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# Comparative Studies of Diabetes in Adult Nigerians: Lipid Profile and Antioxidants Vitamins (A and C)

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## ABSTRACT

Diabetes mellitus affects the metabolism of carbohydrates and fats which if not properly managed will alter the lipid profile and antioxidant vitamins of the body system. However information on the extend and health consequences of these, are scarce in Nigeria. This study compared the lipid profile and some antioxidant vitamins in diabetics and apparently healthy adults were conducted in Imo State Nigeria. Standard protocols were followed for all determination of samples obtained from patients at two major tertiary health institutions in the state. The mean fasting blood sugar (FBS) concentrations of the experimental group were 8.36±1.1mmol/L for males, 9.75±0.5mmol/L for females while the control was 4.8±0.44mmol/L for both sexes. Majority of subjects with diabetes were within the ages of 40years and above. Dyslipidemia was higher among diabetic patients compared to control, while there were significant increases in low density lipoprotein cholesterol (LDL), triglyceride (TG) and reduction in high density lipoprotein cholesterol (HDL) compared to the controls. Also there were significant reductions in antioxidant vitamins C and E of the experimental groups compared to the controls (P > 0.05). Antioxidants maybe a prospect in the treatment/ management of diabetes. More robust studies are needed to further confirm these findings and identify other causes.

***KEYWORDS:*** *diabetes mellitus, dyslipidemia, antioxidant vitamin, fasting blood sugar*

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## INTRODUCTION

Diabetes mellitus (DM) refers to a group of metabolic diseases in which there are high levels of blood sugar over prolong period. The common symptoms of diabetes include polyuria, increased thirst and hunger (WHO, 2014). It results in aberration in carbohydrates, fats, and protein metabolism, which arise due to defects in insulin secretion, and/or actions (Ejike *et al*., 2015). DM is currently a very prevalent disease, especially in Africa (Bos and Agyemang, 2013). Diabetes if left untreated can cause many complications which include diabetic ketoacidosis, hyperosmolar hyperglycemic state or death. Other long term complications includes cardiovascular diseases, stroke, chronic kidney disease, foot ulcer and eye damage (WHO, 2013). Globally at the end of 2017, 425 million people had diabetes worldwide (IDF, 2017); up from an estimated 382 million people in 2013 (Shi and Hu, 2014). The increase in prevalence of diabetes accounts for the shifting age structure of the global population of people living with the disease with type 2 or DM accounting for over 90% of cases (Vos et al., 2012). Diabetes occurs throughout the world but is more common in more developed countries. The greatest increase in rate has been seen in low and middle income countries (LMIC) where more deaths occur (WHO, 2016; Mathers and Loncar, 2006).The increase in rate in developing countries follows the trends in urbanization and lifestyle changes, including sedentary lifestyles, less physically demanding work and the global nutrition transition marked by increased intake of foods that are high energy-dense but nutrient-poor (often high in sugar and saturated fats sometimes referred to as “western-style” diet) (who, 2016; Wild, 2004).

Diabetes mellitus usually have a serious impact on the metabolism of carbohydrates and fats in the body, if they cannot be properly utilized will alter the lipid profile and antioxidant vitamins, especially vitamin C and E that fights to remove or restore homeostatic changed by the hyperglycemic condition in diabetic cells. Comparing the lipid profile and antioxidant vitamins of diabetic and non-diabetic individuals will be useful in guiding future research effects and public policy formulations and action toward proper management and cure of the diabetic disease.

## MATERIALS AND METHODS

STUDY AREA: The study was conducted at two tertiary health institutions in Imo- State – Imo- state University Teaching Hospital Orlu and Federal Medical Center Owerri. Orlu and Owerri are among the major towns in Imo State with a combined population of 3,927,563 according to the 2006 census. The towns lies within latitude $4^{o}45^{'}$ N and $7^{o}$ 15' and longitude $6^{o}$ 50'E and $7^{o}$25'E AND COVERS AN AREA OFABOUT 5100Sq Km.

**STUDY POPULATION:** Adult subjects (18years and above) who are patients of the Federal Medical Center (FMC) Owerri and Imo-State University Teaching Hospital Orlu were approached and the goals of the research explained to them, those that gave their consent were recruited for the study. Those with any chronic illness, pregnancy or recent delivery (in women) were excluded. A total of 150 subjects participated actively in the study.

## SAMPLE COLLECTION

Blood samples were collected from subject who have fasted for at least 12hours (overnight) and used for the study. The samples were collected under aseptic condition into Lithium Heparin anticoagulant bottles and used for the determination of the lipid profile parameters. Other parameters analysed are vitamins C and E.

## METHODS

Diabetes was diagnosed as fasting blood sugar concentration of ≥ 7.0mmol/L (126mg/dL), using Randox glucose reagent (Gluc PAP)RX MONZA GL 364, United Kingdom. Total cholesterol (TC), High density lipoprotein cholesterol (HDL), Low density lipoprotein cholesterol (LDL) and triglyceride (TG) were analyzed using BioSystem Reagents SA. Barcelona (Spain), Reagent COD11506, COD11523, COD11579 and COD11529 respectively. Vitamins C and E were determined using ELISA kits, SMI – RO1KO2 – EX and MBS728239 respectively.

The subjects were stratified into five different age groups or ranges i.e. 18 – 29years, 30 – 39years, 40 – 49years, 50 – 59years, 60years and above. Other data necessary for the research were obtained using a structured questionnaire.

The ethical clearance for the study was gotten from Research Ethical Committee of the Abia State University Uturu and the Ministry of Health Owerri Imo-State Nigeria.

## DATA ANALYSIS

Descriptive statistics were used and data generated presented as mean ± standard deviation. Also differences between group means were separated using one – way analysis of variance (ANOVA) with significant value at $P < 0.05$.

## RESULTS

The fasting blood sugar levels of the experimental groups compared to controls, stratified according to groups and gender showed that the mean fasting blood sugar concentration were 8.35± 1.1 (mmol/L) for males, 9.75± 2.0 (mmol/L) for females while the control was 4.8± 0.44 for both gender. Majority of the experimental group subjects with diabetes are within the ages of 40years and above as contained in Table 1.

**Table 1: Concentration of FBS of the experimental groups and control (mmol/L)**

| Ages (years) | 18 - 29 | 30 – 39 | 40 - 49 | 50 - 59 | 60 and above | All | Control |
|---|---|---|---|---|---|---|---|
| FMC OWERRI | | | | | | | |
| Male | 0 | 0 | 0 | 7.9±0 | 8.5±0.5 | 8.2±0.6 | 4.3±1.9 |
| Female | 0 | 0 | 10.9± 0 | 8.3± 0.7 | 10.7±4.3 | 10.0±2.6 | 4.9±0.1 |
| Total | 0 | 0 | 10.9± 0 | 8.1± 0.2 | 9.6±1.1 | 9.5±2.8 | 4.6±0.3 |
| IMSUTH ORLU | | | | | | | |
| Male | 0 | 0 | 9.5±0 | 8.1±0.2 | 7.9±0.6 | 8.5±1.6 | 5.3±1.7 |
| Female | 0 | 0 | 9.4±33 | 10.2±0.0 | 8.8±2.2 | 9.5±1.4 | 4.7±0.0 |
| Total | 0 | 0 | 9.5±0.1 | 9.2±1.1 | 8.4±0.0 | 9.0±1.1 | 5.0±0.3 |

Values are means ±SD of 150 determinations of the subjects FBS from the health institutions at various age groups. FBS – Fasting blood sugar.

**Table 2: Lipid profile of the experimental groups and control**

| Parameters | TC (mmol/L) | TG (mmol/L) | LDL (mmol/L) | HDL (mmol/L) | VLDL(mmol/L) |
|---|---|---|---|---|---|
| Group 1(FMC) | 8.28±2.62[a] | 2.37± 0.84[a] | 4.58±2.75[a] | 1.43±0.57[a] | 1.46±1.19[a] |
| Group2(IMSUTH) | 7.98±1.96[a] | 3.10±0.73[a] | 5.22±1.11[a] | 1.55±0.23[a] | 1.87±1.28[a] |
| Group3(Control) | 5.02±0.97[b] | 1.77±0.60[b] | 1.96±0.61[b] | 1.77±0.69[a] | 1.10±0.60[a] |

Values are means ± S.D. of 150 determinations of subjects' samples. Mean values with different superscript alphabets along a column differs significantly (P < 0.05). *TC – Total cholesterol, TG – Triglycerides, LDL – Low density lipoprotein cholesterol, HDL – High density lipoprotein cholesterol, VLDL – Very low density lipoprotein cholesterol, Group1 – Experimental group at FMC Owerri, Group2 Experimental group at IMSUTH Orlu. Group3 (Control) – Non diabetic subjects.*

**Table 3: Concentrations of vitamins C and E of the experimental groups and control**

| Experimental Groups | Vitamin C (mg/dl) | Vitamin E (mg/dl) |
|---|---|---|
| Group 1 (FMC Owerri) | 1.16±0.34[a] | 1.35±0.42[a] |
| Group 2 (IMSUTH Orlu) | 1.07±0.44[a] | 1.01±0.22[a] |
| Group 3 (Control) | 1.68±0.07[b] | 2.03±0.19[b] |

Values are means ± S.D. OF 150 determinations. Mean values with different alphabets superscript along a column differs significantly (P < 0.05). *Group1 – Experimental group at FMC Owerri, Group2 Experimental group at IMSUTH Orlu. Group3 (Control) – Non diabetic subjects.*

## DISCUSSION

The incidence of diabetes has continued to rise all over the world even to epidemic proportions especially in developing countries like Nigeria. Unlike in developed economies where people60 years and above are mostly affected, diabetes in this study is comparatively high in young to middle-aged people as indicated in table 1 above. These findings are in line with that of Enang *et al*., (2014) and Ejike, et al., (2015). Hyperglycemia is associated with long term damage, dysfunction and failure of normal functioning of many organs including eyes, heart, kidney, nerve and blood vessels. The concentration of fasting blood sugar (FBS) was slightly higher in female subjects than in males as contained in table 1. This report is in agreement with that or Chinenye, et al., (2008) and Enang, et al., (2014). This change can be attributed to the recent trend in urbanization and lifestyle changes, including a "western style" diet promoted mostly by the rise in establishment of 'fast food' joints and mechanized lifestyle (Rosenheck, 2008). Other factors that may contribute to this change include the poor state of healthcare in developing countries, poverty and poor nutrition. This study showed significant increases in low density lipoprotein cholesterol (LDL-C), Total cholesterol (TC) and Triglyceride (TG) of the experimental groups from the two study areas compared to the control. Also decrease in high density lipoprotein cholesterol (HDL-C) was recorded in the Experimental Groups 1 and 2 (i.e. the subjects with diabetes) compared to the controls (see Table 2). This report is in agreement with that of American Diabetic Association, which stated that diabetes mellitus is characterized by lipid abnormalities such as low density lipoprotein cholesterol (LDL) and total cholesterol (ADA, 2011; Ronald and Krauss, 2004).

The explanation for this observation is the fact that excess sugar in a diabetic cell is often converted to fats (Triglycerides and low density lipoprotein cholesterol) which are deposited in the blood vessels. Thus diabetes increases some components of the lipid profile like low density lipoprotein cholesterol (LDL-C), total cholesterol (TC) and triglycerides (TG) while it decreases high density lipoprotein (HDL-C) (Heidi, 2009). These findings are in accordance with that of Kayode, *et al.* 2010.

Human body is continuously being exposed to different types of agents that result in production of reactive species called free radicals. These free radicals by the transfer of their unpaired electrons cause the oxidation of cellular machinery. Diabetes comes with increased sugars in tissue and fluids of the body. These increase results in increased free radicals which in turn induces oxidative stress, inflammation and insulin resistance (Ejike, *et al.* 2015; Watson, *et al*. 2014). This relationship explains the complicity of diabetes as contained in this study. In order to prevent their deleterious effects, body has endogenous antioxidant system or obtained from diet that neutralizes such species and keeps the body homeostasis. Any imbalance between the reactive species (RS) and antioxidant systems lead to a condition known as "oxidative stress" and results in development of pathological conditions including diabetes and others (Twari, et al. 2013). Oxidative stress plays a pivotal role in the development of diabetes and their complications. Some studies reveal the inference of oxidative stress in pathogengsis by

alteration in enzymatic systems, lipid peroxidation, impaired glutathione metabolism and decreased vitamin C (Ullah, *et al.*2015; Ferdinando and Micheal, 2010; Johansen, *et al*. 2005 and Valko, *et al*. 2007).

The concentrations of vitamins C and E in the serum of the experimental subjects with diabetes in this study were significantly reduced compared to the controls (non-diabetics). The reduction in vitamin C could be as a result of the toxicity caused by the oxidative stress induced by the diabetic conditions. Concentrations of vitamin E in this report either decreases or increases in some experimental subjects of the study. These conflicting reports showed that diabetes have deleterious effects on vitamin E concentration in the body, and is in line with the report of Maritim, *et al*., 2003 which stated that vitamin E may either be increased or decreased by diabetes. Vitamins play important roles in different biochemical processes. Vitamins C and E act as antioxidants that detoxify the free radicals. Alterations in their concentrations are significant biomarker of oxidative stress (Johansen, *et al*., 2005; Valko, *et al*. 2007).

## CONCLUSION

As diabetes is characterized by hyperglycemia, this study showed that the mean fasting blood sugar (FBS) concentration were 9.3±1.1 (mmol/L) for males, 9.5±0.5 (mmol/L) for females while the control was 4.8±0.44 (mmol/L) for both sexes. Majority of the experimental subjects with diabetes are within the ages of 40years and above unlike compared to developed world were mostly aged people 60years and above were affected. Dyslipidemia were higher among experimental subjects with diabetes compared to the controls. These abnormalities in lipid profile include elevated low density lipoprotein cholesterol (LDL-C) and triglyceride (TG), and reduced high density lipoprotein cholesterol (HDL-C). The diabetic conditions in the cell of subjects result in production of reactive oxygen species (ROS) that causes oxidative stress. This caused the reduction in concentration of antioxidant vitamins in the serum of the experimental groups compared to the control. Thus oxidative stress plays important roles in the progression of diabetes and their complications. Therefore, antioxidants maybe a prospect in the treatment and management of diabetes. More robust studies are needed to further confirm these finding and identify other causes.

## LIMITATIONS

The study was limited by the small sample size which was necessitated by limited funds at our disposal, unwilliness of people to give their blood due to cultural belief systems and lack of honoraria paid to participants.

## CONFLICT OF INTREST

None

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