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A Cross-Sectional Study of Factors Associated with Poor Glycemic Control in Type 2 DM Patients in Tertiary Care Centre

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ABSTRACT

In patients diagnosed with type 2 diabetes mellitus, inadequate management of glycemic levels represents a prominent concern within the realm of public health. This factor holds substantial implications for the advancement of diabetic complications. The objective of this study was to evaluate the extent and underlying factors associated with suboptimal glycemic control in individuals diagnosed with type 2 diabetes. A cross-sectional study was undertaken with a sample size of 100 individuals diagnosed with type 2 diabetes. Inclusion criteria for participation in the study were being a type 2 diabetes patient aged 18 years or older, seeking healthcare services at the designated facilities. Retrospective data collection was conducted on a cohort of patients diagnosed with diabetes. The data was gathered with respect to variables such as age, gender, body mass index (BMI), duration of diabetes, presence of comorbidities and patterns of drug utilization. The assessment of glycemic control was conducted using measurements of HBA1C and FBS levels. sample Out of the 100 participants diagnosed with type 2 diabetes who were included in the study, it was found that 66 individuals exhibited inadequate glycemic control. The average age of the participants was 59.67 (SD = 9.617), with 76.9% of them being male. A significant proportion of patients (41%) employed either insulin or oral anti-diabetic medications as monotherapy in order to manage their blood glucose levels. The study findings indicate a significant association between the duration of diabetes and deteriorating glycemic control. Specifically, patients with diabetes for 5 to 10 years exhibited a 1.74 times higher odds ratio (OR) of experiencing worsened glycemic control compared to those with less than 5 years of illness. Moreover, patients with diabetes for more than 10 years demonstrated an even higher OR of 2.55, further highlighting the progressive decline in glycemic control with prolonged disease duration. Patients without co-morbidity exhibited significantly superior glycemic control (OR = 1.56) when compared to patients with co-morbidity. Significant associations were observed between gender, age, body mass index (BMI), occupation, medical history, medication history, triglyceride levels, high-density lipoprotein (HDL) levels, duration of diabetes, type and number of diabetes medications and glycated hemoglobin (HbA1c) levels. These factors have the potential to identify patients who are at a higher risk of experiencing poor glycemic control, thereby enabling the implementation of targeted interventions aimed at achieving optimal outcomes. The impact of adherence, physical activity, diabetes education and training on glycemic control was not observed in this particular study.

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Key Words
type 2 diabetes, glycemic control, co-morbidity

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INTRODUCTION

Diabetes mellitus (DM) is a prevalent metabolic disorder that is distinguished by persistent hyperglycemia. This condition arises from various causes, such as impairments in insulin secretion, insulin action, or a combination of both[1-5]. It is widely recognised as one of the most prevalent non-communicable chronic-degenerative diseases on a global scale[1,6,7]. Current estimates suggest that approximately 5-10% of the population is affected by this condition.5 Type 2 diabetes is the prevailing form of diabetes, constituting approximately 85-95% of all cases[2,3,8].

All types of diabetes have a profound impact on an individual's health, leading to an elevated susceptibility to debilitating and potentially fatal complications[1-4]. Diabetes is a significant contributor to morbidity and mortality due to its direct and indirect clinical implications[4,9,10]. Moreover, the presence of consistently elevated blood glucose levels can lead to severe health complications affecting various bodily systems, including the cardiovascular system, blood vessels, renal system, nervous system and other vital organs[1-3]. Type 2 diabetes mellitus (DM) has emerged as a significant public health concern on a global scale. The factors contributing to suboptimal glycemic control in individuals with type 2 diabetes are intricate and multifactorial[11]. Insufficient glycemic control is a significant factor in the elevated incidence of both macrovascular and microvascular complications associated with diabetes, posing a risk to public health. The primary therapeutic intervention for preventing diabetes complications and mitigating organ damage is the regulation of glycemic levels[12].

In the year 2013, the worldwide population of individuals diagnosed with diabetes was approximately 382 million, resulting in a global prevalence rate of 8.3%.1 Based on data provided by the International Diabetes Federation (IDF), it was estimated that approximately 415 million individuals were impacted by diabetes in the year 2015. Projections indicate that by the year 2040, this figure could potentially increase to 642 million individuals[6]. Historically, diabetes has exhibited a greater prevalence in high-income nations. However, there has been a rapid increase in the incidence of this disease in developing countries, which now account for approximately 80% of all global cases of diabetes. According to the International Diabetes Federation (IDF), it was estimated that approximately 19.8 million adults in Africa were affected by diabetes. Furthermore, in the year 2018, the global prevalence of type 2 diabetes exceeded 500 million cases[1]. The future is expected to witness a rise in the prevalence of diabetes across all countries, with developing nations being particularly affected. The increased prevalence of diabetes and its associated complications in Africa can be attributed to factors such as modernization, improvements in economic conditions and the adoption of a westernized lifestyle[13]. The prevalence of diabetes and its associated complications in Africa is increasingly recognized as an epidemic, driven by the adoption of new lifestyles, the introduction of imported dietary practices and the influence of globalization[14]. The prevalence of diabetes in Africa is emerging as a growing concern within the realm of public health, with a substantial number of cases likely remaining undiagnosed[15]. The healthcare systems within the sub-Saharan Africa (SSA) region exhibit significant variation. In low-resource countries, the presence of inadequate access to quality healthcare contributes to suboptimal health-seeking behaviors, thereby heightening the vulnerability to complications associated with diabetes mellitus. The management of diabetes mellitus (DM) is a multifaceted task and achieving optimal glycemic control has been shown to substantially decrease the likelihood of developing complications. The availability of management for diabetes mellitus in low resource settings is limited[16,17]. Given the constraints of limited resources and health budgets, coupled with a significant increase in the prevalence of type 2 diabetes, the current staffing levels are insufficient to effectively manage and provide appropriate care for the patients. The high prevalence of diabetic complications can be attributed to a lack of awareness and inadequate monitoring facilities[18]. Conversely, the absence of comprehensive national guidelines, socioeconomic disadvantage and limited knowledge contribute to the emergence of various complications. Hence, it can be inferred that there exists a significant peril to both individual well-being and the overall capacity of health systems[19].

MATERIALS AND METHODS

This was an Observational study conducted tertiary care Hospital of Central India. The Institutional Ethics Committee approved the study protocol and permission from the hospital superintendent was obtained before the initiation of the study. The study participants were type 2 diabetics. A sample of 80 type 2 diabetics of both sexes was obtained Diabetes Endocrinology Clinic, Any type 2 diabetes patient at the healthcare facilities over the age of 18 was eligible to participate in the study. Those patients who accepted to participate were provided with the study questionnaire when they visited the healthcare facilities for physician appointments, hospital visits and/or diabetes education sessions. Data was collected in terms of age, sex, BMI, duration of Diabetes, comorbidity and drug utilization pattern. Level of glycemic control was assessed with help of HBA1C and FBS levels. Levels of HbA1C <7% and FBS <110 mg dL^{-1} were taken as good glycemic control. The outcome of HbA1C and FBS levels were collected from patient information sheet. Fasting Blood Sugar levels were

measured by enzymatic reference method with Hexokinase. Descriptive statistics are used to show the features and characteristics of the collected data. Association of categorical variables are analyzed using chi square test. Quantitative data-expressed as mean+/-SD. Student 't' test are applied on quantitative data. If data found to be normal p<0.05 will be considered statistically significant.

RESULTS

Among the 80 patients who were part of this study, the average age was 59.67 years with a standard deviation of 9.617. The majority of the participants, specifically 62 individuals (76.9%), were male. Additionally, the largest age group among all the study patients was the 51-70 years category, which consisted of 55 individuals (68.3%). A majority of the patients, specifically 37 individuals (46%), were found to have a normal weight. Additionally, 13 patients (16.1%) were identified as obese, as indicated in Table 1. The patients exhibited a variety of diabetic complications. Among the total sample size of 80 patients, it was observed that 62 individuals, accounting for 78.2% of the population, experienced a single diabetic complication. Conversely, 17 patients, constituting 21.8% of the cohort, exhibited the presence of two distinct complications related to their diabetic condition. Among the patient population under study, a significant proportion (n = 21, 26.6%) presented with diabetic peripheral neuropathy. Of these cases, 18 (22.5%) were identified as male, while 3 (4.1%) were identified as female.

The study observed a total of 80 patients diagnosed with diabetic retinopathy, with 13 (16.6%) being male and 6 (7.3%) being female. Out of the total patient population, a significant proportion of 37 individuals (46.6%) were diagnosed with cardiovascular disorders, such as hypertension and dyslipidemia. Within the scope of this investigation, it was determined that out of the total sample size, 25 individuals (equivalent to 13.1% of the population) were diagnosed with infectious diseases. Notably, it was observed that the prevalence and severity of these diseases were notably higher among patients diagnosed with Type 2 Diabetes Mellitus (T2DM). A total of 22 patients, representing 27.7% of the sample, were identified as individuals without any co-existing medical conditions.

The study was categorised into five groups based on the patient's occupation and level of physical activity. The majority of the participants in the study were individuals engaged in physically demanding occupations, with 46.6% identified as physical labourers and 21.5% as houseworkers. The remaining individuals consisted of office workers (18.7%), retirees (7.5%), or individuals who were unemployed (5.8%). A significant proportion of the participants in the study, specifically 52 individuals (accounting for 65.4% of the total sample), were identified as non-alcoholics. Similarly, 62 participants (representing 77.6% of the total sample) were classified as non-smokers. Furthermore, it was observed that 58 patients (constituting approximately 72% of the total sample) bore the financial responsibility for their own medical expenses. These findings are summarised in Table 1.

Table 1: Association of HbA1c levels with demographic factors

	Total patients (N = 80)		HbA1c ≤7% (≤53 mmol mol^{-1})		HbA1c >7% (>53 mmol mol^{-1})		
Variables	No.	Percentage	No.	Percentage	No.	Percentage	p-value
Gender							
Male	62	76.9	15	18.4	47	58.4	0.013*
Female	18	23.1	2	3.3	16	19.8	
40-50	15	18.6	3	4	12	14.6	<0.001*
51-60	28	34.6	5	6.5	22	28.0	
Age year							
61-70	27	33.7	6	7.3	21	26.4	
71-80	9	11.3	2	2.6	7	8.7	
> 80	1	1.8	2	1.6	0	0.2	
Underweight	2	2.7	0	0.5	2	2.3	0.014*
BMI kg m^{-2}							
Normal	37	46.0	10	12.7	28	35.3	
Overweight	28	35.2	8	9.6	21	26.2	
Obese	13	16.1	1	1.7	12	14.5	
House work	17	21.5	3	3.2	15	18.3	0.042*
Occupation							
Office work	15	18.7	3	4	12	14.7	
Physical labor	37	46.6	8	10.4	29	36.2	
Retired	6	7.4	2	2.6	4	4.8	
Unemployed	5	5.8	1	1.7	3	4.1	
History of alcohol consumption							
No	52	65.4	11	14.3	41	51.1	0.935
Reformed	28	34.6	6	7.5	22	27.1	
Regular	0	0	0				
No	62	77.6	13	16.1	49	61.5	0.256
History of smoking							
Reformed	18	22.4	4	5.6	14	16.8	
Regular	0	0	0				
Insurance	22	28	4	5.6	18	22.5	0.394
Types of payment							
Out of pocket	58	72	13	16.3	45	55.7	

*p<0.05 (significant) and BMI: Body mass index

Table 2: Association of HbA1c levels with patient history and therapy

	Total patients (N = 80)		HbA1c ≤7% (≤53 mmol mol^{-1})		HbA1c >7% (>53 mmol mol^{-1})		
Variables	No.	Percentage	No.	Percentage	No.	Percentage	p-value
Medical history							
HTN	43	54.2	12	14.5	32	39.9	0.003*
Hyperlipidemia	3	4.0	1	0.8	2	3.2	
HTN+Hyperlipidemia	8	9.4	0	0.4	7	8.8	
No HTN or Hyperlipidemia	26	32.4	5	6.1	21	26.3	
Insulin	34	42.9	6	8.1	28	34.9	0.007*
Medication history							
OHA	24	29.5	7	8.5	17	21.0	
Insulin+OHA	22	27.4	4	5.0	18	22.4	
No drug	0	0.2	0	0.2	0		
No	42	51.9	11	12.6	31	39.3	0.097
Family history							
Yes	38	48.1	7	9.1	31	39.0	
Duration of diabetes illness y							
<5	18	22.2	6	7.5	12	14.7	<0.001*
5-10	19	24.4	4	5.5	15	18.9	
>10	43	53.4	7	8.8	36	44.6	
OHA	17	21.3	6	7.3	11	14.0	<0.001*
Type of antidiabetic drugs at discharge							
Insulin	34	42.1	6	7.8	27	34.3	
Insulin+ OHA	29	36.6	4	5.4	25	31.2	
No drug	2	2.0	1	1.7	0	0.3	<0.001*
Number of antidiabetic drugs at discharge							
1-2	62	77.5	14	17.2	49	60.3	
3-4	16	20.2	3	2.9	14	17.3	
> 4	0	0.3	0	0 0.3			

*p<0.05 (significant), HTN: Hypertension and OHA: Oral hypoglycemic agent

A majority of the study participants, specifically 43 individuals (54.2%), exhibited a medical background of hypertension. Additionally, a smaller proportion of patients, 3 individuals (4.0%), had a history of hyperlipidemia. The remaining portion of patients, constituting 32.4%, did not have any documented instances of hypertension or hyperlipidemia. Out of the total patient population, 34 individuals (42.6%) employed insulin as a means of diabetes management. Additionally, 22 patients (27.7%) had a prior record of utilising combination therapy, which involved both insulin and oral hypoglycemic drugs. Furthermore, 24 patients (29.5%) exclusively relied on oral hypoglycemic agents for their treatment. One patient who had recently been diagnosed with type 2 diabetes mellitus (T2DM) and associated complications was included in the study. It was observed that the majority of participants did not have a familial history of diabetes. The majority of patients (n = 43, 53.4%) had received a diagnosis of type 2 diabetes mellitus (T2DM) for a duration exceeding 10 years. A total of 20 patients (24.4%) had a duration of 5-10 years with Type 2 Diabetes Mellitus (T2DM), while 18 patients (22.2%) had a duration of less than 5 years with T2DM, as indicated in Table 2. The evaluation of the prescribed drugs revealed that a total of 2 patients, constituting 2% of the sample, were not prescribed any anti-diabetic medication. In order to manage their condition, a total of 29 patients (36%) were prescribed a combination of insulin and oral hypoglycemic agents.

The state of their condition. The majority of patients, comprising 33 individuals (41%), utilised insulin as a means of regulating their blood glucose levels. Alternatively, a smaller proportion of patients, specifically 17 individuals (21%), relied on oral anti-diabetic medications as a singular form of treatment. The provided information is presented in Table 2.

A noteworthy correlation was observed between HbA1c levels and demographic variables, namely gender, age, BMI and occupation. The majority of the patients exhibited a HbA1c level greater than 7% (equivalent to 53 mmol mol^{-1}), indicating inadequate glycemic control among these individuals (Table 1). Among the cohort of patients exhibiting suboptimal glycemic control, it was observed that 32 individuals (39.9%) had a documented medical background of hypertension, while 18 individuals (22.4%) had a history of being prescribed both insulin and oral anti-diabetic medications. This study observed patients who exhibited either a positive or negative family history of diabetes and found that both groups demonstrated suboptimal glycemic control. A notable correlation was observed between the duration of diabetes and HbA1c levels. Specifically, 36 (44.6%) patients who exhibited inadequate glycemic control had a history of diabetes lasting over a decade. A total of 27 patients (34.3%) relied solely on insulin for glucose control, while 25 patients (31.2%) underwent combination therapy involving both oral hypoglycemic agents (OHA) and insulin. Additionally, 48 patients (60.3%) were prescribed one or two forms of medication for managing their diabetes, as indicated in Table 2.

The study findings indicate that there is an increased likelihood of experiencing suboptimal glycemic control among female individuals (odds

ratio [OR] = 1.86), patients aged 65 years or younger (OR = 1.51) and individuals classified as obese (OR = 2.72). The study found that housewives faced a significantly higher risk of adverse outcomes compared to retired individuals, with an odds ratio of 3.04. Patients who had a family history were found to have a higher likelihood of experiencing poor control, as indicated by an odds ratio of 1.37 (Table 3). The study findings indicate that individuals exhibiting a systolic blood pressure exceeding 130 mmHg were found to have a higher likelihood of experiencing suboptimal glycemic control, as evidenced by an odds ratio of 1.21. Similarly, patients with a diastolic blood pressure surpassing 80mmHg were also observed to have an increased probability of poor glycemic control, with an odds ratio of 1.04.

The study findings indicate that there is a significant association between the duration of diabetes and glycemic control. Specifically, patients with a diabetes duration of 5-10 years had a higher odds ratio (OR) of 1.74, while patients with a history of diabetes for more than 10 years had an even higher OR of 2.55, when compared to individuals with less than 5 years of illness. Patients who did not have any co-morbidities exhibited significantly superior glycemic control in comparison to patients who had co-morbidities, with an odds ratio of 1.56. Various additional factors, such as total cholesterol, triglyceride level and the specific type of diabetes medications, were found to exert a substantial influence on glycemic control, as indicated in Table 4.

The findings of the multivariate analysis indicated that individuals identified as female

The study found that females had an odds ratio (OR) of 1.86, indicating a higher likelihood of the outcome being observed. Additionally, patients aged 65 years or younger had an OR of 1.51, suggesting a moderately increased probability of the outcome. Furthermore, individuals who were obese had an OR of 2.72, indicating a substantially higher chance of the outcome occurring. The study found that housewives faced a significantly higher risk of adverse outcomes compared to retired individuals (odds ratio = 3.04). Individuals who had a familial background exhibited a higher likelihood of experiencing suboptimal management of their condition [OR = 1.37 (Table 3)]. Individuals exhibiting a systolic blood pressure exceeding 130mmHg demonstrated a heightened propensity for suboptimal glycemic control (odds ratio [OR] = 1.21). Similarly, individuals with a diastolic blood pressure surpassing 80mmHg exhibited an increased likelihood of poor glycemic control (OR = 1.04).

The study findings indicate a positive correlation between the duration of diabetes and the severity of glycemic control. Specifically, patients with a diabetes duration of 5-10 years exhibited an odds ratio (OR) of 1.74, suggesting a higher likelihood of poor glycemic control. Moreover, individuals with a diabetes history exceeding 10 years demonstrated an OR of 2.55 when compared to those with less than 5 years of illness, further emphasising the association between longer diabetes duration and worsened glycemic control. Patients who did not have any co-morbidities exhibited significantly superior glycemic control in comparison to patients who had co-morbidities, as indicated by an odds ratio of 1.56. Various additional factors, such as total cholesterol, triglyceride level and the specific type of diabetes medications, were found to have a substantial impact on glycemic control, as indicated in Table 4.

Table 3: Univariate analysis of demographic factors associated with poor glycemic control

Variables	OR	CI (95%)	p-value
Gender			
Male	1	1.13-3.06	0.014*
female	1.86		
Age (year)			
>65	1	1.01-2.25	0.044*
≤65	1.51		
BMI (kg m^{-2})			
<30	1	1.414-5.23	0.003*
≥30	2.72		
Occupation			
House work	3.04	1.44-6.42	0.004*
Office work	1.98	0.95-4.11	0.066
Physical labor	1.86	0.97-3.55	0.060
Retired	1		
Unemployed	1.3	0.52-3.26	0.570
Family history			
No	1	0.94-2.00	0.097
yes	1.37		
Type of payment			
Out of pocket	1	0.787-1.84	0.394
insurance	1.2		

*p<0.05 (significant), BMI: Body mass index, CI: Confidence interval, OR: Odd ratio

Table 4: Univariate analysis of clinical variable associated with poor glycemic control

Variables	OR	CI (95%)	p-value
SBP (mmHg)			
≤130	1	0.83-1.76	0.315
>130	1.21		
DBP (mmHg)			
≤80	1	0.71-1.51	0.829
>80	1.04		
Duration of diabetes (year)			
<5	1		
5-10	1.74	1.0-2.89	0.032*
>10	2.55	1.64-3.98	<0.001*
Total cholesterol (mg dL^{-1})			
<200	1	0.73-2.30	0.369
≥200	1.3		
Triglyceride (mg dL^{-1})			
<150	1	1.03-2.48	0.036*
≥150	1.6		
HDL (mg dL^{-1})			
>45	1	1.03-2.67	0.036*
≤45	1.66		
Type of diabetes medication			
OHA	1		
Insulin	2.31	1.45-3.68	<0.001*
OHA+Insulin	3	1.81-4.96	<0.001*
No. of complication			
2	1	0.79-1.89	0.375
1	1.22		
Presence of comorbidity			
Yes	1	1.08-2.27	0.019*
No	1.56		

*p<0.05 (significant), CI: Confidence interval, DBP: Diastolic blood pressure, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, OR: Odd ratio, OHA: Oral hypoglycemic agent and SBP: Systolic blood pressure

Table 5: Multivariate analysis of variable associated with poor glycemic control

Variables	OR	CI (95%)	p-value
Gender			
Male	1	1.12-3.82	0.021*
Female	2.07		
Age (year)			
>65	1	1.0-2.81	0.049*
≤65	1.67		
BMI (kg m^{-2})			
< 30	1	0.97-4.15	0.062
≥30	2		
Triglyceride (mg dL^{-1})			
<150	1	0.84-2.19	0.219
≥150	1.35		
HDL (mg dL^{-1})			
>45	1	1.01-2.95	0.048*
≤45			
Duration of diabetes illness (year)	<5	1	
5-10	1.35	0.78-2.50	0.344
>10	2.53	1.46-4.40	0.001*
Diabetes medication			
OHA	1		
Insulin	2.03	1.15-3.58	0.014*
OHA+Insulin	2.41	1.35-4.28	0.003*
Presence of comorbidity			
Yes	1	0.91-2.27	0.125
No	1.43		

*p<0.05 (significant), BMI: Body mass index, CI: Confidence interval, HDL: High-density lipoprotein, OR: Odd ratio and OHA: Oral hypoglycemic agent

The findings of the multivariate analysis indicated that individuals identified as female.

The odds ratio (OR) for patients younger than 65 years old was 1.67, indicating a significant association with poor glycemic control. Similarly, an abnormal high-density lipoprotein (HDL) level had an OR of 1.72, also significantly associated with poor glycemic control. Additionally, a duration of diabetes exceeding 10 years and the type of diabetes medication used were both found to be significantly associated with poor glycemic control, as indicated in Table 5. The logistic regression model that was developed incorporated significant variables that exhibit associations with suboptimal glycemic control, with HbA1c serving as the reference line. The model that was developed exhibited an area under the receiver operating characteristic (ROC) curve of 0.683, which was statistically significant at a p-value of less than 0.001.

DISCUSSIONS

The presence of diabetes significantly elevates the likelihood of encountering various significant health complications. The prevalence of morbidity and mortality resulting from diabetes, along with its potential long-term complications, can present substantial healthcare challenges for both individuals and the broader community[20]. There are several factors that can have an impact on achieving optimal glycemic control. These factors include gender, age, body mass index (BMI), duration of illness, type of medication, lipid profile and blood pressure. The utilisation of HbA1c value in this research was justified due to its widely recognised status as the definitive measure for assessing glycemic control. In individuals with diabetes, optimal glycemic control is characterised by HbA1c values of 7% or lower, while suboptimal glycemic control is indicated by HbA1c values exceeding 7% (ranging from 8-10%). This study comprised a sample size of 80 patients, the majority of whom exhibited suboptimal glycemic control (78.2%). Males constituted the predominant gender within the study population. Notably, a statistically significant association was observed between female gender and an elevated risk of poor glycemic control (p<0.001). In a study conducted by Roy *et al*.[21], it was demonstrated that sub-optimal control was observed in males.

This study revealed a statistically significant correlation between glycemic control and age. The majority of patients exhibiting suboptimal glycemic control were found to fall within the age ranges of 50-60 years and 60-70 years, a finding consistent with the research conducted by Huang *et al*.[22] and Woldu *et al*.[23]. The present study examined the correlation between glycemic control and body mass index (BMI) as well as occupation in individuals with diabetes. The findings revealed a statistically significant association between glycemic control and both BMI (p = 0.014) and occupation (p = 0.042). These results are consistent with previous research conducted by Lee *et al*.[24] and Kassahun *et al*.[25], which also demonstrated the impact of being overweight or obese and occupation on type 2 diabetes mellitus (T2DM). Several studies conducted by Roy *et al*.[21], Agarwal *et al*.[26], Esposito *et al*.[27] and Schweizer *et al*.[28] have examined this topic.

In the present investigation, no statistically significant associations were observed between variables such as alcohol consumption history, smoking habits, family medical history, type of medical expenses coverage and glycemic control. In a separate investigation conducted by Juarez *et al*.[29], it was found that the specific type of insurance coverage did not have a significant effect on the regulation of glycemic control. The findings of this study indicate that male patients exhibited superior glycemic control, while the risk of inadequate glycemic control was notably elevated among female patients, particularly among those who assume caregiving responsibilities for their families and may consequently neglect their own healthcare. These results align with the findings reported by Kirk *et al*.[30] and Zhao *et al*.[31], which were also observed in the present study. There is a notable correlation between patients below the age of 65 and a higher likelihood of experiencing suboptimal glycemic control. The research conducted by Harrabi *et al*.[32] and Eid *et al*.[33] has demonstrated that age exerts a substantial influence on glycemic control. The impact of body mass index (BMI) on the level of glycated haemoglobin (HbA1c) was reported in a study conducted by Adham *et al*.[34]. This study elucidates the notable impact of obesity on suboptimal glycemic

control, which can be attributed to compromised insulin resistance and insulin secretion. In a separate study conducted by Bays *et al*.[35], it was reaffirmed that there is a correlation between being overweight or obese and an elevated likelihood of developing diabetes. The findings of this study indicate that retired individuals exhibited significantly superior glucose control in comparison to housewives and individuals belonging to other categories. This phenomenon may be attributed to the fact that individuals who are retired possess a sufficient amount of time to effectively engage in therapy and make necessary adjustments to their lifestyle. According to a survey conducted by Kassahun *et al*.[25], it was observed that farmers exhibited a higher prevalence of poor glycemic control in comparison to unemployed individuals. In the current investigation, it was observed that individuals who personally financed their medical costs exhibited a tendency towards improved glycemic control in comparison to patients who possessed insurance coverage. However, it is important to note that this observed effect did not reach statistical significance. In contrast to the findings of Juarez *et al*.[29], which indicated that there was no significant association between insurance coverage and glycemic control. According to the findings of Papazafiropoulou *et al*.[36] and Bo *et al*.[37], there was no observed impact of family history on the clinical features of individuals with diabetes, except for the levels of low-density lipoprotein cholesterol. The present study revealed that individuals who had a familial predisposition to diabetes exhibited a higher likelihood of experiencing suboptimal glycemic control. However, it is important to note that this association did not reach statistical significance. According to a study conducted by Khattab *et al*.[9] and Eid *et al*.[33], there is a significant correlation between the duration of type 2 diabetes mellitus (T2DM) and suboptimal glycemic control. The findings of this study indicate that a prolonged duration of diabetes has a negative impact on glycemic control, potentially attributable to diminished insulin secretion or heightened insulin resistance among affected individuals. Furthermore, a survey conducted by Juarez *et al*.[29] revealed that individuals with a diabetes duration of 6-7 years or 10 years or more exhibited a higher propensity for experiencing significant fluctuations in glycemic levels in comparison to those with a diabetes duration of 3 years or less. The risk of sustained, poor glycemic control is positively associated with a longer duration of diabetes[29].

Patients with diabetes frequently experience lipid abnormalities. This study found a significant association between dyslipidemia and suboptimal glycemic control, particularly in cases where triglyceride levels exceeded or equaled 150 mg dL^{-1}. The findings of Adham *et al*.[34] and Benoit *et al*.[38] indicate that improved glycemic control is associated with decreased levels of total cholesterol, low-density lipoprotein cholesterol and triglycerides. This study revealed a significant association between the type of medication and the level of HbA1c. Specifically, patients who received a combination of insulin and oral hypoglycemic agents or insulin alone were more prone to experiencing inadequate glycemic control compared to patients who solely relied on oral diabetes medication. This phenomenon may be attributed to the adoption of an insulin regimen or the pursuit of an ideal glycemic level that cannot be attained solely through oral medication. The present finding aligns with previous studies conducted by Khattab *et al*.[9] and Benoit *et al*.[38]. According to El-Kebbi *et al*.[39], the presence of co-morbidity does not seem to impede the attainment of satisfactory glycemic control in individuals with type 2 diabetes mellitus (T2DM). There was no statistically significant difference observed in glycemic control between patients with multiple complications of diabetes and those with only one complication. The results of the multivariate analysis revealed a statistically significant relationship between several variables, including gender (specifically female), age, HDL level, duration of diabetes illness and type of medication and the presence of poor glycemic control.

CONCLUSION

The current investigation demonstrated a noteworthy correlation between specific demographic variables, such as gender, age, BMI, occupation and clinical factors, including medical history, medication history, triglyceride level, HDL level, duration of diabetes illness, type and number of prescribed diabetes medication and HbA1c level. Based on the aforementioned factors, it is possible to identify patients who are at risk of experiencing suboptimal glycemic control. Subsequently, targeted interventions can be employed with the aim of achieving the most favourable outcomes. Variables such as adherence level, physical activity and diabetes education and training programmes are known to influence optimal glycemic control. However, it is important to note that these specific factors were not examined in the present study.

REFERENCES

1. Cho, N.H., J.E. Shaw, S. Karuranga, Y. Huang, J.D. da. R. Fernandes, A.W. Ohlrogge and B. Malanda 2018. IDF diabetes atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract, 138: 271-281.

2. Craig, M.E., A. Hattersley and K.C. Donaghue, 2009. Definition, epidemiology and classification of diabetes in children and adolescents. Pediatr. Diabetes, 10: 3-12.
3. Nathan, D.M., J.B. Buse, M.B. Davidson, E. Ferrannini, R.R. Holman, R. Sherwin and B. Zinman, 2009. Medical management of hyperglycemia in type 2 diabetes: A consensus algorithm for the initiation and adjustment of therapy. Diabetes Care, 32: 193-203.
4. Litwak, L., S.Y. Goh, Z. Hussein, R. Malek, V. Prusty and M.E. Khamseh, 2013. Prevalence of diabetes complications in people with type 2 diabetes mellitus and its association with baseline characteristics in the multinational a1chieve study. Diabetol Metab Syndr, Vol. 5. 10.1186/1758-5996-5-57.
5. WHO, 1999. Definition, diagnosis and classification of diabetes mellitus and its complications: Report of a WHO consultation. Part 1, Diagnosis and classification of diabetes mellitus, https://apps.who.int/iris/handle/10665/66040.
6. Ogurtsova, K., J.D.D. Fernandes, Y. Huang, U. Linnenkamp and L. Guariguata *et al*., 2017. IDF diabetes atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. Diabetes Res. Clin. Pract., 128: 40-50.
7. Olokoba, A.B., O.A. Obateru and L.B. Olokoba, 2012. Type 2 diabetes mellitus: A review of current trends. Oman Med. J., 27: 269-273.
8. Eticha, T., A. Mulu, H. Gebretsadik, G. Kahsay, D. Ali and Y. Rajeshwar, 2016. Factors associated with poor glycemic control in type 2 diabetic patients investigated at Ayder referral hospital, Mekelle, Ethiopia. Human J., 6: 160-171.
9. Khattab, M., Y.S. Khader, A. Al-Khawaldeh and K. Ajlouni, 2010. Factors associated with poor glycemic control among patients with type 2 diabetes. J. Diabetes Complications, 24: 84-89.
10. Koro, C.E., S.J. Bowlin, N. Bourgeois and D.O. Fedder, 2004. Glycemic control from 1988 to 2000 among u.s. adults diagnosed with type 2 diabetes. Diabetes Care, 27: 17-20.
11. Pamungkas, R.A., S. Hadijah, A. Mayasari and N. Nusdin, 2017. Factors associated with poor glycemic control among type 2 diabetes mellitus in Indonesia. Belitung Nurs. J., 3: 272-280.
12. Kamuhabwa, A. and E. Charles, 2014. Predictors of poor glycemic control in type 2 diabetic patients attending public hospitals in dar es salaam. Drug, Healthcare Patient Saf., 24: 155-165.
13. Mbanya, J.C. and K. Ramiaya, 2006. Diabetes Mellitus. In: Disease and Mortality in Sub-Saharan Africa., Jamison DT, R.G. Feachem, M.W. Makgoba, (Ed.)., 2006, Washington (DC).
14. Azevedo, M. and S. Alla, 2008. Diabetes in sub-saharan Africa: Kenya, mali, mozambique, Nigeria, south Africa and zambia. Int. J. Diabetes Dev. Ctries., 28: 101-108.
15. Onodugo, O.D., B.A. Ezeala-Adikaibe, O.B. Anyim, P. Onodugo and I.N. Anyim *et al*., 2019. Glycemic control among medical outpatients in Enugu: A cross sectional survey. J. Diabetes Mellitus, 9: 50-61.
16. Buowari, O.Y., 2012. Diabetes Mellitus in Developing Countries and Case Series. In: Diabetes Mellitus: Insights and Perspectives., Oguntibeju, O., (Ed.)., IntechOpen, ISBN-17: 978-953-51-0939-6, 2013.
17. Edo, A.E. and A.S. Adediran, 2006. Carbohydrates in diabetic diet in Nigeria: is it evidence based. Nig. J. Gen. Pract., 79: 19-23.
18. Swai, A.B., J. Lutale and D.G. McLarty, 1990. Diabetes in tropical Africa: A prospective study, 1981-7. I. characteristics of newly presenting patients in dar es salaam, Tanzania, 1981-7. BMJ, 300: 1103-1106.
19. Stephani, V., D. Opoku and D. Beran, 2018. Self-management of diabetes in sub-saharan Africa: A systematic review. BMC Public Health, Vol. 18. 10.1186/s12889-018-6050-0
20. Jeffcoate, S.L., 2003. Diabetes control and complications: The role of glycated haemoglobin, 25 years on. Diabetic Med., 21: 657-665.
21. Roy, S., A. Sherman, M.J.M. Sparks, O. Schweiker and N. Jain *et al*., 2016. Association of comorbid and metabolic factors with optimal control of type 2 diabetes mellitus. N. Am. J. Med Sci., 8: 31-39.
22. Huang, E.S., J.Y. Liu, H.H. Moffet, P.M. John and A.J. Karter, 2011. Glycemic control, complications and death in older diabetic patients. Diabetes Care, 34: 1329-1336.
23. Woldu, M.A., C.D. Wami, J.L. Lenjisa, G.T. Tegegne, G. Tesafye and H. Dinsa 2014. Factors Associated with Poor Glycemic Control among Patients with Type 2 Diabetes Mellitus in Ambo Hospital, Ambo; Ethiopia Endocrinol Metab Syndr, Vol. 3, No. 4.
24. Lee, D.C., I. Park, T.W. Jun, B.H. Nam, S. Cho, S.N. Blair and Y.S. Kim, 2012. Physical activity and body mass index and their associations with the development of type 2 diabetes in korean men. Am. J. Epidemiol., 176: 43-51.
25. Kassahun, T., T. Eshetie and H. Gesesew, 2016. Factors associated with glycemic control among adult patients with type 2 diabetes mellitus: A cross-sectional survey in Ethiopia. BMC Res. Notes, Vol. 9, No. 78 .10.1186/s13104-016-1896-7.
26. Agarwal, A., P. Jadhav and Y. Deshmukh, 2014. Prescribing pattern and efficacy of anti-diabetic drugs in maintaining optimal glycemic levels in diabetic patients. J. Basic Clin. Pharm., 5: 79-83.

27. Esposito, K., P. Chiodini, G. Bellastella, M.I. Maiorino and D. Giugliano, 2011. Proportion of patients at hba1c target <7% with eight classes of antidiabetic drugs in type 2 diabetes: Systematic review of 218 randomized controlled trials with 78 945 patients. Diabetes, Obesity Metab., 14: 228-233.
28. Schweizer, A., A. Couturier, J.E. Foley and S. Dejager, 2007. Comparison between vildagliptin and metformin to sustain reductions in hba 1ac Over 1 year in drug-naïve patients with type 2 diabetes. Diabetic Med., 24: 955-961.
29. Juarez, D.T., T. Sentell, S. Tokumaru, R. Goo, J.W. Davis and M.M. Mau, 2012. Factors associated with poor glycemic control or wide glycemic variability among diabetes patients in hawaii, 2006–2009. Preventing Chronic Dis., Vol. 9. 10.5888/pcd9.120065.
30. Kirk, J.K., S.W. Davis, C.A. Hildebrandt, E.N. Strachan, M.L. Peechara and R. Lord, 2011. Characteristics associated with glycemic control among family medicine patients with type 2 diabetes. N .C. Med .J., 72: 345-350.
31. Zhao, W., P.T. Katzmarzyk, R. Horswell, Y. Wang, J. Johnson and G. Hu 2014. Sex differences in the risk of stroke and HbA1c among diabetic patients. Diabetologia, 57: 918-926.
32. Harrabi, I., F.A. Harbi and S.A. Ghamdi, 2014. Predictors of glycemic control among patients with type 2 diabetes in najran armed forces hospital: A pilot study. J. Diabetes Mellitus, 4: 141-147.
33. Eid, M., M. Mafauzy and A.R. Faridah 2003. Glycaemic control of type 2 diabetic patients on follow up at hospital universiti sains Malaysia. Malays J. Med Sci., 10: 40-49.
34. Adham, M., E.S. Froelicher, A. Batieha and K. Ajlouni 2010. Glycaemic control and its associated factors in type 2 diabetic patients in Amman, Jordan. East Mediterr Health. J., 16: 732-739
35. Bays, H.E., R.H. Chapman and S. Grandy, 2007. The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: Comparison of data from two national surveys. Int J. Clin Pract, 16: 737-747.
36. Papazafiropoulou, A., A. Sotiropoulos, E. Skliros, M. Kardara, A. Kokolaki, O. Apostolou and S. Pappas, 2009. Familial history of diabetes and clinical characteristics in greek subjects with type 2 diabetes. BMC Endocr. Disord., Vol. 9. 10.1186/1472-6823-9-12
37. Bo, S., P. Cavallo-Perin, L. Gentile, E. Repetti and G. Pagano, 2000. Influence of a familial history of diabetes on the clinical characteristics of patients with type 2 diabetes mellitus. Diabetic Med., 17: 538-542.
38. Benoit, S.R., R. Fleming, A.P. Tsimikas and M. Ji, 2005. Predictors of glycemic control among patients with type 2 diabetes: A longitudinal study. BMC Public Health, Vol. 5. 10.1186/1471-2458-5-36
39. Qaseem, A., S. Vijan, V. Snow, J.T. Cross, K.B. Weiss and D.K. Owens, 2007. Glycemic control and type 2 diabetes mellitus: The optimal hemoglobin A1c targets. A guidance statement from the American College of Physicians. Ann Intern Med, 18: 417-422.