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Correlation Between Glycemic Control and Cardio-Metabolic Risk Factors in Type 2 Diabetes Patients: Cross-Sectional Experimental Study

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Abstract

Background: A scarcity of evidence-based study concerning the correlation between impaired lipid metabolism and the onset of cardiometabolic complications in Yemeni diabetic patients. **Objective:** An experimental based cross-sectional study aimed to explore the link between lipid abnormalities and glycemic control in patients with type 2 diabetes mellitus (T2DM). **Methods:** Out of 145 individuals diagnosed with T2DM were participated in this study. Anthropometric status of chosen patients was measured, isolated blood samples were investigated for fasting blood glucose (FBS), glycated hemoglobin A1c (HbA1c), and fasting serum lipids, including total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). Descriptive statistics, Pearson's correlation, and multiple logistic regression were used in data analysis. **Results:** T2DM patients aged from 20 to 80 years, with an average age of 54.35±8.02 years. 82 males (56.6%) and 63 females (43.4%) were grouped in gender. The majority of subjects (72.4%) were not at diabetic dyslipidemia risk, while 27.6% were counted at risk. Body mass index (BMI), FBS, and HbA1c mean values were 25.02±5.22 kg/m², 0.37±0.489, and 1.67±0.474, respectively. Statistically, a positive association was observed between HbA1c and FBS with BMI, TC, TG, and LDL-C, while negative correlations were found with HDL-C. Diabetic patients with poor glycemic control (HbA1c ≥ 6.0) had shown higher TC, TG, LDL-C, and HDL-C in comparison with subjects had good glycemic control (HbA1c < 6.0). **Conclusion:** The results demonstrate that HbA1c levels can serve as a predicator marker for manifesting diabetic patients at high risk, facilizing early diagnosis of dyslipidemia and aiding timely treatment with lipid-controlling therapies.

Keywords: type 2 DM; glycemic control; lipid profile; dyslipidemia; cardiometabolic diseases; HbA1c

1. Introduction

The increasing prevalence of both obesity and diabetes commonly referred to as "diabesity" has been accompanied by a marked rise in cardiometabolic complications worldwide [1.2]. Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by persistently high blood glucose levels, which arise due to increased insulin resistance or reduced insulin secretion [3.4]. Approximately 347 million people globally are affected by T2DM. Over 80% of diabetes-related deaths occur in low- and middle-income nations, and about half of these individuals succumb to cardiovascular events such as stroke [5,6]. Chronic hyperglycemia in T2DM leads to sustained

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damage, dysfunction, and deterioration in various organs, with the eyes, kidneys, nerves, heart, and blood vessels being particularly vulnerable [7].

A typical metabolic disturbance seen in T2DM is diabetic dyslipidemia, presenting as increased triglycerides in both fasting and postprandial states, decreased high-density lipoprotein cholesterol (HDL-C), elevated low-density lipoprotein cholesterol (LDL-C), and a greater proportion of small, dense LDL particles. These lipid abnormalities play a crucial role in the elevated cardiovascular risk frequently observed in individuals with poorly controlled type II diabetes. [8]. Besides genetic predispositions, environmental factors such as nutrition, physical activity, and smoking habits significantly influence the onset and progression of dyslipidemia. [9]. Dyslipidemia is a major contributor to coronary heart disease (CHD), and patients with T2DM are at higher risk of developing cardiovascular problems associated with atherogenic lipid profiles. Alterations in lipoproteins, especially in the context of coronary artery disease and myocardial infarction, remain leading causes of global morbidity and mortality [9-11].

Persistently raised blood glucose results in the glycation of various proteins, including the cross-linking of collagen and matrix proteins within arterial walls, and over time this leads to endothelial cell injury, further accelerating atherosclerosis [12]. Studies among individuals with T2DM have demonstrated strong correlations between endothelial dysfunction, elevated triglyceride (TG) levels, and reduced HDL-C. [13]. Despite multiple studies supporting the connection between glycemic regulation and lipid profile parameters in T2DM, the results remain variable [14]. Prior research indicates that maintaining optimal control over glycemic and lipid parameters can significantly lower the risk of complications such as cardiovascular disease, diabetic nephropathy, and diabetic retinopathy [15].

Glycated hemoglobin (HbA1c) is a hemoglobin variant formed by the non-enzymatic attachment of glucose to the N-terminal valine residue of each β-chain, initially creating an unstable Schiff base. HbA1c is primarily measured to estimate the average plasma glucose over the preceding two to three months. Under normal glycemic conditions, a typical proportion of hemoglobin becomes glycated, making HbA1c a reliable indicator of recent glycemic control [13,15]. HbA1c is also a significant predictor of the risk for both microvascular and macrovascular complications in diabetes. Both the World Health Organization (WHO) and the American Diabetes Association now recommend HbA1c for the diagnosis and assessment of glycemic management in diabetes mellitus. [16,17]. Numerous studies have indicated a positive relationship between HbA1c and other markers of glycemia. However, there remains a scarcity of research, both globally and within our community, that explores the interconnectedness of the HbA1c biomarker, serum lipid profiles, and cardiovascular risk in people with type 2 diabetes. The precise nature of this relationship remains unclear.

Therefore, further research is essential to better understand the association between glycemic control as assessed by HbA1c and lipid profile abnormalities, as both are independent risk factors for cardiovascular disease. Based on this need, the current study was conducted to assess the link between glycemic control and serum lipid parameters in patients with Type 2 Diabetes Mellitus, and to evaluate the potential of HbA1c as an indirect biomarker for predicting cardiometabolic risk.

2. Materials and Methods

2.1. Study Setting

This research took place at the National Center of Public Health Laboratories (NCPHL), the main diagnostic laboratory in the Capital Municipality of Sana'a, Yemen. Recognized by the Ministry of Health, this facility serves as the largest and most prominent reference laboratory, offering diagnostic services to people across the country.

2.2. Study Design and Duration

A quantitative, laboratory-based cross-sectional study design was used to examine the association between glycemic control and lipid profile variables, as well as the potential role of HbA1c

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as an indirect marker of cardiometabolic risk in patients with type 2 diabetes. Study period was performed from January 2022 to July, 2022.

2.3. Sample Size

From a total population of 622 patients visited NCPHL for routinely medical checkup during a period of 3 months, 145 individuals diagnosed with Type 2 Diabetes Mellitus (T2DM) were chosen as the study sample. Sample size calculations were performed with the Raosoft® online calculator (http://www.raosoft.com/samplesize.html) [18], using a 5% margin of error, 95% confidence level, and an expected response rate of 80%.

2.4. Study Population (Inclusion and Exclusion Criteria)

All patients diagnosed with Type 2 Diabetes Mellitus (T2DM) attending the National Center of Public Health Laboratories for routine checkups and who consented to participate were included. Exclusion criteria were hyperlipidemia due to other causes (e.g., nephrotic syndrome, thyroid diseases, heart or liver disease), current use of lipid-lowering drugs, Type 1 Diabetes Mellitus (T1DM), pregnancy, and age under 20 years.

2.5. Definition of Variables

Obesity was defined as a BMI of 25 kg/m² or higher for both genders. T2DM was diagnosed based on fasting plasma glucose (FPG) ≥ 7.0 mmol/L or 2-hour postprandial blood glucose (2hPPBG) ≥ 11.1 mmol/L. The cut-off points for lipid profiles were: total cholesterol ≥ 5.0 mmol/L, triglycerides ≥ 1.7 mmol/L, LDL-C ≥ 3.4 mmol/L, and HDL-C <1.04 mmol/L for men or <1.3 mmol/L for women [19,20].

2.6. Ethical Considerations

The study followed the ethical guidelines of the Declaration of Helsinki. Approval was granted by the Research Ethics Committee for Medical Research at Al-Hikma University (decision number, 900/2022) and the Ethics Committee of the National Center of Public Health Laboratories in Sana'a, Yemen. Before joining the study, all participants were fully informed about its aims, importance, and possible benefits. Participation was voluntary, and verbal consent was obtained. Participants were assured that their data would remain confidential and be used only for research purposes.

3. Data Collection and Sampling Method

Participants were selected using a convenience sampling approach from individuals with Type 2 Diabetes Mellitus (T2DM) attending the center for routine follow-up visits who agreed to join the study during the specified period. Demographic and clinical information was gathered through direct, face-to-face interviews using a structured questionnaire. Collected details included gender, age, duration of diabetes, type of diabetes medication taken, physical activity level, presence of any chronic conditions, and compliance with a restricted carbohydrate diet.

3.1. Anthropometric Measurements

Participants' heights and weights were measured after they removed their shoes, heavy clothing, and belts. Body mass index (BMI) was then determined by dividing weight in kilograms by height in meters squared (kg/m²).

3.2. Biochemical Analysis

Trained healthcare professionals collected 5 mL of venous blood from each T2DM participant following an overnight fast. The blood samples were allowed to clot undisturbed for 20 to 30 minutes, then centrifuged at 3000 rpm to separate the serum. Laboratory analyses included fasting blood

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glucose (FBG), postprandial blood glucose (PPBG), glycated hemoglobin (HbA1c), and lipid profile parameters such as triglycerides (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). All tests were performed using a Cobas 6000 automated clinical chemistry analyzer in accordance with the manufacturer's protocols.

3.3. Statistical Analysis and Power Calculations

All statistical analyses were performed using SPSS version 21 (IBM, USA). Descriptive statistics including means, standard deviations, frequencies, and percentages were used to summarize the socio-demographic characteristics of the participants. Pearson correlation coefficients were computed to assess the relationships between glycated hemoglobin (HbA1c) and variables such as BMI, fasting blood sugar (FBS), and lipid profile measures. Differences between dependent and independent variables were evaluated using unpaired t-tests. Furthermore, odds ratios (OR) were estimated through multiple logistic regression to determine the associations between various risk factors (independent variables) and specific outcomes (dependent variables). The G*Power software (version 3.1.9.7) was utilized to calculate the statistical power of the analyses. Statistical significance was established at a p-value less than 0.05 with a 95% confidence level.

4. Results

4.1. Demographic and Lifestyle Characteristics of Study Participants

Most participants (80.6%) were aged between 40 and 80 years, while 19.3% were between 20 and 40. Males comprised 56.6% and females 43.4% of the group. BMI categorization showed 35.9% underweight and 31.7% obese. Dietary compliance was low, with only 22.1% fully adhering to their diet, 26.2% sometimes following it, and 51.7% not following it at all. Nearly half (47.6%) engaged in 30 minutes of daily exercise, but 29.7% reported no physical activity.

Table 1. Demographic and Lifestyle Characteristics of Study Participants (N = 145).

Variable	Category	N	%	Mean	SD
Age (years)	20–40	28	19.3	1.81	0.396
	41–80	117	80.7		
Sex	Male	82	56.6	1.43	0.497
	Female	63	43.4		
BMI Category	Healthy weight	10	6.9	2.82	0.962
	Underweight	52	35.9		
	Overweight	37	25.5		
	Obese	46	31.7		
Healthy Diet	Always Restricted	32	22.1	1.38	0.809
	Sometime Restricted	38	26.2		
	Not Restricted	75	51.7		
Physical Activity	Active > 60 min/day	5	3.4	2.03	0.794
	Active = 60 min/day	28	19.3		
	Active = 30 min/day	69	47.6		
	Sedentary	43	29.7		

Data expressed as Mean ±SD., "N" = Number of participants; "%" = percentage of total sample; "SD" = Standard deviation. Mean and SD are only shown for primary groupings.

4.2. Clinical Characteristics of Study Participants

Table No. (2) indicates that most patients (80%) had diabetes for over a year; 13.8% had less than one year, and 6.2% exactly one year. Medication use was common (76.6% on medication), and 88.3% had no other chronic disease. The remaining 11.7% had additional chronic illnesses.

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Table 2. Clinical Characteristics of Study Participants (N = 145).

Variable	Category	N	%	Mean	SD
Diabetes Duration	One year	9	6.2	2.21	0.756
	> One year	116	80.0		
	< One year	20	13.8		
Drugs Use	Yes	111	76.6	0.77	0.425
	No	34	23.4		
Chronic Disease	No	128	88.3	0.12	0.323
	Yes	17	11.7		

Data expressed as Mean ±SD., N" = Number of participants; "%" = percentage of total sample; "SD" = Standard deviation. Mean and SD are only shown for the primary grouping within each variable.

4.3. Biochemical and Risk Profile Characteristics of Study Participants

Table 3 shows that a large proportion (88%) had normal blood sugar, but 57% had abnormal levels, and 66.9% showed poor glycemic control by HbA1c, with only 33% maintaining good control. Control rates for total cholesterol, triglycerides, HDL-C, and LDL-C were 57.2%, 71.7%, 66.9%, and 97.2%, respectively. The LDL/HDL ratio suggested that 72.4% were not at significant risk for dyslipidemia or cardiovascular disease, while 27.6% were at higher risk.

Table 3. Biochemical and Risk Profile Characteristics of Study Participants (N = 145).

Variable	Category	N	%	Mean	SD
FBS (mmol/L)	3.5–6.4	88	60.7	1.37	0.4885
	>6.5	57	39.3		
HbA1c (%)	4.8–6	48	33.1	1.67	0.474
	>6	97	66.9		
TC (mg/dL)	<200	83	57.2	1.43	0.483
	≥200	62	42.8		
TG (mg/dL)	<200	104	71.7	1.28	0.431
	≥200	41	28.3		
LDL (mg/dL)	50–150	97	66.9	1.33	0.472
	>150	48	33.1		
HDL (mg/dL)	35–65	141	97.2	1.02	0.148
	>65	4	2.8		
Risk Factor	0.0–3.3	105	72.4	1.28	0.451
	>3.3	40	27.6		

Figure A1 c = Glycated hemoglobin; TC = Total cholesterol; TG = Triglycerides; LDL = Low-density lipoprotein; HDL = High-density lipoprotein; SD = Standard.

4.4. Correlation of HbA1c with BMI, FBS, and Lipids

Table (4) shows that Significant positive correlations were observed between HbA1c and BMI, FBS, total cholesterol, triglycerides, and LDL-C. A negative correlation was found between HbA1c and HDL-C, indicating poorer glycemic control is linked to lower HDL-C.

Table 4. Correlation of HbA1c with Clinical and Biochemical Parameters (N = 145).

Variable	r	p-value
BMI	0.237	0.004*
FBS	0.506	0.001*
TC	0.415	0.000*
TG	0.204	0.014*

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LDL	0.191	0.021*
HDL	–0.274	0.001*

r = Pearson correlation coefficient; BMI = Body mass index; FBS = Fasting blood sugar; TC = Total cholesterol; TG = Triglycerides; LDL = Low-density lipoprotein; HDL = High-density lipoprotein. $p < 0.05$ (statistically significant).

Clinical and Biochemical Parameters by Sex:

There were slight, but not statistically significant, differences between males and females T2DM for FBS, HbA1c, and lipid profiles (Table 5).

Table 5. Clinical and Biochemical Parameters by Sex.

Variable	Sex	N	Mean	SD	t	p-value
TC	M	82	1.6585	0.4771	0.097	0.923
	F	63	1.6508	0.4806		
TG	M	82	1.4390	0.4993	0.700	0.485
	F	63	1.3810	0.4895		
HDL	M	82	1.1585	0.3675	–0.256	0.798
	F	63	1.1746	0.3827		
LDL	M	82	1.4512	0.5007	–0.486	0.628
	F	63	1.4921	0.5040		
HbA1C	M	82	1.6463	0.4811	–0.657	0.512
	F	63	1.6984	0.4626		
FBS	M	33	1.3939	0.4962	0.345	0.732
	F	23	1.3478	0.4870		

M = Male, F = Female; TC = Total cholesterol; TG = Triglycerides; HDL = High-density lipoprotein; LDL = Low-density lipoprotein; HbA1C = Glycated hemoglobin; FBS = Fasting blood sugar; SD = Standard deviation. All comparisons are not statistically significant ($p > 0.05$).

4.5. Associations Between Demographic/Clinical Variables and Lipid Abnormalities

Table (6) indicates that older age (41–80 years) was significantly associated with higher total cholesterol and triglycerides respectively, (TC) (OR: 2.250, $p < 0.05$) and triglycerides (TG) (OR: 4.08, $p < 0.005$). Not using medication was strongly linked to higher total cholesterol TC (OR: 2.4, $p < 0.05$) and LDL-C. OR: 2.59, $p < 0.017$). Other risk factors showed no significant associations. Detailed data supporting these findings are included in the (supplementary file).

Table 6. Associations Between Demographic/Clinical Variables and Lipid Abnormalities.

Lipid Variable	Predictor	Category	< Threshold (N, %)	≥ Threshold (N, %)	Total (N)	χ^2	OR	95% CI	p-value
Total Cholesterol	Age	41–80	36 (30.8%)	81 (69.2%)	117	3.698	2.250	0.973–5.203	0.050
	Drugs	No drug	43 (38.7%)	68 (61.3%)	111	3.795	2.439	1.000–6.089	0.051
Triglycerides	Age	41–80	62 (53.0%)	55 (47.0%)	117	7.915	4.081	1.452–11.465	0.005
LDL	Drugs	No drug	65 (58.6%)	46 (41.4%)	111	5.657	2.591	1.166–5.756	0.017

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Table 200. mg/dL vs. ≥200 mg/dL; TG <200 mg/dL vs. ≥200 mg/dL; LDL 50–150 mg/dL vs. >150 mg/dL. χ^2 = Chi-square statistic; OR = Odds ratio; CI = Confidence interval. Significant p-values ($p < 0.05$) are in bold.

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5. Discussion

To the best of our knowledge, this study is the first of its kind being conducted in Yemen, and among the few in West Asia, to systematically assess the association between serum lipid levels (T-Chol, TG, LDL-C, and HDL-C) and differing levels of glycemic control. in type 2 diabetes. The findings highlight the preventive value of good diabetes management in reducing diabetic dyslipidemia and the onset of cardiometabolic complications. Collectively, our results indicate that early detection and treatment of hyperlipidemia in T2DM can substantially lower the risk of atherogenic cardiovascular disease.

The average BMI of respondents was 2.82 ± 0.962, with a range of 18.5–24.9 kg/m²; most diabetic patients (35.9%) were in the BMI range of ≤18.5 kg/m². The Western Pacific Region of the World Health Organization (WHO) considers a BMI above 23 kg/m² in Asian populations to be associated with increased metabolic risk. Most participants were underweight or obese, reflecting the diversity of BMI among Yemeni diabetics. Male predominance may reflect higher stress among men in the region, as seen in other studies [21,22]. In the current research it was observed that the majority of population were > 40 years. Most likely middle and elderly aged populations in Yemen are having higher predisposition to develop diabetes mellitus. Out of these 145 subjects 82 (56.6%) were males and 63 (43.4%) were females. There were more males than females with T2DM in this study. One explanation for this gender difference, the high percentage of males than females in this work may be attributed to the nature of living stressors associated with the impact of socioeconomic pressure and social conflict that are commonly higher in men than women in Yemeni population. Similar findings were reported by Khan, who noted a mean age of 58.69±10.21 years, with 51.7% males and 49.3% females among diabetic patients [21].

A high prevalence of dyslipidemia (elevated cholesterol, triglycerides, or LDL-C; low HDL-C) was observed in this study among diabetic patients, consistent with their known role as cardiovascular risk factors. Our findings regarding persistent hyperlipidemia in T2DM patients are consistent with previous work [23,24]. Dyslipidemia in T2DM may be due to insulin dysfunction affecting the production of liver apolipoproteins, which regulate lipid metabolism. The metabolic role of lipoprotein lipase (LPL) enzyme activity and cholesterol ester transport protein is mediated by apolipoprotein particles. As such, impaired insulin action is a likely cause of dyslipidemia in diabetes, in line with Goldberg's explanation [23]. No statistically significant gender differences were found for glycemic or lipid parameters. HbA1c showed strong positive correlations with triglycerides, LDL-C, and total cholesterol, and a negative correlation with HDL-C. These relationships, seen in both men and women, underscore the links between glycemic control and lipid disorders in diabetes. These findings are in agreement with other studies conducted by [16,21]. Patients with poor glycemic control (HbA1c ≥6.0%) had significantly higher cholesterol, LDL, and triglycerides, and lower HDL-C, compared to those with better control. This matches findings from other studies that link higher HbA1c to more severe dyslipidemia [25-28]. Because both high HbA1c and dyslipidemia are independent risk factors for cardiovascular disease, patients with both are at especially high risk [28-30]. Improving glycemic control can reduce cardiovascular events, with research showing that even modest reductions in HbA1 can reduce mortality. [31-33]. In this study, diabetic participants were grouped according to an HbA1c cutoff value of 6.0%. Those with HbA1c ≥ 6.0% exhibited significantly higher TC, LDL-C, and TG, as well as significantly lower HDL-C, compared to those with HbA1c ≤6.0%. Subsequently the present study further supports the use of HbA1c as a marker for managing both glycemia and dyslipidemia, and for predicting cardiovascular risk in T2DM. While HbA1c and BMI were significantly correlated with lipid profiles, FBS was not, which may reflect differences in diet and exercise among participants. Despite the variations in lifestyle and genetic makeup among people throughout the world. The outcomes of our study at the level of Yemeni patients have positively empowered the practical guidelines that recommended by the World Health Organization (WHO) and American Diabetic Association (ADA regarding recommend using HbA1c as biomarker for diagnosis and management of glycemic status amongst patients with diabetes mellitus [20,29]. Ultimately, its noticed that several studies have reported significant correlations between HbA1c and

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lipid profiles, supporting the notion that effective glycemic control is important for normalizing dyslipidemia [34]. At the same context, the results of the present study highlight the necessity of maintaining good glycemic control to manage dyslipidemia and reduce cardiovascular risk.

5.1. Limitations and Strengths of the Study

This study had some limitations. First, the sample was drawn from a single diagnostic center in Sana'a, which may not be fully representative of the broader population of Yemen. The cross-sectional design also prevents any conclusions about causality between glycemic control and lipid abnormalities. Additionally, we relied on self-reported information for certain lifestyle and medication adherence factors, which could introduce response bias. Finally, the study did not assess some potential confounding factors, such as dietary intake details, socioeconomic status, or genetic factors that might influence lipid levels or glycemic control. Nonetheless, this research represents the first of its kind in Yemen and provides significant insights into valuable metabolic risk factors and early biomarkers of cardiovascular diseases, encouraging medical researchers for conducting large scale and longitudinal studies to reveal potential mechanisms involved in cardiometabolic diseases.

6. Conclusions

In summary, this study found a strong association between poor glycemic control and abnormal lipid profiles in Yemeni patients with type 2 diabetes. Elevated HbA1c levels were linked to higher total cholesterol, LDL-C, and triglycerides, and lower HDL-C, all of which increase cardiovascular risk. These results support the use of HbA1c as a useful indirect marker for identifying diabetic patients who may benefit from early intervention to manage dyslipidemia and prevent cardiometabolic complications. Ongoing monitoring and integrated management of both blood glucose and lipid levels are crucial for reducing the risk of serious complications in this population.

Clinical and Practical Applications

The findings of this research emphasize the importance of regular monitoring of both glycemic status and lipid profiles in patients with type 2 diabetes. Healthcare providers should consider using HbA1c as a readily available marker not only to assess long-term blood sugar control but also to identify patients at greater risk for dyslipidemia and cardiovascular disease. Early detection of abnormal lipid levels can prompt timely intervention such as lifestyle counseling, dietary modifications, or initiation of lipid-lowering medications to reduce the risk of future complications. Integrating routine HbA1c and lipid assessments into diabetes management protocols may improve patient outcomes and reduce the burden of cardiovascular disease among diabetic populations [34,35]. It's also worth to mention that lack of specific guidelines and evidence-based diagnostic criteria for lipid tests and reference range in developing countries, including Yemen. This drawback underscores the necessary need for standardized guidelines. [36,37]. Altogether, effective control of blood sugar via strictly adherence to practical guidelines of antidiabetic regimens, healthy diet, sustained physical activity, and regular monitoring of lipid parameters is essential for preventing cardiometabolic complications in T2DM patients.

Author Contributions: Ali, F., the first author, has contributed significantly across all items of the manuscript particularly in project design, administration, data curation, artworks, original draft, critically editing and reviewing. Other authors have actively participated in proofreading reviewing, data analysis and have given their final approval for publication. Each author has agreed the selection of journal for submission and all requirements of publication.

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Informed Consent Statement: The study was conducted according to the guidelines in the Declaration of Helsinki and all procedures were approved by the Research Ethics Committee for Medical Research at Al-Hikma

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University, as well as the ethics committee of National Center of Public Health Laboratories, Sana'a, Yemen. The research ethics committee agreed to obtain verbal consent from the respondents. In addition, participation in the study was voluntary, anonymous and independent, and the confidentiality of the study was guaranteed.

Data Availability Statement: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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