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Research Article

The effect of maternal pregnancy body mass index as a measure of pregnancy weight gain on neonatal birth weight in Maiduguri metropolitan council of Borno state, Nigeria.

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ABSTRACT

Aim: **The effect of maternal pregnancy body mass index as a measure of pregnancy weight gain on neonatal birth weight outcome in the labor ward of the University of Maiduguri Teaching Hospital.**
Methods: **One hundred and four mother-neonatal pairs were selected using systematic random sampling method. Maternal pregnancy body mass index was calculated from maternal weight and height using the formula maternal body weight divided by the square of maternal height in kilogram/meter square (kg/m^2), and neonatal birth weight was assessed using the bassinet weighing scale. Chi-square test of association was used to investigate the effect of maternal pregnancy BMI on neonatal birth weights.**
Results**: There were 55 (52.9 %) males and 49 (47.1 %) females. The male to female ratio is 1.1:1. The mean (SD) neonatal birth weight was 3.02 (0.58), 95 CI (2.91 - 3.14), whereas the mean (SD) maternal pregnancy body mass index was 23.69 (4.33), 95 CI (22.84 - 24.53). Association between neonatal birth weight and maternal body mass index was not significant ($\chi^2 = 0.974$, $p = 0.614$) in this study.**
Conclusion: **Our work has demonstrated that maternal pregnancy BMI may not contribute significantly to birth weight outcome of neonates. However, further research in this regard is hereby recommended.**

Keywords: Maternal body mass index, neonatal birth weights, Mother-neonatal pairs, Maiduguri, Nigeria.

INTRODUCTION

The increase in body mass index (BMI) among pregnant women worldwide has become one of the most significant public health concerns (Yazdani et al., 2012). Kelly et al in (1996) have discovered that maternal anthropometry including BMI varies across different populations of the world. They found that women from ethnic groups characterized by small body size have been reported to gain less weight on average during pregnancy than larger women. In 2012, Yadzani et al, however, established an inverse relationship between maternal BMI and weight gain during pregnancy. For women with a pregnancy BMI < 19.9 kg/m^2, they could have a weight gain of 12-18.5 kg; those with a pregnancy BMI of 19.8-24.9 kg/m^2 might have a weight gain of 11.5-16 kg; and those with a BMI of ≥ 25.0 might have weight gain of 7- 11.5 kg. Neonatal birth weight is an important determinant of infant's well being,

and maternal BMI during pregnancy is one modifiable factor influencing neonatal birth weight outcome (Upadhyay et al., 2011). In 2007, Berghoft et al published that high maternal BMI is related to neonatal macrosomia. Low maternal BMI during pregnancy is long recognized risk factor for delivery of neonates with low birth weight (LBW).
Vast literature search revealed that studies on the relationship between maternal BMI during pregnancy and neonatal birth weight outcome were carried out in advanced societies mostly. Understanding the influence of maternal pregnancy, BMI as a measure of maternal weight gain on neonatal birth weight outcome is important in developing society like Maiduguri, where dearth of information on this subject matter exist. The aims of this study were threefold: 1) To determine maternal pregnancy weight and height at term at the labor ward of University of Maiduguri Teaching Hospital (UMTH). 2) To estimate the birth weight of neonates delivered to these mothers. 3) To assess the effects of maternal BMI on neonatal birth weight. To our knowledge, no such study was performed before in Maiduguri, Borno State.

MATERIALS AND METHODS

Study Area

The study was carried out at the Department of Paediatrics, and Obstetrics unit of the UMTH, Nigeria. Apart from being the largest health facility in the area, UMTH serves as a referral centre for the six Northeastern states and neighboring countries of Chad, Cameroon and Niger Republics.

Ethical Considerations

The study protocol was reviewed and authorised by the Medical Research and Ethics Committee of the UMTH. The approval was on the agreement that patient anonymity must be maintained, best clinical practice be ensured, and that every finding would be treated with utmost confidentiality and for the purpose of this research only. All work was performed according to the international guidelines for human experimentation in clinical research (World Medical Association Declaration of Helsinki, 2000).

Sampling Technique/Study Population

The minimum sample size was determined using a statistical formula that compares mean (SD) of BMI of pregnant mothers in two different communities at effect size of 0.2, alpha levels of 0.05 and power of 80% (Upadhyay et al., 2011; Browner, 2001). However, 30% of the calculated minimum sample was added to maximize power. Therefore, the sample size for this study was one hundred and four mother-neonatal pairs. A pregnant woman was eligible for participation in the study at the labor ward of UMTH before delivery and met the following study inclusion criteria: (i) had an uncomplicated singleton birth at term based on Eregie estimate for gestational age or Naegale's rule (Eregie 1991 and Basket et al., 2000). (ii) had no known underlying chronic illness and not on drugs other than the ones used for routine antenatal care. Mothers who smoke cigarette and drink alcoholic beverages or coffee were also excluded from this study. Mother-neonatal pairs were enrolled in this study using the systematic random sampling method where the first of every four mother-neonatal pairs were picked at the labor ward. Where the first mother-neonatal pair did not fulfil the inclusion criteria above, the immediate next mother-neonatal pair that qualified was selected.
On enrolment of the mother-neonatal pairs, study proforma were administered to the mothers to collect information on their bio-data, pregnancy history and antenatal care history. Information was also obtained on the delivery outcome which included the sex of the neonates. The birth weight of the neonates in kilogram was determined using the bassinet weighing scale which has a sensitivity of 50 grams.

Maternal BMI was calculated from maternal weight and height using the formula maternal body weight divided by the square of maternal height in kilogram/meter square (kg/m^2) (Yazdani et al., 2012; and Upadhyay et al., 2011). Maternal weight and height were measured using Salter weighing scale and stadiometer in Kilogram (kg) and metre (m) respectively. Maternal BMI was categorized into three sub groups as follows: 1) Low: BMI $\leq$ 19.9 kg/m^2, 2) Normal: BMI of 20-24.9 kg/m^2, 3) High: BMI $\geq$ 25 kg/m^2 ((Yazdani et al., 2012).

Statistical Analysis

Means and standard deviations (SD) were calculated for neonatal birth weight, maternal BMI, maternal weight and height. The 95% confidence intervals of the means were calculated as described by Hanley et al, in 1982. Chi-square test of association was used to investigate the effect of maternal pregnancy BMI on neonatal birth weights. Statistical analysis was performed using statistical package for social science (SPSS) statistical software version 16, Illinois, Chicago, USA. Statistical significance was defined as a p value <0.05. Tables were used for illustrations.

RESULTS

A total of 104 mother-neonatal pairs participated in this study. There were 55 (52.9 %) males and 49 (47.1 %) females. The male to female ratio is 1.1:1. Majority of the neonates 90 (86.5 %) had acceptable birth weight (Table 1).

Table 1: Birth weight and sex distribution of the neonates

Neonatal birth weight (kg)	Male n (%)	Female n (%)	Total n (%)
LBW (< 2.5)	8 (7.7)	6 (5.8)	14 (13.5)
ABW (≥ 2.5)	47 (45.2)	43 (41.3)	90 (86.5)
Total	55 (52.9)	49 (47.1)	104 (100)

LBW = Low birth weight, ABW = Acceptable birth weight

Table 2 revealed the distribution of neonatal birth weight, maternal body mass index, maternal weight and height. Overall mean neonatal birth weight was 3.02 (0.58), 95 CI (2.91 - 3.14).

Table 2: Distribution of neonatal birth weight, maternal body mass index, maternal weight and height of the study population

Parameters	Mean (SD)	95 % Confidence Interval
Neonatal birth weight (kg)	3.02 (0.58)	2.91 - 3.14
Maternal body mass index (kg/m^2)	23.69 (4.33)	22.84 - 24.53
Maternal weight (kg)	63.39 (12.59)	60.95 - 65.84
Maternal height (m)	1.63 (0.05)	1.62 - 1.64

Table 3 shows neonatal birth weight profile and maternal body mass index of the subjects. Association between neonatal birth weight and maternal body mass index was not significant ($\chi^2 = 0.974$, $p = 0.614$).

Table 3: Association between neonatal birth weight and maternal body mass index

Mat BMI (kg/m^2)	Neonatal birth weight (kg) LBW < 2.5			ABW ≥ 2.5		
	n (%)	mean (SD)	(95 CI)	n (%)	mean (SD)	(95 CI)
Low (≤ 19.9)	2 (1.9)	18.2		11(10.6)	16.9 (1.2)	16.1-17.8
Normal (20-24.9)	6 (5.8)	21.8 (0.8)	20.9-22.7	51(49.0)	22.3 (1.2)	21.9-22.7
High (≥ 25)	6 (5.8)	27.9 (1.6)	26.2-29.5	28 (26.9)	28.8 (3.4)	27.4-30.1

LBW = Low birth weight, ABW = Acceptable birth weight, MAT =Maternal, BMI = Body mass index

DISCUSSION

The mean birth weight of neonates and mean maternal pregnancy BMI in present study were within acceptable limits. This was comparable to findings in Sherpa and Tamang communities of Nepal (Upadhyay et al., 2011). However, Thorsdottir et al. (2002) have observed that neonatal birth weight and maternal BMI were remarkably elevated in Iceland. Dissimilarity between our findings and that in Iceland could have been from the fact that our study was conducted in a population resident in developing country, whereas, that in Iceland is from developed society. Developed communities have better health care, social services and low poverty rates compared to developing countries. As such, there may be lower rates of infections, hunger and malnutrition in populations resident in developed countries. The result of which could be increase prevalence of high maternal BMI that could lead to increased neonatal birth weight outcome.

Maternal pregnancy BMI did not significantly contribute to the birth weight of neonates in current study. Similar observation was made by researchers elsewhere (UshaKiran et al., 2005). Many colleagues have also argued that neonatal birth weight is favored greatly to a point of having macrosomic neonates in obese mothers mostly (Brennand et al., 2005). Their argument could be seen to further buttress our observation in recent study. In another study, maternal pregnancy BMI was found to have strong association with birth weight of neonates in Asia (Upadhyay et al., 2011). Variation of observations in the latter study and that of the present study could be due to differences in study design because Landmann et al. in (2006) have suggested a BMI cut off point of 23.0 for obesity in Asian populations. One reason that could be offered for this would possibly be due to the small build of individuals found in the Asian continent. The above BMI set point for obesity is lower than the standard value that is applied for most population worldwide. Therefore, research findings of this nature may differ in many parts of the world due to lack of uniform standards of importance is that parental genetic factors are the greatest contributors to neonatal birth weight (Johnston et al., 2002). This was made evidence from epidemiological studies which estimated that environmental influences accounted for about 25% birth weight variance and genetic influences accounted for 38–80% birth weight variance (Johnston et al., 2002). Overall there is strong evidence that genetic factors play a significant role in determining birth weight of neonates.

The present study had some limitations. For example, this study was performed in the UMTH and does not cover all hospitals in Maiduguri, which may affect the external validity of the findings. In addition, the study sample was not homogeneous with regard to age, education and socio-economic status. All these factors may impact quality of life and maternal pregnancy BMI and, hence, the study results. We suggest to future researchers to consider other effective factors besides maternal BMI such as both parental anthropometry and placental ratio in future studies.

CONCLUSION

This research demonstrated that maternal pregnancy BMI did not contribute significantly to neonatal birth weight outcome of our subjects. Clinicians and public health policymakers should not place undue expectations that maternal pregnancy BMI will have a large beneficial impact on the birth weight outcome of neonates.

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