



PREPONDERANCE OF INCREASED GLYCOSYLATED HEMOGLOBIN (HBA1c) AND CHRONIC COMPLICATIONS IN DIABETES MELLITUS PATIENTS RECEIVING MEDICARE IN A TERTIARY INSTITUTION IN NIGERIA; WHAT NEED TO BE DONE

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ABSTRACT

Background: HBA1c serves as a marker for average blood glucose levels over the previous months prior to the measurement. In diabetes mellitus, higher amounts of glycosylated hemoglobin, indicates poor glycemic control which have been associated with cardiovascular diseases. **Objectives:** We, therefore compared HbA1c and fasting blood glucose among subjects of varying degree of complications with controls to evaluate the effect of glycemic control on chronic complications of diabetes mellitus in developing country in order to emphasize the need for tight glycemic control as a means of prevention of chronic complications among diabetic patients. **Methods:** 109 type 2 DM subjects (47 males and 62 females) and 100 non-DM controls of the same age range (40-80 yrs) were recruited for this study. The chronic complications found were: nephropathy, retinopathy, coronary artery disease, cerebrovascular disease, peripheral vascular disease and diabetic foot. These were further classified into microvascular complications (nephropathy and retinopathy) and macrovascular complications (Coronary Artery Disease, Cerebrovascular Disease, Peripheral Vascular Disease and diabetic foot). Of these 109 DM subjects, 36 were without chronic complications, 37 have microvascular complications only and 36 have a combination of microvascular and macrovascular complications. HbA1c and fasting blood glucose were analysed using standard methods. **RESULT:** The mean levels of HbA1c, fasting blood glucose and diastolic blood pressure were significantly higher in DM subjects when compared to the control ($p < 0.05$). HbA1c, fasting blood glucose and diastolic blood pressure were significantly higher in DM subjects with chronic complications than those without complications ($p < 0.05$). In this study among the 109 diabetic subjects 36, 37 and 36 had no complications, microvascular complications only and a combination of microvascular and macrovascular complications respectively. The prevalence of chronic complications among the diabetic subjects studied were 66.9%. More so 73.4 % of the diabetic subjects had elevated glycosylated hemoglobin. Education, Age, exercise, employment status, alcohol consumption and medical checkup are significant variables associated with complications in the subjects. **Conclusion:** Poor glycemic control is an important variable that determined the emergence of chronic complication among diabetes mellitus subject studied. Other variables such as Age, exercise, employment status, alcohol consumption and medical checkup are significant variables associated with complications in the subjects.

KEYWORD: microvascular and macrovascular complications.

INTRODUCTION

Diabetes Mellitus (DM) and its complications pose significant economic consequence on individuals, families, health systems and countries.^[1] Diabetes Mellitus was considered rare in Africa in the beginning of the last century but there is now evidence to demonstrate an increasing incidence and prevalence of diabetes in Nigeria; and the burden is expected to increase further.^[2] There are 1.71 million people living with diabetes in Nigeria and this figure is projected to reach 4.84 million by the year 2030^[1]

The threat is growing; the number of people, families and countries afflicted is increasing. This growing threat is an under-appreciated cause of poverty and hinders the economic development of many countries.^[1] Diabetes Mellitus takes a staggering toll on Nigerians and the economic burden is heavy.^[3] It is associated with reduced life expectancy, morbidity and reduced quality of life. More so, premature death is twice as high among individuals with diabetes than those without.^[4]

Glycosylated hemoglobin (hemoglobin A1c, HbA_{1c}, A1C, or Hb_{1c}; sometimes also HbA1c) is a form of hemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods of time. It is formed in a non-enzymatic glycation pathway by hemoglobin's exposure to plasma glucose. Normal levels of glucose produce a normal concentration of glycated hemoglobin. As the average concentration of plasma glucose increases, the fraction of glycated hemoglobin increases in a predictable way. This serves as a marker for average blood glucose levels over the previous months prior to the measurement. In diabetes mellitus, higher concentration of glycated hemoglobin, indicating poorer control of blood glucose levels, have been associated with cardiovascular disease, nephropathy, and retinopathy. A buildup of glycated hemoglobin within the red cell, therefore, reflects the average level of glucose to which the cell has been exposed during its life-cycle. Measuring glycated hemoglobin assesses the effectiveness of therapy by monitoring long-term serum glucose regulation. The HbA_{1c} level is proportional to average blood glucose concentration over the previous four weeks to three months. Some researchers state that the major proportion of its value is weighted toward the most recent 2 to 4 weeks. This is also supported by the data from actual practice showing that HbA_{1c} level improved significantly already after 20 days since glucose-lowering treatment intensification.^[5]

The importance of tight blood glucose control in preventing or delaying the progression of complications in DM persons cannot be overemphasized. In the Diabetes Control and Complications Trial (DCCT) study, the incidence or progression of retinopathy was reduced by 54-76% and the need for photocoagulation was reduced by 56%; the incidence of clinical albuminuria reduced by 54% and clinical neuropathy by 69%. There was also a continuous reduction in complications as glycaemic levels approached the normal range. In the United Kingdom Prospective Diabetes Study (UKPDS) done in type 2 DM persons it was similarly shown that retinopathy, nephropathy and neuropathy were benefited by lowering the blood glucose levels with intensive therapy in which a mean HbA_{1c} of 7.0% was achieved.^[6] It was also shown that for every percentage point decrease in HbA_{1c}, there was a 25% reduction in diabetes related deaths, a 7%, reduction in all cause mortality and an 18% reduction in combined fatal and non fatal myocardial infarction.^[7] The guidelines for management of DM recommend intensive control of blood glucose reaching target HbA_{1c} as close to physiological level as possible, preferably less than 7%, since this was associated with reduced morbidity and mortality.^[8]

However, despite all the wealth of evidence available as to the benefit of good glycaemic control in preventing diabetic complications, studies has shown that good glycaemic control is not achieved in many subjects.^[9] Studies show that poor glycaemic control is common in

Nigerian persons with diabetes mellitus. A study done in Calabar, Nigeria, 63% of the subjects had poor glycaemic control^[10]. Factors identified for the poor glycaemic control in that study included poverty, illiteracy, poor compliance and adherence with medications^[10]. Coker and Fasanmade documented poor glycaemic control in their study amongst persons with diabetes in Lagos, Nigeria.^[11] In their study the mean HbA_{1c} level was 10.5%. They concluded also that both physician and patient dependent factors were responsible for this poor outcome.^[11] Adebisi et al in Ilorin, Nigeria also documented poor glycaemic control in 500 persons with diabetes mellitus and the mean HbA_{1c} level was 8.0%.^[12] Results of a study done by Ngwogu et al. in Umuahia show that only 38% of the subjects had good diabetic control while poor glycaemic control was seen in 62% of the subjects.^[13]

Diabetes mellitus has been reported to be the commonest endocrine-metabolic disorder characterized by chronic hyperglycaemia giving rise to the risk of microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (Ischaemic heart disease, stroke and peripheral vascular disease) damage, with associated reduced life expectancy and diminished quality of life.^[14] The contributory factors to high mortality were ignorance, poor hygiene, infections, lack of foot care and inadequate glycaemic/blood pressure control.^[14] This tendency of increased morbidity and mortality is seen in patients with type 2 DM because of the commonness of this type of DM, its insidious onset and late recognition, especially in resource-poor developing countries like Africa.^[15] More so, common risk factors like greater duration of diabetes, hypertension, poor metabolic control, smoking, obesity and dyslipidemia had made diabetes patients prone to development of diabetic complications.^[15]

In the light of the foregoing, the following questions were posed: what are the factors that contributes to poor glycaemic control among diabetic patients are receiving medicare in tertiary institutions in Nigeria? What are the factors that impact on the management outcome of diabetes mellitus in Nigeria? What role does socioeconomic status such as education, gender and income play in diabetes outcome in Nigeria?

This study is justified by the fact that it will make an attempt to re-examine the possibilities of re-evaluation, modification and restructuring of the healthcare delivery systems in Nigeria in other to adopt more appropriate and effective preventive treatment strategies in the management of diabetes mellitus in Nigeria. It is also intended to increase government awareness of the high morbidity and mortality associated with this disease in Nigeria; and to emphasize its burden on the patients, their families and the country. Consequently, it may result in better planning and increased budgetary allocations from the health ministry. Moreover, findings of this study are intended to inform, educate and

empower diabetic patients to be able to take care of themselves better, thereby reducing complications and fostering improved quality of life free of disabilities. The study may also provide the much needed information that will enable public health educators in the planning and provision of effective and efficient Diabetes Mellitus education.

2. MATERIALS AND METHODS

2.1 Study design and population

The study was conducted at the Federal Medical Centre, Makurdi, Benue State located in the north central part of Nigeria. It was a comparative cross-sectional descriptive study done from March to May 2013. This study was approved by the Medical Ethics Committee of Federal Medical Centre Makurdi, Benue State. Questionnaires were completed by oral interviews and information were extracted from medical file records. The questionnaire collected data on demographic characteristics (age, sex, educational status, employment status, occupation, tribe, religion, history of alcohol consumption, present alcohol consumption status, dietary habit, exercise, smoking) and medical history (medical checkup, medication, duration, present symptoms of chronic complications). Physical examination was done to elicit signs of chronic complications which included neurological examination, and peripheral pulses and measurement of height, weight, B.M.I, blood pressure (sitting), and ankle brachial index (ABI) was calculated to assess for peripheral arterial disease, defined as a ratio less than 0.9; fundus examination was performed following mydriasis of both eyes with tropicamide and phenylephrine eye drops. Patients answered questions about their symptoms such as a feeling of pins and needles, abnormal cold or warm sensations in their feet, sharp pain, aching pain, or irritation to feet or legs by bedclothes at night. List of Complications assessed was developed from International Classification of Diseases 9(ICD-9) codes and laboratory data and they were classified into microvascular and macrovascular complications.

A total of two hundred and nine (209) subjects were recruited for this study. One hundred and nine (109) type 2 DM patients (36 subjects with no complications, 37 subjects with microvascular complications only and 36 subjects with a combination of micro vascular and macrovascular complications) were recruited by consecutive sampling method from the diabetic clinic of the Federal Medical Centre, Makurdi, Benue State. Age and sex matched healthy controls were recruited from the blood bank donors as well as non-diabetic subjects. Male and female DM patients under treatment between 40-80 years were included in the study. Pregnant women, patients with abnormal liver or kidney function, anemia, hemoglobinopathies and those treated with drugs affecting HbA1c (dapsons, antiretrovirals, trimethoprim sulphamethoxazole, hydroxyurea, vitamin C and E, aspirin and opiate users) in the last 3 months were excluded from the study. Subjects that were pregnant,

had any form of chronic disease or less than or greater than 40-80 years respectively were excluded from the control subjects.

2.2 Sample collection and biochemical analysis

A sample of blood was drawn after overnight fasting of 12 hours. The sample was collected using EDTA and plain. The sample was centrifuged, separated and aliquot analyzed. Fasting blood glucose was determined using enzymatic method. HbA1c was determined using device by Bio-Rad HbA1c based on Boronate affinity chromatography described by.^[16] Values <7% was considered normal.

3.10 STATISTICAL ANALYSIS

Data analysis was done using the statistical package for social sciences (SPSS) for windows version 20. Comparison was made using student t-test and anova with post hoc test; while Cross-tabulations were done using chi-square.

RESULTS

The total number of diabetic subjects enrolled were 109 while there were 100 controls. The prevalence of at least one chronic complication among the diabetic subjects studied was 66.9%. Moreso, 73.4% of the diabetic subjects have elevated glycosylated hemoglobin. Table 1 shows that HbA1c was significant at $P < 0.05$ on comparing diabetic subjects with controls. Table 2 also shows significant difference in HbA1c with presence of complications ($p < 0.05$). However, no significant difference was seen with respect to fasting blood glucose. Diastolic blood pressure was higher in subjects with microvascular complications and those with microvascular and macrovascular complications on comparing with subjects without complications.

Table 3 shows that 27 (36.9%) and 20 (55.6%) of the subjects that had chronic complications and nil complications respectively, were males while 46 (63.0%), and 16 (44.4%) of subjects with chronic complications and nil complications respectively, were females.

Sixty (55.0%), 16 (14.7%), 3 (2.8%), 30 (27.5%) represents all those that had no formal education, primary education, secondary education and post secondary education respectively. Among those that had no formal education 54 (57.4%) had complications. Then Among those with primary education, 16 (17.0%) persons had complications while 0 (0.0%) and 24 (25.5%) of those that had complications had secondary education and post-secondary education.

Fourteen (12.8%), 17 (15.6%), 18 (16.5%), 30 (27.5%), 30 (27.5%) are within the age range of 40-45 years, 46-50 years, 51-55 years, 56-60 years, > 60 years, respectively. Among those within 40-45 yrs 11 (11.7%) had complications while 3 (20.0%) had no complications. Those within 46-50 yrs, 11 (11.7%) also had complications while 6 (40.0%) had no complications. For

those within 51-55 years, 18(19.1%) had complications. Among subjects > 60 years, 28(29.8%) had complications while 2(13.3%) had no complications.

Thirteen subjects exercised occasionally while 96 did not exercise at all. Among those that exercised occasionally 7 (53.8%) had complications while 6 had no complications while among that did not exercise at all, 88 (91.7%) had complications while 8 (8.3%) had no complication. Cross tabulation was significant at $P < 0.01$.

Fifteen of the subjects snacked regularly among which 13 (86.7%) had complications while only 2 (13.3%) had no complications. Of, 58 subjects that snacked occasionally, 52 among them had complications while only 6 (16.7%) had no complications. Out of the 36 that did not snack at all, 30 had (83.3%) had complication while 6 (16.7%) had no complications.

Thirty have ever smoked while 79 had never smoked. Amongst those that had ever smoked 27(90%) had complications while only 3(10%) had no complications while 68 (86.1%) of those that has never smoked still had complications while only 14 (12.8%) had no complications.

Fifty eight diabetic subjects were unemployed whereas 51 were employed. Of the 51 that were employed 39 (76.5%) had complication while 12 (23.5%) had no complications while out of the 58 unemployed, 56 (96.6%) have complications while 2 (34.4%) had no complication. This association was statistically significant (0.002).

Out of the 109 T2 DM subjects studied 78 had ever drank alcohol, 17 were currently drinking while 14 never drank. Seventy three (93.6%) of the patients that had ever drank alcohol had complication while 5 (6.4%) had no complications. Eleven (64.7%) of those that were currently drinking had complications while 6 (35.3%) of those currently drinking had no complications. Eleven (78.6%) of the 147 patients that had never drank still had complications while 3 (21.4) had no complications.

Thirty nine, 37 and 33 were of normal weight, over weight and obese, respectively. Of subjects that had normal weight, 34 (89.2%) had complications while 5 (12.8%) had no complications. Among the overweight subjects, 34 (91.9%) had complications while 3 (8.1%) had no complications. Of the 33 obese diabetic subjects, 27 (81.8%) had chronic complications while 6 (18.2%) subjects had no complications.

Eighty seven subjects were on oral hypoglycemic, 6 on insulin only, 16 on combined oral hypoglycemic and insulin 75 (86.2%) out of those that are on oral hypoglycemics have complications while 6 (100%) of all that are on insulin had complications. 14 (87.5%) of those that are combined insulin and oral hypoglycemic all had complications.

Twenty seven of the diabetic subjects had a family history of hypertension while 3 had no family history of hypertension and 79 were not. Among those that had family history of hypertension 24 of them had complications while 3 had no complications while of the subjects that had no family history of hypertension, all had complications of those that had were not aware 68 (86.1) had complications while just 11 (13.96%) had no complications.

Ninety seven of the 109 diabetes subjects studied were hypertensive, giving a prevalence of 88.9% and only 12 subjects are not hypertensive. Out of those that had hypertension 86 (88.7%) had complications while 11(11.3%) did not have complications. Out of those that were not hypertensive, 9(75%) had complications while 13 (25%) did not have complications.

Of the 109 subjects, 95 subjects had complications while 14 has no complication. Of the 95 with complications, 50 (52.6%) were < 6 years duration of diabetes mellitus diagnosis while 21 (22.1%) and 24 (25.3%) are of 6-10 years and > 10 years duration respectively.

Fifty eight, 46, and 5 subjects attended medical checkup regularly, occasionally and rarely respectively. Of the subjects that were regular with medical checkup, 50 (86.2%) had chronic complications while, 8(13.8%) had no complications. Of the 46 (93.5%) that occasionally attended medical checkup 43(93.5%) also had complications while 3 (6.5%) did not. Of the, 5 that rarely had checkup 2 (40%) had complications while 3 (60%) did not ($P < 0.003$).

TABLE 1: Glycated hemoglobin, hemoglobin concentration in diabetes mellitus type 2 subjects and control

Parameters	diabetic subjects (n=109)	control (n=100)	p-value
HBA1c (%)	9.41±2.68	5.00±0.55	0.00*
Hemoglobin Concentration (g/dl)	13.51±1.22	14.01±0.72	0.884
Fasting plasma glucose(mmol/l)	11.42± 3.21	3.70±0.32	0.00*

*significant at P < 0.05.

HBA1c=glycated haemoglobin

TABLE 2: FASTING PLASMA GLUCOSE, GLYCOSYLATED HAEMOGLOBIN AND HAEMOGLOBIN CONCENTRATIONS OF DIABETIC TYPE II SUBJECTS WITH VARYING COMPLICATIONS (MEAN±SD)

PARAMETERS	NO COMPLICATIONS (N=36)	MICROVASCULAR COMPLICATION ONLY(N=37)	BOTH MICRO AND MACROVASCULAR (N=36)	P-VALUE
FASTING PLASMA GLUCOSE(mmol/l)	12.09±2.49	10.84±3.5	11.32±3.69	.709
HBA1c (%)	8.68±0.3	9.29±0.6	10.80±0.72 ^a	.048*
HEMOGLOBIN CONCENTRATION(g/dl)	13.13±0.93	13.54±1.26	13.70±1.26	.414
SYSTOLICBLOOD PRESSURE(mm/Hg)	120.00±9.26	138.03±25.88	136.11±20.35	.057
DIASTOLIC BLOOD PRESSURE(mm/Hg)	76.00±5.07	88.62±13.21 ^a	85.56±6.98 ^a	.001*

*=Significant at <0.05

a = Significant at <0.05 when compared with No complication

b= significant at <0.05 when compared with micro vascular

c = significant < 0.05 when compared with both micro and macro vascular complication.

TABLE 3: SOCIO-DEMOGRAPHIC VARIABLES AND PRESENCE OF COMPLICATIONS IN TYPE 2 DIABETES MELLITUS SUBJECTS .

VARIABLES	Frequency			P-value
	CHRONIC COMPLICATIONS	NIL CHRONIC COMPLICATIONS	TOTAL	
	n(%)	n(%)	n(%)	
SEX				
Male	27(36.9)	20(55.6)	47(43.1)	.271
Female	46(63.0)	16(44.4)	62(56.9)	
EDUCATION				
no formal education	54(57.4)	6(40.0)	60(55.0)	.000**
primary education	16(17.0)	0(0.0)	16(14.7)	
secondary education	0(0.0)	3(20.0)	3(2.8)	
post-secondary education	24(25.5)	6(40.0)	30(27.5)	
AGE				
40-45	11(11.7)	3(20.0)	14(12.8)	.022*
46-50	11(11.7)	6(40.0)	17(15.6)	
51-55	18(19.1)	0(0.0)	18(16.5)	
56-60	26(27.7)	4(26.7)	30(27.5)	
>60	28(29.8)	2(13.3)	30(27.5)	
EXERCISE				
Regular	Nil	Nil	Nil	.000**
Occasional	7(53.8)	6(46.2)	13(11.92)	
not at all	88(91.7)	8(8.3)	96(88.07)	

SNACKING				
Regular	13(86.7)	2(13.3)	15(13.76)	.671
Occasional	52(89.7)	6(10.3)	58(53.21)	

not at all	30(83.30)	6(16.7)	36(33.03)	
EMPLOYMENT STATUS				
Employed	39(76.5)	12(23.5)	51(46.78)	.002**
unemployed	56(96.6)	1(3.4)	58(53.2)	
ALCOHOL CONSUMPTION				
ever drank	73(93.6)	5(6.4)	78(71.55)	.003**
currently drinking	11(64.7)	6(35.3)	17(15.59)	
never drank	11(78.6)	3(21.4)	14(12.84)	
SMOKING				
Ever smoked	27(90)	3(10)	30(27.52)	.584
Never smoked	68(86.1)	11(13.9)	79(72.48)	
B.M.I				
Normal weight	34(87.2)	5(12.8)	39(35.77)	.453
over weight	34(91.9)	3(8.1)	37(33.94)	
Obesity	27(81.8)	6(18.2)	33(30.28)	

TABLE 4: MEDICAL HISTORY AND PRESENCE OF COMPLICATIONS IN TYPE 2 DIABETES MELLITUS SUBJECTS

VARIABLES	Frequency		TOTAL n(%)	P-value
	CHRONIC COMPLICATIONS n(%)	NIL CHRONIC COMPLICATIONS n(%)		
DURATION				
<6 yrs	50(52.6)	11(76.6)	61(55.96)	.082
6-10 yrs	21(22.1)	3(21.4)	24(22.01)	
>10yrs	24(25.3)	0(0.0)	24(22.01)	
MEDICATION				
oral hypoglycemic	75(86.2)	12(13.8)	87(79.8)	.620
Insulin	6(100)	0(0.0)	6(5.5)	
Combined Insulin and oral hypoglycemic	14(87.5)	2(12.5)	16(14.6)	
FAMILY HX OF HYPERTENSION				
Yes	24(88.9)	3(11.1)	27(24.77)	0.742
No	3(100)	0(0.00)	3(2.75)	
Don't know	68(86.1)	11(13.9)	79(72.48)	
SUBJECT'S HISTORY OF HYPERTENSION				
Yes	86(88.7)	11(11.3)	97(88.99)	.182
No	9(75)	3(25)	12(11.00)	
FREQUENCY OF MEDICAL CHECK UP				
Regular	50(86.2)	8(13.8)	58(53.2)	.003*
Occasional	43(93.5)	3(6.5)	46(42.2)	
not at all	2(40)	3(60)	5(4.58)	

** significant at $P < 0.01$

* significant at $P < 0.05$

DISCUSSION

In this study among the 109 diabetic subjects 36,37 and 36 had no complications, microvascular complications only and a combination of microvascular and macrovascular complications respectively. The prevalence of chronic complications among the diabetic subjects studied were 66.9%. More so 73.4% of the diabetic subjects had elevated glycosylated hemoglobin. This is an indication of poor management

outcome in these patients which may be as a result of inconsistency in attendance of clinic for medical checkup they only present to the hospital when they have complications. HbA1c was found to be significant in the subjects when compared with the control in the subjects ($P < 0.05$). This serves as a marker for average blood glucose levels over the previous months prior to the measurement. In diabetes mellitus, higher amounts of glycated hemoglobin, indicates poor glycemic control

which have been associated with cardiovascular diseases. Measuring glycated hemoglobin assesses the effectiveness of therapy by monitoring long-term serum glucose regulation. For a single blood sample, it provides far more revealing information on glycemic behavior than a fasting blood sugar value. However, fasting blood sugar tests are crucial in making treatment decisions. The American Diabetes Association guidelines are similar to others in advising that the glycated hemoglobin test be performed at least two times a year in patients with diabetes that are meeting treatment goals (and that have stable glycemic control) and quarterly in patients with diabetes whose therapy has changed or that are not meeting glycemic goals.^[17]

Exercise and employment status was found to be associated with complications in the subjects. Complications were found more in subjects that are unemployed. This may probably be due to their inability to provide financially for the continuous medicare which the chronicity of the disease requires. Hence, routine medical care is compromised leading to poor metabolic control and ultimately leads to chronic complications. Also physical activity is a key element in the prevention and management of diabetes mellitus. It has been well established that participation in physical activity improves blood glucose control, positively impacting lipids, blood pressure, cardiovascular events, mortality and quality of life.^[18] Balducci *et al* (2006) observed that long-time aerobic exercise training can prevent the onset or modify the natural history of diabetic peripheral neuropathy which until then had no definitive treatment^[19]. The indigenous food in Nigeria are mostly carbohydrate based which provide adequate energy for farming which was formerly the predominant occupation. But recently sedentary life style predominates without a modification in family menu which was initially meant to serve farmers. Moreover, diabetics further have less activity owing to the illness, thus leading to a vicious cycle. Therefore, exercise is very important in ensuring good glycemic control.

Age plays a major role in complications which may suggest that complication increases with age. Thus subjects older than 50 years had greater prevalence of chronic complications.^[20] This may indicate that insulin secretion declined with age.^[21] Muller *et al* (1996) argued that in a recent interventional study where attempts was made to reverse risk factors of complications, had demonstrated that elderly patients showed insulin sensitivity and glucose tolerance but insulin secretion seems to decrease with age. Deches, *et al* (1998) also found out that there was an association with parallel reductions in insulin and amylin release. Thus, increasing age may be associated with worsening reduction in insulin production, thus worsening chronic complications.^[21]

Education was found to be a significantly important variable, because complications were found to be

prevalent among subjects with no formal education in this study. This may mean that illiteracy may have hampered self management education which goes pari pasu with clinical management, thus inadvertently leading to total failure of clinical management. Since, the vast majority of day-to-day care in diabetes mellitus is handled by patients and/or families, formal education is a very important variable in diabetes mellitus management^[22] because it poses a barrier to implementation of self care in diabetes mellitus. The American College of clinical endocrinologists; 2002 emphasized the importance of patients learning self management or care.^[23] Likewise, World Health Organisation has also recognized the importance of patients learning to manage themselves.^[24] A review of diabetes mellitus self management education is successful in lowering glycosylated hemoglobin levels.^[25] Nwankwo *et al* (2010) observed that majority of subjects in his study (93.6%) lacked basic knowledge of diabetes management or care and reported inability to visit the doctor except when manifesting serious symptoms or complications.^[26] This may further be the reason this study recorded great complications amongst those that are regular with medical checkup because majority of patient only present when complications have set in.

RECOMMENDATIONS

1. Glycosylated hemoglobin test should be performed at least twice a year in patients with diabetes that are meeting treatment goals (and that have stable glycemic control) and quarterly in patients with diabetes whose therapy has changed or that are not meeting glycemic goals.
2. Blood pressure in diabetes mellitus patients should be tightly regulated.
3. Subsidization of cost of HbA1c analysis in Nigeria as the test costs approximately 5000naira and not yet available in most tertiary health care centre.
4. Self- Care- Management should be energetically advocated in diabetes mellitus management in Nigeria in order to ensure consistent good glycemic control.
5. Exercise should be encouraged by advocacy and enlightenment.

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