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Demographic and Anthropometric Indices of Male and Female Type 2 Diabetes Mellitus Patients in Anambra State, Nigeria

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Abstract

Gender differences in demographics, anthropometric and clinical characteristics of Type 2 diabetes mellitus (T2DM) patients attending Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Awka, Anambra State, Nigeria were studied between January and December, 2016. A total of 60 patients (30 males and 30 females) between the ages of 40 and 70 years old, clinically diagnosed of T2DM with fasting blood sugar ≥ 126mg/dl, participated in the recent study. These were age-matched with 40 (20 males and 20 females) healthy non-diabetic control subjects. The survey instruments used were structured questionnaire, anthropometric and blood pressure standard measurement tools. The survey outcome showed that significant ($p < 0.05$) population of male T2DM patients compared to that of female T2DM patients were more educated (49.0% vs. 26.7%), resident in urban areas (46.7% vs. 35.0%), had higher co-morbidity with hypertension (18.3% vs. 10.0%),showed more signs of complications (31.0% vs. 19.0%), had family history of T2DM (43.3% vs. 30.0%) and had over 10 years of suffering from T2DM (10.0% vs. 5.0%). On the other hand, female T2DM patients were involved in lower income occupation and practiced better nutritional regimen than male T2DM patients but had significantly ($p < 0.05$) higher BMI (30.30 ± 5.51 vs. 24.57 ± 4.16 kg/m^2), waist circumference (1.02 ± 0.08 vs. 0.96 ± 0.08m), waist to hip ratio (0.66 ± 0.06 vs. 0.56 ± 0.05), systolic (143.17 ± 12.83 vs.138.67 ± 10.42 mmHg) and diastolic (84.33 ± 5.53 vs. 80.33 ± 7.18 mmHg)blood pressures than male T2DM patients. Female T2DM patients are less prone or exposed to DM-associated lifestyle changes. Intervention policies for effective management of diabetes should be sex-specific.

Keywords: Anthropometry, Diabetes mellitus, Metabolic diseases, Nigeria

1. Introduction

Diabetes mellitus (DM) is an aetiologically multifactorial metabolic disorder, characterized by chronic hyperglycemia, which arise due to defects in insulin secretion, and/or action. Defects in insulin secretion or action results in aberrations in carbohydrate, fat and protein metabolism (Bos and Agyemang, 2013). Although, the aetiology of this disease is not well defined, viral infection, autoimmune disease, and environmental factors have been implicated (Sander, Anderson and Barbu, 2000).

There are two main types of DM. The first is type 1 diabetes mellitus (T1DM), previously known as insulin dependent diabetes mellitus (IDDM) which is caused by lack of insulin secretion by beta cells of the pancreas. The other is type 2 diabetes mellitus (T2DM) previously known as non-insulin dependent diabetes mellitus (NIDDM) which is caused by decreased sensitivity of target tissues to insulin (Ozougwu, Obimba, Belonwu and Unakalamba, 2013).T2DM is the commonly documented form of DM in most endocrine clinics, and accounts for about 90-95 % of all cases of DM (Ogbera and Ekpebegh, 2014).

DM is a disease with high prevalence, morbidity and mortality (Ogbonna, Opara, Ezenduka and Udochukwu, 2013). It is known to affect the developing countries of the world much more than their developed counterparts (Kengne, Amoah and Mbanya, 2005). Almost, 80 % of DM related deaths occur in low and middle-income countries (WHO, 2010).In the year 2015 alone, 415 million adults (20-79 years) were estimated to have DM worldwide, and by 2040, it is projected that the number will rise to 642 million (IDF, 2015). Data from the World Health Organization (WHO) suggests that Nigeria has the highest number of people living with DM in Africa (Wild, Roglic, Green, Sicree and King, 2004).There were more than 1.56 million cases of DM in Nigeria in 2015. Escalation of the incidence of DM in developing countries, like Nigeria, follows the trend of urbanization and lifestyle changes, and perhaps most importantly, a western-style diet (IDF, 2015).

Anambra State located in South-eastern Nigeria, is undergoing rapid urbanization, social and economic changes. The resultant effect is the adoption by residents of the State of a more western lifestyle characterized by excessive consumption of calorie-dense foods and decreased physical activity, which may result in increased prevalence of DM in the State.

It has been established that demographic profile of chronic diseases plays a major role in the application of prevention and control measures. In DM as with most diseases, demographic data help in the development of targeted intervention policies. The occurrence of DM is associated with a number of socio-demographic factors such as age and gender (Valliyot, Sreedharan, Valliyot and Jayakumary-Muttappallymyalil, 2014).

Anthropometry is thestudyof human body measurements. Anthropometric parameters are commonly used as research tools to assess the non-communicable disease risk factors in populations as they are easy to implement, inexpensive, and valid (Himabindu, Sriharibabu, Alekhya, Saisumanth, Lakshmanrao and Komali, 2013).Studies have shown that anthropometric indices such as waist circumference were strongly associated with T2DM in both male and female. Thus, it was suggested that they should be used in routine practice for the follow up of patients with T2DM (Lotfi, Saadati and Afzali, 2014).

There is currently insufficient data on demographics and anthropometric indices of T2DM in Nigeria. Moreover, no study has specifically assessed the gender differences in demographics and anthropometric indices of T2DM in Anambra State. This study was therefore designed to determine the differences in and relationships between demographics, anthropometric data and other clinical characteristics among male and female T2DM subjects in Anambra State. The study will provide useful up-to-date data for planning health budgets by the state and local governments, as well as help to apply appropriate national and international management interventions which could be gender specific as the case may be.

2.0 Subjects and Methods

2.1 Selection of Human Subjects

This study was conducted among patients with T2DM attending Chukwuemeka Odumegwu Ojukwu University

Teaching Hospital, Awka, Anambra state, Nigeria. The subject size used in the study was calculated as previously described in (Kadam and Bhalerao, 2010).A total number of 60 T2DMsubjects (aged 40-70 years) who attended the hospital between January and December 2016 enrolled in the study. The subjects were made up of 30males and 30females, who were clinically diagnosed T2DM patients with fasting blood sugar ≥ 126mg/dl (Preeti, 2014). The T2DM patients were age-matched with 40 (20 males and 20 females) healthy non-diabetic control subjects.

The study was approved by the hospital's ethical committee (COOUTH/AA/VOI.I.012). All the subjects were fully informed about the nature and purpose of the study. Written informed consent was also obtained from the participants.

2.2 Demographic profile

The subjects' demographic data, nutrition/life style and other clinical characteristics were obtained with the aid of a structured questionnaire. The questionnaire included data on age, gender, occupation, and duration of onset of T2DM, family history of diabetes, residence, co-morbidity, educational status, occupation, drugs, diet, diagnosis/treatment duration and additional symptoms observed over time.

2.3 Anthropometric Measurements

The body weights of the subjects were measured with the aid of a mechanical weighing scale (SALTER 200, England) to the nearest 0.5 kg, with the participants wearing light clothing and without shoes. Heights of barefooted participants were measured using a measuring tape to the nearest 0.1m. Body mass index (BMI) was calculated as weight (kg) of the participants divided by their corresponding squared height (m^2).

The waist, hip and arm circumferences were measured to the nearest 0.1m with the aid of a non-stretch measuring tape. The tape was snug around the body, but not too tightly pulled. Waist circumference (WC) was measured at the midpoint between the lower ribs and the iliac crest, while hip circumference (HC) measurement was taken around the widest portion of the buttocks (WHO, 2011).Arm circumference was measured at the mid-point between the tips of the shoulder and the elbow that is at the acromion and olecranon process(Devang, Nandini, Rao, and Adhikari, 2016).Waist-to-hip and waist-to-height ratios were computed as the quotient of waist and hip circumferences and of WC and height (m), respectively.

Blood pressure was measured using Mercury sphygmomanometer (Desk 605P, Suzuken Company, Japan) according to standard protocol.

2.4 Blood Glucose Analysis

Venous blood samples (5 ml) were collected by venipuncture in the morning after an overnight fast, into sodium fluoride (NaF) tubes. The serum was separated immediately and used for fasting blood glucose analysis using the glucose oxidase method (Barham & Trinder, 1972).

2.5 Statistical Analysis

The data obtained were analyzed using Chi-square / Fisher's exact test, one-way Analysis of Variance (ANOVA) and Pearson's correlation analysis with the aid of GraphPad Prism 5.3 (GraphPad Inc., USA). Values for $p \leq 0.05$ were considered statistically significant.

3.0 Results

Out of the 60 T2DM patients investigated in this study, Table 1 showed that, 16.7, 30 and 53.4 % of the patients were within the age intervals of 40-49, 50-59 and 60-70 respectively, with unequal prevalence between gender groups of ages 40-59. Majority of the subjects reside in urban areas (81.7 %), with greater number of these (46.7 %) being males. 55 % of the subjects were gainfully employed, in which the main types of employment were: civil service (33.3 %), trading (11.7 %) and farming (10.0 %). Majority of the civil servants (23.3 %) and traders (8.3 %) were males compared to females (10.0 % and 2.0 % respectively), while all the farmers (10.0 %) were female T2DM patients. 51.7 % of the patients were on anti-DM diets, out of which 25.0 % were males while 26.7 % were females. Meanwhile, only 16.7 % of the T2DM patients eat vegetables daily (6.7 % males and 10.0 % females).

Table 1: Demographic and Nutritional Characteristics of the Type 2 Diabetes Mellitus Patients

Variables	Groups	Number of Patients (%)			
		All Patients	Sex Grouping		
			Male	Female	P-Value*
Residence	Urban	49 (81.7)	28 (46.7)	21 (35.0)	
	Rural	11 (18.3)	2(3.3)	9 (15.0)	0.0453**
Educational Status	No Formal Education	14 (23.3)	0 (0.0%)	14 (23.3)	
	Primary Education	12 (20.0)	8 (13.3)	4 (6.7)	
	Secondary Education	15 (25.0)	12 (20.0)	3 (5.0)	
	Above Secondary Education	19 (31.7)	10 (16.7)	9 (15.0)	0.0001**
Marital Status	Single	2 (3.3)	2 (3.3)	0 (0.0)	
	Married	58 (96.7)	28 (46.7)	30 (50.0)	0.4915
Age Intervals	40-49	10 (16.7)	4 (6.7)	6 (10.0)	
	50-59	18 (30.0)	10 (16.7)	8 (13.3)	
	60-70	32 (53.4)	16 (26.7)	16 (26.7)	0.6222

Occupation	Employed Patients	33 (55.0)	18 (30.0)	15 (25.0)	
	Unemployed	27 (45.0)	12 (20.0)	15 (25.0)	0.6038
Type of Employment	-Farmers	6 (10.0)	0 (0.0)	6 (10.0)	
	-Civil Servants	20 (33.3)	14 (23.3)	6 (10.0)	
	-Traders	7 (11.7)	5 (8.3)	2 (3.3)	0.0069**
Diet	Diabetic Meals	31 (51.7)	15 (25.0)	16 (26.7)	
	Non Diabetic Meals	29 (48.3)	15 (25.0)	14 (23.3)	1.0000
Intake of Vegetables	Daily	10 (16.7)	4 (6.7)	6 (10.0)	
	Three Times A Week	46 (76.7)	22 (36.7)	24 (40.0)	
	Once A Week	4 (6.7)	4 (6.7)	0 (0.0)	0.1061

*Chi-square / Fisher's exact analysis of male and female observations. **Significant observations

Table 2 shows the clinical characteristics of the T2DM patients. Majority of the patients (56.6 %) were diagnosed / started treatment for diabetes in the last 2-10 years, with the female patients being the majority (33.3 %) that fall into this group. Out of a total of 44 T2DM patients (73.3 %) that have family history of the disease, 43.3 % were males while 30 % were females. Only about 28.3 % of the T2DM patients had hypertension in association with T2DM, majority of this participants were male T2DM patients (18.3 %). 58.3 % and 86.7 % of the T2DM patients had systolic and diastolic blood pressures (BP) of < 130 mmHg and < 90 mmHg respectively, with majority being T2DM male patients (35 % and 46.7 %).Greater percentages of the T2DM patients that exhibited systolic BP ≥130 mmHg and diastolic BP ≥ 90 mmHg were females.

Table 3 shows the anthropometric data obtained from the study. The survey outcome showed that significant ($p < 0.05$) population of the participants had higher values of BMI, WC, and WHtR than non-DM participants, and also in females than male participants. There was a non-significant ($p > 0.05$) increase in hip circumference (HC) ofT2DM patients (1.02 ± 0.10 m) compared to non-DM participants (1.00 ± 0.10 m), as well as between females than male T2DM patients. There were non-significant ($p > 0.05$) differences in the AC and WHR of male and female T2DM patients. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were slightly but non-significantly ($p>0.05$) higher in female (143.17 ± 12.83 mmHg) than male (138.67 ± 10.42 mmHg) T2DM patients.

The result of fasting blood glucose analysis is shown in Fig 1. There was significantly ($p < 0.05$) higher fasting blood glucose concentration in the T2DM patients (176.42 ± 46.86 mg/dl) than the control subjects (93.87 ± 15.33 mg/dl).The same trend was observed between groups of both the male and female T2DM patients.

FBG was found to be positively correlated ($r=0.38$; $p<0.003$) with weight (Wt) only (Table 4). Meanwhile, BMI of the T2DM patients correlated positively with Wt, WC, HC, WHtR, SBP and DBP but negatively with Ht and WHR. SBP was found to be positively correlated with Wt, WC, HC, WHtR and DBP.

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Table 2: Clinical Characteristics of the Type 2 Diabetes Mellitus Patients

Variables	Groups	Number of Patients (%)			
		All Patients	Sex Grouping		
			Male	Female	P-Value*
Diagnosis/Treatment Duration	≤ 1 Year	17 (28.4)	10 (16.7)	7 (11.7)	
	2-10 Years	34 (56.6)	14 (23.3)	20 (33.3)	
	> 10 Years	9 (15.0)	6 (10.0)	3 (5.0)	0.2741
Co-Morbidity (With Hypertension)	Present	17 (28.3)	11 (18.3)	6 (10.0)	
	Absent	43 (71.7)	19 (31.7)	24 (40.0)	0.2516
Those on Drug(S) other Than Diabetes Drugs	Antibiotics Only	3 (5.0)	3 (5.0)	0 (0.0)	
	Antibiotics &Hypertensive Drugs	4 (6.7)	4 (6.7)	0 (0.0)	
		17 (28.4)	10 (16.7)	7 (11.7)	
	Hypertensive Drugs& Vitamins	32 (53.4)	13 (21.7)	19 (31.7)	0.0382**
	Vitamins Only				
Additional Symptoms Over Time	Feet Numbness/Leg Pain	26 (43.3)	15 (25.0)	11 (18.3)	
	Chest Pain	11 (18.4)	10 (16.7)	1 (1.7)	
	Increased Weakness	13 (21.7)	6 (10.0)	7 (11.7)	0.0642
Family History Of Diabetes	Present	44 (73.3)	26 (43.3)	18 (30.0)	
	Absent	16 (26.7)	4 (6.7)	12 (20.0)	0.0391**
Regular Fasting Blood Sugar Test	≤ 3 Times A Week	12 (20.0)	7 (11.7)	5 (8.3)	
	Once In 2 Weeks	42 (70.0)	19 (31.7)	23 (38.3)	
	Once A Month	6 (10.0)	4 (6.7)	2 (3.3)	0.5013
Blood Glucose Level	Fluctuates	58 (96.7)	28 (46.7)	30 (50.0)	
	Decreased	2 (3.3)	2 (3.3)	0 (0.0)	0.4915
Blood Pressure	Systolic <130 Mmhg	35 (58.3)	21 (35.0)	14 (23.3)	
	≥130 Mmhg	25 (41.7)	9 (15.0)	16 (26.7)	
	≥140mmhg	19 (31.6)	5 (8.3)	14 (23.3)	0.0354**
	Diastolic <90 Mmhg	52 (86.7)	28 (46.7)	24 (40.0)	
	≥90 Mmhg	8 (13.3)	2 (3.3)	6 (10)	0.2542

*Chi-square / Fisher's exact analysis of male and female observations. **Significant observations.

Table 3: Anthropometric Indices and Blood Pressure Values of Type 2 Diabetes Mellitus Patients and Non-Diabetic Subjects.

Parameter	All Subjects		Male		Female	
	Control (n = 40)	Test (n=60)	Control (n=20)	Test (n=30)	Control (n=20)	Test (n=30)
BMI (kg/m²)	20.98 ± 2.92[a]	27.43 ± 5.64[bd]	20.30 ± 3.41[a]	24.57 ± 4.16[bc]	21.66 ± 2.22[ac]	30.30 ± 5.51[d]
WC (m)	0.84 ± 0.07[ac]	0.99 ± 0.08[bd]	0.79 ± 0.07[a]	0.96 ± 0.08[b]	0.89 ± 0.04[c]	1.02 ± 0.08[d]
HC (m)	1.00 ± 0.10[a]	1.02 ± 0.10[ab]	1.04 ± 0.09[ab]	0.97 ± 0.07[a]	0.97 ± 0.10[a]	1.07 ± 0.11[b]
AC (m)	0.31 ± 0.04 [ad]	0.35 ± 0.03[bc]	0.29 ± 0.03 [a]	0.35 ± 0.03[be]	0.33 ± 0.03[cde]	0.35 ± 0.03[be]
WHR	0.84 ± 0.10[a]	0.98 ± 0.09[b]	0.86 ± 0.07[a]	0.99 ± 0.07[b]	0.82 ± 0.12[a]	0.96 ± 0.10[b]
WHtR	0.50 ± 0.04[a]	0.61 ± 0.07[b]	0.51 ± 0.04[a]	0.56 ± 0.05[c]	0.49 ± 0.03[a]	0.66 ± 0.06[d]
SBP (mmHg)	125.50 ± 14.22[a]	140.92 ± 11.81[b]	128.50 ±14.88[ac]	138.67 ± 10.42[bc]	122.50 ± 13.23 [a]	143.17 ± 12.83[b]
DBP (mmHg)	78.50 ± 8.34[a]	82.33 ± 6.67[ab]	80.00 ±8.58[ab]	80.33 ± 7.18[ab]	77.00 ± 8.01[a]	84.33 ± 5.53[b]

Values are mean ± standard deviation.BMI – Body mass index; WC –Waist circumference; HC – Hip circumference; AC – arm circumference; WHR – Waist to hip ratio; WHtR – Waist to height ratio; SPB – systolic blood pressure; DBP – diastolic blood pressure.

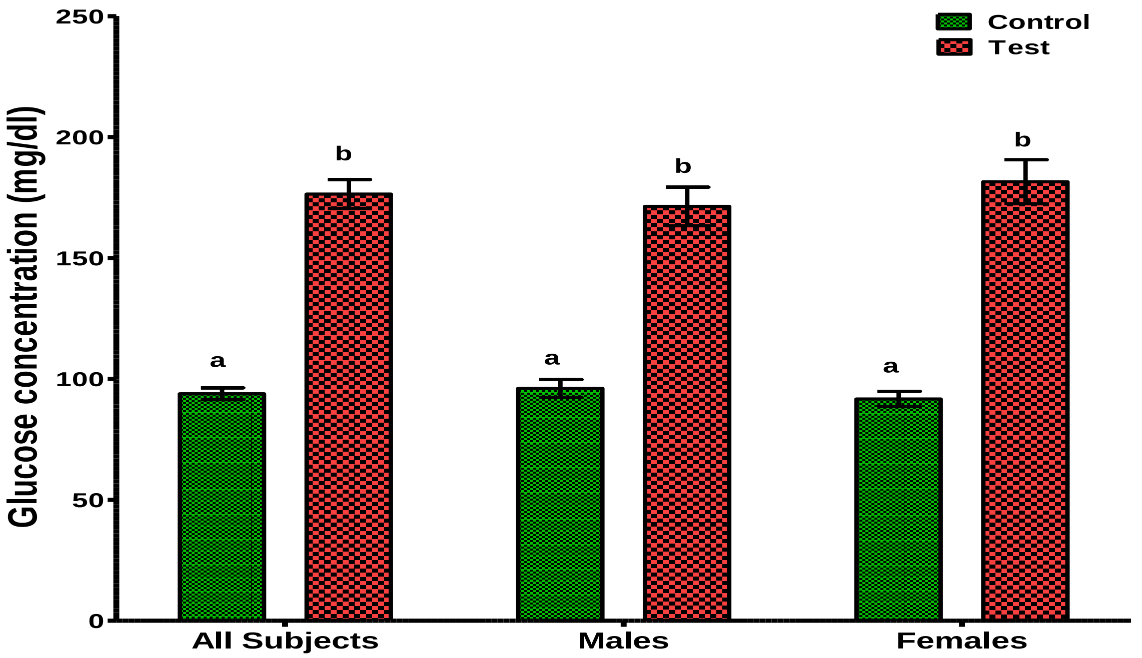

Fig. 1: Blood glucose concentration (mg/dl) of T2DM and non-diabetic subjects.

Bars are mean ± standard deviation. Bars bearing different letters are statistically significant ($p < 0.05$) within and between groups.

Table 4: Correlation Coefficient (P Value) Matrix of Blood Glucose Concentration and Anthropometric Indices of Type 2 Diabetes Mellitus Patients (n = 60).

	FBG	Ht	Wt	WC	HC	AC	BMI	WHR	WHtR	SBP	DBP
FBG		-0.25 (0.055)	0.38 (0.003)*	0.00 (0.997)	-0.15 (0.247)	0.16 (0.237)	0.18 (0.176)	0.16 (0.219)	0.16 (0.217)	-0.20 (0.132)	0.02 (0.878)
Ht	-0.25 (0.055)		0.28 (0.033)*	-0.17 (0.184)	-0.21 (0.155)	-0.02 (0.852)	-0.38 (0.003)*	0.04 (0.748)	-0.69 (0.000)*	-0.20 (0.118)	-0.22 (0.085)
Wt	0.38 (0.003)*	0.28 (0.033)*		0.57 (0.000)*	0.73 (0.000)*	0.01 (0.921)	0.78 (0.000)*	-0.32 (0.013)*	0.27 (0.039)*	0.32 (0.012)*	0.15 (0.249)
WC	0.00 (0.997)	-0.17 (0.184)	0.57 (0.000)*		0.59 (0.000)*	0.21 (0.109)	0.64 (0.000)*	0.29 (0.025)*	0.83 (0.000)*	0.27 (0.036)*	0.22 (0.088)
HC	-0.15 (0.247)	-0.21 (0.115)	0.73 (0.000)*	0.59 (0.000)*		0.08 (0.538)	0.84 (0.000)*	-0.60 (0.000)*	0.55 (0.000)*	0.30 (0.020)*	0.17 (0.193)
AC	0.16 (0.237)	-0.02 (0.852)	0.01 (0.921)	0.21 (0.109)	0.08 (0.538)		0.08 (0.564)	0.12 (0.377)	0.18 (0.165)	-0.08 (0.528)	-0.15 (0.245)
BMI	0.18 (0.176)	-0.38 (0.003)*	0.78 (0.000)*	0.64 (0.000)*	0.84 (0.000)*	0.08 (0.564)		-0.36 (0.005)*	0.69 (0.000)*	0.45 (0.000)*	0.31 (0.017)*
WHR	0.16 (0.219)	0.04 (0.748)	-0.32 (0.013)*	0.29 (0.025)*	-0.60 (0.000)*	0.12 (0.377)	-0.36 (0.005)*		0.18 (0.168)	-0.07 (0.611)	0.01 (0.957)
WHtR	0.16 (0.217)	-0.69 (0.000)*	0.27 (0.039)	0.83 (0.000)*	0.55 (0.000)*	0.18 (0.165)	0.69 (0.000)*	0.18 (0.168)		0.31 (0.015)*	0.29 (0.027)*
SBP	-0.20 (0.132)	-0.20 (0.118)	0.32 (0.012)*	0.27 (0.036)*	0.30 (0.020)*	-0.08 (0.528)	0.45 (0.000)*	-0.07 (0.611)	0.31 (0.015)*		0.42 (0.001)*
DBP	0.02 (0.878)	-0.22 (0.085)	0.15 (0.249)	0.22 (0.088)	0.17 (0.193)	-0.15 (0.245)	0.31 (0.017)*	0.01 (0.957)	0.29 (0.027)*	0.42 (0.001)*	

*Statistically significant ($p < 0.05$). FBG, Fasting blood glucose; Ht, height; Wt, weight; WC, waist circumference; HC, hip circumference; AC, arm circumference; BMI, body mass index; WHR, waist to hip ratio; WHtR, waist to height ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure.

4. Discussion

4.1 Demographic, Nutritional and Clinical Characteristics of the T2DM Patients

Gender differences are crucial issues of consideration for a patient to learn to live effectively with T2DM and for effective policy formulation in disease management projections (Siddiqui, Khan & Carline, 2013). Most of the patients (81.7 %) reside in urban area, which may have contributed to the incidence of T2DM in the area, since urbanization has been linked to rapid rise in the prevalence of T2DM (Misra & Ganda, 2007; Cheema Adeloye, Sidhu, Sridhar, and Chan, 2014). Majority of the T2DM patients residing in the urban area (46.7 %) are males, and this, as well as being more educated (49.0 %) than the females (26.7 %), could explain why most of the civil servants(23.3 % out of 33.3 %) and traders (8.3 % out of 11.7 %)are males, while all the farmers (10.0 %) are females.

Our results showed a steady rise in prevalence of T2DM with age. Worsening of insulin resistance with age, increased physical inactivity, and improved longevity of T2DM patients due to better healthcare could be the possible reasons (Burattini, Di Nardo, Boemi and Fumile, 2006). We observed equal prevalence rates of T2DM (26.7 % males and 26.7 %

females) among the gender groups of 60-70 years old. Our study also showed equal incidence without age factor. Equal incidence of T2DM among various adult age groups had been reported earlier (Wild *et al.,* 2004).However, a previous study in North Kerala, India reported male DM predominance (Valliyot *et al,* 2014), which is in agreement with the present study for the ages of 50-59.In present study, 10% females and 6.7% males were between the ages of 40-49 years of age, suggesting that females avail themselves early enough for diagnosis than men. In the traditional African family setting, men unlike women tend to resist or argue about going for medical checkup until it becomes inexpedient, under persuasion of their family members (Igwe, Ibegbulem, Ukwamedua and Ikaraoha, 2008).

Only 16.7% of the T2DM patients, out of which 10% are females, realized the need to increase the intake of vegetables to improve their health condition by making it a daily practice. This is probably due to the fact that most females in this part of the world eat home prepared meals, unlike males that often eat outside their homes, and therefore may be prone to eating more of junk foods, rather than vegetables containing meals.

About 56.6% of the diabetics (33.3% females and 23.3% males) in this study have hadT2DM for 2-10 years duration. However, out of 15% of the patients that had over 10 years diabetes duration, 10% are males while 5% are females, implying that the males may possess tendency to live longer with diabetes than females. It has been earlier reported that total life expectancy increase among diabetics is stronger in men than women (Muschik, Tetzlaff, Lange, Epping, Eberhard and Geyer, 2017).

Although fewer T2DM patients(28.3%) have diabetes-hypertension co-morbidity, male patients (18.3%) showed more tendency to co-morbidity with hypertension than females (10%).This demands for more research, since a higher prevalence of hypertension in T2DM women had been previously reported (Collier, Ghosh, Hair, and Waugh, 2015). However, the variance could be adduced to differences in lifestyle as well as efficacy and gender-associated side effects of anti-DM drugs.

After diagnosis, some of the patients were reported to have developed additional symptoms over time (Table 2).Clinical presentations associated with DM complications include: diabetic neuropathy (feet numbness), diabetic nephropathy (weakness and leg pain) and heart attack (chest pain) (Marks, 2016). There was a marked significant difference ($p < 0.05$) between male (31.0%) and female (19.0%) T2DM patients that developed additional symptoms. Arnetz, Ekberg, and Alvarsson (2014) reported that men with T2DM appear to suffer more microvascular complications. Majority of the male T2DMpatients that participated in the present study are civil servants, and as such predisposed to sedentary lifestyle due to long sitting time in offices, which may also contribute to higher percentage of T2DM complications.

Our results showed unequal prevalencein family history of T2DM (43.3% males and 30.0 % females), whereas equal prevalence of family history was observed by Valliyot *et al.,* (2014).Conversely, higher prevalence in family history of DM was reported by Annis, Caulder, Cook and Duquette, (2005).Thus more research with respect to role of paternal/maternal linage, sibling, and age on T2DM may give more insight into the observed gender-based differences in family history inT2DM.

4.2 Anthropometric and Blood Pressure Indices of the T2DM Patients

Our result showed that females had significantly higher BMI than males for both diabetics and non-diabetics studied (Table 3). Higher BMI in females than males have also been previously reported in T2DM (Adunbiola,2014; Lotfi *et al.,* 2014; Devang *et al.*, 2016).The results confirm the reported relationship between obesity and DM, but suggest the need for gender-specific BMI cut off points for T2DM patients. Results of our study also showed that WC, HC, and WHtR were significantly ($p < 0.05$) higher in female than male T2DM patients, which corroborates previous reports in T2DM women and men (Mogre Abedandi and Salifu, 2014; Adunbiola, 2014).

T2DM patients in the present study showed significantly ($p < 0.05$) higher blood pressure compared to non-diabetic subjects (Table 3). High salt intake has continuously been associated with abnormality in blood pressure. However, a recent study suggested that sugar (glucose) is worse than salt in elevating blood pressure (Mercola, 2015). The present study also showed as light non-significant ($p < 0.05$) increase in both SBP and DBP of diabetic females than males. This observation is in tune with the report of Devang *et al.,* (2016)of an increase in both SBP and DBP of female than male diabetics. It is however surprising that blood pressure levels are lower in non-diabetic women, compared with age-matched non-diabetic men. This observation, OngCheung, Man, Lau, and Lam, (2007) reported occurs at least until menopause in women. This implies that diabetes eliminates the protective effect of the female sex with respect to hypertension (Maric, 2011).

4.3 Fasting Blood Glucose (FBG) Concentration of the Diabetic Subjects

Significant ($p < 0.05$) increase was observed in fasting blood glucose (FBG) concentration of the T2DM patients (176.42 ± 46.86 mg/dl) compared to the controls (93.87 ± 15.33 mg/dl) both within and between male and female groups. Hyperglycaemia is a hallmark of diabetes mellitus (Mandal, 2012). Although, FBG concentration is usually high in T2DM patients, but the level tends to fluctuate especially during treatment. This buttresses the observed 96.7% (46.7% and 50.0% in males and females) of T2DM patients with abnormal fluctuations in their blood glucose levels (Table 2). However, measurement of FBG remains a major diagnostic marker of a patient's response to diabetic drugs.

4.4 Correlation of FBG and Anthropometric Indices of T2DM Patients

Our results showed that FBG was not significantly ($p > 0.05$) correlated with the anthropometric indices except weight of the T2DM patients. However, BMI correlated positively with WC, HC and WHtR, but negatively with WHR. WC and WHtR have been reported to have higher sensitivity and specificity for identifying diabetic individuals at increased risk of coronary artery disease (Kaur, Sharma, & Singh, 2014), thus complementing the use of BMI. The negative correlation between BMI and WHR may be due to the fact that WHR reflects abdominal adiposity, rather than overall adiposity as in the case of BMI, and have been suggested as being superior to BMI in predicting cardiovascular disease risk (WHO, 2011). In this study, BMI was also positively correlated with both SBP and DBP, which is in agreement with previous studies (Gupta and Kapoor, 2010; Dua, Bhuker, Sharma, Dhall, and Kapoor, 2014)buttressing the recognition of BMI as important predictor of CVD and hypertension (Dua *et al.,* 2014).

5. Conclusion

More diabetic males compared to females were more educated, resident in urban areas and were mainly civil servants. They exhibited less healthy dietary habits, had higher co-morbidity (with hypertension), and showed more signs of complications.Surprisingly, they appear to live longer. On the other hand, female diabetics had significantly higher BMI, WC, WHtR, SBP and DBP than male diabetics.

The present study suggests that intervention measures for effective management of T2DM, such as treatment guidelines, weight loss goal, life style changes and health education should remain broad based but have some sex-specificity. The observed need for sex-specificity, however calls for more cohort studies to further evaluate and confirm their efficacy and outcome through gender-specific clinical trials. Furthermore, variations in family history of T2DM patients as well as BMI and WC cut-off points for T2DM patients should also have some level of gender consideration given the observations in the present study. Meanwhile, adoption of healthy lifestyle and dietary pattern such as daily consumption of fiber and protein-rich foods, as well as vegetables should continue to be encouraged for all T2DM patients.

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