International Journal of Science and Healthcare Research
Vol.5; Issue: 4; Oct.-Dec. 2020
Website: ijshr.com
Original Research Article *ISSN: 2455-7587*

Determinants of Poor Glycaemic Control among Type 2 Diabetic Patients at a Suburban Tertiary Hospital in North-Western Nigeria

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ABSTRACT

Background: Poor glycaemic control is a major public health problem among patients with type 2 diabetes mellitus. It has been implicated in the development of most diabetes complications. This study was carried out to identify the determinants of poor glycemic control among type 2 diabetes patients attending Rasheed Shakoni specialist hospital, Dutse. Nigeria.

Materials and Methods: A cross sectional study was conducted among eighty type 2 diabetic patients attending diabetic clinic of Rasheed Shakoni specialist hospital, Dutse. Structured questionnaire was used for data collection. Systolic blood pressure and diastolic blood pressure were measured using a standard Mercury Sphygmomanometer. Ion-exchange method was used for the estimation of glycated haemoglobin.

Results: About seventy three (73.75 %) percent of the patients had poor glycaemic control. Forty-five percent (45 %) of the patients practiced dietary control as recommended by the clinicians while 50 % of the patients observed regular follow-up to the diabetic clinic, and 64% of patients participated in regular physical exercise. Poor glycaemic control was significantly associated with male gender ($p<0.05$) and non-practice of dietary control ($p<0.05$). Males were about four times more likely to have poor glycaemic control than females and patients who did not practice dietary control were about five times more kely to have poor glycaemic control than those that practice dietary control. There was evidence of effect modification and confounding by other factors including the presence of co-morbidities (hypertension and obesity), marital status, employment status, regular follow-up to diabetic clinic, duration of the diabetes, and age of the patients.

Conclusion: The proportion of diabetic patients with poor glycemic control in Dutse, Jigawa State was high. Male gender and non-practice of diet control were the major determinants of poor glycaemic control. Effect modification and confounding of this may be brought about by presence of co-morbidities (hypertension and obesity), marital status, employment status, regular follow-up to diabetic clinic, duration of the diabetes, and age of the patients. We recommend strict diet control especially in the higher risk groups for successful diabetes management.

Keywords: Poor Glycaemic Control, Type 2 Diabetic, Tertiary Hospital, North-Western Nigeria

INTRODUCTION

Diabetes Mellitus (DM) is a metabolic disorder characterised by hyperglycaemia in which glucose is underutilized due to defects in insulin secretion, insulin action, or both. As of 2014, an estimated 387 million people had DM worldwide [1], with type 2 diabetes mellitus (T2DM) making up about 90% of the cases [2]. In Africa, the estimated number of people living with diabetes in 2009 was 12.1 million, but a recent projection showed that the number will reach 23.9 million by 2030 [3]. World Health Organization (WHO) suggests that Nigeria has the greatest number of people living with diabetes in Africa, with about 1.7 million people, which will increase to 4.8 million by 2030. Diabetes is estimated to result in 1.5 to 4.9 million deaths yearly [1].

Diabetes mellitus remains a significant health and socio-economic challenge for patients and health care systems. It is indeed the most common serious metabolic disease in the world. The world is experiencing definite surge in the prevalence of diabetes from 366 million in 2011, which is expected to increase to 522 million by 2030 [4].

Type 2 DM is due primarily, to lifestyle factors and genetics. A number of lifestyle factors are known to be important to the development of T2DM, including obesity, lack of physical activity, poor diet, stress and urbanization [5]. The impact of DM goes beyond chronic hyperglycaemia. DM is the leading cause of blindness (diabetic retinopathy), end-stage kidney diseases (diabetic nephropathy) and non-traumatic lower extremity amputations secondary to diabetic neuropathy and peripheral vascular disease in working age adults [6].

Long-term complications of diabetes are usually due to problems of blood vessels; uncontrolled hyperglycemia that remains over a long period of time causes both the small and large blood vessels to narrow, mainly as a result of complex sugar-based substances that build-up in the walls of blood vessels, leading to microvascular and macrovascular diseases.

In DM, maintaining normal blood glucose is therefore essential to prevent many medical complications, including ischaemic heart and blindness [7]. Most commonly, blood sugars are measured by either blood glucose monitoring which measures the current blood glucose level, fructosamine level which correlates best with average glucose levels in the previous 10 -14 days [8], or by glycated haemoglobin (HbA1c) which measures average glucose levels over approximately 3 months [2].

HbA1c level of <7% is designated as a goal of optimal blood glucose control by the American Diabetes Association (ADA) [9] and the American Association of Clinical Endocrinologist has further recommended HbA1c level of < 6.5% [10].

In Nigeria, poor glycaemic control ranging between 70% and 80% among diabetic patients has been reported [11]. Studies have shown that poor glycaemic control is associated with male gender [12], ethnicities [13] not practicing self-monitoring of glucose [11], and non-adherence to therapy [14]. However, there is paucity of such research data on T2DM patients in Northern Nigeria.

Therefore, this study aimed to assess the determinants of poor glycaemic control among T2DM patients in Dutse; a suburban state capital in North-Western, Nigeria.

MATERIALS AND METHODS

STUDY DESIGN

A cross sectional study design was adopted. Structured questionnaire was used as a data tool to obtain the socio-demographic and clinical information of the respondents.

STUDY SUBJECTS

Eighty patients who were diagnosed to have T2DM and attending the diabetic clinic of Rasheed Shakoni Specialist Hospital Dutse (RSSHD) – Jigawa State, Nigeria, were enrolled into the study.

ANTHROPOMETRIC MEASUREMENTS

Height measurement was made using stadiometer (model 220, Seca Gmbh and Co., Germany). Weight of the respondents was taken while wearing light clothing, to the nearest 0.1 kg by using weighing health scale (model ZT 120, Seca Gmbh and Co., Germany). The waist circumference was measured using a stretch-resistant tape; Hip circumference was measured with the tape parallel to the floor. For both measurements, subjects were made to stand with feet close together, arms at the side and weight evenly distributed. Blood pressure was measured using mercury sphygmomanometer and stethoscope.

BIOCHEMICAL MEASUREMENTS

Fasting Blood Glucose (FBG) was measured by the glucose oxidase method [15]; modified by Bauminger [16]. While glycated haemoglobin was measured by Ion Exchange Resin Method [17]. Glycated haemoglobin (HbA1c) measurements greater than 7% and FBG ≥ 7.0 were considered as poor glycaemic control.

ETHICAL CONSIDERATION

The ethical clearance for the study was obtained from the Research and Ethics Committee of the Rasheed Shakoni Specialist Hospital, Dutse (RSSHD). Informed consent of the recruited subjects was obtained.

STATISTICAL ANALYSIS

Data were cleaned and analyzed using Epi Info for windows version 7. The data were analyzed, demographic and other clinical characteristics were treated as categorical variables. Mean and standard deviation were determined for quantitative variable. Variables were coded as binary dummy variables. For example gender (males = 0, females = 1), and so on. Data were presented as frequency distribution generated for all categorical variables, while Mean and standard deviation were determined for quantitative variable. A Binary logistic regression was conducted to identify the risk factors associated significantly between Independent variables [Sex, Age, Educational status, Marital status, occupations] and dependent variable (Glycaemic control, had two outcome coded as 0 = good and 1 = poor) Linear regression also done to examine the linear relationship between BMI and HbA1c . P-values ($p \leq 0.05$) was considerate statistically significant.

RESULTS

Table 1: Socio-demographic and clinical characteristics of the patients

Gender	Frequency (F)	Percentage (%)
Male	40	50.0
Female	40	50.0
Age group		
< 40 years	20	25.0
≥ 40 years	60	75.0
Marital Status		
Single	16	20.0
Married	42	52.5
Divorced	15	18.75
Widowed	7	8.75
Education level		
No formal education	31	38.75
Primary	11	13.75
Secondary	21	26.25
Tertiary	17	21.25
Employment status		
Un employed	36	45.0
Employed	44	55.0
Diabetes Duration		
≤ Years	24	30.0
> 5 Years	56	70.0
Glycaemic control		
Poor	59	73.75
Good	21	26.25
Hypertension status		
Hypertensive	28	35
Normotensive	52	65

Of the 80 patients studied, 40 (50 %) were males and the remaining 40 (50 %) were females. Mean age and duration of diabetics of the patients were 49 ± 1.62 and 9.17 ± 6.69 years respectively. Fifty nine (73.75 %) of the patients had either a mean HbA1c of > 7.0 % or FBG of ≥ 7.0 or both, and therefore had poor glycaemic control. Table 1 demonstrates these results. About 45 % of the patients practiced diet control as recommended by the clinicians, 50 % of the patients observed regular follow-up to the diabetic clinic, and 64 of patients participated in physical exercise. Patients who did not practice dietary control were about five times more likely to have poor glycaemic control than those that practice

diet control. Poor glycaemic control is significantly associated with gender ($p<0.05$). Males were about four times more likely to have poor glycaemic control than females. Similarly, those that are not married are 1.68 times more likely to have poor glycaemic control than married patients. Table 2 illustrates these results. Using waist-to-hip ratio as a measure of obesity (> 0.85 and > 0.90 for females and males respectively), 53 % of the patients were obese. A scatter plot of Body Mass Index (BMI) versus HbA1c reveals a weak negative association between BMI and glycaemic control. Figure 1 represents these results.

Table 2: Bivariate Analysis of Determinants of Poor Glycaemic Control

Variable	Glycaemic control		OR	C.I
Age	**Poor**	**Good**		
< 40 years	14	6	0.7778	(0.2536 – 2.3856)
≥ 40 years	45	15		
Sex				
Male	34	6	4.3590	(1.1565 – 10.00)
Female	25	15		
Marital Status				
Unmarried	30	8	1.6810	(0.6074 – 4.6533)
Married	29	13		
Employment Status				
Unemployed	29	7	1.9333	(0.6826 – 5.4754)
Employed	30	14		
Hypertension Status				
Hypertensive	20	8	0.8333	(0.2967 – 2.3403)
Normotensive	39	13		
Obesity Status				
Obese	32	10	1.3038	(0.4806 – 3.5361)
Non-Obese	27	11		
Diabetes Duration				
> 5 years	42	14	1.2353	(0.4246 – 3.5942)
≤ 5 years	17	7		
Follow-up to Clinic				
Not Regular	32	8	1.9259	(0.6953 – 5.3348)
Regular	27	13		
Practice Diet Control				
No	38	6	4.5238	(1.5264 – 13.408)
Yes	21	15		

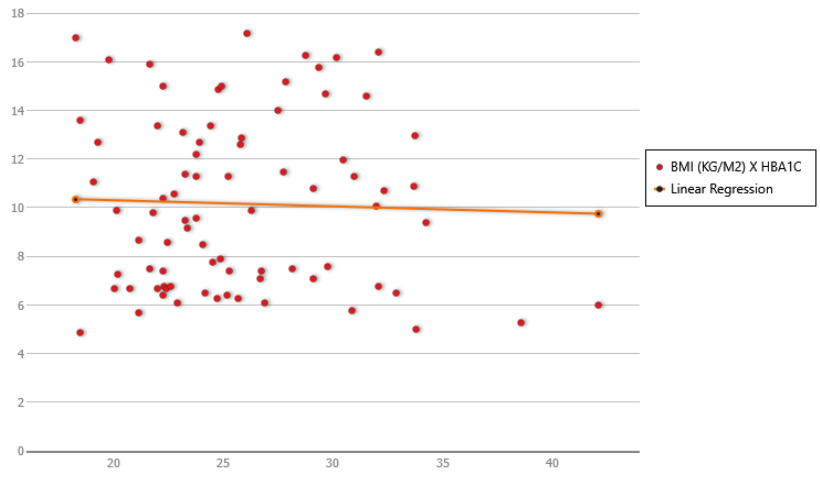

Figure 1: Scatter Plot of BMI and HbA1c [*Equation:* Y = (-0.0251) X + 10.8059]

DISCUSSION

Poorly controlled T2DM results in increased rates of micro and macrovascular diabetic complications which in turn lead to increased healthcare costs[18] (Koro CE, Bowlin SJ, Bourgeois N, Fedder DO.

Glycaemic control from1988 to 2000 among U.S. adults diagnosed with type 2 diabetes: a preliminary report. Diabetes Care. 2004; 27(1):17–20. Conversely, good glycaemic control can help in improving T2DM outcomes in terms of morbidity, mortality and quality of life of diabetic patients. Therefore, identification of the determinants of glycemic control can be of great importance in managing diabetic patients. The burden of T2DM is said to be higher in developing countries where competing infrastructural and human capacity development deficits make screening and access to care and treatment not readily available[19] (Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of DM for 2010 and 2030. Diabetes Res Clin Pract. 2010; 87(1):4–14.

A wide variety of factors have been identified by different studies as contributing to poor glycaemic control in T2DM, often with conflicting associations which mostly arose from varying study designs and background characteristics of the study populations. These factors include age, marital status, level of education, physical activity, longer duration of DM, poor compliance with diet and medication, therapeutic regimen, attitude towards the disease, poor self management behavior, anxiety/depression, alcohol, renal impairment, co-mobidities such as hypertention, dyslipidaemia etc.

However, the rates of poor glycaemic control among T2DM patients are high in many parts of the world including in some of the highly developed regions [20-26].

Of the 80 T2DM patients attending (RSSHD) studied, 73.75 % had a mean HbA1c 10.69±0.25% showing that a large majority of the diabetic patients at RSSHD had poor glycaemic control. This finding was in line with other studies using similar HbA1C results as a measure of glycaemic control [27 – 28]. However our mean HbA1c value of 10.69% is higher compared to findings from Morocco (8.4%), Jordan(8.10%)[24], UK(8.16%) [23], Canada (7.3%) [25] and Germany(7.1%) [26] . The percentage of diabetics with poor glycaemic control in these countries ranged from 45%-66.3% which was lower than ours (73.75%). Better control in these countries has been linked to better understanding of basic knowledge about the disease, easy access to healthcare services as well as availability of cutting-edge modalities of therapy. Similar values were reported from Saudi Arabia (74%), Kenya (81.6%), Plestine (80%), Ethiopia (59-70%) and India (63-91.8%) [29]. In contrast, the study from Gombe, North east Nigeria [30] used fasting blood glucose to measure control with the attendant drawback in assessing long term diabetes control. Additionally, the Gombe study unlike ours, was a retrospective study. Another study from the Niger Delta region of Nigeria [31], found a lower rate of poor glycaemic control of 55% and a mean HbA1c of 8.2%. The study involved nearly twice the number of our participants with a narrower age range of participants (minimum age of 40 yrs) and a higher literacy level. Purchasing power and health seeking behavior could also have played a role in the lower value of mean HbA1c. Lower values were also reported from Enugu [32] and Ibadan [33] all in the Southern region of Nigeria; probably for similar reasons.

Although some studies have demonstrated association between poor glycaemic control and dyslipidaemia, our study did not delve in to that and it would be interesting to study that in the future among this suburban population. The relationship between elevated total cholesterol and triglcerides has been explained by the concept of lipid spill over in which excess lipids get deposited on non-adipose tissues such as pancreatic β cells resulting in cellular dysfunction and lipoappotosis[34-35]. It has also been accepted that high serum triglceride is associated with insulin resistance [36].

Gender and ability to practice dietary control as recommended by clinicians were significantly associated with

glycaemic control. It was observed that males were at higher risk of having poor glycaemic control compared to females. This is consistent with previous study [13]. Socioeconomic struggles in this suburban, traditional, resource-poor setting may likely keep the male diabetics preoccupied as bread winners, while they support the women in seeking health care. Furthermore, a study by Geer and Shen pointed out that, males have higher insulin resistance compared to females [37].

Poor glycaemic control was associated with duration of diabetes ≥ 5 years in the present study but not to the level of statistical significance. Duration of T2DM could negatively impact on glycaemic control by way of progressive deterioration of pancreatic β cell function. Sazlina et al., (2015) reported that "Progressive loss of pancreatic β cell function has been shown to cause poor glycaemic control regardless of treatment regimen" [13].

Other factors identified to be associated with increased frequency of poor glycaemic control by the present study include age, marital status, employment status, follow-up to the diabetic clinic, and the presence of co-morbidities hypertension and obesity. But these did not reach level of statatistical signifigance. It has been opined that parameters that rely on patient recall (such as age and duration of illness) in the presence of a chronic disease that may in itself affect cognition coupled with low educational status may introduce inaccuracies in results [38]. Being married may provide the advantage of mutual psychosocial support while employment positively impacts purchasing power hence relative affordability and access to healthcare. Similar to the findings of a Thai study, it was discovered that patients without hypertension have poor glycaemic control as compared to those with hypertension. As in other studies, obesity did not show statistical significance as a predictor of poor glycaemic control. Other studies however showed that obese patients tend to have poorer glycaemic control than the non-obese. This could be as a result of higher risk of insulin resistance in obese individuals [39 – 40].

CONCLUSION

In conclusion, the proportion of diabetic patients at the Rasheed Shakoni Specialist HOSPITAL Dutse Jigawa State, Nigeria with poor glycemic control was high. The present study identified gender and non-adherence to dietary control as the major predictors of poor glycaemic control in these patients. Other factors such as presence of co-morbidities (hypertension and obesity), marital status, employment status, regular follow-up to diabetic clinic, duration of the diabetes, and age of the patients were less likely to be associated with poor glycaemic control but could serve as effect modifiers or confounders to its association with gender and practicing diet control. We therefore recommend strong advocacy for strict dietary control, for successful diabetes management. A larger study possibly multicenter, capturing more predictors of poor glycaemic including therapeutic modalities for the attainment of good glycaemic control is advocated in order to stem the burgeoning cost of diabetic care.

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How to cite this article: Yakubu A, Dahiru S, Mainasara AS et.al. Determinants of poor glycaemic control among type 2 diabetic patients at a suburban tertiary hospital in North-Western Nigeria. *Int J Sci & Healthcare Res*. 2020; 5(4): 207-214.

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