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Relationship Between Body Mass Index, And Type 2 Diabetes Mellitus Among Adult Nigerians In Makurdi, Nigeria.

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Abstract: *Obesity and diabetes are major public health problems in developing countries in the 21st century. The fundamental cause is imbalance between energy intake on one hand and energy expenditure on the other hand which is attributable to westernized lifestyle and decreased physical activity. This study was designed to assess the relationship between body mass index and fasting blood glucose of adult Nigerians in Makurdi metropolis, North Central Nigeria. . A total of five thousand one hundred and twenty participants (3326 males (65%) and 1794 females (35%) were randomly recruited for this study. The following measurements were taken -weight, height, and fasting blood sugar. Results showed mean values to be as follows, weight (68.8±0.2 kg), height (1.61±0.002 m^2), BMI (26.42±0.08kg/m^2) and FBG (6.7±0.03) for male participants compared to female with weight 70.1±0.3kg) height (1.62±0.002m^2), BMI(26.9±0.1kg/m^2),FBG(6.7±0.4mmol/L)Fasting blood sugar showed no significant differences (P<0.05)..Female showed higher body mass index in respect to male participants. Females were predisposed to higher risk factors of overweight and obesity compared to the males participants. Female have higher overweight and obesity tendency than male of the same age distribution .In conclusion, there is therefore a need to organize nutritional and physical, educational program to enhance a healthy living among adult Nigerians in Makurdi .North Central Nigeria.*

Keywords*: Body mass index, obesity, diabetes Mellitus*

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I. Introduction

Interest in the upsurge of non-communicable diseases such as obesity and diabetes are becoming an increasingly important public health concern in the developing countries in recent time. [1] .This disease contribute to increased risk of certain disorders, such as hyperlipidemia, hypertension and certain form of cancers and premature mortality [2]. There are several predictive indices used as indicators for obesity and diabetes. One of such indices is the anthropometric measurements. Body mass index (BMI) is commonly used to measure the degree of overweight and obesity. BMI is weight in kilogram (kg) divided by the height square in meter. (m^2). Obesity is defined as body mass index equal to or greater than 30kg/m^2.while underweight is BM I>25kg/m^2 [3]. Fundamentally obesity occurs due to complex interaction between genetic and environmental factors, resulting in an imbalance between calories intake and calories expenditure. [4] The number of obese people (BMI ≥ 30kg/m^2) has risen globally from 105 million in 1975 to 641 million in 2014 [5] . Since 1975, the prevalence of obese men has more than tripled, and that of obese women has more than doubled ,while the number of adults with diabetes has quadrupled [5] In the past two decades obesity was demonstrated to be most prevalent in African-Americans [26.5%], adolescent and young adults [5]. The major reasons responsible for this condition are multifactorial ranging from genetic, gender [6], environmental factors , increased caloric intake and decreased physical activity and psychological disorders [7]. In developing countries overweight /obesity has been on the increased in the recent time and believed to be the major cause of premature death in recent time and in the near future [8-9]. Obesity and diabetes result in decreased health related quality of life with impairment in physical functioning resulting in increased mortality and mobility .There is also associated general health and bodily pain ,loss of self-esteem and psychosocial states [10].

Recent findings shows that obesity in adults occur over time when one eats more calories than he/ she can expands . Whereas, young adults nowadays tend to eat more calories, do less physical activities, prefer sedentary life styles like watching Television, operating phone sets and video games to a

worrisome level in the developing world, particularly in Nigeria. This indeed predispose to accumulation of fat in the body especially in the abdomen and other parts of the body. [11]. The other major possible factor was a shifts to westernized diets and activity patterns to higher fat intake and lower physical activity and heavy alcohol consumption are contributing to a higher prevalence of obesity /overweight as indicated among women [13]. Glucose and lipid toxicity associated with insulin resistance plays a role in the pathogenesis of co-morbid diseases of obesity and diabetes mellitus. No wonder then, there is reported increased in sudden death, secondary to obesity [silent killer disease] and sudden cardiac failure, in recent time in Makurdi the Benue State Capital, North Central Nigeria. In Nigeria, a recent research reported that obesity related T2DM is a potential cardiovascular risk factor irrespective of age group. [14]. It is estimated that obesity affects about 1 billion people all over the world. The prevalence of this twin disorders in Nigeria forms a substantial portion of the total burden in Africa because of the large population of the country currently estimated to be over 170 million [15].In Nigeria, the last two decades has seen a rise in the number of prevalence studies concerning obesity, diabetes and other non-communicable diseases [16].

In Makurdi, however, there is a dearth of statistical information on the prevalence of obesity, and diabetes among adult population. Makurdi is the capital city of Benue state. 90% of the population are indigence of the state .This includes< Tivs, Idoma , Igede, Etulo, and the remaining 10% comprises of Igbo. Hausas and Yoruba. About 85% of the total populations are Christians while 15% are Muslims .The state is an agrarian community located in the Benue valley in middle Belt region of Nigeria, with a population of 342,500, according to the National Population Commission of Nigeria 2015 census. The aim of this study therefore, was to determine the relationship between obesity and T2DM factors among adult Nigerians in Makurdi .North Central, Nigeria.

II. Materials And Methods

Study Design: This was a cross-sectional study conducted in various geographical locations among all professions in Makurdi metropolis, The participants were selected from among a cross section of the population in Makurdi area. They includes staff and students of Benue State University , business men and women, skilled and unskilled workers ,staff from selected banks and civil servants from various ministries in Makurdi .A total of five thousand one hundred and twenty participants (3326 males (65%) and 1794 females (35%) were randomly recruited for this study, age ranging from 18 to 65 years.

Study Location: Makurdi metropolis the capital city of Benue State, Nigeria

Study duration:February 2016 to January 2018.

Study size: 5120 participants.

Sample size: The sample size was estimated according to Denga and Alli (2014) .The target population was 30,000 from which 5120 were randomly selected. This represent 17% of the studied group.

Inclusion criteria

1.Either sex
2. Age between 18 years and above,
3 Apparently in good health condition,
4. No history or concurrent treatment for-diabetes mellitus

Exclusion criteria.

The following categories of persons were excluded from the study groups:

1 Age below 18 and above 70 years
2 Pregnant and lactating mothers
3 Deformed individuals
4 Hypertension ,diabetes mellitus and cardio-pulmonary disease, and
5. Those on medications for above stated illnesses were excluded from the study.

Ethical clearance/consent

Ethical clearance was obtained from Medical Ethical Research Committee of the College of Health Sciences, Benue State University Makurdi. Also Informed consent was obtained from each subject, after which a structured health and life style questionnaire was administered to obtained information on socio-demographics data.

Procedure methodology

The research instrument used in this study was according to the World Health Organization universal standard condition [16]. Participants were selected after a written informed consent was obtained, by sequential randomization. A well stratified questionnaire, included socio-demographic data such as age, sex marital status,

nationality height, weight, level of physical activity, and lifestyle habits like smoking and alcohol were administered to each participant.

The following measurements were carried out, weight (Kg), height (M), fasting blood sugar (mmol/L). The obesity status of participants was assessed using body mass index (BMI) as recommended by WHO [16]. Body Mass Index (BMI), was then calculated using the standard formula as follows

BMI= Weight (Kg)/Height (M^2)…… (1)

Weight [kg] was measured with light clothes on using a calibrated beam scale placed on a hard surface and height measured using a meter rule . BMI <18.5 was considered Underweight [17], BMI≥18.5 and <25 was considered normal weight [17],BMI ≤ 25 and <30 was regarded as overweight [17],BMI ≥30 and <35 was considered class 1 obesity [16],BMI ≥35 and <40 was considered as class ii obesity [17] and BMI ≥ 40 was classified as class iii obesity [17]. Fasting blood sugar was estimated using digital glucometer. Diabetes was diagnosed based on the 2011 revised criteria by the Expert Committee on the diagnosis and classification of diabetes mellitus .[16]. FBG (3.6-6.5mmol/L) was considered normal,FBG(6.9mmol/l) was regarded as pre-diabetes ,and FBG>7mmol/L was regarded as diabetes.

Statistical Analysis

Statistical analysis were done using SPSS statistical package (Inc Chigago,II, USA, version 22.) Result obtained were expressed as mean ± SEM . Correlation between variable were done using Person correlation. P value < 0.05 was considered to be statistically significant.

III. Results

Table 1 Distribution of body weight, height, body mass index and fasting blood glucose in relation to age of male participants

Age range(years)	N	Sex	Weight (kg) ±SEM	Height (M) ±SEM	BMI (Kg/M^2) ±SEM	FBG (mmol/L) ±SEM
20-29	445	M	69.8±0.5	1.64±0.005	26.05±0.19	6.7±0.07
30-39	1212	M	68.5±0.3	1.61±0.003	26.73±0.13	6.7±0.05
40-49	921	M	68.6±0.3	1.62±0.003	26.60±0.15	6.7±0.05
50-59	431	M	68.6±0.5	1.60±0.005	26.81±0.22	6.5±0.07
60-69	257	M	69.5±0.7	1.62±0.006	26.75±0.31	6.8±0.11
≥ 70	60	M	67.4±1.2	1.60±0.012	26.63±0.56	6.5±0.18
Total	3326		68.8±0.2	1.61±0.002	26.62±0.08	6.7±0.03

Table 1. Showed mean values to be as follows, weight (68.8±0.2 kg), height (1.61±0.002 m^2), BMI (26.42±0.08kg/m^2) and FBG (6.7±0.03) for male participants.

Table 2 Distribution of body weight, height, body mass index and fasting blood glucose in relation to age of female participants

Age range(years)	N	Sex	Weight (kg) ±SEM	Height (M) ±SEM	BMI (Kg/M^2) ±SEM	FBG (mmol/L) ±SEM
20-29	236	F	69.6±0.7	1.65±0.006	25.8±0.3	6.5±0.08
30-39	360	F	68.5±0.6	1.61±0.005	26.5±0.2	6.6±0.08
40-49	650	F	70.1±0.5	1.62±0.004	27.0±0.2	6.8±0.06
50-59	358	F	71.3±0.7	1.62±0.006	27.4±0.3	6.6±0.09
60-69	169	F	71.5±0.9	1.61±0.008	27.7±0.4	6.7±0.12
≥ 70	21	F	70.0±2.0	1.64±0.025	26.3±0.8	8.1±0.3
Total	1794		70.1±0.3	1.62±0.002	26.9±0.1	6.7±0.4

Table 2 showed mean values to be as follows weight 70.1±0.3kg) height (1.62±0.002m^2),BMI(26.9±0.1kg/m^2),FBG(6.7±0.4mmol/L)

Table 3. Correlations between fasting blood glucose and body mass index of male participants

		FBG mmol/L	MALE BMI
FBG mmol/L	Pearson Correlation	1	.106**
	Sig. (2-tailed)		.000
	N	3319	3319
MALE BMI	Pearson Correlation	.106**	1
	Sig. (2-tailed)	.000	
	N	3319	3326

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3 showed a significant correlation between FBG and BMI for male participants (P<0.010)

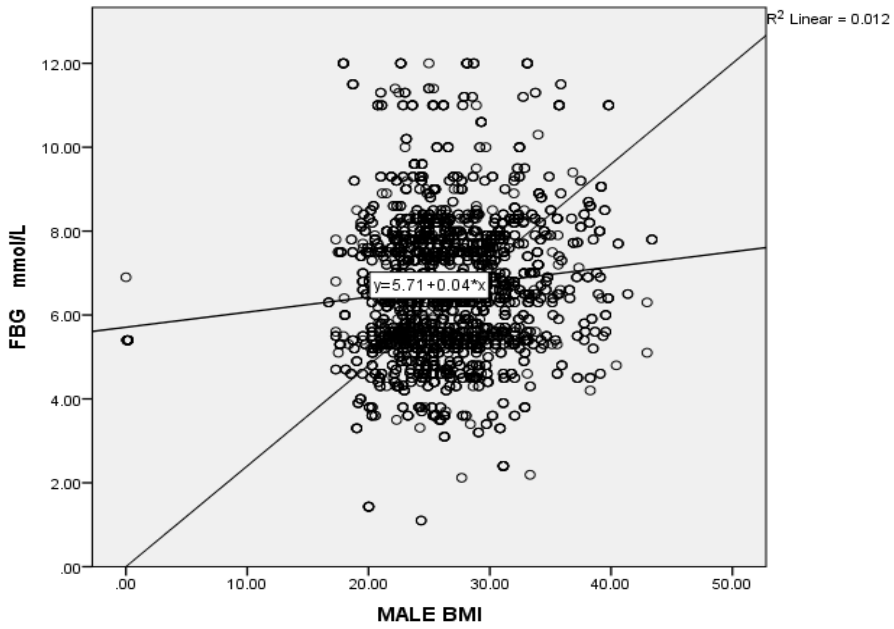


Fig 1 . Scattergraph showing a positive significant relation between FBG and BMI for male participants.

Table 4: Correlations between fasting blood glucose and body mass index of female participants			
		FBMII	F FBS
BMII	Pearson Correlation	1	.059*
	Sig. (2-tailed)		.012
	NC	1794	1787
FBS	Pearson Correlation	.059*	1
	Sig. (2-tailed)	.012	
	N	1787	1787
*. Correlation is significant at the 0.05 level (2-tailed).			

Table 4.Showing a significant correlation between FBS and BMI for female subjects (P<, 0.05)

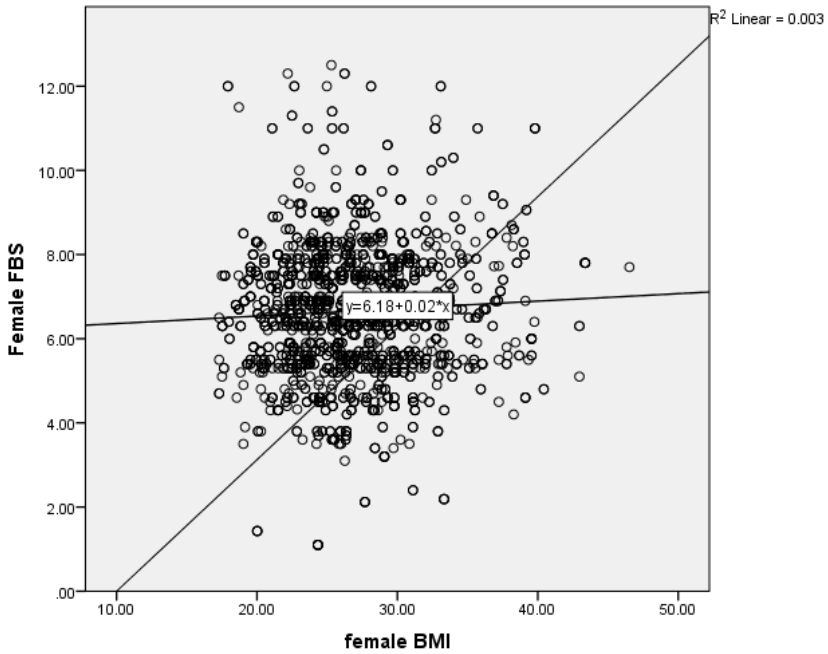


Figure 2. Scattergraph .showed positive relation between FBG and BMI for female participants (y=6.18+0.02*x).

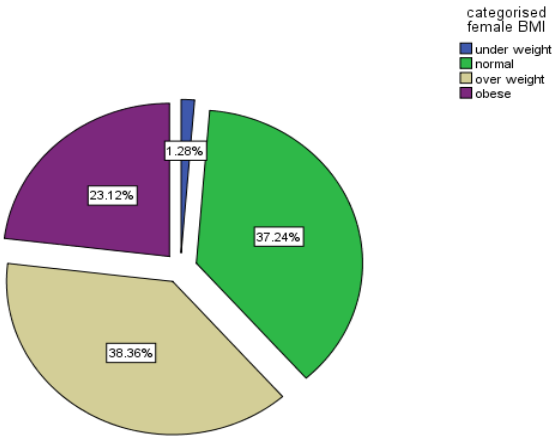


Fig 3.Showed distribution percentage of overweight, and obesity for female participants.

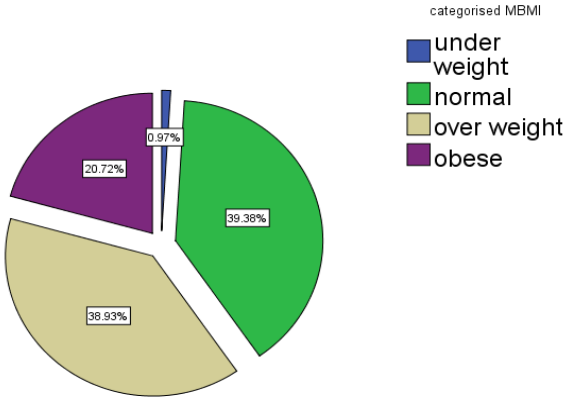
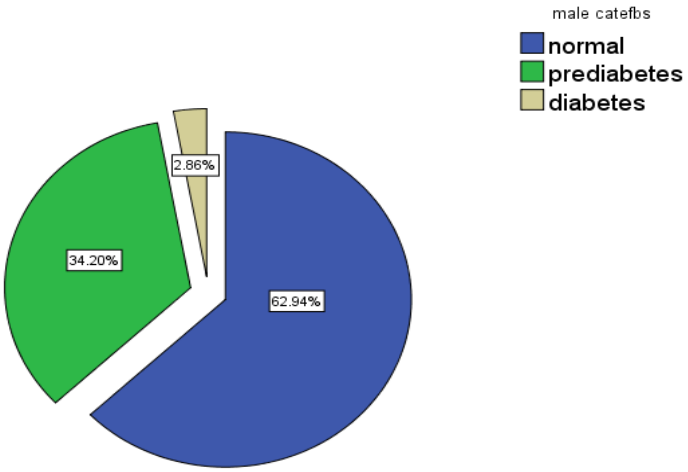


Figure 4. showed percentage distribution of overweight and obesity for male subjects.

Figure 5.showed percentage distribution of pre-diabetes and diabetes mellitus for male .



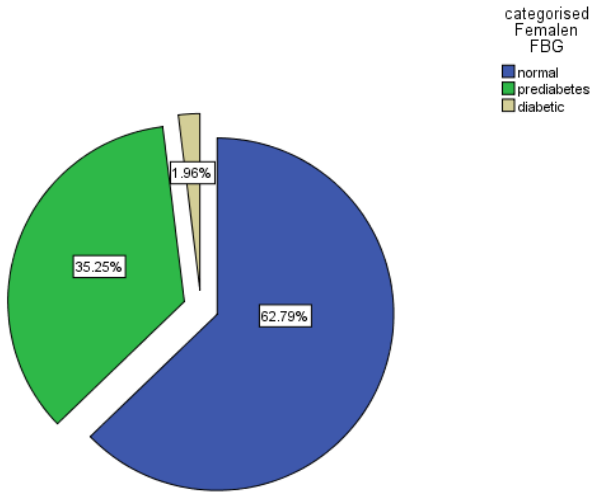


Fig 6. showing percentage distribution of normoglycemia,prediabetes and hyperglycemia for female subjects.

IV. Discussion

Table 1. and 2 Showed mean values of weight, height ,BMI and FBG to be (68.8±0.2 kg), (1.61±0.002 m^2), (26.42±0.08kg/m^2) and (6.7±0.03) for male participants and 70.1±0.3kg) (1.62±0.002m^2),(26.9±0.1kg/m^2),(6.7±0.4mmol/L) for female participants respectively.

Table 3 and 4 showed a significant correlation between FBG and BMI for males and females participants (P<0.010) and (P<, 0.05) respectively. Fig 3.Showed distribution percentage of overweight and obesity for female participants to be 30.36% and 23, 12%compared to 28.93% and 20.72% for male participants.

There was a significant difference between BMI for male and female. Females have higher BMI than male subjects. . Females are more overweight and obese than males in the study population. About 55% are reported to have normal body mass index for height and weight. These findings are in agreement with other previous studies according to world Health Organization [15] on the prevalence of obesity in Sub-Saharan African countries .The predisposing factors includes, westernized lifestyle, high energy diet, and environmental factors. [16] as depicted in the studied . This report however, is in line with previous studies [18, 19]. Who reported similar levels of obesity among urban adults in Benin.

Figure 5 and figure 6 showed percentage distribution of normoglycemia, prediabetes and hyperglycemia to be 62.74%,34.25%,2.8% for males and 62.79%,35.28% and 1.96% for female participants respectively. This study demonstrated that females have higher pre-diabetes tendency than males participants, however males are more diabetics than females within the study groups.

Though genetic factor however plays a very significant role in the development of obesity and diabetes however, genetic factor was not investigated in this research .The socio-economic, behavioral life style and lack of physical activity and emergence of new eateries seem to be the most possible reasons for the increased in the percentage rate of obesity, and type 2 diabetes mellitus among the study population. Most of the adult population in Makurdi area tends to eat more of snacks, junk, processed and carbonated foods. New restaurants have sprang up in every parts of the Makurdi town, such as Mr big, Tito yogurt , symbols eateries and which are witnessing high patronage. In the cause of preparation of these foods, high amounts of saturated fats and salt are used and these also contributed to health problem.

Another factor is the environmental influence on diet which includes the availability of cheap and readymade foods in fast food restaurants. Healthy foods are expensive compared to fast foods [20-21].

. Females are more obese than male under the studied population for the same reason. Physical Inactivity is more in female than male. Females spent more sedentary life, watching movies and televisions. Higher rates of physical activity are reported among the male adults population than female .The male counterparts indulged in football, basketball and strolling than female.

The increased have been felt mostly dramatically in urban settings like Makurdi, where the Benue State Universities is situated. Most of the population have a steady income from the Benue State Government and are adapting to western lifestyle. Increased westernization and social behavioural changes are the most likely probable factors for the increased level of obesity, and diabetes amongst the study population.

V. Conclusion and recommendations

This paper presents for the first time the relationship between overweight/ obesity, and fasting blood glucose among adult Nigerians in makurdi. Females are generally more overweight and obese than male. Obesity and diabetes are associated with premature mortality A situation that predisposes them to develop cardiovascular diseases such as heart failure and sudden death. Diabetes and obesity have increased dramatically over time. These findings therefore confirm the need for effective intervention to reverse anticipated trends. Obesity and diabetes mellitus prevention and treatment should be based on education, behavioral change, political support, and community participation. Prevention should be targeted at identification of risk individual and treatment of co-morbid disease early in life. Obesity and diabetes mellitus control should be integrated into national health program in the country.

It can be concluded that there is a need to perform large scale epidemiologic studies on the general population of Nigerians.

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