Research Article

iMedPub Journals
www.imedpub.com

Insights in Biomedicine
ISSN 2572-5610

2018
Vol.3 No.1:2

DOI: 10.21767/2572-5610.100037

Evaluation of Basal Metabolic Index and Waist to Height Ratio as Anthropometric Indicators of Obesity Among Pregnant Women in Port Harcourt, Nigeria

Vidona WB[1]* and Wadioni A[2]

1 Department of Anatomy, Enugu State University, Enugu State, Nigeria
2 Department of Physiology, Gregory University Uturu, Abia State, Nigeria

***Corresponding author:** Dr. WB Vidona

wills_bills@yahoo.com

Department of Anatomy, Enugu State University, Enugu State, Nigeria.

Tel: 234 (0) 811-369-3826

Citation: Vidona WB, Wadioni A (2018) Evaluation of Basal Metabolic Index and Waist to Height Ratio as Anthropometric Indicators of Obesity Among Pregnant Women in Port Harcourt, Nigeria. Insights Biomed. Vol.3 No.1:2

Abstract

Excess body fat deposition is known to be unhealthy. There have been several discourses on defined anthropometric indices for the assessment and a better prediction of obesity in pregnant women. This is because certain cut-off values relating to obesity in pregnant subjects are highly influenced by age, sex, ethnicity and trimesters of pregnancy. This study is aimed at investigating the use of two basic anthropometric indices to measure obesity and evaluate its prevalence in the different trimesters of pregnancy. The research is a prospective study involving 460 pregnant women in the sample proportion of 110, 110, 240 in the 1st, 2nd, 3rd trimesters respectively chosen randomly from antenatal clinic of the Rivers State Primary Health care centre, Rumukuta, Port Harcourt, Nigeria. Measurements of height, weight, hip circumference (HP) were obtained. Body mass index (BMI) was calculated from values of height and weight. Waist to height ratio (WHtR) was also calculated from waist and hip values. The result showed a BMI prevalence of 3.6%, 7.3% and 0.8%; WHtR prevalence of 56.4%, 51.8% and 40% all in the 1st, 2nd and 3rd trimesters respectively. A negative linear correlation was shown between the other indices and BMI as an independent variable in first trimester with value (r= -0.015) against a (r= 0.165) in WHtR. There was an association of WHtR against BMI with no statistically significant difference at level of 95% ($p<0.05$). Generally, the study provides a low prevalence of BMI and a high prevalence of WHtR in relation to WHO values as well as establishing 1st trimester as a good indicator of obesity in pregnant women and WHtR as a better predictor of obesity in pregnant women in the population studied. The results of this study are therefore recommended as a guide for clinical judgement in preventive comprehensive health care services on obesity management.

Keywords: Body Mass Index (BMI); Waist-to-height ratio; Trimesters of pregnancy; Height; Weight; Hip circumference; Obesity; Indices

Received: October 28, 2018; **Accepted:** March 02, 2018; **Published:** March 05, 2018

Introduction

The fundamental cause of obesity is a long-term imbalance in energy intake and expenditure (i.e., positive energy balance) leading to the increased body mass including the accumulation of subcutaneous and visceral fat [1]. Maternal obesity is emerging as a public health problem; recently highlighted together with maternal under-nutrition as a 'double burden'; especially in African countries undergoing social and economic transition Generally; women exceeded gestational weight gain (GWG) recommendations [2].

Every individual needs a certain amount of body fat for energy; heat insulation and shock absorption. Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health; leading to reduced life expectancy and/or increased health problems [3]. Obesity is defined by body mass index (BMI) and further evaluated in terms of fat distribution via total cardiovascular risk factors.

There have been several studies on the anthropometric indices particularly body mass index of obesity in different parts of the world. However not much has been established with regards to other reliable and early indicators for obesity at different trimester levels of pregnancy in women in this south-south geopolitical zone of Nigeria of which Port Harcourt is chosen due to its physiological and socio-economic status. Of importance as one of the parameters is BMI which is seen as a surrogate marker of adiposity and does not measure adipose tissue directly. Even in non-pregnant adolescent it is established according to Anibeze et al. [4] that BMI provides more information only to body weight and growth than determining fat content of the body. As a result; it does have limitations and provides no information on fat distribution [5]; neither can it distinguish fat from muscle mass distribution as well as the nature of obesity across different trimesters of pregnancy; ages and populations; and the joint relation of body composition and body size to health outcomes like Waist to height ratio (WHtR).

Hence the inherent gap and essence of this study to investigate other reliable alternative (waist-to-height ratio) among the populace of which this study seek to evaluate a better indicator across the various trimester stages of pregnancy. The pregnant women become a ready subject so as to get instant relation from those known to be diagnosed with the disease and pregnancy is an opportune time to review a woman's risk factor status associated with high value as observed by Denison et al. [6] and health behaviors to reduce future disease occurrence.

To contribute information regarding the use of pregnancy measures of obesity in the prediction of adverse gestational outcomes; this study aims to evaluate waist-to-height ratio; and BMI using reported weight measured between gestational weeks.

The aims of this study are; to measure anthropometric indices for identification of obesity and the prevalence among pregnant women in Port Harcourt. Determine prevalence of obesity in pregnant women using BMI; WHtR; at different stages of the indices. Relate BMI as a measure of obesity against WHtR index within the different trimesters as to get a reasonably best index for prediction in pregnancy.

The contribution of this work to human progress is to provide updated; modified and verifiable information that will guide clinical judgement thus improving preventive; therapeutic strategies and management programmes in health care services of obesity that will decrease incidence of low birth weight infants; miscarriages and still birth and its associated varied complications prevalent in maternal mothers of this region and Nigeria at large with regards to the uniqueness of the sex and surrounding environmental condition supporting pregnancy.

Materials and Methods

Research area

The study was undertaken in Port Harcourt of Rivers State; specifically, in Rivers State primary health care center; Rumukuta; Port Harcourt; Nigeria chosen for its referral base and a comprehensive emergency obstetric services where pregnant women of all socio-economic classes are always undergoing routine antennal care.

The population of the study

The populations of the study were all pregnant women on antenatal visit to the clinics in the area. Criteria for selection included all normal pregnant women with no special obesity conditions associated with them while attending the antenatal clinic.

Sample size and sampling techniques

The sample size was determined using Fisher's formula

$$n = \frac{Z^2 pq}{d^2} \qquad where\, q = (1 - p)$$

The calculated sample size of approximately 400 was further increased to 460 to make up for cases of attrition.

A stratified random sampling technique was used in the selection of this cross-sectional study.

Exclusion Criteria

Adolescent pregnant women of less than 18 years were excluded. Secondly; women in their pregnancy term of less than one month are excluded. This is because their presence at the clinics was low or near zero thereby making no valid premise for discuss. Also, women with multiple pregnancies as well as those with hyper-emesis gravidarum were excluded.

Also, there were no special controls as the subjects identified by the doctor to be at risk of obesity using BMI ≥ 35 kg/m^2 were noted against those not remarked about.

The research designs

The research is a prospective study that primary data was collected from direct measurement taken from time of our contact with the patients in the centers. Prior to data collection; oral questions were asked to ascertain the months of pregnancy of the patient and other necessary data necessary for study. A total of 460 pregnant females participated in the study after sampling and included in analysis.

Method of data collection

The parameters taken include:

1. BMI done by weight value from the weighing scale and height using measuring tape and then calculated using Garrow and Wedsler formula of 1985 as BMI (kg/m^2)=weight/height
2. Hip circumference HC done (cm) by measuring the widest portion of hips or point yielding the maximum circumference over the buttocks by measuring tape.
3. Waist to height ratio (WHtR) calculated by dividing values of Waist circumference (WC)/Height for each person.

Information on parity and trimester were asked directly from the subjects and recorded.

Instrumentation

1. Elastic tailor's measuring tape (Butterfly model – made in China); graduated in centimeters (0-150) was used to measure the waist and hip circumferences.
2. Height meter: A vertical long bar calibrated in Centimeters (0-200) with a movable horizontal bar which could be adjusted to touch the vertex of the Participant's head was used to measure the height of the participants.
3. DANS weighing scale (Seca; UK) calibrated from 0-200 kg was used to measure body weight to the nearest kilogram.

Method and data analysis

All anthropometric measurements were taken; in the morning; according to WHO recommendations by me and supported by clinic trained staff. Weight was measured to the nearest 0.1 kg; height to the nearest 0.5 cm. BMI (kg/m^2) and other indices were computed.

Data were analysed using IBM SPSS statistics version 15.0. Descriptive statistics were used for demographic information and Arithmetic mean and standard deviation of the values were taken and results reported as (S ± SD) and the comparison of indices and significance of association were done with the Analysis of variance and then polynomial regression model to find the degree of correlation between variables.

Limitations of the study

In carrying out this study; though increase in hormone levels during pregnancy was not followed practically as well as the medical history of obesity condition of the subject was not verified beyond mere asking; the study took into consideration factors like weight of subject from early trimester to last week of delivery. Also; the socio-economic status of subject was highly considered hence the choice of research area.

The values were compared with the standard WHO cut-off value for each indices which for BMI; obesity is at >30 kg/m^2 and WHtR; its cut-off value is >0.59 for pregnant women all for type 1 category.

Ethical clearance

Ethical clearance for this research was obtained from the college of Medicine and Health Sciences Ethics Committee of Abia State University; Uturu for permission from the health centers and subjects easier. The national protocols for utilizing human subjects were strictly adhered to. Verbal; informed consent was also obtained from the pregnant women and purpose of purpose of study duly explained to them to obtain their approval and cooperation.

Results

Descriptive statistics and demographics

The descriptive statistics of the anthropometric indices according to the mean and standard deviation of weight; height; body mass index; waist hip ratio; waist height ratio and waist circumference levels for pregnant women in the three trimesters are collated **(Table 1).**

Prevalence outcome

From the data of appendix, A; B; and C; that now produced **(Table 2)**; it is observed that no subject falls within BMI value of 18.5-29.9 kg/m^2 for a comparative prevalence. In all trimesters the prevalence value was above 50% at the >40 kg/m^2 category.

There is a higher degree of obesity up to 7.3% in the 2nd trimester at >30 kg/m^2 as shown under BMI column in the above **(Table 2).** However, as risk increases (>40 kg/m^2); it was sharply overtaken by the 3rd trimester at prevalence of 90% followed by 1st trimester.

There was a high prevalence of above 40% in all trimesters; with the 3rd trimester showing a continuous increase in the risk level of >0.59 cm WHtR range as evidenced from **Table 2** under WHtR column.

Correlation coefficient of the various indices

Table 3 compares the correlation coefficient of BMI against other three indices in the three trimesters. Analysis of Variance Computation of the mean Obesity in Pregnant Women for the different Anthropometric indices.

Hypothesis

H0: There is no significant difference in terms of the use of BMI and the other anthropometric indices (WC; WHtR) used to determine obesity in pregnant women.

Table 1 Mean and standard deviation of anthropometric indices of pregnant women in the trimesters collected for the study sample.

Variables	1st Trimester	2nd Trimester	3rd Trimester
Indices	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.
Weight	71.1 ± 10.58	71.14 ± 10.66	77.11 ± 9.953
Height	1.637 ± 0.082	1.663 ± 0.058	1.642 ± 0.066
BMI	43.44 ± 6.279	42.76 ± 6.169	48.19 ± 19.71
Hip Cir	107.5 ± 7.926	107.8 ± 8.11	106.7 ± 7.964
WHtR	0.59 ± 0.049	1.118 ± 5.569	0.848 ± 3.575

Table 2 Description of the anthropometric parameters used, showing prevalence percentage rate in the different trimesters of pregnancy against their study samples (N=460).

Prevalence	1st Trimester		2nd Trimester		3rd Trimester	
Variables						
(A) Total number of study						
Sample	110	24%	110	24%	240	52%
(B) BMI categories						
Normal (18.5-24.9)	-	-	-	-	-	-
Overweight (25-29.9)	-	-	-	-	-	-
Obesity/Risk 1 (30-34.9)	4	3.60%	8	7.30%	2	0.80%
Risk 11 (35-39.9)	29	26.40%	39	35.40%	25	10.40%
Risk 111 (≥ 40)	77	70%	63	57.30%	213	88.80%
(c) WHtR categories						
Normal (≤ 0.5-0.59)	62	56.40%	57-	51.80%	96-114	40%
Risk (>0.59)	48	43.60%	53-	48.20%	-	60%

Table 3 Correlation coefficient of anthropometric indices in the trimesters of pregnancy.

Trimesters	1st	2nd	3rd
Indices	f	f	f
BMI	1	1	1
WHtR	0.165	0.041	0.004

H1: There is significant difference in terms of the use of using BMI and the other indices to determine obesity in pregnant women. Since F (= -174.4) is less than the critical value (= -140.6); the *p*-value (= 0.012) is less than á<0.05 we do accept the null hypothesis; and summarizes the result as follows:

H2: There is no significant difference across the trimester groups in the value of BMI and the other indices to determine obesity among pregnant women and that chance or sampling error probably accounted for any observed difference.

Discussion

Relating prevalence data **(Table 2)** that produced **(Figure 1)**; it is shown that in the type 1 obesity category (>30 kg/m^2); prevalence is opposite the value observed in the type 111 obesity range (>40 kg/m^2) as 3rd trimester reveal a sharp upward straight line of up to 89%; followed by 1st trimester (70%) and then 2nd trimester (57.3%) that moved slightly rightward rather than up. This type 1 category data of 3.6% is lower compared to a finding from Australia which recorded a prevalence of 10.7% [7]; in Abakiliki of 7.7% [8]; and also, a bit lower than the 2008 WHO report on Nigeria which gave 6.5% for obesity in category 1 of 1st trimester. Obesity BMI figures from other African countries are also higher than those reported here especially in the type 1 / risk level 1 of obesity. However, the figures presented in this report are one of the highest in the literature particularly in reference to obesity type 111. This may be due to the fact that maternal obesity is known to increase with gestational age and weight [9]. This may also be due to the sudden high rate of food intake by women of this city at this stage of pregnancy for a "prestige" intension of giving birth to heavy; thick baby. It is also one of the lowest in reference to type 1 which may be due to anaemia according to report of in urban city of Pakistan and hence likely responsible for the low birth weight common among people of this region [10]. This assumption from the effect of low maternal BMI agrees with the work of in Thai population [11,12].

From the prevalence of WHtR data **(Table 2);** show a line graph toward the right side due to their less than 50% prevalence value observed for both 1st and 2nd trimester in the >0.59 cm category and a 56%; 52%; 40% respectively in the ≤ 0.5 - >0.59 range as shown in **Figure 2.** With comparison to the WHO value; the value in this study under this index is higher even than in other African countries. For WHtR; considering> 0.5 cm standard for WHO and >0.48 cm for Chinese according to Ho et al. [13]; it is obvious from this data which shows over 50% for 0.5- 0.59 in both first and second trimesters that it can deduce to be another predictor for obesity risk in the trimesters for pregnant women. It should be noted however that WHtR seems a reliable index for obesity determination in the trimesters considering the actual fetal addition effect and also stand as the best for risk warning signs. Again; in adults; since height is approximately constant; WHtR will change only when there is change in waist; therefore, individuals with different heights have their own cut-off waist circumference.

The lower maternal prevalence of BMI and higher WHtR prevalence agrees with a New York survey [14]. From the Pearson correlation value **(Table 4 and Figure 3)** then shows a linear correlation found for all trimester levels between body mass index and other indices. This is in agreement to finding from a recent study in Saudi Arabia according to El-Gilary and Hammad [15]. However; WHtR show a significant positive rank correlation; with BMI as an independent variable in first trimester alone with value against a (r=0.165) in WHtR. In 3rd trimester however; the values were significant to BMI with (r= 0.004) for WHtR.

From the result of study; there was a significant trend of increased value of the prevalence of obesity with an increase in BMI and WHtR in that order in third trimester followed by first trimester.

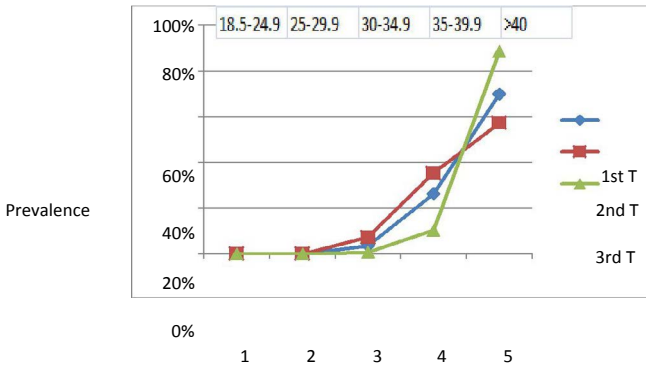

Figure 1 BMI prevalence of obesity among the trimesters.

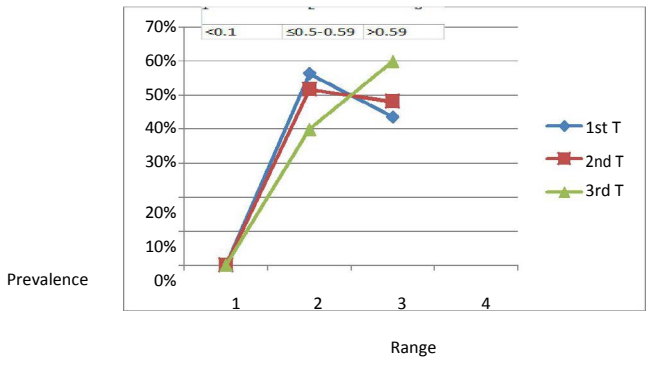

Figure 2 WHtR (cm) obesity prevalence among the trimesters.

Table 4 ANOVA.

Source of Variation	SS	Df	MS	F	*p*-value	F crit
Between Groups	63.84	2	31.92	-174.4	0.0116172	-140.65
Within Groups	-83.52	--	--	460	--	-0.183
Total	-19.67	--	--	462	--	--

In WHtR; the level of risk is in the order 3rd; 2nd; 1st trimester with slight lower percentage value as compared to BMI [16-19].

Conclusion

First the study shows that there is a lower prevalence of obesity with BMI and but a higher prevalence of elevated waist to height ratio in Port Harcourt pregnant women. From prevalence and correlation data of this study it is clear that WHtR gives a realistic value for obesity determination in pregnant women especially in their 1st and 2nd trimesters both for risk assessment and prediction in the environment of study. The use of BMI alone does not give a good indicator of obesity in the subject of study; but a combination of WHtR and BMI can give both obesity prediction and risk indication. The lower BMI prevalence in the 1st trimester and its greater change during the other trimesters is likely associated with the miscarriages and still birth noted commonly amongst the subjects as mention under the introduction.

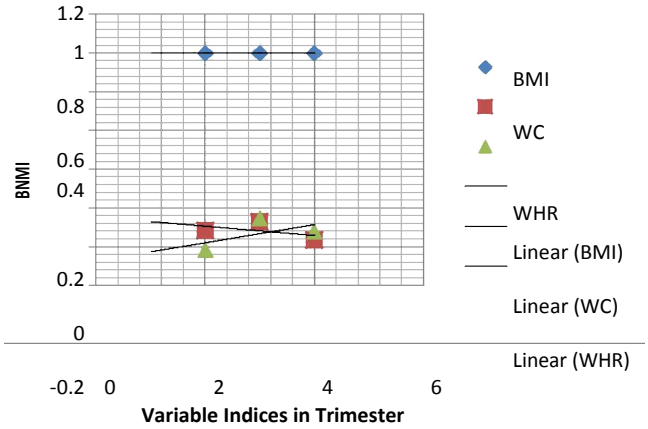

Figure 3 Simple regression model, showing correlation graph between BMI and WC/WHR.

References

1 Finelli C, Sommella L, Gioia S, La Sala N, Tarantino G (2013) Should visceral fat be reduced to increase longevity? Ageing Res Rev 12: 996-1004.

2 Morisset AS, Dubois L, Colapinto CK, Luo ZC, Fraser WD (2017) Pre-pregnancy body mass index as a significant predictor of total gestational weight gain and birth weight. Can J Diet Pract Res 78: 66-73.

3 Haslam DW, James WP (2005) Obesity. Lancet 366: 1197–1209.

4 Anibeze CIP, Akpa AOC, Etudo A (2003) Anthropometric profile, skin fold thickness and subcutaneous fat deposition in Adolescent Southeastern Nigeria. J Expt Clin Anatomy 8: 25-26.

5 Fattah C, Farah N, Barry S, Connor N, Stuart B, et al. (2010) Maternal weight and body composition in the first trimester of Pregnancy. Acta Obstet Gynecol Scand 89: 952-955.

6 Denison F, Price J, Graham C, Wild S, Liston CD (2008) Maternal obesity, length of gestation and spontaneous onset of labour. BJOG 115: 271-725.

7 Satpathy HK, Fleming A, Frey D, Barsom M, Satpathy C, et al. (2008) Maternal obesity and pregnancy. Post Grad Med 120: 1-9.

8 Obi SN, Obute EA (2004) Pregnancy outcome in the Obese Nigerian. Trop J Obstet Gynaecol 21: 32-35.

9 Flegal KM, Carroll MD, Ogden CL, Johnson CL (2002) Prevalence and trends in obesity among US adults. JAMA 288: 1723-1727.

10 Naila BA, Salma HB, Rozina K, Hilary H, Imitaz J, et al. (2008) Anaemia prevalence and risk factors in pregnant women in an urban area of Pakistan. Food Nutr Bul 29: 132-139.

11 Tippawan L (2011) Is international or Asian criteria based body mass index associated with maternal anaemia, low birth weight and preterm birth among Thai population. J Health Popul Nutr 29: 218-228.

12 Riz S, Adair LS, Hobel CJ (1996) Maternal underweight status and inadequate rate of weight gain during the third trimester of pregnancy increases the risk of preterm delivery. J Nutr 126: 146-152.

13 Ho S, Lam T, Janus ED (2003) The Hong Kong cardiovascular risk factor. Prevalence Study Steering Committee. Waist to stature ratio is more strongly associated with cardiovascular risk factors than other simple anthropometric indices. Am Epidemiol J 13: 683-669.

14 Cheron R, Magdalena B, Renu K, Elizabeth N, Robyn P, et al. (2004) Measures of adiposity and cardiovascular disease risk factors. NYC Hanes 8: A56.

15 El-Gilary A, Hammad S (2010) Body mass index and obstetric outcomes in Pregnancy in Saudi Arabia: A prospective cohort study. Ann Saudi Med 30: 376-380.

16 Onubi OJ, Marais D, Aucott L, Okonofua F, Poobalan AS (2016) Maternal obesity in Africa: A systematic review and meta-analysis. J Public Health 38: e218-e231.

17 Flegal KM, Carroll MD, Kit BK, Ogden CL (2012) Prevalence of obesity and trends in the distribution of body mass index among US adults 1999–2010 JAMA 307: 491–497.

18 Niedhammer I, Bugel I, Bonenfant S, Goldberg M, Leclerc A (2000) Validity of self-reported weight and height in the French GAZAL cohort. Int J Obes Relat Metab Disord 24: 1111-1118.

19 World Health Organization (1997) Obesity, preventing and managing the global epidemic—Report of a WHO consultation on obesity. WHO, Geneva, USA.