ORIGINAL ARTICLE

Effects of Maternal Obesity on Fetal Weight and Obstetric Outcomes in an African Population

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Received: October 13th, 2016
Accepted: February 15th, 2017

DISCLOSURE
There was no conflict of interest or financial support

ABSTRACT

Background: Maternal weight is one of the factors that influence obstetric outcome. Women therefore should enter pregnancy with a weight within the normal body mass index category, and stay within the recommended gestational weight gain guidelines for optimal outcome. The limited data on maternal obesity and its contribution to obstetric outcomes especially in the developing societies provoked the interest in this survey.
Objective: To determine the prevalence of first trimester maternal obesity, pattern of gestational weight gain and investigate the effects of maternal obesity on maternal and perinatal outcomes.
Methodology: This was a case control study of 282 pregnant women at a second tier missionary hospital in Southern Nigeria between 1st July 2009 and 30th June 2014. EPI INFO software was used for analysis with statistical significance set at $P<.05$.
Results: The prevalence of first trimester maternal obesity in this population was 28.2%. The obese mothers weighed more at booking and at term, had less gestational weight gain (8.2% vs. 19.3% and less body mass index (8.3% vs.19.6%). They were significantly older (t=5.8, P < 0.001), of higher parity (t=4.2, P <0.001) and had more gestational hypertension (OR 3.03, P <.003), caesarean births (OR 2.4, P <0.01), heavier neonates (P<0.001) and fetal macrosomia (OR 6.33, P<0.003).
Conclusion: Maternal obesity is a significant burden in Nigeria and is associated with excessive fetal weight with consequent adverse maternal and fetal outcomes. Quality preconception and prenatal intervention targeting optimal maternal weight is proffered.

Keyword: *Gestational weight, Feto-maternal, Complications, Perinatal, Nigeria*

INTRODUCTION

Obesity, once a problem of industrialized societies is fast becoming a global public health concern affecting all races, genders and ages. Maternal weight remains one of the main determinants of the obstetric outcome.[1] Pre-pregnancy Body Mass Index (BMI) is considered an independent predictor of many pregnancy outcomes. Women therefore should enter pregnancy with a weight within the normal body mass index category for optimal outcome. This is the reason for the routine maternal weight measurement in prenatal care to screen for maternal obesity and excessive gestational weight gain. The prenatal care should target gestational weight gain within the recommended guidelines.

Maternal obesity poses a significant and growing challenge to the obstetric world. It is associated with increased risk of maternal, fetal, childhood and adult obesity with its consequent health challenges. In pregnancy, there are increased maternal complications like postpartum weight retention, unplanned primary caesarean section rate, gestational hypertension, gestational diabetes mellitus, chronic hypertension and type 2diabetes mellitus (DM).[1] The fetus has increased risks of excessive weight(large for gestational age and macrosomia), congenital malformation and stillbirth.

Later in life, there is also increased risk of offspring obesity, cardiac diseases and DM.[1] Today, lifestyle characterized by high consumption of cheap high calorie low nutritional foods and physical inactivity is increasing worldwide ; these are keys to the development of obesity. To many, obesity, a malnutrition state, is erroneously a sign of affluence. Obesity is a maladaptive state and its associated pathology is due to increase of adipose tissue beyond the tolerable functional range.[2]

It is evident that racial and ethnic factors affect Gestational Weight Gain (GWG) with African Americans most likely to be overweight pre-pregnancy, have excessive gestational weight gain and are more likely to retain weight gained postpartum. White women are most likely to have target weight gain, Hispanic women are least likely to have target weight gain and Asian women more likely to gain less than the recommended weight.[3]

There is dearth of data on maternal obesity and its contribution to obstetric outcomes in most developing societies especially sub Saharan Africa, including Nigeria. This study was therefore designed to explore the pattern of maternal weight in early pregnancy, GWG at term and impact of maternal obesity on the feto-maternal outcome in Nigerian women.

The data generated is hoped to add to the increasing body of knowledge on maternal obesity, contribute to the redesigning and provision of prenatal care aimed at optimizing gestational weight for the best obstetric outcomes in the contemporary obstetric practice, prevent maternal obesity, its immediate and long term effects.

METHODOLOGY

This was a case-control analytical observational study that took place at St Philomena Catholic Hospital Benin City Edo state, Southern Nigeria between 1st July, 2009 and 30th June, 2014. Benin City is the capital city of Edo state, located in oil rich Niger delta region of Nigeria. It is a residence to multiethnic groups who are predominantly civil servants and traders. The hospital is a 120 bedded missionary hospital located at the center of Benin City.

Eligibility criteria were booking status in first trimester, singleton pregnancy and no previous caesarean delivery. For each

eligible obese mother (BMI ≥30 kgm^{-2}) at booking in 1st trimester selected as the study group, the next mother with a normal BMI (18.5-24.9kgm^{-2}) in 1st trimester who met the selection criteria was recruited as a control.

Pre-pregnancy or its approximate maternal first trimester BMI has been considered the most appropriate for gestational weight investigations.[1] Body mass index is body weight in kilograms per square meter height. It is an index for categorizing or assessing underweight, overweight and obesity. The GWG in the 1st trimester is insignificantly 0.5-2kg low compared with the remaining gestational period.[4] The BMI categories according to World Health Organization (WHO) cut-off points were used for this study.[5]

In all, a total of 141 eligible obese mothers and 141 corresponding control were recruited. The relevant socio-demographic details of the subjects were noted. The weight of each subject at the last prenatal visit at term was noted. The mean absolute weight and mean BMI of each category at term was calculated and compared for differences of absolute gestational weight, BMI and gestational weight gain at term. Selected dependent variables; maternal gestational weight gain, Caesarean Section (CS) rate, neonatal birth weight (BWT), gestational diabetes mellitus, gestational hypertension, type and outcome of labor were compared between the two subgroups. Social stratification as propounded by Olusanya *et al.* was used in this study.[6] For the purpose of this study, social classes I and II will be the upper class, class III the middle class while classes IV and V formed the lower class.

The cases of elective caesarean section, preterm births (deliveries before 37 completed weeks of gestation from the first day of the last normal menstrual period), previous CS, booking after first trimester, unbooked status and multiple pregnancies were excluded from the study.

The data was fed into a prepared EPI INFO spreadsheet and the statistical analysis was done using the Fisher's exact test, Instat statistical packages and contingency table as appropriate for statistical tests. Student t-test was used for the comparison of the means. The statistical association of the variables was assessed as Odd Ratio (OR) using the Fisher's exact test since some of the cells were <5. Univariate analyses of continuous variables were presented as frequencies, percentages, means, standard deviations and range. All statistical tests were two-sided and considered statistically significant at $p < .05$ or 95% Confidence Interval (CI) values excluding the nullity of one.

RESULTS

A total of 3740 women had their prenatal care and delivery at the center within the reviewed period. Six hundred and seventy one (17.9%) of this number commenced their prenatal care in the first trimester

One hundred and eighty nine of the 671 (28.2%) of the women who commenced their prenatal care in the first trimester had BMI ≥30kg/m^2.

Table 1 shows the socio-demographic characteristics of the subjects. The mean age of obese mothers was 30.1±4.0 years with a range of 20-41 years and the corresponding values for the normal weight group were 27.3± 4.1 and 17-42 years respectively (t=5.8, P<0.01).The mean age difference of 2.8 years was statistically significant. The mean parity of the study group was 1.14± 1.5 with a range of 0-9 while the corresponding values for the control group were 0.48±1.1 and 0-7 respectively (t=4.2, P <.01).

Table1. Socio-demographic characteristics of subjects N=282

Characteristic	Variable	Obese	Normal	Odd Ratio	*P*-value
		n=141(%)	n=141(%)		
Age	</=19	0	3(2.1)	-	-
	20-24	11(7.8)	28(19.9)	0.34(0.16, 0.72)	0.01
	25-29	53(37.6)	73(51.8)	0.56(0.35, 0.90)	0.02
	30-34	60(42.6)	32(22.7)	2.52(1.51, 4.23)	0.01
	=/>35	17(12.0)	5(3.5)	3.73(1.34, 10.41)	0.01
Mean age (yrs)		30.1±4.0	27.3±4.1	-	<.01
Parity	0	69(48.9)	104(73.8)	0.34(0.21, 0.56)	<.01
	1-2	44(31.2)	31(22.0)	1.61(0.94, 2.75)	0.11
	3-4	25(17.8)	4(2.8)	7.38(2.5, 21.83)	<.01
	≥5	3(2.1)	2(1.4)	1.51(0.25, 9.19)	1.00
	Mean	1.14±1.5	0.48±1.1	-	<.01
Marital status	married	141	141	-	-
Education	≤Secondary	51(36.2)	45(31.9)	1.21(0.74, 1.98)	0.53
	>Secondary	90(63.8)	96(68.1)	0.83(0.51, 1.36)	0.53
Social class	Upper	82(58.2)	92(65.2)	0.74(0.46, 1.20)	0.27
	Middle	53(37.6)	39(27.7)	1.58(0.95, 2.60)	0.10
	Lower	6(4.2)	10(7.1)	0.58(0.21, 1.65)	0.44
Mean Maternal weight (kg)	Booking	88.0±11.4	60.0±6.9	-	<0.01
Mean Maternal BMI (kg/m²)	Booking	33.8±3.5	22.5±1.7	-	<0.01

The mean parity difference of 0.66 was statistically significant. All the subjects were married. The obese mothers were about 20% less likely to attain above secondary level of education when related to the normal weight mothers. The difference however, was not statistically significant. The obese mothers were comparatively 60% more likely to come from middle social class and some 30% and 40% less likely to belong to the upper and the lower social class respectively. The observed difference however was not statistically significant.

Table 2. Maternal outcomes Cross-tabulated by subjects Subgroups (N=282)

Characteristic	Variable	Obese	Normal	OR	*P*-value
		n=141(%)	n=141(%)		
Mean gestational Age (weeks)	At booking	9.88±2.35	9.93±2.10	-	0.85
	At delivery	39.29±1.67	39.34±1.6	-	0.80
Mean Maternal Weight (kg)	At term	95.2±11.9	71.6±8.4	-	<.01
Mean Maternal BMI (kg/m²)	At term	36.6±4.1	26.9±2.8	-	<.01
Type labour	Spontaneous	76(53.9)	86(58.9)	0.79	0.40
	Augmented	30(21.3)	29(20.6)	1.04	1.00
	Induced	33(23.4)	26(18.4)	1.35	0.38
Mode Delivery	Vaginal	106(75.2)	124(87.9)	0.42(0.22-0.78)	
	Caesarean	35(24.8)	17(12.1)	2.41(1.28-4.54)	<0.01
	PPH[ł]	7(5.0)	2(1.4)	3.63	0.17
Maternal Complications	DM*	-	1(0.7)	-	-
	PIH/PE¶	31(22.0)	12(8.5)	3.03(1.48, 6.18)	<.03
	Prolonged Pregnancy	47(33.3)	53(37.6)	0.83(0.51, 1.35)	0.53

*Diabetes Mellitus, łpostpartum hemorrhage, ¶ pregnancy induced hypertension/preeclampsia

From Table 2 showing the maternal outcomes by subjects subgroups, the mean weight increase at term for the obese group was 7.2kg (8.2%),*(t*=5.2.*p*<0.01*)* with a weight range of 65-120 kg. The corresponding values for the normal weight group were 11.6kg (19.3%), *(t*=12.7, *p*<0.01) and 44-82kg respectively. Similarly the mean BMI increase at term among the obese group was 2.8kgm^{-2}; 8.3 %(*t*= 6.12, *p*<0.01). The corresponding values for normal weight group were 4.4kgm^{-2}; 19.6 % (*t*=15.*9, p*<0.01) respectively. There was less maternal gestational weight increase (8.2% vs.19.3%) and BMI (8.3% vs.19.6%) at term among the obese mothers relative to the normal weight mothers.

The two arms were similar in their respective gestational age at commencement of prenatal care and delivery of the neonates (*p*>0.05*)*.There was 40% increased likelihood of induction of labour among the obese mothers; nonetheless the both arms were similar in the types of labour. The obese group had more than half reduced likelihood of achieving vaginal delivery (*OR*=0.42, *p*<0.01) and more than twice increased likelihood of undergoing caesarean delivery (*OR*=2.41, *p*<0.01) compared with the normal weight group. The observed differences were statistically significant.

Comparatively, there appeared to be three-fold increased chance of the obese mothers suffering gestational hypertension (*OR* 3.0, *p*<0.03).The difference again was statistically significant. The cases of maternal diabetes mellitus were too few for statistical comparison.

Table 3. Perinatal outcomes Cross-tabulated by Subjects Subgroups (N=282)

Characteristic	Variable	Obese	Normal	OR	*p*-value
		n=141(%)	n=141(%)		
Outcome	Live birth	137(97.2)	135(95.7)	1.52	0.75
	Stillbirth	4(2.8)	6(4.3)		
	Birth asphyxia	7(5.0)	7(5.0)	1.00	-
	Perinatal death	5(2.8)	6(4.2)	0.49	0.50
	Mean birth Weight (gm)	3471.4±488.2	3207.8±483.2	-	<.01
	Fetal macrosomia	22(15.6)	4(2.8)	6.33 (2.12, 18.90)	<.03

Table 3 is a display of the perinatal outcomes by subgroups. The neonates of the obese group were on average 263.6gram heavier than neonates of the normal weight group at birth. The difference was statistically significant (*t=4.6, p*<.01). The newborns of the obese women were more than six fold at increased odds of being excessively large for gestational age (fetal macrosomia) (*p* <0.03).

DISCUSSION

The prevalence of maternal obesity in this study was 28.2%. This was consistent with another report.[7] Nonetheless, it was higher than earlier reports from this country.[8,9] This appeared to corroborate the increasing trend of the disorder in Nigeria and indeed worldwide.[1,10] Our data seem to suggest that maternal obesity was associated with increased maternal and fetal morbidity. Prominent among these obese mothers were gestational hypertension, caesarean delivery and fetal macrosomia. Pre-pregnancy obesity and excessive gestational weight gain are associated with increased maternal and fetal adverse outcomes. Our data revealed increased obesity with increased parity and maternal age consistent with other reports from this region.[8,11] One of the studies was on the effect of parity on weight gain in non-pregnant subjects.[11] This appeared to suggest a cycle of excess gestational weight gain and postpartum weight retention following each pregnancy. This evidence appeared to confirm the report in the literature that excessive gestational weight gain and

postpartum retention are significant risk factors for later obesity in women.[12]

Again postpartum period has been noted as a critical period for long–term weight gain and development of maternal obesity. Excessive gestational weight gain and persistent weight retention a year postpartum are strong predictors of overweight, a decade or more later.[12] Our data also appeared to indicate that obese mothers, though in overall similar to the normal weight mothers, were less likely to have attained tertiary level of education and to belong to high social class; but seem to concentrate in middle class.

There was about three-fold increased risk of gestational hypertensive disorders among the obese mothers, corroborating the reports from other researchers.[2, 13, 14] It was not clear if the age or obesity led to the observed increased prevalence of gestational hypertension in the obese subset. Similarly, our data indicated that obese mothers were at increased risk of caesarean delivery consistent with other reports.[2, 14, 15] This was because obese mothers are theoretically more prone to dysfunctional labor.[2] They are less likely to present in spontaneous onset labor at term and are at increased risk of prolonged pregnancy.[16,17] However, the two subgroups appeared similar in this data. These conditions are indicative of increasing risk of interventional delivery.

As observed from our study, obese mothers had significantly heavier neonates, this was similar to other reports.[18,19] This again, may contribute to increased failure of vaginal delivery and rise in caesarean section rate among the obese mothers. Comparatively, the obese mothers in this study had less gestational weight gain(GWG).This was probably as a result of quality prenatal care interventions in form of counseling on lifestyle modifications; physical activities and dietary measures which they received in the center. This is expected to positively influence gestational weight gain and by extension the fetal weight and obstetric outcome. This however depends on the maternal baseline weight and her level of compliance with instructions. With quality prenatal interventions, gestational weight gain is expected to be reduced in obese mothers as evidenced in our data corroborating the reports of other authors, increased in underweight and moderate in normal weight mothers. [20] From this data, it was evident that obese mothers may gain comparatively less gestational weight and still deliver good size neonates, confirming reports in the literature.[1,21] The GWG among the subsets in this data appeared within the WHO recommended guidelines of 5-9kg and11.5-16kg for obese and normal weight mothers respectively.[1, 5]

Obvious from this data was the need for quality and intensive postpartum health care; graded physical exercise and other weight loss programs for overweight and obese women to impact on the outcome of subsequent pregnancy and general health. There was also the need for quality pre-conception care to ensure optimal pre-pregnancy weight. Women should enter pregnancy within the weight range of normal BMI category by availing themselves of adequate pre-conception care; counseling, contraception and weight loss interventions. This evidently will assist in optimizing the pregnancy outcomes and improving the health of the mother and the child.[21]

The limitations of this study are that data collection was retrospective and it relied on data from one center; a multicenter data would have been more generalizable. A prospective data is more reliable; however, the study derives its strength in its case control design.

CONCLUSION

Gestational obesity is a significant health burden as noted in this study. It is an emerging morbidity that is correspondingly associated with adverse obstetric outcomes. Quality prenatal care and postnatal lifestyle modification will help to control it.

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