

Prevalence and Risk Factor of Diabetes Mellitus among Civil Servants in Abeokuta Town, Ogun State, Nigeria

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ABSTRACT

Background: Diabetes is insidious in onset and has many patterns of presentation that often militate against early detection and diagnosis. As civil servants advance in service, they take up less physically demanding activities making them more sedentary. **Objective:** This study determined the prevalence of diabetes mellitus and its associated risk factors among civil servants in Abeokuta, Ogun State. **Materials and Methods:** Cross-sectional data were collected through pretested semi-structured interviewer-administered questionnaire from 290 respondents using a stratified sampling method. The selection was across all the 36 Ministries, Departments and Agencies (MDAs) under the Ogun State Civil Service. The data was analyzed using SPSS version 20. The descriptive statistics and chi-square tests were used to determine the association between categorical variables and the significant level of p was set at < 0.05. **Results:** The prevalence of diabetes was 11.4%. The presence of diabetes mellitus (DM) was associated with body mass index BMI ($p < 0.001$), Systolic BP ($p = 0.008$), Diastolic BP ($p < 0.001$), and family history ($p < 0.001$). The result of logistic regression analysis showed a statistically significant relationship between age, BMI, family history, cigarette smoking and DM among civil servants in Ogun State. (OR; p-value = 1.069; 0.010, 1.271; < 0.001, 15.155; < 0.001, 6.095; 0.043). **Conclusion:** This study concluded that BMI, family history, and blood pressure were identified as risk factors for DM, while physical exercise was less practiced among the studied civil servants. Therefore, there is a need to advance necessary awareness and enlightenment of the general public about the risk factors associated with the development of diabetes.

Keywords: Civil Servant; Diabetes mellitus; Physical activity, Prevalence; Risk-factors.

INTRODUCTION

Diabetes is a heterogeneous group of diseases characterized by a chronic state of hyperglycemia resulting from a variety of etiologies; environmental, genetic, social and biological factors acting jointly to cause a

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relative or absolute deficiency of insulin. [1] According to International Diabetes Foundation (IDF), 463 million adults are living with diabetes in 2019, its prevalence is increasing rapidly and the number was projected to almost double by 2030.[2] Civil Servants are selected purposely for the study, because the Civil Service comprise people of different works of life, professions and disciplines with different cadres (senior and junior cadres), different levels of education and literacy, different socio-economic class and above all different backgrounds which qualifies these group of people as an ideal representation of the general public. Prior to this study, it was discovered that no study had been conducted on the prevalence and risk factors of DM among civil servants in Abeokuta. This study, therefore, aimed at determining the prevalence of diabetes mellitus and its associated risk factors among civil servants in Abeokuta, Ogun State.

MATERIALS AND METHODS

Study Area

This study was conducted at Abeokuta, the largest city and the capital city of Ogun State. It covers a landmass of 16,762 square kilometres, and has a population of 3.75million people with 21 Local Government Areas (LGA). It is the headquarter of Ogun Central Senatorial District. It covers an area of about 880km² and 510/km² population density.[3] The Governor's office Secretariat Complex at Oke-Mosan, in Abeokuta, houses all ministries, departments and agencies (MDA) in the state with a few outstation departments outside the state capital. Each of these MDAs allocated into blocks with each ministry having its pool of staff, which is a mixture of professional, administrative, and various categories of senior and junior workers.

Study design

This study was a descriptive cross-sectional study to determine the prevalence and risk factors of Diabetes Mellitus among civil servants in

Abeokuta, Ogun State.

Study population

This included all categories of civil servants who are staff of the state government, permanent workers on the nominal payroll and whose offices are located within the Ogun State Secretariat Complex Oke-Mosan Abeokuta. The staff composed of both senior and junior categories that are mixtures of professionals and administrators, between the ages of 19 to 60 years. They were approximately fifteen thousand (15,000) workers distributed amongst the 26 Ministries and 10 Agencies.[3]

Sample size determination

This was determined using Fishers' formula, where n is the desired sample size, Z is the standard deviate at a 95% confidence level of 1.96, and p is the disease prevalence from a past study done in Uyo metropolis, South-eastern Nigeria with 10.5%.[4]. And q equates to $1 - p$ and a margin of error at 95% degree of accuracy/precision of 0.05. After adjusting for a non-response/attrition rate of 25%, a minimum sample size (n) of 193 was obtained. But for this study, the sample size was increased to 300 out of which 290 respondents completed the questionnaires.

Sampling Technique

A stratified sampling technique method was used. The total population of about 15,000 workers was already grouped based on their respective ministries or agencies of deployment. The sample size of 300 participants was divided among the 36 MDAs and with the sampling frame (nominal role of each ministry and agency) at hand, 9 participants per Ministry and Agency were picked/selected by simple random sampling using balloting.

Study Instruments

The questionnaire was designed to assess knowledge about diabetes, the presence of diabetes (DM) risk factors among the participants and prevalence was assessed by past medical history of DM and by laboratory diagnosis. The questionnaire design

captured four main areas; demographic parameters; socio-economic parameters; lifestyles/physical inactivity; and laboratory/anthropometric parameters. The instrument covered different levels of “steps” of risk factor assessment i.e., questionnaire on socio-demographics, physical measurements and biochemical. The Chronic Disease Indicators (CDI) is a set of indicators developed to allow for uniform definition, collection, and reporting of chronic disease data that are important in public health. The CDI represent a wide spectrum of conditions and risk factors such as physical activity and nutrition, tobacco and alcohol use, cancers, cardiovascular disease, and diabetes.[5] Income score was assessed using the level of education and employment grade level.[5]

Use of tobacco, alcohol and sweet drink/ beverage consumption was assessed by memory recall and estimates of intake frequency per week. Physical inactivity was defined as the absence of non-vigorous physical activity for at least 30mins for at least 5days per week OR the absence of vigorous physical activity for 20mins for at least 3days per week i.e it means when you don't move your body for long periods for example sitting and lying on the sofa watching tv, writing, etc. [5] Accu Check Active Glucometers (models CE 0080 by ROCHE) was used for blood sugar determination, fasting blood sugar (FBS) was done. Omron calibrated weighing scales with weights taken to the nearest 0.5kg and respondent wearing light clothing was used to measure the weight of respondents. Non-stretchable measuring tapes with measurements to the nearest 0.1cm were used for waist circumference measurement. A standard height meter with readings taken to the nearest 0.01m was used for height measurement.

Reliability of Instrument

To ensure the reliability of the instrument, the instruments were pretested by administering 30 questionnaires to civil servants in Sagamu, Ogun State. The coefficient of Cronbach Alpha was used

to test reliability. The value obtained was 0.692, which indicated the high reliability of the instrument.

Data Collection

Research assistants were recruited and trained on how to administer the questionnaire and refer all respondents to Ogun State Civil Service Clinic at Oke-Mosan for the FBS, height, weight and waist circumference measurements. These measurements were done by the nurses and doctors attached to the clinic. The tip of the middle fingers of each of the participants was first cleaned with cotton wool dipped in methylated spirit before the finger was pricked with a sterile lancet and a drop of blood from the finger was placed directly on the Accu-check glucometer which automatically showed the value of the level of glucose in the blood. FBS values > 7.0 mmol/L (126mg/dl) was taken as diabetic range and values between 110mg/dl and 125mg/dl as impaired fasting glucose (IFG) as recommended by WHO.[6] Fasting was observed as no calorie intake for the last 8-10 hours overnight.

Measurements of weight and height to compute BMI expressed in kg/m^2 with levels < 18.5 classified as underweight, 18.5 – 24.9 as normal, 25.0 – 29.9 as overweight and BMI = 30.0 as Obese. Waist circumference (WC) was measured midway between the inferior angle of the ribs and the suprailiac crest. Measurement was taken with the subject in an erect position using a non-stretchable measuring tape. Values = 102cm in males and = 88cm in females were considered abnormal.

Study Duration

The study was conducted from January to June 2019.

Ethical Consideration

Ethical approval was obtained from the ethical committee of the Department of Planning, Research and Statistics, Ministry of Health, Ogun State with reference number HPRS/381/303 before the commencement of the study. Informed written consent adequately signed by the participants was obtained after all procedures required had been

properly explained to them. Confidentiality in handling information and test results were strictly upheld.

Data Management/Analysis

The data were checked for completeness and accuracy. It was coded and analyzed using the SPSS version 20 statistical software programme (IBM Corp, Armonk, NY, USA). Results were presented in frequency tables and percentages with a statistically significant level set at $p < 0.05$. Chi-Square and logistic regression analysis were used to determine the risk factors to the development of DM in this study.

RESULTS

Table 1 presents the profile of the study population. More than half (57.6%) of the respondents had post-secondary education. The senior (41.4%) and junior (35.5%) staff constituted the larger part of the employment cadre. In addition, the majority of the respondents were Christians, those married among all the respondents were 72.1% and in the ages of 31-40 years (27.2%) with an average age of 40.98 ± 11.14 years.

The distribution of respondents according to their fasting blood sugar (FBS) is indicated in Table 2. The majority (69.7%) had less than 100mg/dl of Fasting blood sugar which indicates normal FBS, only 19.0% of the civil servants had between 100mg/dl and 125mg/dl of FBS signifying impaired fasting glucose category while 11.4% of them had greater than 125mg/dl of FBS which suggesting diabetes. The study also reveals that the fasting blood sugar of civil servants in Abeokuta, Ogun State varied from 58mg/dl and 180mg/dl with an average of 95.18 ± 22.05 mg/dl.

The study shows different risk factors associated with diabetes mellitus (DM) under the following categories which are physical activities, diets and medical history.

Table 3 revealed the responses of civil servants

according to the different physical activities they engaged in. About 49.7% of them occasionally engaged in physical activities while more than half (52.8%) were used to sitting positions in the course of their daily activities. The results also indicate that 3.9% of the civil servants seldom or never did any vigorous exercise per day. Only 27% of the respondents had their health checked.

Table 4 presents the distribution of the civil servants according to their dietary intake. The results show that 68 (23.4%) drank alcohol out of which 98.5% of this number took between 1-2 bottles per day.

Table 5 shows that out of 290 civil servants, only 5.9% had a history of having high blood sugar while 23.4% are with a family history of diabetes. In addition, out of 160 female civil servants, only 5(3.1%) of them had a history of gestational diabetes and 2(40.0%) of them had persistent high blood sugar.

Table 6 shows that there was a statistically significant association between BMI, family history of DM, and systolic and diastolic blood pressure, with DM ($p < 0.05$). A higher proportion of respondents who were overweight and obese (88.7; 74.3 %) were diabetic compared to those with normal BMI (90.5%) ($p < 0.001$). The results also indicate that the prevalence of diabetes was 8.3% among civil servants with normal BP and was 31.6% among people with high diastolic BP ($p < 0.001$).

Moreover, it was revealed that civil servants with normal waist circumference had a lower (8.0%) prevalence of diabetes while there was a slightly high (13.9%) prevalence of diabetes among people with abnormal waist circumference. There was no statistically significant association between WC and DM with a $p = 0.115$.

The results reveal that the prevalence of diabetes was 36.8% among civil servants with a family history of diabetes compared to 3.6% among civil servants without a family history of diabetes ($p < 0.001$).

As seen in Table 7, the multiple logistic regression models show a statistically significant relationship

Table 1: Demographic characteristics of respondents

Demographics	Frequency (n= 290)	Percent(%)
Age (Years)		
=20	5	1.7
21 – 30	57	19.7
31 – 40	79	27.2
41- 50	73	25.2
=51	76	26.2
Mean±SD	40.98±11.14	
Sex		
Male	130	44.8
Female	160	55.2
Religion		
Christian	209	72.1
Islam	81	27.9
Level of Education		
None	3	1.0
Primary	2	0.7
Secondary	118	40.7
Post-Secondary	167	57.6
Marital Status		
Single	72	24.8
Married	209	72.1
Divorced	3	1.0
Widow/Widower	6	2.1
Employment Cadre		
Junior Staff	103	35.5
Middle Cadre	67	23.1
Senior/Management	120	41.4

Table 2: Distribution of Fasting Blood Sugar of respondents

Fasting Blood Sugar (mg/dl)	Frequency (n = 290)	Per cent (%)
< 100 (Normal)	202	69.6
100-125 (Impaired)	55	19.0
> 125 (Diabetic)	33	11.4
Mean±SD	95.18±22.05	

Table 3: Distribution of respondents by physical activities

Activities	Frequency	Percent(%)
Rating of overall daily physical exercise level (n= 290)		
Little or no activity	66	22.8
Occasional activity	144	49.7
Regular activities at least 3 times per week	80	27.6
Position of daily activity (n= 290)		
Sitting	153	52.8
Standing	130	44.8
Heavy labour	7	2.4
Frequency of vigorous exercise (n= 290)		
Seldom/never	104	35.9
Once a week	96	33.1
2-3 times per week	43	14.8
4-5 times per week	22	7.6
more than 5 times per week	25	8.6
Period of exercise (minutes) (n= 290)		
= 30.00	256	88.3
31.00 - 60.00	26	9.0
61.00 - 90.00	2	0.7
=91.00	6	2.1
Health checkup(n= 290)		
Yes	79	27.2
No	211	72.8
Frequency of health checkups (n= 79)		
once a year	22	27.8
once in 6 months	23	29.2
Occasionally	34	43.0

Health Check-up: Medical examination carried out by a doctor

Table 4: Distribution of respondents by diets

Diet	Frequency	Per cent (%)
Alcohol intake (n = 290)	68	23.4
Frequency of alcohol intake per day (n = 68)		
1-2	67	98.5
3-4	1	1.5
Soft drink intake (n= 290)	280	96.6
Frequency of soft drink intake per day (n = 280)		
1-2	259	92.5
3-4	21	7.5
Tobacco or cigarette smoking (n = 290)	15	5.2
Cigarette sticks per day (n= 15)		
1	0	0.0
2-5	15	100.0
> 5	0	0.0

Table 5: Distribution of respondents by medical history

Medical history	Frequency	Percent (%)
History of high blood sugar (n = 290)	17	5.9
Family history of diabetes (n= 290)	68	23.4
Female respondents with a past history of gestational diabetes (n= 160)	5	3.1
A steady increase of high blood sugar (n = 5)	2	40.0
Placement on any form of steroids for more than six months (n = 290)	13	4.5
Measured Raised blood pressure identified (n = 290)	50	17.2

Table 6: Association of Prevalence of diabetes and associated risk factors

Variables	Fasting Blood Sugar				Total Freq.	%	X ²	p-value
	Non-diabetics		Diabetics					
	Freq.	%	Freq.	%				
Body Mass Index (kg/m²)							22.57	<0.001*
Underweight (<18.5)	2	100.0	0	0.0	2	100.0		
Normal (18.5-24.9)	137	95.8	6	4.2	143	100.0		
Overweight (25.0-29.9)	63	88.7	8	11.3	71	100.0		
Obese/Severe Obesity (30 & above)	55	74.3	19	25.7	74	100.0		
Blood Pressure (Systolic- mmHg)							7.05	0.008*
Normal (<=140)	229	90.5	24	9.5	253	100.0		
High (>140)	28	75.7	9	24.3	37	100.0		
Blood Pressure (Diastolic- mmHg)							17.69	<0.001*
Normal (<=90)	231	91.7	21	8.3	252	100.0		
High (>90)	26	68.4	12	31.6	38	100.0		
Waist circumference							2.48	0.115
Normal	115	92.0	10	8.0	125	100.0		
Abnormal	142	86.1	23	13.9	165	100.0		
Family history of diabetes							56.76	<0.001*
Yes	43	63.2	25	36.8	68	100.0		
No	214	96.4	8	3.6	222	100.0		

*= 5% significance level Mean of BMI (kg/m²); non-diabetics = 25.7 and Diabetics = 31.13

Table 7: Risk factors of DM from Logistic Regression Analysis

Variables	B	Odds Ratio	S. E	p-value	95% CI limit	
					Lower	Upper
Age	0.067	1.069	0.026	0.010	0.016	0.118
BMI	0.240	1.271	0.059	0.000	0.125	0.355
Waist Circumference	-0.026	0.974	0.018	0.143	-0.062	0.009
Smoke(Cigarette)	1.807	6.095	0.893	0.043	0.058	3.557
Family history of diabetes	2.718	15.155	0.510	0.000	1.719	3.718
History of gestational diabetes	1.850	6.362	1.211	0.127	-0.524	4.225
Constant	-10.851	0.000	2.285	0.000	-15.330	-6.372

between age, BMI, family history, cigarette smoking and DM among civil servants in Ogun State. As age, BMI, family history, cigarette and smoking increases, the odds of having diabetes also increases (OR; p-value = 1.069;0.010, 1.271; <0.001, 15.155; <0.001, 6.095;0.043).

DISCUSSION

This study assessed the prevalence of diabetes mellitus and its associated risk factors among civil servants in Abeokuta, Ogun State. It established that the majority (52.4%) of the civil servants in Abeokuta, Ogun State were between the ages of 31 and 50 years, this result was similar to a recent study conducted in Ado-Odo Ota in Nigeria with the majority (69.0%) of the employees in the same age categories.[7]

The prevalence of diabetes observed in this study (11.4%) was higher than that observed among civil servants in Oyo state [8] with 4.7% and in Uyo, [4] Nigeria which reported 0.8%. Likewise, a study conducted in Congo observed 1.5%.[9] This observed increase in this study may be associated with a global increase in the trend of DM and predicted epidemic in developing countries with Nigeria inclusive. It could also partly be due to differences in the composition of the study population. However, reports in the literature indicated that the prevalence of undiagnosed DM can be as high as 18.9% in Nigeria [10] and 18.1% in South Africa.[11]

From this study, only 27.2% of the respondents did health check-ups yearly while of the 79 civil servants that went for health check-ups, only 43.0% had their health checked occasionally. This is similar to another study that reveals that 59.0% of people in low and middle-income countries hardly go for health check-ups because of the cost of regular medical check-ups, which may be out of reach of ordinary people, and hence they are not aware of some of their health conditions.[12] This study shows that 23.4% of the respondents

took alcohol, out of which 98.5% of them took less than two bottles per day. Also, 96.6% of the civil servants drank soft drinks and out of which 92.5% took less than 2 bottles per day. About 5.2% of the respondents smoke a cigar and out of which all (100.0%) took between 2 and 5 sticks in a day. Previous studies reported that cigarette smoking is a risk factor for developing type 2 diabetes.[13,14]

This study also revealed that 5.9% of civil servants were diagnosed with high blood sugar while 23.4% of them had a family history of diabetes. Similarly in Onitsha among local government employees, it was reported that 36.4% had a family history of diabetes while accessing the risk of developing diabetes mellitus.[15]

The mean BMI of detected diabetes in this study (31.13kg/m²) was higher than that of non-diabetes (25.70kg/m²). This is in keeping with the results of a study done in The Republic of Congo which reported a higher mean BMI among their detected diabetics compared with normal subjects.[9] However, BMI in this study was found to be significantly related to DM, and so is the systolic and diastolic BP. Meanwhile, a family history of diabetes and physical inactivity are important risk factors for developing diabetes.

The BMI of the respondents in this study shows a positive relationship with the development of DM, which makes it a significant risk factor for DM. Similarly, the DR Congo study reported that there is a higher mean BMI among those with detected DM when compared with the normal subjects.[9] The negative relationship of family history of diabetes in this study is however contradictory to the findings from a study by Nwafor and Owhojiwho on their part reported a positive relationship between family history of DM and the development of diabetes.[10] Due to the genetic basis of the illness, a family history of diabetes especially in the first-degree relative is a strong predisposing factor. Diabetic patients usually from studies give a history of the father, mother, uncle or siblings being diabetic.[8-10] Individuals with a positive family history of DM

or found to possess one or more of the modifiable risk factors as stated earlier need special attention, intense care and education and more frequent screening for the disease.

Physical inactivity is a well-known risk factor for type 2 diabetes. In a study done in Port Harcourt Nigeria, it was reported that the risk of diabetes is reduced by 50% among men who take moderately vigorous exercise.[10] Furthermore, a study in South Africa showed that physical activity is inversely related to the development of diabetes.[11] This conforms to this study showing that physical exercise reduced the likelihood of diabetes among civil servants. However, the mechanism of protective effects of physical activity on the risk of developing DM is seen in the study among South Africans.[11] This study on metabolic syndrome in the South African coloured population reported that this protective mechanism can be explained by effective body-weight control, improvement of biomarker profiles and reduction of metabolic syndrome risk.[11]

The fact that family history as a risk factor for type-2 DM was based on direct questioning of the respondents only, this alone without considering other first degree relatives and siblings may not be enough to determine the genetic influence in DM. Owing to financial and other logistic reasons, we are unable to incorporate other tests like the Oral glucose tolerance test (OGTT) and urinalysis (to determine glucose in the urine) which could have increased the specificity of the study. Above all, only the blood glucose test was used to diagnose DM, and this cannot differentiate DM types.

CONCLUSION

The study has established that the prevalence of diabetes was 11.4% while the study also showed that the fasting blood sugar of civil servants in Ogun State varied from 58mg/dl and 180mg/dl with an average of 95.18 ± 22.05 mg/dl. The study indicated that to decrease the incidence of diabetes,

it is essential to control the modifiable risk factors such as; soft drink consumption, alcohol consumption, tobacco smoking, physical inactivity and a healthy diet.

We, therefore, recommend that the government should intensify efforts on educating the populace on the importance of prevention of diabetes mellitus to enhance the significant reduction in the prevalence of DM and associated complications, involved in training and educating health workers with the right information and equipping the facilities with the appropriate equipment and human resources.

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Author contributions:

AA- Conceptualization, design, data presentation and review of the manuscript; OO- Design and manuscript draft revision; OA Data collection and writing of the manuscript; CC- Data analysis and review the of manuscript

Data availability:

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

1. Park A. Parks textbook of preventive and social medicine. 23rd ed: Banarsidos Bhanot; 2015.
2. International Diabetes Federation. IDF Diabetes Atlas, 9th edn. Brussels, Belgium: 2019. Available at: <https://www.diabetesatlas.org>. Accessed 25th May 2022.
3. National Bureau of Statistics. Annual abstract of statistics: Federal Republic of Nigeria. Abuja: National Bureau of Statistics. 2016; Link: <https://bit.ly/3oJQgco>
4. Ekpenyong C, Akpan U, Ibu J, Nyebuk D. Gender and age-specific prevalence and associated risk factors of type 2 diabetes mellitus in Uyo metropolis, southeastern Nigeria. *Diabetocroatica* 2012; 41:17-28.
5. Centre for Disease Control. Chronic Disease Indicators: National Centre for Chronic Disease Prevention and Health Promotion. 2016. Available at: <http://apps.nccd.cdc.gov/cdi/>
6. Franklin BA. American College of Sports Medicines' Guidelines for Exercise Testing and Prescription: 11th edn; 2019; 18-22.
7. Adiele, GN. A Study of Manpower Training and Productivity in Ado-Odo Ota Local Government, Ogun State (2006-2016): A Master of Science (M. Sc) Dissertation in Public Administration, Department of Political Science and International Relations, College of Leadership Development Studies, Covenant University, Ota, Ogun State: 2017.
8. Shittu RO, Kasali FO, Biliaminu SA, Odeigah LO, Sule AG, Musah Y. Prevalence of Diabetes and Pre-Diabetes in Oke-Ogun Region of Oyo State, Nigeria. *J Med Research & Health Educ* 2018;1(6):1-7.
9. Muyer MT, Muls E, Mapatano MA, Makulo JR. Diabetes and intermediate hyperglycaemia in Kisantu, DR Congo: a cross-sectional prevalence study. *BMJ* 2012; 2.
10. Uloko AE, Musa BM, Ramalan MA, Gezawa ID, Puepet FH, Uloko AT, Borodo MM, Sada KB. Prevalence and Risk Factors for Diabetes Mellitus in Nigeria: A Systematic Review and Meta-Analysis. *Diabetes Ther.* 2018 Jun;9(3):1307-1316. doi: 10.1007/s13300-018-0441-1. Epub. PMID: 29761289; PMCID: PMC5984944.
11. Eransmus RT, Soita DJ, Hassan MS, Blanco-blando E, Vergotine Z. High prevalence of diabetes mellitus and metabolic syndrome in South African coloured population: baseline data of a study in Bellvine, Cape town. *S Afr Med J* 2012; 102:841-844.
12. Ejike EC, Ejike NK, Nwachukwu SO. Diabetes and Pre-diabetes in adult Nigerians: prevalence and correlations of blood glucose concentrations with measures of obesity. *Afric J BCM Research* 2015;9(3):55-60.
13. Danjin M, Usman NU, Adamu D. Prevalence of diabetes mellitus in a tertiary health institution in Gombe Metropolis, Nigeria. *Sudan Med Monit* 2016;11:113-8.
14. Farvid MS, Homayouni F, Shokoohi M, Fallah A, Farvid MS. Glycemic index, glycemic load and their association with glycemic control among patients with type 2 diabetes. *Eur J Clin Nutr.* 2014 Apr;68(4):459-63. doi: 10.1038/ejcn.2013.288. Epub 2014 Feb 19. PMID: 24549029.
15. Uloma A, Maurice CA, Godswill AN. Assessment of risk of developing diabetes mellitus among Local Government Employees in Onitsha, South-Eastern Nigeria. *Epidemiology Report* 2015; 3:105-106.