All the participants volunteered to take part in the study, and all the participants signed an informed consent form.

Only women with singleton pregnancies were included in the study. Women with diseases (diabetes mellitus, hypertension, or any other chronic disease) known to influence birth weight, women with multiple pregnancies, women with intrauterine fetal death, and severely ill pregnant women were excluded from the study.

Trained medical officers collected sociodemographic and obstetric history data via an interview and a structured questionnaire. Age, parity, gestational age, antenatal attendance, education level, a history of miscarriages, occupation, hemoglobin level, and MUAC were recorded.

Anthropometric measurements were obtained following standardized techniques. Newborns were weighed within 1 h after delivery. The MUAC of the mother was measured after delivery using a flexible non-stretchable standard tape measure. The circumference was measured at the mid-point between the tip of the acromion process of the scapula and the olecranon process of the ulna. The right arm was used to measure the MUAC, and the measurement was recorded to the nearest 0.1 cm. Hemoglobin was determined using an automated hematology analyzer according to the manufacturer's instructions (Sysmex, KX-21, Japan). A Salter scale, which was checked for accuracy on a daily basis, was used to weigh the newborns immediately following birth to the nearest 10. The gender of each newborn was recorded.

A sample of 339 pairs of women and their newborns with completed data was calculated to have a significant minimum difference^[16] in the correlations ($r = 0.15$) between birth weight and the other variables, including BMI and MUAC. This sample would have an 80% power and a difference of 5% at $\alpha = 0.05$.

The data were analyzed using the Statistical Package for the Social Sciences, version 22 (SPSS Inc.). Continuous variables, including BMI and MUAC, are presented as the mean and standard deviation (SD). Categorical variables are presented as frequencies and proportions. Multicollinearity was checked for and was not detected (multicollinearity variance inflation factor of <4). Linear regression analyses were performed with birth weight (continuous variable) as the dependent variable, and clinical data and obstetrics data (age, parity, employment, education, interpregnancy interval (IPI), antenatal care, MUAC, BMI, hemoglobin, gestational age, and newborn gender) as the independent variables. A two-sided P value of < 0.05 was considered statistically significant.

Results

Three hundred thirty-nine pairs of pregnant women and their newborns were enrolled in the study. Half of these women were primiparas (170/50.1%). The majority of the women were housewives (308/90.9%). Over one-third (135/39.8%) of the women had a secondary level of education or higher. More than two-thirds of the participants (235/69.3%) had attended three or more antenatal visits. Fifty-three (15.6%) of the women had a history of miscarriages.

The birth weight range was 1,330–4,640 g (mean SD: 3,029.4 613.0 g). The 10th and 90th centiles were 2,450 and 3,790 g, respectively. Thirty-three (9.7%) of the newborns were small for gestational age, and an equal number was large for gestational age.

There was no significant difference in the birth weights of the male ($n = 160$, 3086.2 614.0 g) and female ($n = 179$, 2,978.6 611.0 g) ($P = 0.107$) newborns. The birth weights of newborns of primiparous mothers were significantly lower than those of newborns of multiparous mothers (2,902.2 654.0 g vs. 3,157.3 542.0 g, $P < 0.001$).

In the linear regression, parity (43.1, $P = 0.045$), MUAC (39.3 cm, $P = 0.001$), gestational age (75.6 weeks, $P = 0.017$), and BMI (0.4 kg/m², $P = 0.006$) were significantly associated with birth weight. There was no significant association between age, employment, a history of miscarriages, antenatal care, gender, IPI, and birth weight [Table 1].

Discussion

LBW is a global public health problem, especially in developing countries like Sudan. According to the WHO, LBW is defined as a birth weight of less than 2,500 g, regardless of the gestational age. Despite substantial efforts to lower LBW rates, little success has been made in this regard, mainly due to the multifactorial nature of the problem and complex determinants of LBW. Research is urgently needed to achieve the WHO's target to reduce LBW by 30% by 2023. LBW is one of the most important factors affecting the viability of the newborn and is associated with high rates of morbidity, as well as mortality. This places a major burden on health, education, and social services, as well as on families.

Table 1: Factors associated with birth weight

Variables	Coefficient	Standard error	P
Age, years	1.37	8.8	0.877
Parity	43.1	21.2	0.045
History of miscarriage	-155.3	99.4	0.120
Education level $\geq$ secondary	37.9	117.8	0.748
Employee	127.3	187.9	0.499
Antenatal care (3 or more visits)	109.0	104.8	0.300
IPI, months	-0.2	2.1	0.907
MUAC, cm	39.3	11.4	0.001
Gender	-161.7	83.8	0.056
Gestational age, weeks	75.6	31.3	0.017
Hemoglobin, g/dL	10.6	37.8	0.779
BMI, kg/m ²	0.4	0.145	0.006

The main finding of the current study was the association of birth weights with parity (43.1, $P = 0.045$), gestational age (75.6 weeks, $P = 0.017$), MUAC (39.3 cm, $P = 0.001$), and BMI (0.4 kg/m², $P = 0.006$). Several studies have demonstrated the influence of parity on LBW.^[17-19] In a previous study, grand multiparity (i.e., ≥ 5 pregnancies) was associated with reduced birth weight.^[13]

In a previous study, both a low MUAC (relative risk (RR) = 1.60) and low BMI (RR = 1.49) were associated with LBW. Moreover, a low MUAC or a low BMI was significantly associated with an increased risk of preterm birth. In a 2011 meta-analysis, underweight women had an increased risk of LBW (RR = 1.64).^[14] Thus, adequate maternal nutrition is essential for fetal growth.^[5]

There is sufficient evidence in the literature that maternal nutritional status both before and during pregnancy is linked to the pregnancy outcome in terms of newborn birth weight. Maternal nutritional status is reflected by the BMI. For females, a BMI of 18.5 or less denotes being underweight. MUAC corresponds well with the BMI, and it has been used in some studies as a measure of maternal nutritional status.^[20] However, as noted in a previous study, optimum cutoff values are lacking.^[14] Gestational weight gain is as important and has been used by researchers to predict newborn weight.

In the present study, antenatal care was cross-tabulated and found to be an insignificant factor affecting LBW. This may be explained by the antenatal care provided, with nearly 70% of the participants attending three or more antenatal visits. This result was in accordance with that of a WHO study in Mexico.^[21] In the study, women with a sufficient number of antenatal care visits had lower odds of having a baby with LBW than women with fewer than three visits.^[21] This result and those of similar studies in the literature reinforce and emphasize the importance of regular high-quality supervision during pregnancy. Healthcare physicians had a vital role in counseling women regarding their dietary practice during pregnancy. Healthy food leaflets and health education supplied by physicians can reduce the incidence of LBW.

Conclusion

The main finding of the current study was the significant association between parity, gestational age, MUAC, BMI, and birth weight.

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Conflicts of interest

There are no conflicts of interest.

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