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Effect of Nutrition Education on Serological Variables of Type 2 Diabetes Mellitus Patients Attending Nigerian National Petroleum Company Limited Clinic Warri, Delta State Nigeria

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ABSTRACT

Background: The increasing prevalence of diabetes mellitus around the world appears as dramatic as to have been characterized as an epidemic. Diabetes mellitus causes prolonged ill-health, imposes morbidity and mortality risks, and necessitates a change in lifestyle, with a meticulous daily routine and long-term self-care.
Objective: The objective of the study was to assess the effect of nutrition education on serological variables of the type 2 diabetes mellitus patients.
Methodology: Two Hundred and Thirty (230) out of 258 subjects who participated in the longitudinal study were confirmed Type 2 diabetics. One hundred and Fifty (150) subjects were grouped into education group and Eighty (80) subjects into control group. Information on socio-demographic, life-style characteristics, and management regimens of the diabetes were collected using structured, validated and pretested questionnaire. Subject's serological variables such as glycated hemoglobin (HbA1c), Fasting Blood Glucose (FBG), 2-hours post prandial and fasting lipid profile were collected. Nutrition education was instituted and was performed in a group of 15 patients per session in 2 hours.
Results: Most of the subjects (70.0%) in the education group at baseline had elevated HbA1c with a mean baseline HbA1c level of 8.08+1.88%. While most of the subjects (65.00%) in the control group at baseline had normal HbA1c with a mean baseline glycated hemoglobin level of 7.01+1.86%. However, there was a significant difference ($P<0.05$) in the mean and percentage number of HbA1c of the subjects in education and control group. Only 6.7% of the subjects had low Fasting Blood Glucose (<4.2mmol/l), 58.0% had high Fasting Blood Glucose (>7.0mmol/l) and 35.3% had normal Fasting Blood Glucose (4.2-5.9mmol/l). After three months follow up, the number of subjects who had normal FBG increased from 35.3% to 54.7%, the low FBG levels increased from 6.5% to 10.0% but high Fasting Blood Glucose levels reduced from 58.0% to 35.3%.
Conclusion: There was significant reduction in the glycated hemoglobin (HbA1c) and Fasting Blood Glucose (FBG) of the subjects after nutrition education and follow up, indicating that nutrition education and follow up has positive impact the serological variables of the subjects who are diabetics.

Keywords: *Nutrition Education, FBG, HbA1C, Total Cholesterol*

INTRODUCTION

Diabetes Mellitus is a group of multi-system endocrine disorder characterized by a raised blood glucose concentration due to defects in insulin secretion or action or both (1, 2). It is a heterogeneous group of clinical disorders with abnormalities in the metabolism of carbohydrate, protein and fat that results primarily from the deficiency in the synthesis, secretion or function of insulin (3). Diabetes mellitus occurs throughout the world. Mokdad, Ford & Bowman (3) observed that an epidemic of diabetes mellitus was occurring worldwide and warned that communities in developing countries were now at greatest risk of the disease.

Nutrition education is an essential component in improving dietary habits and food choices, in order to reverse the under nutrition and improve the nutritional diagnosis. Poor dietary habits and lack of physical activity can be the main reason for poor nutritional status among Type 2 diabetics (4). The increasing prevalence of diabetes mellitus around the world appears as dramatic as to have been characterized as an epidemic (5). Diabetes mellitus causes prolonged ill-health, imposes morbidity and mortality risks, and necessitates a change in lifestyle, with a meticulous daily routine and long-term self-care. The cardiovascular complications of diabetes, which is also a leading cause of blindness, amputation and kidney failure, account for much of the social and financial burden of the disease (6). The prediction that diabetes incidence will double by the year 2025 indicates a parallel risk in cardiovascular related illness and death, an inevitable and profound impact on global health-care system and a rise in co-morbid

diseases (7). The burden on the health-care system and budget are enormous.

Nutrition education is a key component of diabetes self-management because it teaches individuals to manage their diabetes (8). Knowledge about disease management is critical for diabetic patients as well as family members in order to fully understand the disease.

The American Diabetes Association opined that dietary management is crucial for all types of diabetes (8). The basic nutritional requirement of diabetic patient is the same as those of a non-diabetic. However, the regimentation of food intake is the cornerstone of diabetic therapy. Poor dietary habits and lack of physical activity can be the main reason for poor nutritional status among Type 2 diabetics (7).Timing of food intake, the caloric value of food ingested, the proportions and quality of carbohydrate, fat and protein are all-important aspect of the diet (8). The major principle is to reduce hyperglycemia, avoid hypoglycemia, and maintain appropriate weight. In an attempt to lower blood glucose, the patient should avoid easily absorbable simple carbohydrates and highly processed and refined foods. The levels of energy recommendation for a patient depend on the age, body weight and activity.

Dietary management is considered the basis of glycemic control in diabetes mellitus patients (9). Patient education including nutrition education is now accepted as an essential component of diabetic management (10). Numerous studies with diabetes mellitus patients have shown the association of nutrition education with improving dietary behavior (11, 12), nutritional knowledge (13,14) and improving clinical outcomes such as lower blood glucose and Glycated hemoglobin (HbA1c) levels (15,16,17,18) and lipid concentrations (19,20).

The objective of the study is to assess the effect the of nutrition education on the serological variables of the Type 2 diabetics. Attending Nigerian National Petroleum Company Limited Clinic Warri, Delta State Nigeria.

MATERIALS AND METHODS

Study Design

The study was multi-stage intervention prospective study.

Study Location

This study was carried out in the Nigerian National Petroleum Company (NNPC) Medical Services Ltd, Warri Delta State. The NNPC Medical Services is basically an industrial hospital located in the NNPC Housing Complex Ekpan. It has field clinics in various subsidiary units such as Warri Refining Petrochemical Company (WRPC), Nigerian Gas Company (NGC), and Pipeline Products Marketing Company (PPMC) respectively. NNPC medical Services offers treatment only to NNPC staff, Retirees, staff spouses and dependents. It is a secondary health care facility with over 30 beds and has the following departments: Accident and Emergency, Theatre, Pharmacy, Medical Laboratory, Radiology, Dental, Ophthalmology, Nutrition and Dietetics, and Physiotherapy.

Subjects and Sample size:

Two Hundred and Thirty (230) out of 258 subjects who participated in the intervention prospective study were confirmed Type 2 diabetics. The subjects were group into education group and control group.

Data Collection

Baseline information on socio-demographic, life-style characteristics, and management regimens of the diabetics were collected using structured, validated and pretested questionnaire. The initial Subject's serological variables such as glycated hemoglobin (HbA1c), Fasting Blood Glucose (FBG), 2-hours post prandial (2HPP), total Cholesterol (TC), Low density Lipoprotein Cholesterol (LDL-C), High density Lipoprotein Cholesterol (HDL-C), and Triglyceride (TG) were collected.

Post Nutrition education and three (3) months follow up on Subject's serological variables such as glycated hemoglobin (HbA1c), Fasting Blood Glucose (FBG), 2-hours post prandial (2HPP), total Cholesterol(TC), Low density Lipoprotein Cholesterol (LDL-C), High density Lipoprotein Cholesterol (HDL-C), and Triglyceride (TG) were collected.

A sub-sample of 24 subjects was selected by purposive sampling technique from the education group. A meal plan was developed for the subjects based on their calorie requirements and subjects were followed up monthly for three months, Their FBG, 2HPP, BMI and WC were evaluated monthly to assess the immediate effect of the nutrition education and meal plan intervention on blood glucose and anthropometric data.

Time and Duration of the Study

After the education session, the subjects were given follow up monthly appointment in addition with follow-up telephone calls for 3 months and each subject was called ones in a week. The control group was neither call nor followed up for three month.

Nutrition education lesson were given to the education group who were booked for the endocrinologist on out-patients department (OPD). The education session was every Thursdays being the consultation day for endocrinologist. The nutrition education lesson consisted of two sessions for 2 hours and was done in a group of 15 patients per session. The lesson note for the nutrition education was structured to provide an understanding of meal planning, carbohydrate counting, importance weight loss and physical activities. The purpose of the lesson was to encourage

and support self-management leading to long-term adherence to diet recommendations and lifestyle changes.

Inclusion criteria

Only outpatient confirmed type 2 diabetics who have been diagnosed for more the three (3) months and attend NNPC medical Services Ltd Warri Delta State for medical treatment were included. Patients with any obvious internal organ disorders (renal failure, severe heart or liver diseases) were excluded from the study. Patients in very poor state or bedridden were also excluded from the study.

Ethical Clearance/Subject's Consent

Ethical Clearance approval was obtained from board of NNPC Medical Services Ltd, authorities. The subjects consent was obtained verbally after the purpose of the research and their involvement was explained to them.

Sample Size Determination

Sample size was obtained using 0.65% prevalence rate of type 2 diabetes mellitus (21). Sample size was calculated using the formula N = 4p (1 – P)/ W2 (22). Where N = total number of patients required

P = proportion of people assumed to have diabetes, p = 0.65% (21)

W = required precisions level or probability level. For this study, W was taken to be

0.01 (1%). N = 4P (1-P)/ W2= 4 x 0.0065 (1-0.0065)/ (0.01)2 = 0.026 x 0.9935/0.0001 = 0.0258/0.0001= 258 patients.

Sampling Technique

The subjects were selected by heterogeneous purposive sampling technique which relies on researcher's judgment to select participants with diverse characteristics. This is done to ensure the presence of maximum variability within the primary data.

Nutrition education Lesson plan

Table 1 shows nutrition education lesson plan. It is structured to provide an understanding on the importance of diet in the management of type 2 diabetes mellitus and dietary recommendation for diabetics. The purpose of the lesson was to encourage and support self-management leading to long-term adherence to diet recommendations.

Table 1: Nutrition education Lesson plan

TOPIC: NUTRITION EDUCATION ON THE MANAGEMENT OF TYPES 2 DIABETES MELLITUS			
NUMBER OF LEARNERS=15		**DATE:……..**	
AIM	• Understand the importance of diet in the management of type 2 diabetes mellitus • Dietary recommendation for diabetics		
LESSON PERIOD	**LEARNING OBEJCTIVE**	**LEARNING ACTIVITIES**	**INTRUCTION MATRIALS**
45minutes	At the end of this lesson, leaners should be able to understand: 1. the importance of diet therapy and general principles of diabetes management 2.The concept of carbohydrate counting, food groups, food items for each food group, and food exchange units 3. Dietary recommendation, signs, and symptoms for complications of diabetes e.g. hypoglycemia, proper strategy to raise blood glucose. 4.Importance dietary, drug and physical activity compliance	• Introduction of topic to the learners • Explaining and demonstration of topics with food models and aids. • demonstration of topics with food models and aids by learners	• Educational leaflet diabetes management, simple and complex carbohydrate, saturated and unsaturated fat, portion sizes, calories contained in beverages and alcohol • Food models of different sizes and shapes
15-25 minutes	Answer learners questions and clarifications	• Respond to learners Questions	

Statistical Analysis

The data were analyzed using statistical package for social sciences (SPSS) version 21 and Microsoft Excel. Descriptive statistics, (frequencies, bar and pie charts, percentages, mean and standard deviations (SD) were calculated. Paired t-test was used to identify significant differences, serological data. P-value of <0.05 was taken as statistically significant.

RESULTS

Socio-economic characteristics of the Subjects

Table 2 presents baseline socio-economic characteristics of the subjects. About 54% of the subjects in the education group were middle age (40-59 years) and 36% of the subjects in the control group were 40-59 years. For the control group only 6.25% were between 20-30 years and 45.00% of the subjects studied were middle age (60-79 years) while 12.25% were 80 years and above. About 56.7% and 52,5% of education group and control group were males respectively. For the education group 1.3% was single, 87.3%married, 8.7% and 2.76% were widowed and separated respectively while most (80.75%) in the control group were married, 8.75% and 2.50% were widowed and separated respectively. About 80.7% in the education group were Christians, 16.8% Muslims and 2.7% practice other religion while in control group Christians were 83.8% and Muslims 16.3% About 74.7% had tertiary education, 20.0% secondary education and 5.3% primary education while in the control group, 83.8% had tertiary education and 16.3% secondary education

Table 2: Socio-economic characteristics of the subjects:

Variables	Education Group (n=150) F (%)	Control Group (n=80) F (%)
Age (Years)		
20-39	3(2.00)	5(6.25)
40-59	82(54.67)	29(36.25)
60-79	50(33.33)	36(45.00)
80 and Above	15(10.00)	10(12.25)
Total	150(100)	80(100)
Sex		
Female	65(43.33)	38(47.50)
Male	85(56.67)	42(52.50)
Total	150(100)	80(100)
Marital Status		
Single	2(1.33)	-
Married	131(87.33)	71(80.75)
Divorced	-	
Separated	4(2.67)	2(2.50)
Widowed	13(8.67)	7(8.75)
Total	150(100)	80(100)
Religion		
Islam	25(16.67)	13(16.25)
Christian	121(80.67)	67(83.75)
Others	4(2.67)	-
Total	150(100)	80(100)
Educational Level		
Primary Education	8(5.33)	-
Secondary education	30(20.0)	13(16.25)
Tertiary	112(74.67)	67(83.75)
Total	150(100)	80(100)

Table 3 Socio-demographic characteristics of the subjects

Table 3 shows that Urhobo was the most predominant tribe (20.0%) followed by Igbo (18.0%) and Yoruba (16.0%). Hausa, Edo and others accounted for 12.67%, 12.0% and 21.33%, respectively. Most (53.33%) of the subjects earned an average income of ₦40,000 and above while 22.67% earned ₦30,000-39,000 followed by 13.33% (₦20,000-29,000)8.67% (₦10,000-19,000) and 2.0% (<₦10,000), respectively. Most (76.67%) of the subjects were retired staff while 15.33% were active staff and 8.00% were Staff spouse. About 2.67% had diabetes mellitus < 1 year of diagnosis. Most of the subjects (41.33%) had diabetes mellitus 11 years and above while 36.00% and 20.00% had diabetes mellitus for 1-5years and 6-10 years

respectively. Most of the subjects (81.33%) had family history of diabetes mellitus while 18.67% had no family history of diabetes mellitus. Most of the subjects (55.3%) admitted that they are hypertensive while 44.7% were not.

Table 2 Socio-demographic characteristics of the subjects

Variables	Frequency(F)	Percentage (%)
Tribe		
Hausa	29	12.67
Igbo	41	18.00
Edo	28	12.00
Urhobo	46	20.00
Yoruba	37	16.00
Others	49	21.33
Total	230	100
Average monthly Income (Naira)		
<10,000	5	2.00
10,000-19000	20	8.67
20,000-29,000	31	13.33
30.000-39,000	52	22.67
>40,000	122	53.33
Total	230	100
Categories of Staff		
Active staff	35	15.33
Retired Staff	176	76.67
Staff Spouse	19	8.00
Total	230	100
Duration of Diabetes		
<1year	6	2.67
2-5 years	46	20.00
6-10years	83	36.00
>11 years	95	41.33
Total	230	100
Family history of Diabetes		
Yes	187	81.33
No	43	18.67
Total	230	100

Table 4 shows change in the mean serological variables of the subjects. The mean FBG of the education group at baseline and after 3 months follow up were 7.21±3.34mmol/l and 6.4.40±2.10mmol/l, respectively. The HbA1c were 8.08±1.88% and 7.02±1.43%, respectively. Also the mean FBG of the control group at baseline and after 3 months was 7.57±2.73mmol/l and 8.09±2.65mmol/l and HbA1c were 8.09±1.86% and 8.23±1.74%, respectively. There was no significant (P>0.05) difference in the mean FBG of the education group and control group. But significant (P<0.05) difference was observed in the mean HBA1C of the education group and control group.

The mean 2HPP of the education group at baseline and after 3 months follow up were 9.75±4.12mmol/l and 8.32±3.12 mmol/l respectively. Also the mean 2HPP of the control group at baseline and after 3 months was 10.24±2.20mmol/l and 8.09±2.65mmol/l respectively. There was significant difference (P<0.05) in the mean 2HPP of the education group and control group.

The mean total cholesterol (TC) levels of the education group at baseline and after 3 months follow up were 177.93±38.90mg/dl and 164.47±26.30mg/dl respectively. LDL-C was 129.95±31.35mg/dl and 125.65±28.40mg/dl respectively. Also the mean total cholesterol (TC) levels of the control group at baseline and after 3 months were 162.48±57.5mg/dl and 185.86±45.79mg/dl respectively. Low density lipoprotein cholesterol (LDL-C) was 125.25±28.19mg/dl and 137.77±31.32mg/dl respectively. There was significant difference (P>0.05) in the mean total cholesterol (TC) levels of the education group and control group. Significant (P<0.05) difference was also observed in the mean LDL-C of the education group and control group.

The mean HDL-C of the education group at baseline and after 3 months follow up were (male) 40.20±6.34mg/dl, (female) 38.41±8.50mg/dl and

(male) 48.68±7.40mg/dl, (female) 42.98±6.90mg/dl, respectively. Also, the mean HDL-C of the control group at baseline and after 3 months was (male) 32.74±4.40mg/dl, (female) 32.29±4.90mg/dl and (male) 30.87±5.81mg/dl, (female) 32.54±4.56mg/dl. There was significant (P<0.05) difference in the male mean HDL-C of the education group and control group. But no significant difference (P>0.05) was observed in the female mean HDL-C of the education group and control group.

The mean triglyceride (TC) levels of the education group at baseline and after 3 months follow up were 139.12±33.47mg/dl and 89.68±35.60mg/dl. Also, the mean triglyceride (TC) levels of the control group at baseline and after 3 months were 128.30±32.43mg/dl and 140.52±41.70mg/dl. There was no significant (P>0.05) difference in the mean triglyceride (TC) levels of the education group and control group.

Table 4: Change in the serological variables of the subjects

Variables	Education Group		Control Group		P-value
	Pre intervention	Post intervention	Baseline	After3 Months	
FBG(mmol/l)	7.21±3.34[a]	6.4.40±2.10[b]	7.57±2.73[a]	7.09±2.65[a]	0.270
HbA1c (%)	8.08±1.88[a]	7.02±1.43[b]	7.01±1.86[a]	8.23±1.74[a]	0.000
2HPP(mmol/l)	9.75±4.12[a]	8.32±3.12[c]	10.24±2.20[b]	10.65±2.06[b]	0.02
TC(mg/dl)	177.93±38.90[a]	164.47±26.30[b]	162.48±57.5[b]	185.86±45.79[c]	0.005
LDL-C (mg/dl)	129.95±31.35[a]	125.65±28.40[b]	125.25±28.1[b]	137.77±31.32[c]	0.013
HDL-C(mg/dl)					
Male	40.20±6.34[a]	48.68±7.40[b]	32.74±4.40[c]	30.87±5.81[c]	0.000
Female	38.41±8.50[b]	42.98±6.90[a]	32.29±4.90[b]	32.54±4.56[b]	0.756
TG (mg/dl)	139.12±33.4[a]	89.68±35.60[c]	128.30±32.4[b]	140.52±41.70[a]	0.054
SBP(mmHg)	148.37±22.10[a]	140.06±18.20[a]	125.86±26.9[c]	162.10±39.58[c]	0.000
DBP(mmHg)	78.41±10.68[b]	74.04±6.21[a]	80.35±9.14[c]	81.78±7.90[c]	0.005

SBP=Systolic blood pressure; DBP=Diastolic blood pressure; FBG= Fasting Blood Glucose; HbA1c= glycated hemoglobin; 2HPP= 2 hours post prandial; WC= waist circumference; TC= total cholesterol; LDL-C= low density lipoprotein cholesterol; HDL-C= high density lipoprotein.
[a-c] values means in a row with different superscript are significantly different (P <0.05)

Table 5 shows the prevalence of serological variables among the subjects.

Only 6.7% of the subjects had low Fasting Blood Glucose (<4.2mmol/l), 58.0% had high Fasting Blood Glucose (>7.0mmol/l) and 35.3% had normal Fasting Blood Glucose (4.2-5.9mmol/l). After three months follow up, the number of subjects who had normal FBG increased from 35.3% to 54.7%, the low FBG levels increased from 6.5% to 10.0% but high Fasting Blood Glucose levels reduced from 58.0% to 35.3%. None of the control subjects had low FBG, 52.50% also had high FBG (>7.0mmol/l) while 47.50% were within normal values (4.2-5.9mmol/l). After three months, the number of subjects who had normal FBG decreased from 47.50% to 35.00% while the number of subjects that with high FBG levels increased from 52.50% to 65.00%.

The 2HPP blood sugar of the education group at baseline showed that 61.3% of the subjects had normal 2HPP blood sugar (<10mmol/l) and 38.7% had elevated 2HPP blood sugar (>10mmol/l). After three months follow up the number of subjects who had normal 2HPP blood sugar levels slightly increased from 61.3% to 62.7% while the number of subjects who had elevated 2HPP marginally reduced from 38.7% to 37.3%. The 2HPP blood sugar of the control group at baseline shows that 40.00% of the subjects had normal 2HPP blood sugar (<10mmol/l) and 60.00% had elevated 2HPP blood sugar (>10mmol/l). After three (3) months, the number of subjects who had normal 2HPP levels slightly decreased from 40.00% to 31.25% while the number of subjects who had elevated 2HPP increased from 60.00% to 68.75%.

About 76.0% of subjects had normal total cholesterol (<200mg/dl) and 24.0% had elevated total cholesterol (>200mg/dl) at pre intervention at the education group. After three months follow up, an increase was observed in the number of subjects who had normal total cholesterol from 76.0% to 80.0%, reduction was observed in the number of the subjects who had elevated total cholesterol from 24.0% to 20.0%. In the control group, 35.00% of the subjects had normal total cholesterol (<200mg/dl) and 65.00% had elevated total cholesterol (>200mg/dl) at baseline. After three months, subjects who had normal total cholesterol increased from 35.00% to 40.00% while number of the subjects who had elevated total cholesterol reduced from 65.00% to 60.00%.

About 86.0% subjects in the education group had normal LDL-C level (<150mg/dl) and 13.3% had

elevated LDL-C levels (>150mg/dl) at pre intervention. After three months follow up, the number reduced from 86.7% to 77.3% and the number of subjects who had elevated LDL-C levels increased from 13.3% to 22.7%. At baseline, 37.50% of the subjects in the control group had normal LDL-C level (<150mg/dl) and 62.50% had elevated LDL-C levels (>150mg/dl). Three mothers after, LDL-C levels of the subjects reduced from 37.50% to 35.00% and subjects who had elevated LDL-C levels increased from 62.50% to 65.00%.

Majority (63.5%) of the male subjects in the education group had normal HDL-C levels (>40mg/dl) and 36.5% had low (<40mg/dl) HDL-C levels. About 63.0% of the female subjects had normal HDL-C levels (>50mg/dl) and 36.9% had low HDL-C levels. The HDL-C levels of the control group at baseline shows that 42.85% of the male subjects had normal HDL-C levels (>40mg/dl) and most of the male subjects (57.14%) had low (<40mg/dl) HDL-C levels. Most of the female subjects (63.15%) had normal HDL-C levels (>50mg/dl) while 36.84% had low HDL-C levels. Most of the subjects in the education group had normal TG levels (<150mg/dl) both at pre and post intervention. Most of the subjects in the control group at baseline and after three months had elevated TG levels (>150mg/dl).

Table 5 Fasting Blood Glucose, Two hours postprandial, total cholesterol, Low density lipoprotein cholesterol, High density lipoprotein cholesterol and Triglyceride levels of the subjects.

VARIABLES	Education Group(n=150)		Control Group(n=80)		P-value
	Pre intervention F (%)	Post intervention F (%)	Baseline F (%)	After3 months F (%)	
FBG (MMOL/L)					
Low (<4.2)	10(6.7)	15(10.0)			
Normal (4.2-6.9)	53(35.3)	82(54.7)	38(47.50)	28(35.00)	0.000
High (>7)	87(58.0)	53(35.3)	42(52.50)	52(65.00)	
2HPP(MMOL/L)					
Normal (<10)	92(61.3)	94(62.7)	32(40.00)	25(31.25)	0.000
High (>10)	58(38.7)	56(37.3)	48(60.00)	55(68.25)	
TOTAL CHOLESTEROL (MG/DL)					
Normal (<200)	114(76.00)	120(80.00)	28(35.00)	32(40.00)	
High (>200)	36(24.00)	30(20.00)	48(65.00)	48(60.00)	0.000
LDL-C(MG/DL)					
Normal (<150)	130(86.7)	116(77.3)	30(37.50)	28(35.00)	0.000
High (>150)	20(13.3)	34(22.7)	50(62.50)	42(65.00)	
HDL-C (MG/DL)					
MALE: Normal (>40)	31(36.5)	22(25.9)	18(42.85)	12(28.57)	0.000
Low (<40)	54(63.5)	63(74.1)	24(57.14)	30(71.42)	
FEMALE: Normal (>50)	24(36.9)	30(46.2)	24(63.15)	15(39.47)	0.00
Low (<50)	41(63.1)	35(53.8)	14(36.84)	23(60.52)	
TRIGLYCERIDE(MG/DL)					
Normal (<150)	93(62.0)	83(55.3)	35(43.75)	25(31.25)	0.000
High (>150)	57(38.0)	67(44.7)	45(56.25)	55(68.78	

Table 6 shows monthly mean FBG, 2HPP, BMI and WC of the 24 subsamples who were placed on diet plan for three months. At the baseline the subjects had mean Fasting Blood Glucose levels of 8.36±3.30mmol/l but after the nutrition education and implementation of the menu plan the were decrease in the mean fasting bloods levels of the subjects after for one month (7.22±2.71mmol/l), two months (7.86+2.92mmol/l), and three months (6.39±1.75mmol/l) respectively. There was significant difference (P<0.05) in the mean Fasting Blood Glucose levels of the subjects. The baseline mean 2HPP sugar levels of the subjects was 11.32+3.54mmol/l and there was progressive decrease from one Month (10.83±1.78mmol/l), two Months (10.41±1.58mmol/l) and three Months (9.76+1.89mmol/l) respectively after nutrition education and followed diet plan for three months.

The baseline BMI result shows that the subjects' mean BMI was 29.79±6.95kg/m^2 and after nutrition education and followed diet plan for three months, mean BMI were 28.41+5.33kg/m2 for one month, 28.48±5.33kg/m2 for the two months and 28.19±5.38kg/m^2 for the three months respectively. There was significant difference (P<0.05) in the mean BMI of the subjects. After nutrition education and

implementation of the diet plan for three months, there was progressive decrease in the mean waist circumference of the male subjects for one month (100.56±2.93cm), two months (99.73±5.76cm) and three months (95.41±15.31cm) respectively from the baseline (101.61±3.39cm). However there was significant difference (P<0.05) in the mean waist circumference of the male subjects. The baseline mean waist circumference of the female subjects was 98.57±16.18cm and after nutrition education and implementation of diet plan for three months the mean waist circumference of the female subjects for one month, two months and three months were 94.00±12.27cm, 93.44±9.88 and 95.41±15.31 respectively.

Table 6 Monthly mean FBG, 2HPP, BMI and WC of the subsample who were placed on diet plan for three months. .

Variables	Pre Intervention	One Month	Two Months	Three Months	P-Value
FBG(MMOL/L)	8.36±3.30[a]	7.22±2.71[b]	7.86±2.92[b]	6.39±1.75[c]	0.000
2HPP(MMOL/L/)	11.32±3.54[a]	10.83±1.78[b]	10.41±1.58[b]	9.76±1.89[c]	0.000
BMI (KG/M^2)	29.79±6.95[a]	28.41±5.33[c]	28.48±5.33[c]	28.19±5.38[b]	0.000
WC MALE (CM)	101.61±3.39[a]	100.56±2.93[a]	99.73±5.76[b]	95.41±15.31[c]	0.000
WC FEMALE (CM)	98.57±16.18[a]	94.00±12.27[d]	93.44±9.88[c]	95.41±15.51[b]	0.000

a-c values means in a row with different superscript are significantly different (P <0.05)

Table 7 shows the serological variable results of the subjects on diet plan. Baseline result shows that none of the subjects had low Fasting Blood Glucose (<4.2mmol/l). Most of the subjects (58.3%) had elevated Fasting Blood Glucose (>7.0mmo/l) and 41.7% had normal Fasting Blood Glucose (4.2-6.9mmol/l). However, after nutrition education and implementation of menu plan for three months, 20.8% of the subjects had low Fasting Blood Glucose and 62.5% had normal Fasting Blood Glucose while 16.7% had elevated Fasting Blood Glucose. The difference observed in the Fasting Blood Glucose levels of the subjects after nutrition education and follow up was significant (P<0.05).

Baseline result of 2HPP glucose level of the subjects revealed that 66.7% had high levels of 2HPP (>10.0mmol/l) and 33.3% had normal levels (<10.0mmol/l). After nutrition education and implementation of menu plan for three months, there was increase in the number of subjects who had normal 2HPP from 33.3% to 58.3. %. There was significant difference (P<0.05) in the 2HPP of the subjects.

Baseline result of total cholesterol (TC) shows that most of the subjects (58.3%) had normal total cholesterol (<200mg/dl) and 41.7% had high levels of total cholesterol (>200mg/dl). The number of subjects who had normal total cholesterol increased from 58.3% to 66.7% after nutrition education and implementation of the menu plan for three months. However no significant (P>0.05) was difference observed in the total cholesterol levels of the subjects.

Baseline result of low density lipoprotein cholesterol (LDL-C) shows that 54.2% of the subjects had normal levels of LDL-C (<150mg/dl) and 45.8% had elevated levels LDL-C (>150mg/dl). After nutrition education and implementation of menu plan for three months, the number of subjects who had normal LDL-C levels increased from 54.2% to 66.7%. However there was no significant difference (P>0.05) in the LDL-C levels of the subjects.

Baseline result of male subjects' HDL-C shows that 60.0% of the male subjects had low HDL-C levels(<40mg/dl) and 40.0% had normal HDL-C levels(>40mg/dl).After implementation of the menu plan for three months and nutrition education, the number of the subjects who had normal HDL-C increased from 40.0% to 66.7%. Significant difference (P<0.05) in the HDL-C levels of the male subjects was observed at level of <0.05. Also the baseline result of female subjects' HDL-C shows that most of the female subjects (55.6%) had low levels of HDL-C (<50mg/dl) and 44.4% had normal HDL-C levels (>50mg/dl). But after nutrition education and implementation of the menu plan for three months, the number of female subjects who had normal HDL-C levels increased from 44.4% to 88.9%. There was significant difference (P<0.05) in the HDL-C levels of the female subjects.

Baseline result of triglyceride (TG) of the subjects shows that 58.3% of the subjects had normal TG levels and 41.7% had elevated TG levels. After nutrition education and implementation of the menu plan for three months the number of the subjects who had normal TG levels increased from 58.3% to 70.8%. There was no significant difference (P>0.05) in the triglyceride levels of the subjects.

Table 7 Serological variable result of the subsample on who were placed on diet experimental menu

VARIABLES	PRE INTERVENTION	POST INTERVENTION	P-VALUES
Fasting Blood Glucose (MMOL/L)	FREQUENCY (%)	FREQUENCY (%)	
Low <4.2	-	5(20.8)	
Normal 4.2-6.9	10(41.7)	15(62.5)	0.000
High >7.0	14(58.3)	4(16.7)	
Total	24(100)	24(100)	
2HPP(MMOL/L)			
Normal <10	8(33.3)	14(58.3)	
High >10	16(66.7)	10(41.7)	0.011
Total	24(100)	24(100)	
Total Cholesterol (MG/DL)			
Normal <200	14(58.3)	16(66.7)	
High >200	10(41.7)	8(33.3)	0.162
Total	24(100)	24(100)	
LDL-C(MG/DL)			
Normal <150	13(54.2)	15(62.5)	
High >150	11(45.8)	9(37.5)	0.162
Total	**24(100)**	**24(100)**	
HDL-C (MG/DL) MALE			
Normal >40	6(40.0)	10(66.7)	
Low <40	9(60.0)	5(33.3)	0.041
Total	**15(100)**	**15(100)**	
HDL-C (MG/DL) FEMALE			
Normal >50	4(44.4)	8(88.9)	
Low <50	5(55.6)	1(11.1)	0.035
Total	**9(100)**	**9(100)**	
TRIGLYCERIDE (MG/DL)			
Normal <150	14(58.3)	17(70.8)	
High>150	10(41.7)	7(29.2)	0.083
Total	**24(100)**	**24(100)**	

Figure 1 Shows glycated hemoglobin (HbA1c) levels of the subjects. Glycated Hemoglobin (HbA1c) levels of the education group at baseline result shows that only 30.0% of the subjects had normal HbA1c values (<6.5%) while most of the subjects (70.0%) had elevated HbA1c values (>6.5%). After nutrition education and three (3) months follow up an increase was observed in the number of the subjects who had normal HbA1c values from 30.0% to 48.7% and there was a reduction in the number of subjects who had elevated HbA1c values from 70.0% to 51.30%. Glycated Hemoglobin (HbA1c) levels of the control group at baseline result shows that 65.0% of the subject had normal HbA1c values (<6.5%) 35.0% had elevated HbA1c values (>6.5%). After three (3) months increase was observed in the number of the subjects who had high HbA1C values from 35.0% to 40.0% and there was a reduction in the number of subjects who had normal HbA1c values from 65.0% to 60.0%. There were significant (P<0.05) differences in the HbA1c levels of the subjects in education group and control group.

Figure 1: Glycated Hemoglobin (HbA1c) level of all the subjects.

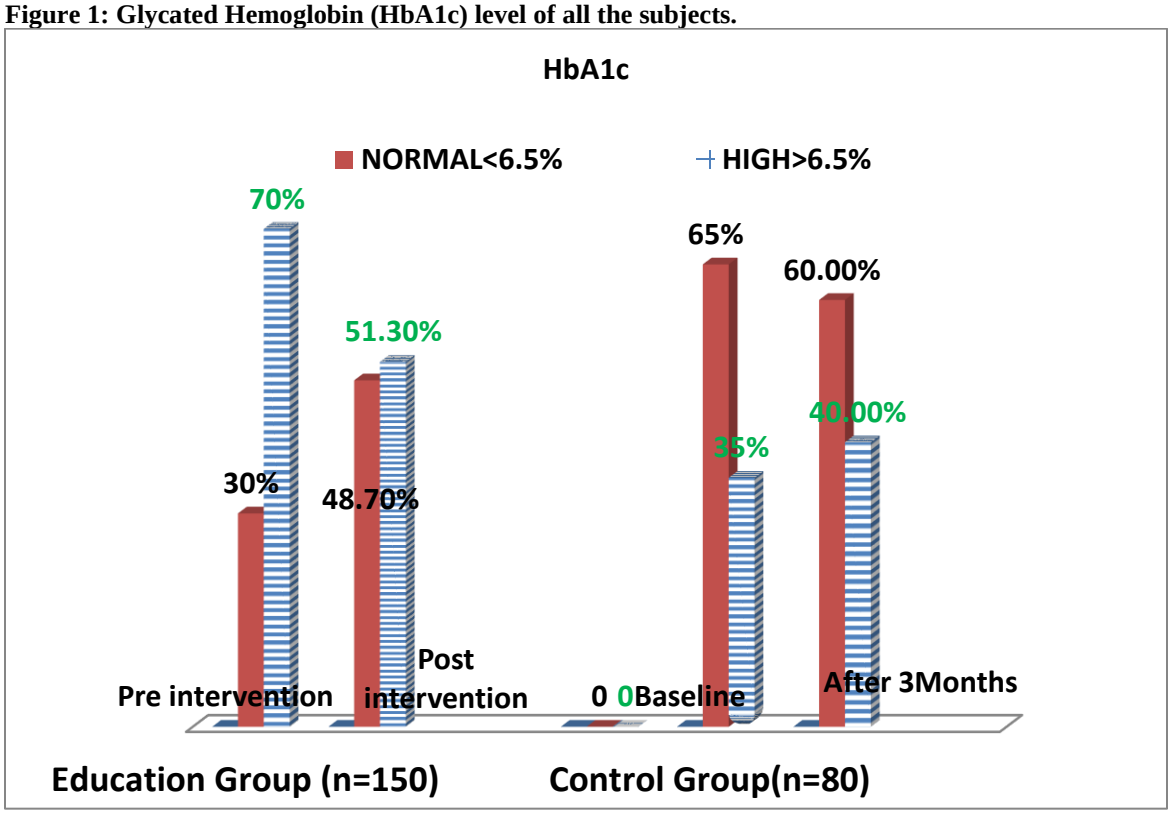

Figure 2: Glycated Hemoglobin (HbA1c) level of the subsample

Baseline result shows that most of the subjects (75.00%) had high levels of HbA1c however after nutrition education and implementation of the diet plan for three months, there was significant (P<0.05) reduction in the number of subjects who had high levels of HbA1c from 75.00% to 37.50% and increase in the number of subjects who had normal levels of HbA1c from 25.00% to 62.50% respectively.

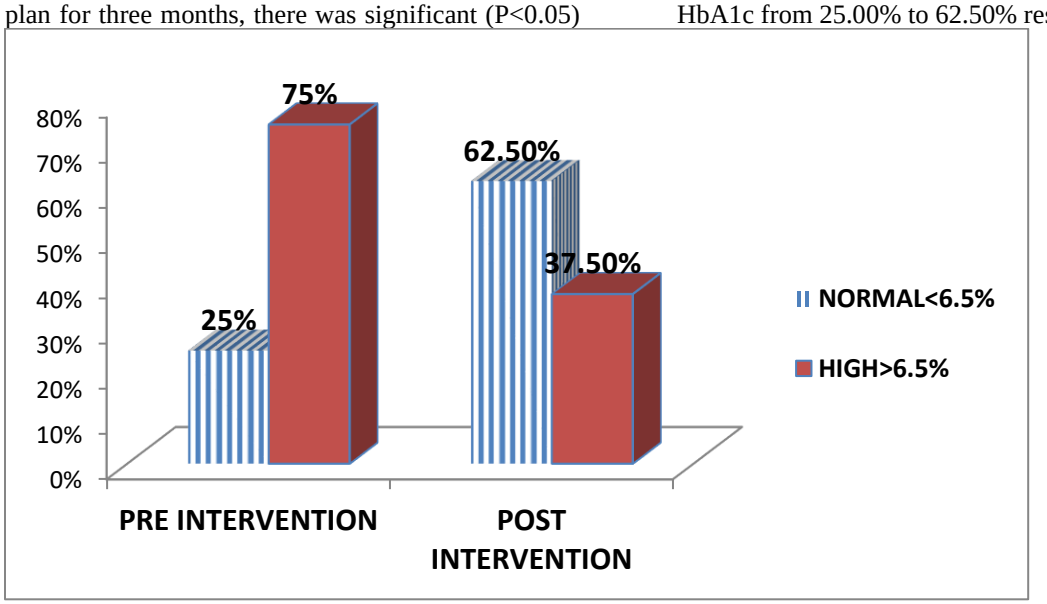

Figure 2: Glycated Hemoglobin (HbA1c) level of the subsample

DISCUSSION

The prevalence of type 2 diabetes increases with age of population (23). The International Diabetes Federation (24) reported that the greatest number of people with diabetes is between 40 and 59 years of age. In developing countries, the largest numbers of people with diabetes were in the age group 45 to 64 years and 65 years and over for the in developed

countries (24). Majority of the subjects both in control and education group were Christians. This can be attributed to the location of the study area – south-south Nigeria which is dominated by Christian religious practices.

Most of the subjects both in the control and education group were married. This is expected in a viable oil rich company like NNPC with well remuneration packages that would enable couples face the financial responsibility of married life. Ackley (25) noted that economically viable individuals can tackle the huge responsibilities of married life.

All the subjects had formal education and were reasonably literate as evidence by the percentage of the subjects who had tertiary education (74.7%) and secondary education (20.0%).
More (53.3%) than half of the subjects earned an average of ₦40,000 and above. This was not surprising because most subjects were mostly retired staff and active staff who were paid well as pensions and salaries. One point which emerged in the epidemiology of diabetes in developing country is that its prevalence is associated with affluence (26). Economic status of the subjects in this study was in line with the finding by Unwin and Alberti (26) confirming that many of the subjects could afford any form of care given the right advice.

Majority (81.3%) of the subjects had family history of diabetes mellitus. It has long been known that type 2 diabetes is, in part, inherited. Family studies by Flores *et al.,* (27), Hansen (28) and Gloyn (29) revealed that first degree relatives of individuals with type 2 diabetes mellitus are about 3 times more likely to develop the disease than individuals without a positive family history of the disease. It has also been shown that concordance rates for monozygotic twins, which have ranged from 60-90%, are significantly higher than those for dizygotic twins. Thus, type 2 diabetes mellitus has a strong genetic component (27, 28, 29).
More than half of the subjects (55.3%) were hypertensive. Epidemiological studies have indicated that hypertension and type 2 diabetes mellitus are commonly associated conditions, and their concordance is increased in populations (30). The ADA (31) reported that hypertension affects up to 40% or more of diabetic patients.

Serological variables of the subjects
Most of the subjects (70.0%) in the education group at baseline had elevated HbA1c with a mean baseline glycated hemoglobin level of 8.08±1.88%. While most of the subjects (65.00%) in the control group at baseline had normal HbA1c with a mean baseline glycated hemoglobin level of 7.01±1.86%. However, there was a significant difference ($P<0.05$) in the mean and percentage number of HbA1c of the subjects in education and control group. The value observed in the number of subjects in the control group with normal HbA1c at baseline could be that most of the subjects were on under good glycemic control during the period the study commenced hence were not referred to endocrinologist for expert management. Also, the value observed in the number of subjects in the education group with elevated HbA1c at baseline could be attributed to the fact that the subjects had poor glycemic control hence referred to endocrinologist for expert management. In education group however, there was reduction the number of subjects who had elevated HbA1c from 70.00% to 51.30% after nutrition education and follow up.

The improvement in glycemic control shown by reduction HbA1c in this study was similar to that of the study by Christensen *et al.* (32) in which medical nutrition therapy brought about mean reduction of HbA1c levels to < 8%. The U.K Prospective Diabetes Study (33) showed that a 1% reduction in HbA1c reduces diabetes-related deaths by 21%, risk of microvascular complications by 37% and myocardial infarction by 14%. Diabetes Control and Complications Trial (34) showed that Lowering HbA1c Levels reduces Retinopathy by 63%, Nephropathy by 54%, Neuropathy 60% and Macrovascular disease by 41% in Patients With Type 1 and Type 2 Diabetes Mellitus. A review of diabetes self-management education revealed that education is successful in lowering glycosylated hemoglobin levels (35).

Most of the subjects had elevated FBG. In the education group only 6.70% of the subjects had hypoglycemia at baseline and 10.00% after nutrition education and follow up. In the control group none of the subjects had hypoglycemia both at baseline and after 3 months. However, the number of subjects had normal FBG in the education group after 3 months follow up increased from 35.30% to 54.70% while the number of the subjects who had normal FBG in the control group reduced after 3 months from 47.50% to 35.00%. No significant ($P<0.05$) reduction in the mean FBG of the education and control group. Patients with type 2 diabetes who do not properly and precisely control their blood sugar levels are generally observed with an increase in the level of glycosylated hemoglobin in serum through which the level of blood glucose is measured during a period of 2-3 months as observed in this study. A meta-analysis of self-management education for adults with type-2 diabetes revealed improvement in glycemic control at

immediate follow-up. However, the observed benefit declined one to three months after the intervention ceased, suggesting that continuing education is necessary (36). EDIC Study Findings showed that intensive blood glucose control reduces risk of any cardiovascular disease event by 42%, reduced risk of nonfatal heart attack, stroke, or death from cardiovascular causes by 57% in Patients with Type 1 and Type 2 Diabetes Mellitus (37). Also 20.80% (n=24) of the subsamples who were placed on diet for three months and 10.00% (n=150) of the education group after three months had hypoglycemia. This could be attributed to the fact that the subjects have never been placed on the appropriate diet based on their calorie needs hence may have been taken too much calories to march their oral hypoglycemic agents and insulin. Gita S *et al.,* (38) observed that change in diet of diabetics is a risk factor for hypoglycemia in patients who are on oral hypoglycemic agents and insulin.

The prevalence of individual lipid profile was almost similar to a study conducted in by Bello-Ovosi BO et al., (42) except that the prevalence of dyslipidemia among the subjects was low in the education group. Most of the subjects (76.0%) had normal values of total cholesterol at baseline and 80.00% after 3 months with mean baseline values of 177.93±38.90mg/dl and164.47±26.30mg/dl after 3 months follow up. While the prevalence of dyslipidemia among the subjects was high in the control group, most of the subjects (65.00%) had elevated values of total cholesterol at baseline and 60.00% after 3 months with mean baseline values of 162.48±57.50mg/dl and 185.86±45.79mg/dl after 3 months follow up. Although significant difference ($P<0.05$) was observed in the total cholesterol levels of the education and control group. This study is contrary to the report of Saydah *et al.,* (39) that, dyslipidemia is strikingly common in patients with type 2 diabetes, affecting almost 50% of this population. However, low prevalence of dyslipidemia in the education group could be possibly being attributed to the fact that most of the subjects were placed on cholesterol lowering drugs as part of their routine medications by the endocrinologist. Moreover IDF (5) stated that managing lipids in older subjects should be part of a multifaceted approach to diabetes care.

The prevalence of hypertension among the subjects in the education group was 38.7% at baseline with a mean SBP and DBP of 148.37±22.10 mmHg and 78.41+10.68 mmHg respectively. However, the prevalence of hypertension among the subjects was further reduced from 38.7% to 36.00% after nutrition education and 3 months follow up. In control group the prevalence of hypertension among the subjects was 60.00% at baseline and 51.25% after 3 months. There were significant changes ($P<0.05$) both in the mean SBP and DBP of the subjects in the control and education group. The Arauz-Pacheco *et al,* (40), Sowers *et a.l,* (41) report supported the findings of this study in which they reported that hypertension is a common comorbidity in people with diabetes being 1.5 to three times more common than in those without diabetes. They stated that most (60-80%) people with type 2 diabetes die of cardiovascular complications, and up to 75% of specific cardiovascular complications have been attributed to hypertension. Hypertensive people with diabetes are also at increased risk for diabetes-specific complications including nephropathy and retinopathy (40). In the UKPDS (33) blood pressure was controlled at 150/90 mm Hg, which is no longer considered intensive blood pressure control. The benefit of tight blood pressure control in that trial exceeded the benefit of glucose control, indicating that even mediocre blood pressure control was more effective than glucose control.

CONCLUSION

The study indicated that, the prevalence of dyslipidemia among the subjects was low and there was significant reduction in the glycated hemoglobin (HbA1c) and Fasting Blood Glucoses level of the subjects after nutrition education and follow up. This study has shown that nutrition education and follow up are important components of type 2 diabetes mellitus management care which must be considered as a treatment option for all type 2 diabetes patients.

Ethical Consideration

Ethical clearance was obtained from ethical review board of NNPC Medical Services Ltd, authorities. Before actual data collection, the purpose of the study was explained to each study participant. The data collected from each study participant were used only for the purpose of this study. Verbal consent was obtained from each study participant, and the study participants had full right to withdraw from the study at any time.

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Conflict of Interests

The authors report no conflicts of interest in this work.

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