Impact of first-trimester body mass index on pregnancy outcomes: observational study

Ayodeji A. Oluwole,[1,2] Aloy Okechukwu Ugwu[2,3]

[1]College of Medicine, University of Lagos, Nigeria; [2]Department of Obstetrics and Gynaecology, Lagos University Teaching Hospital, Nigeria; [3]Department of Obstetrics and Gynaecology, Nigerian Army Reference Hospital, Yaba, Nigeria

Abstract

The epidemic of obesity is gradually becoming a global health concern across all age groups. In pregnant mothers, overweight or obesity have been known to be associated with significant antenatal, intrapartum, postpartum, and neonatal complications. Therefore, this study aimed to investigate the association between high maternal Body Mass Index (BMI) and adverse pregnancy outcomes. This was a longitudinal observational study done at the Lagos University Teaching Hospital between May 2019 and February 2020. Antenatal women with gestational age <12 weeks with singleton pregnancies were recruited for the study. They were followed up throughout pregnancy and postpartum to assess for complication during pregnancy, labour, and puerperium. A total of 568 pregnant women were involved in the study. Five hundred and fifty six (556) had complete data and were included in the data analysis. Of these, 169 (30.4%) had BMI of 30 and above while 387 (69.6%) had BMI<30. Women with BMI of 30 and above had significant ($p<0.05$) risk for development of complications in pregnancy. There is an obvious association between increased maternal BMI and adverse pregnancy outcomes. Public health implications of obesity are enormous for both the mother and baby during pregnancy and delivery. Preconception counselling and health education programs may be beneficial in order to maintain normal BMI in women of reproductive age.

Correspondence: Aloy Okechukwu Ugwu, Department of Obstetrics and Gynaecology, Lagos University Teaching Hospital, Nigeria.
Tel. +2347033132189.
E-mail: Okeyugwu92@gmail.com

Key words: Obesity, pregnancy, adverse pregnancy outcomes, Lagos.

Contributions: All the authors made a substantive intellectual contribution. All the authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Conflict of interest: The authors declare no potential conflict of interest.

Funding: None.

Ethics approval and consent to participate: Ethical approval was obtained from the Health Research Ethics Committee (HREC) of LUTH. Approval number was ADM/DCST/HREC/APP/431 Ethical principles according to Helsinki's declaration were observed throughout the study duration.

Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Received for publication: 29 November 2022.
Accepted for publication: 24 January 2023.

Annals of Clinical and Biomedical Research 2023; 4:273
doi:10.4081/acbr.2023.273

Introduction

Obesity in pregnancy has been associated with critical challenges and adverse pregnancy outcomes.[1] The prevalence of obesity is increasing worldwide.[1] However, it is less widespread in developing countries, though rates are increasing rapidly among some groups. There are few studies on the effects of maternal Body Mass Index (BMI) and pregnancy outcomes.[2]

Obesity is a nutritional disorder characterized by excessive fat accumulation in the subcutaneous tissues, in the omentum and viscera, and in muscles.[3]

A variety of classifications have been used to define obesity in pregnancy. These include height and weight indices like the height and weight tables, Ponderal's Index, and the BMI. Subscapular and triceps skin fold thickness and an empirical definition of maternal obesity as body weight greater than 90 kg at booking, regardless of height and pre-pregnancy weight have also been used.[3] However, the most commonly used method is Body Mass Index (BMI), also known as the Quetelet's Index.[4] BMI is the most appropriate measure for assessing pregnancy weight change, ranging from 18.5 to 24.9 kg/m.[2,3] Women are considered as obese when their BMI is greater than 30 kg/m.[2]

Obesity in pregnancy has been associated with an increased risk of urinary tract infection, hypertensive disorders in pregnancy, diabetes mellitus, increased risk of postpartum hemorrhage, genital lacerations, prolonged pregnancy, thromboembolic disorders, macrosomic babies, shoulder dystocia, and increased risk of operative deliveries.[5-9]

Weight gain is a normal physiological change associated with pregnancy. This weight gain in pregnancy may be due to fat deposition in the breast and subcutaneous tissues, fluid retention, amniotic fluid volume, weight attributed by the growing fetus, uterus, placenta and breasts. This physiological increase in maternal

weight during pregnancy may be influenced by factors such as increased appetite, nausea and vomiting, smoking habits, alcohol intake. However, mothers who are obese prior to pregnancy are much more predisposed to excessive weight gain in pregnancy with its attendant immediate and long-term sequelae.[10,11] There is a recent shift from diagnosis and treatment of diseases to health promotion and prevention. It is also a fact that being overweight and obesity are known risk factors for non-communicable diseases and therefore important targets for health promotion and prevention especially during preconception care for intending couples.[12,13] In the past obesity was seen as a problem of developed countries, but, with the increasing westernization of our diet there seem to be an increased burden of this problem in our country.[12,13,14] Lagos is a fast developing megacity, with very rapid growing urbanization, and related changes in lifestyle such as sedentary lifestyle, increased consumption of processed food, change in smoking habits even in women and increased alcohol use may contribute to perceived rising levels of overweight and obesity in women of reproductive age.[12-14]

However, very few data is available concerning the hazardous effect of increased BMI on pregnancy outcomes.

Therefore, this study aimed to investigate the association between high maternal BMI and adverse pregnancy outcomes.

Materials and Methods

Study design and setting

This was an observational study done at the Lagos University Teaching Hospital between 1st March 2019 and 28th February 2020.

LUTH is the teaching hospital of the College of Medicine, University of Lagos. It has about 800-bed spaces and serves as a referral center for other government-owned and private hospitals in the state and its environs. It is located on the mainland of Lagos which has a population of over 20 million inhabitants.

Study population and eligibility criteria

The participants were pregnant women at gestational age ≤12 weeks at their first booking visit. (this was chosen considering the negligible weight gain before 12 weeks). At booking, the patient's height and weight are usually recorded. The weight is taken with clients in their usual clothing to the nearest kg using a weighing scale while the height was measured using a height board to the nearest cm with the clients standing erect, without shoes, with eyes facing forward and feet together on the horizontal plane. The patients undergo routine antenatal visits and assessments every four weeks until the pregnancy is about 28 weeks, fortnightly until about 36 weeks' gestation and thereafter weekly until delivery. BMI was calculated using the formula: Weight (kg) / [Height (m)]2. For this study, the weight at booking was used for the calculation of early pregnancy body mass index. These pregnant women were followed up until delivery.

Data collection and analysis

A structured pretested study proforma was used to collect relevant data such as patients' sociodemographic data, parity, gestational age (calculated from the last menstrual period and/or early ultrasound scan). Anthropometric measurements and relevant investigations were carried out as per standard protocol. All the women were followed up till delivery and records of the delivery and neonatal outcomes were obtained subsequently. Data were entered and analyzed using the IBM Statistical Package for Social Sciences (SPSS Statistics) Version 23 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized and presented as frequency distribution tables, whereas continuous variables were presented as mean and standard deviation. A value of $p<0.05$ was considered significant.

Results

A total of 568 patients were recruited for the study, but only 556 had complete data and were included in data analysis (Table 1). Six (1.07%) patients travelled to have their babies abroad, four (0.72%) were lost to follow-up, and two (0.36%) left Lagos to join their husbands in other states. One hundred and sixty-nine (30.4%) had BMI of 30kg/m^2 and above (obese), while 397 (69.6%) had BMI of 18 to 29.9kg/m^2 (non-obese). Overall, the mean age of the patients was 31.03 years with a range of 19 to 41 years. The data was normally distributed and the mean age in the obese group was 31.6 (±4.30) years.

Table 2 shows ante-natal complications in both groups of women. These include Urinary Tract Infection (UTI), pregnancy-induced hypertension, pre-eclampsia, eclampsia, ante-partum hemorrhage, gestational diabetes mellitus, cardiac disease. It was observed that for all the complications examined, pregnant women in the obese group had higher proportions when compared with non-obese women. However, the observed difference in incidence, was significant ($p<0.05$) only for pre-eclampsia and gestational diabetes mellitus.

Discussion

This study reviewed the association between high maternal BMI and pregnancy outcomes (Table 3). The proportion of non-obese women who had no ante-natal complication (84.2%) was significantly higher than that of the obese group ($p<0.005$) suggesting that being obese is a risk factor for developing significant antenatal complications. This study showed significant association between maternal obesity and occurrence of pre-eclampsia and gestational diabetes mellitus ($p<0.03$), and it is similar to earlier study from Ghana[12] who reported similar incidence. It also showed

Table 1. Socio-demographic and clinical characteristics.

	BMI≥30 N=169	BMI 18-29.9 N=397
Age (years)		
Mean	31.6 (±4.30)	30.8 (±4.3)
Occupation		
Skilled	108 (64.3%)	272 (67.7%)
Semi-skilled	50 (20.8%)	108 (27.9%)
Unskilled	11 (5.9%)	17 (4.4%)
Educational level		
Primary	5 (3.0%)	12 (3.1%)
Secondary	58 (33.9%)	115 (29.7%)
Tertiary	106 (63.1%)	260 (67.2%)
Parity		
Nullipara	69 (40.8)	178 (45.9)
Primipara	72 (42.6)	105 (27.2)
Multipara	28 (16.6)	104 (26.9)
Mean duration of labour (hours)	8.6	7.8

Table 2. Ante-natal complications.

Problems	BMI ≥30 - N (169) N	%	BMI 18-29.9 - N (399) N	%	p-value
None	102	60.7	324!	83.7	0.01
UTI	6	3.5	12!	3.1	0.07
PIH	18	10.7	26!	6.7	0.09
Pre-eclampsia	14	8.3	5	1.3	0.04
Eclampsia	-	-	-	-	-
APH	3*	1.8	5	1.3	0.06
GDM	26	15.5	13!	3.4	0.03
Cardiac disease	2*	1.2	2*	0.5	0.8

X^2, Chi-square value; *, Fisher exact. UTI, Urinary Tract Infection; PIH, Pregnancy Induced Hypertension; APH, Antepartum Haemorrhage; GDM, Gestational Diabetes Mellitus.

Table 3. Maternal Body Mass Index (BMI) and labour outcome.

Outcomes	BMI ≥30 N	%	BMI 18-29.9 N	%	Odds Ratio	95% CI
Labour onset						
Spontaneous	85	50.3	269	69.5	0.49	0.33 - 0.72.
Induced	84	49.7	118	30.5	1.60	0.81 – 3.17
SVD						
Instrumental	77	45.6	278	71.8	0.36	0.24 - 0.52
Caesarean section	3*	1.7	1*	0.26	9.65	1.01 - 228.36
	89	52.7	108	27.9	2.59	1.76 - 3.81

SVD, Spontaneous Vaginal Delivery.

Table 4. Maternal Body Mass Index (BMI) and birth weight.

Birth weight	BMI ≥30	BMI 18-29.9	Odds Ratio	95% C.I
Mean (kg)	3.44±0.63	3.26±0.2	0.42	0.36–0.49
Range	1.42–4.50	1.20–4.60		
≥4 kg	32 (18.9%)	27 (7.0%)	3.22	1.80–5.77
<2.5 kg	14 (8.3%)	29 (7.3%)	1.15	0.56–2.34

association with other maternal complications in pregnancy such as UTI, pregnancy induced hypertension, antepartum hemorrhage, or cardiac disease. This is also similar to the finding by study by Van Der Linden *et al*. that demonstrated strong associations between obesity and these conditions.[15] Van Hoorn F. *et al*.[16] also examined high maternal weight status and complications during pregnancy and delivery, where they also found that overweight or obesity during pregnancy was associated with increased odds of several adverse pregnancy and delivery complications. They demonstrated that gestational hypertension, gestational diabetes and pre-eclampsia increased steadily with increasing body mass index.[16]

Our study also demonstrated that obese women had bigger babies when compared with their non-obese counterparts (Table 4). There is also increased number of caesarean sections among women with increased Body Mass Index when compared with non-obese women in our participants. This is similar to the findings in similar studies where increased incidence of macrosomia and caesarean sections were also reported.[15,16]

Conclusions

There is an obvious association between increased maternal BMI and adverse pregnancy outcomes. The public health implications of obesity are enormous for both the mother and baby during pregnancy and delivery. Preconception counselling and health education programs may be beneficial in order to maintain normal BMI in women of reproductive age prior to pregnancy.

Limitations of the study

There was a single measurement of weight for these patients at recruitment; inter individual differences in weight gain during pregnancy may have influenced the outcomes.

References

1. Huang X, Tan H, Cai M, et al. Gestational weight gain in Chinese women - results from a retrospective cohort in Changsha, China. BMC Pregnancy Childbirth 2018;18:185-90.
2. Crozier SR, Inskip HM, Godfrey KM, et al. Southampton

Women's Survey Study Group. Weight gain in pregnancy and childhood body composition: findings from the Southampton Women's Survey. Am J Clin Nutr 2010;91:1745-51.
3. Ma RCW, Schmidt MI, Tam WH. Clinical management of pregnancy in the obese mother: before conception, during pregnancy, and postpartum. Lancet Diabetes Endocrinol 2016;4:1037–49.
4. Knight-Agarwal CR, Williams LT, Davis D, et al. Association of BMI and interpregnancy BMI change with birth outcomes in an Australian obstetric population: a retrospective cohort study. BMJ Open 2016;6:e010667.
5. Kalliala I, Markozannes G, Gunter MJ, et al. Obesity and gynaecological and obstetric conditions: umbrella review of the literature. BMJ 2017;359:j4511.
6. Sridhar SB, Darbinian J, Ehrlich SF, et al. Maternal gestational weight gain and offspring risk for childhood overweight or obesity. Am J Obstet Gynecol 2014;211:259.e1–8.
7. Nehring I, Lehmann S, von Kries R. Gestational weight gain in accordance to the IOM/NRC criteria and the risk for childhood overweight: a meta-analysis. Pediatr Obes 2013;8:218–24.
8. Ovesen P, Rasmussen S, Kesmodel U. Effect of prepregnancy maternal overweight and obesity on pregnancy outcome. Obstet Gynecol 2011;118:305–12.
9. Wang X, Zhang X, Zhou M, et al. Association of prepregnancy body mass index, rate of gestational weight gain with pregnancy outcomes in Chinese urban women. Nutr Metab (Lond) 2019;16:54.
10. Zhao R, Xu L, Wu ML, et al. Maternal pre-pregnancy body mass index, gestational weight gain influence birth weight. Women Birth 2018;31:e20–e25.
11. Rong K, Yu K, Han X. Pre-pregnancy BMI, gestational weight gains and postpartum weight retention: a meta-analysis of observational studies. Public Health Nutr 2015;18:2172–82.
12. Adegoke O, Ozoh OB, Odeniyi A, et al. Prevalence of obesity and an interrogation of the correlation between anthropometric indices and blood pressures in urban Lagos, Nigeria. Sci Rep 2021;3522-9.
13. Ben-Bassey UP, Oduwole AO, Ogundipe OO. Prevalence of overweight and obesity in Eti-Osa LGA, Lagos, Nigeria. Obes Rev 2007;8:475-9.
14. Ng M, Fleming T, Robinson M. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2014;6736:1–16.
15. Van Der Linden EL, Browne JL, Vissers KM, et al. Maternal body mass index and adverse pregnancy outcomes: A ghanaian cohort study. Obesity (Silver Spring) 2016;24:215-22.
16. van Hoorn F, de Wit L, van Rossem L, et al. A prospective population-based multicentre study on the impact of maternal body mass index on adverse pregnancy outcomes: Focus on normal weight. PLoS One 2021;16:e0257722.