Metabolic Control and Its Correlates among Diabetic Patients in Aljouf Region, Saudi Arabia: A Cross-Sectional study

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Abstract

Background: Throughout the world, diabetes, and its consequences, constitutes a serious problem for public health. Metabolic control can reduce the risk of diabetes complications. The present study aims to determine diabetic metabolic control among diabetic patients in the Aljouf region, Saudi Arabia, and its association with family function, depression, and other sociodemographic and clinical data.

Methods: A cross-sectional study was conducted among 279 diabetic patients attending the diabetic center in a specialized hospital in Aljouf Region, Saudi Arabia. A structured anonymous questionnaire was distributed to the targeted population during a direct interview.

Results: The present study showed that HbA1c was ≥7% among 86% of the participants. Regarding lipid profile, abnormal HDL, LDL, triglycerides, and cholesterol levels were detected among 39.4%, 41.2%, 68.5%, and 50.2% of the participants, respectively. Severe depression and severe family dysfunction were detected among 22% and 6% of the participants, respectively. Increasing age was associated with higher LDL levels and diabetes duration was associated with higher HbA1c levels in patients with diabetes.

Conclusion: The study concluded that family function and depression do not directly affect diabetic patients' diabetes metabolic control and the study showed a high prevalence of uncontrolled HbA1c levels and dyslipidemia among the study participants. Further investigation into the variables underlying the control of diabetes is required to further enhance patient outcomes because many people are still failing to meet the metabolic control objectives.

Keywords: Metabolic control; Depression; Family function; Diabetes mellitus; Saudi Arabia

Introduction

Diabetes mellitus (DM) is a critical and complicated metabolic illness, and over the recent decades, its prevalence has increased to epidemic levels (1). Diabetes is currently on the political agendas around the world due to its severe effects on a variety of levels, including the personal, social, and healthcare systems. It is crucial to slow down its epidemic curves and risk factors (2). The prevalence of type 2 diabetes mellitus in the Kingdom of Saudi Arabia has risen markedly in recent years. It is estimated to approach 40.37% in 2025, and 45.36% in 2030 (3). In KSA, the incidence of diabetes is rising due to marked growth, aging, civilization, and emergent incidence of weight problems and lack of physical activity (4).

In Type 2 DM, metabolic management is a crucial part of diabetic care. Without solid metabolic management, problems may occur that impair quality of life and raise mortality rates. Additionally, several comorbidities, such as dyslipidemia, hypertension, and obesity are linked to poor metabolic control as measured by HbA1c, high-density lipoprotein (HDL), low-density lipoprotein (LDL), total cholesterol (TC), and triglycerides, raising the risk of long-term macro and micro-vascular problems (5).

In the Middle East and North Africa, 1 in 6 adults (73 million) is living with diabetes, and the number of adults with diabetes is expected to reach 95 million by 2030 and 136 million by 2045 (6). In addition to the negative effects on health and budget, DM presents both social and psychological concerns (1). It is not fully understood why depression worsens glycemic control, but it does. It might, however, be connected to how diabetes patients' self-care activities are affected by sadness. Evidence supports the idea that depression may contribute to and speed up diabetes problems (7). The American Diabetes Association strongly emphasizes helping persons with type 2 diabetes identify, treat, and manage depression (8). Early detection, regular screenings, and the application of evidence-based strategies to depression treatment can enhance HbA1c, cholesterol, and physical well-being while lowering medical expenses (9).

The family function is defined as "the ability of families to coordinate and adapt to the changes throughout life, resolve the conflicts, cooperate between members and success in disciplinary patterns, respect the boundaries between individuals and respect the rules and principles which help the family to protect the entire family system." (10). Family is therefore a key source of social support in the daily management of diabetes (2). Diabetes is a chronic illness that affects many areas of one's life and is challenging to manage without the help of family and community. Patients' general lifestyles must modify for the better in order to manage this chronic illness (11). Despite improvements in diagnosis and therapy, many patients continue to have insufficient blood glucose control. In type 2 diabetes patients, contact between adult patients and families, perceived support from family, and family barriers are related to self-management and HbA1C levels (12).

Planning special meals, checking blood sugar frequently, reminding patients to take their medications, and maintaining exercise schedules are all ways that well-balanced families support their patients. As a result, patients' glycemic control is improved, the onset of complications is delayed, and their general health is improved. Patients with diabetes are vulnerable to several life changes that affect their psychological well-being and social interactions. The adverse effects of blood glucose-lowering medications impact patient behavior and quality of life (13).

Little data is available regarding the role of the family in improving the mental health status of patients with DM in Saudi Arabia. Also, few studies have addressed family function as a correlation to diabetes mellitus. Therefore, we conducted this study to determine diabetes metabolic control, as measured by HbA1c, HDL, LDL, total cholesterol (TC), and triglycerides among diabetic patients in Aljouf, Saudi Arabia. In addition, the present study will explore the association of diabetes metabolic control in these patients with family function, depression, and other sociodemographic and clinical data.

Materials and Methods

Study design and setting

This is a cross-sectional study conducted in the Aljouf Region of the KSA, situated in the Northern part of Saudi Arabia. The sample was recruited between January 2021 to August 2021 from diabetic adults attending the diabetic center in King Abdulaziz Hospital situated in Aljouf City, the capital of the Aljouf region.

Sample size estimation and sampling method

The sample size calculation was done using n = P (1-p) z2/d2 assuming the prevalence of depression as 20.6% (14). Z = 1.96 and d = 0.05 and applying to a confidence level of 95%. The calculated sample size was 251. The sample size was raised to 279 after adding 10% as a non-response rate. A systematic random sampling technique was adopted in the present study to select cases. The total number of diabetic patients attending the diabetic center in King Abdulaziz Hospital was 1450 and the sample size was 279. Therefore, the sampling interval was 5.2. The case was selected for every 5th patient if it fulfilled the inclusion criteria.

Inclusion and exclusion criteria

The present study included males and females aged 18 years and above with type 2 diabetes mellitus for more than one year and attending the diabetic center. The participants who were not willing to participate and those who had a history of debilitating illness, current psychiatric problems, or a history of substance abuse were excluded from the study.

Ethical consideration

The study was done with the approval of the local committee of Bioethics at Jouf University, Saudi Arabia (reference number 11-07/41). Further approval was

taken from the local committee of research ethics in the Northern Border region registered with the National Bioethics Committee No. (H-09-A-51) (reference number 691498). The objectives of the study were clarified to the participants and written informed consent was provided from participants who decided to participate in the study. The participants had the right to withdraw at any time if they decided to. By using anonymous questionnaires, the authors guaranteed the privacy and confidentiality of the data obtained.

Data collection method

A structured, anonymous questionnaire was used in the present study. The questionnaire consisted of five parts. The first part was about sociodemographic data (age, sex, marital status, educational level, occupation, and monthly income). The second part inquired about clinical data (Duration of diabetes and Type of treatment). Assessment of depression was in the third part of the questionnaire and done by using the Patient Health Questionnaire PHQ9 (15). It is a predesigned validated questionnaire with a sensitivity of 88% and a specificity of 88%. Cronbach's alpha was 0.826. The questionnaire consists of nine questions and the results are divided into no depression (0-4), mild (5-9), moderate (10-19), and severe (20-27). The fourth part was about family function assessment and was done using SMILKSTEIN'S FAMILY SYSTEM APGAR ITEMS (16). It consists of five questions that assessed a member's report of satisfaction with five parameters of family function: adaptation, partnership, growth, affection, and resolve. The results are divided into highly functional (0-3), moderately dysfunctional (4-7), and severely dysfunctional (8-10). These four parts of the questionnaire were filled in by direct interviews with the patients. The fifth part of the questionnaire was the laboratory investigations obtained from medical records recorded approximately in the previous 3 months (HbA 1C, HDL, LDL, Cholesterol, triglyceride). Diabetes metabolic control was assessed by these parameters. It was collected from records during the same session of the interview. A pilot study was done to assess the questions' relevance to the work's aim, determine whether the respondents understood it, and determine the time needed to complete the interview.

Statistical analysis

Analysis of data was done using the SPSS program, version 24 (SPSS Inc., Chicago, IL, USA). Qualitative data was displayed as numbers and percentages while quantitative data was as mean and standard deviation (SD). Linear regression was done to investigate the correlates of metabolic control. A p-value ≤ 0.05 was considered statistically significant.

Results

Table (1) describes the sociodemographic and clinical data of the respondents. The present study included 279 participants with a mean age of 51.73±9.12. Most of the participants were females (57.7%), married (81.4%), and working (43.4%). Nearly half of the participants (49.1%) have income less than 5000 RS. Concerning clinical characteristics of the respondents, 36.6% have diabetes with a duration of more than ten years with most of them using oral therapy (47.3%). Table (2) summarizes the mean values of the studied population's glycemic control and metabolic markers. HbA1c was ≥7% among 86% of the participants. Regarding lipid profile, abnormal HDL, LDL, triglycerides, and cholesterol levels were detected among 39.4%, 41.2%, 68.5%, and 50.2% of the participants, respectively. The study revealed that 35% of the participants have no depression. Mild, moderate, and severe depression was detected among 24%, 19%, and 22% of the studied population (Figure 1). Figure 2 revealed that 70% of participants were found to be highly functional. Only 6% suffered from severe family dysfunction and 24% from moderate dysfunction. Table (3) shows a linear regression model demonstrating the predictors of metabolic control among diabetic patients. Increasing age was associated with higher LDL levels. Diabetes duration was associated with higher HbA1c levels in patients with diabetes.

Table 1: Sociodemographic data and clinical characteristics of diabetic patients in the Aljouf region, Saudi Arabia

Variables	No. (%) n= 279
Age	
≤40	44 (15.8)
>40	235 (84.2)
Mean ± SD (Range)	51.73±9.12 (33-79)
Sex	
Male	118 (42.3)
Female	57.7 (57.7)
Marital status	
Single	5 (1.8)
Married	227 (81.4)
Divorced/widowed	47 (16.8)
Education	
Illiterate/Read and write.	61(21.9)
Primary/Preparatory/Secondary	111(39.8)
University/postgraduate	107 (38.4)
Occupation	
Working	121(43.4)
Not working	91(32.6)
Retired	67 (24.0)
Income	
<5000 RS	137 (49.1)
5000-7000 RS	71(25.4)
>7000 RS	71 (25.4)
Diabetes Duration	
≤ 10 years	177 (63.4)
>10 years	102 (36.6)
Medication regimen	
Oral	132 (47.3)
Insulin	78 (28.0)
Both	69 (24.7)

Table 2: Glycemic control and metabolic markers values of diabetic patients in the Aljouf region, Saudi Arabia

Variables	No. (%) n= 279
HbA1c	
<7 % (controlled)	39 (14.0)
≥7 % (uncontrolled)	240 (86.0)
Mean ± SD	8.66 ± 1.85
HDL	
≥ 1.05 mmol\L	169 (60.6)
< 1.05 mmol\L	110 (39.4)
Mean ± SD	2.64±1.52
LDL	
≥ 2.60 mmol\L	115 (41.2)
< 2.60 mmol\L	164 (58.8)
Mean ± SD	3.08±1.98
Triglycerides	
≥ 1.70 mmol\L	191 (68.5)
< 1.70 mmol\L	88 (31.5)
Mean ± SD	20.87±4.68
Cholesterol	
≥ 5 mmol\L	140 (50.2)
< 5 mmol\L	139 (49.8)
Mean ± SD	17.95±4.16

Figure 1: Prevalence of depression among diabetic patients in the Aljouf region, Saudi Arabia

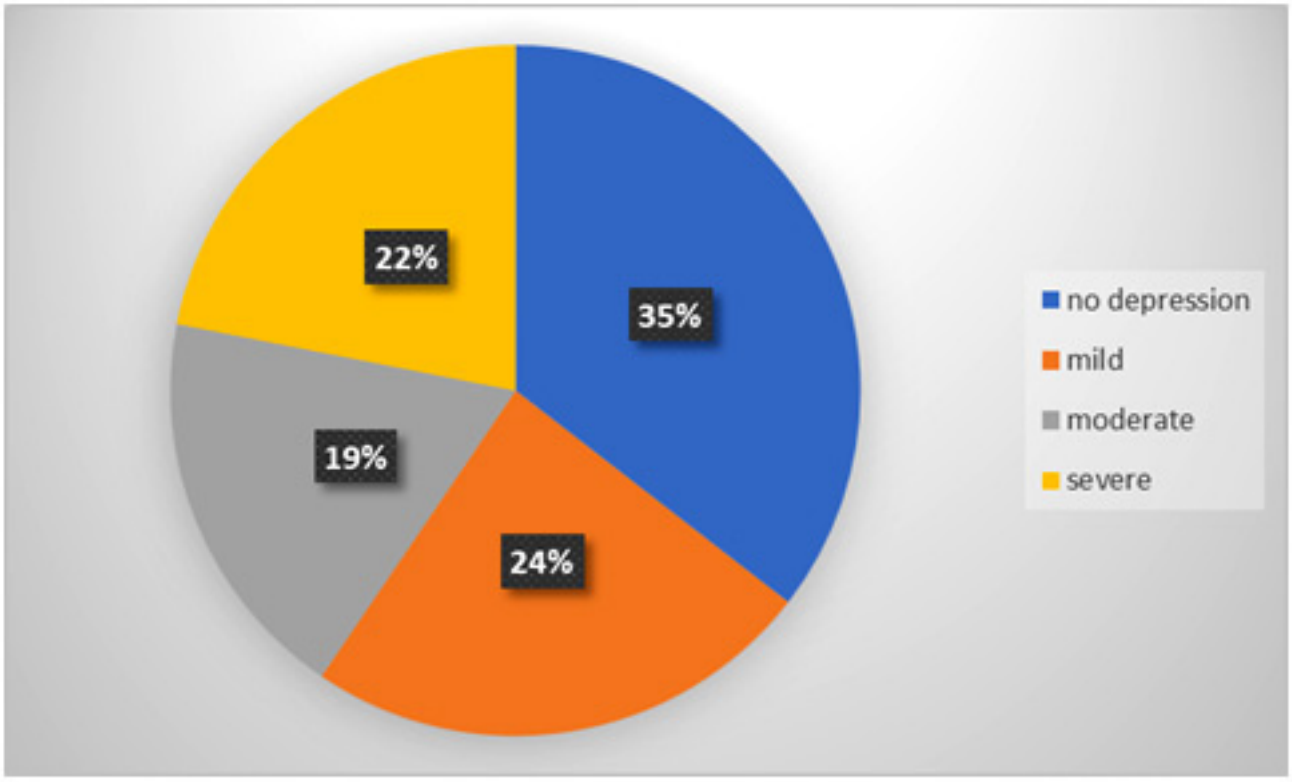

Figure 2: Distribution of family function/dysfunction among diabetic patients in the Aljouf region, Saudi Arabia

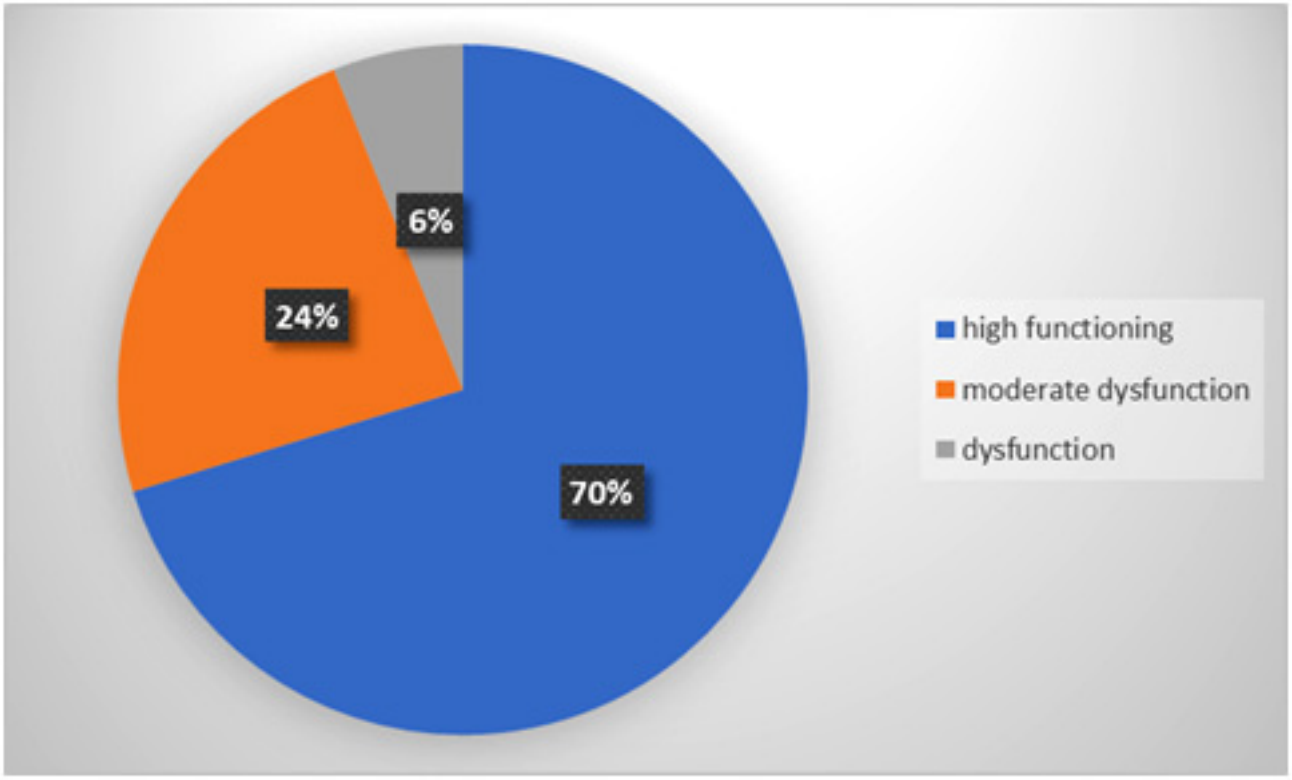

Table 3: Linear regression model showing the predictors of metabolic control among diabetic patients in the Aljouf region, Saudi Arabia

Variables	B	t	p-Value	95% Confidence Interval	
				Lower Limit	Upper Limit
HDL					
Depression	.118	1.849	.066	-.015	.475
Family Function	-.071	-1.126	.261	-3.766	1.026
Age	-.033	-.463	.643	-.217	.134
Diabetes duration	-.026	-.358	.721	-3.976	2.753
Gender	-.080	-1.282	.201	-4.712	.995
Medication regimen	.040	.596	.552	-1.279	2.390
LDL					
Depression	.078	1.245	.214	-.084	.374
Family Function	-.039	-.631	.529	-2.955	1.521
Age	.219	3.170	**.002**	.100	.428
Diabetes duration	-.058	-.834	.405	-4.474	1.813
Gender	.074	1.208	.228	-1.030	4.302
Medication regimen	.051	.778	.437	-1.037	2.391
Triglycerides					
Depression	-.070	-1.091	.276	-1.510	.433
Family Function	-.029	-.464	.643	-11.731	7.259
Age	.081	1.145	.253	-.291	1.101
Diabetes duration	-.041	-.578	.564	-17.249	9.422
Gender	.058	.939	.348	-5.915	16.706
Medication regimen	-.083	-1.251	.212	-11.891	2.650
Cholesterol					
Depression	-.031	-.484	.629	-1.094	.662
Family Function	.080	1.279	.202	-3.008	14.156
Age	.031	.436	.663	-.490	.768
Diabetes duration	-.077	-1.069	.286	-18.594	5.511
Gender	-.039	-.629	.530	-13.489	6.955
Medication regimen	-.014	-.209	.834	-7.269	5.872
HbA1c					
Depression	-.044	-.719	.473	-.051	.024
Family Function	.074	1.237	.217	-.137	.599
Age	-.048	-.713	.477	-.037	.017
Diabetes duration	.311	4.552	**.000**	.677	1.710
Gender	-.030	-.503	.615	-.550	.326
Medication regimen	.075	1.183	.238	-.112	.451

Discussion

The aim of this study is to determine diabetes metabolic control, as measured by HbA1c, HDL, LDL, total cholesterol (TC), and triglycerides among diabetic patients in Aljouf, Saudi Arabia. In addition, the present study explored the association of diabetes metabolic control in these patients with family function, depression, and other sociodemographic and clinical data.

A recent epidemiological research study with 90,686 individuals discovered individuals with diabetes had higher rates of depression. One argument is that anxiety and sadness may be brought on by the psychological strain of having a chronic illness (17). On the other hand, family members can be viewed as facilitators and supporters when they help the patient maintain self-management. Moreover, family support has a greater impact on self-reported diabetes coping than support from professionals (18). The aim of this study was to assess the relationship between family function, depression, and metabolic control in diabetic patients.

A study in Egypt stated that the prevalence of depression was 69% (19). This is consistent with this study, revealing that the prevalence of depression among diabetic patients was 65% ranging from mild to severe depression. A previous study in Saudi Arabia stated that of the total number of diabetic patients who participated the study, 37% had depression (20). Another study in Pakistan revealed that depression was found to be 40.0% of participants in the study (21). Also, in research by Thour et al., 41% of participants reported having depression (22). Moreover, a study conducted in Ethiopia found that the overall prevalence of depression was (37.2%) (23). In KSA, another lower prevalence rate of 45.8% was found (24).

The discrepancy regarding this prevalence may be attributed to a variety of variables, such as research design, variations in method, use of various scales, data gathering tools, the culture of the participants, and social factors, as well as characteristics of the studied population.

The family, which serves as the primary source of health information, has an impact on how people suffering from diabetes accept the demands and difficulties that diabetes enforces (25). Children and/or adolescents with type 1 diabetes and their carers, typically the parents, are the primary subjects of studies on family participation in diabetes. There are few studies on the families of adults with diabetes in the available literature. A study investigating family function in diabetic patients found that most of the respondents had family function based on good Family APGAR scores (63%) (26). The finding of this study aligns with the result of the current study that showed 70% of highly functioning families. Also, a study in Nigeria showed that (90.8%) of the study participants had healthy family functioning (27).

In Iran, diabetic women reported worse family functioning than non-diabetic ones (28). Even though it is simple to assess family functioning in diabetic patients in clinical practice, identifying potentially modifiable risk factors that are linked to dysfunctional families in diabetic patients is important during doctor-patient interactions (29). A substitute predictor of the extent to which a diabetic patient would be able to handle his or her disease and sustain long-term health and wellness states could be the absence of strong family functioning for the treatment of diabetes (27).

The present study found that the participants' mean HBA1C (8.6%) was above the recommended control level (7%) (30) which is consistent with a study by Fitzgerald et al., (31) and with studies in Pakistan and Peru (21,5). Moreover, previous studies in Saudi Arabia found that most diabetic patients did not attain the HbA1C target (32,33). A large percentage of persons with T2DM in Saudi Arabia remain to have insufficient glycemic control despite access to excellent medical care and a variety of free anti-diabetic drugs (32). Living an inactive lifestyle and consuming processed, high-fat foods have made it more challenging for diabetics to regulate their blood sugar levels. A recent study showed that the mean body mass index among the Saudi Arabian population was 33.9% (34). Undoubtedly, individuals suffering from diabetes have greater rates of overweight and obesity than the nation's overall population. This leads to more uncontrolled glycemic control among diabetics. This suggests that a portion of the individuals in this sample may be at higher risk for problems due to diabetes.

Consistent with other studies, the linear regression model demonstrated the predictors of metabolic control among diabetic patients, and diabetes duration was associated with higher HbA1c levels in the study participants (31, 35). A short life expectancy, cognitive decline, functional dependency, and medication resistance may be contributing factors leading to this poor control (35). Saudi Arabia is one of the top MENA nations in terms of the prevalence of metabolic syndrome. Additionally, compared to other ethnic groups, Saudis have a higher prevalence of metabolic syndrome (36). The current study also discovered an alarmingly high frequency of dyslipidemia in the study's population of adult T2DM patients residing in Aljouf, Saudi Arabia. These findings are consistent with those made by earlier studies conducted in Middle Eastern settings, such as Saudi Arabia, which revealed the disorder's high incidence (37,38).

According to the study's findings, the mean HDL level was 2.64 mmol/L, which is in line with the recommended target. This is consistent with Fitzgerald et al findings (31). In the present study, more than half of the participants reached the recommended goal for HDL level. Also, more than half of the participants reached the recommended goal for HDL level while it was about 20% among the participants of the Yousefzadeh et al., study (39). This difference may be due to differences in sampling population ethnicity, lifestyle,

and medical services. The present study also found that triglyceride was the most common lipid with abnormality, as 68.5% of the sample had high levels of triglycerides. This was congruent with a study conducted in Saudi Arabia (40). On the other hand, Alzaheb and Altemani concluded that hypercholesterolemia was the most common lipid abnormality in their study sample (37).

However, in the current study, the mean cholesterol level, nor triglyceride reached the recommended target for type 2 diabetic patients. To be able to fulfill the goal level for triglycerides, a higher percentage of these patients should have their lipid profiles closely monitored. Strict control of lipids is crucial in lowering the risk of cardiovascular incidents (31). This study demonstrated a high prevalence of dyslipidemia as well as possible risk factors contributing to the illness. According to the current study, increasing age was associated with higher LDL levels. This association is consistent with earlier studies that discovered a link involving a patient's age and higher blood lipid levels (37, 38). Older age has always been recognized as the most harmful cause of dyslipidemia. According to both cross-sectional and longitudinal investigations, age was positively correlated with TC, LDL, and TG values (41). Gradual weight gain and insulin resistance that accompanies increasing age may be contributing factors to this association.

Regarding depression and family function as predictors of glycemic control, the study found no association between these predictors and glycemic control. These findings were consistent with a previous study indicating that family function does not influence the degree of glycemic control in people with type 2 diabetes (12). Another study suggests that sustaining lifestyle modifications and diabetes self-management depend heavily on relationships between the patient and their family (13). Members of the family can therefore be thought of as enablers and supporters when they help the patient's self-management (18).

Some studies were consistent with this study and did not find a significant association between poor glycemic control and depression (42,43). Although, according to several research, distressed T2DM patients have greater HbA1c values than people who are not depressed (44,45).

Limitations of the study

The study was cross-sectional in nature, so no causal relationships could be drawn. A rising body of research suggests that a combination of several genes carrying risk alleles is responsible for the community's variation in lipid levels. The scoring tool PHQ-9 could over or underestimate the prevalence of depression or the bidirectional relationship between depression and metabolic parameters. The findings cannot be generalized to the total population of Saudi Arabia as the study was conducted in only one province. Also, we cannot ignore the possibility of bias in self-reported studies.

Conclusions

This study suggests that family function and depression do not directly affect diabetic patients' metabolic control and the study showed a high prevalence of uncontrolled HbA1c levels and dyslipidemia among the study participants. Increasing age was associated with higher LDL levels and diabetes duration was associated with higher HbA1c levels in patients with diabetes. It is necessary to conduct more research on the short- and long-term effects of family function and depression in various disease control contexts and at various disease management levels. Further investigation into the variables underlying the control of diabetes is required to further enhance patient outcomes because many people are still failing to meet metabolic control objectives.

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Institutional Review Board Statement: "The study was conducted following the Declaration of Helsinki. The study was approved by the local committee of Bioethics at Jouf University, Saudi Arabia (reference number 11-07/41). Another approval was taken from the local committee of research ethics in the Northern Border region registered with the National Bioethics Committee No. (H-09-A-51) (reference number 691498).
Informed Consent Statement: "Informed consent was obtained from all subjects involved in the study."
Data Availability Statement: The data used to analyze the present study findings will be provided by the corresponding author upon request.
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Conflicts of Interest: "The authors declare no conflict of interest."

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