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**Research Article**

**Keywords:** Fasting, Non-Fasting, Lipid Profile, Dyslipidemia, Type 2 Diabetes Mellitus, Yemen, Cardiovascular Risk

**Posted Date:** August 28th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-10843081/v1

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**Additional Declarations:** No competing interests reported.

# Comparison of Fasting and Non-Fasting Lipid Profiles in Patients with Type 2 Diabetes Mellitus and Healthy Individuals: A Case-Control Study from Aden, Yemen

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## Abstract

Background: Dyslipidemia is a major metabolic complication of type 2 diabetes mellitus (T2DM) and contributes substantially to atherosclerotic cardiovascular disease (ASCVD). This study aimed to compare fasting and non-fasting lipid profiles among T2DM patients and healthy individuals in Aden, Yemen.

Methods: This analytical case-control study evaluated 120 participants (60 T2DM cases and 60 age- and sex-matched healthy controls). Serum fasting blood glucose (FBG) and lipid parameters—total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol

(LDL-C), and high-density lipoprotein cholesterol (HDL-C)—were measured in fasting (10–12 h) and non-fasting (2–4 h postprandial) states using automated chemistry analyzers (Cobas c311). Data were analyzed using SPSS v28.

Results: In T2DM patients, fasting TC was significantly elevated compared to controls (179.7±39.2 vs. 172.5±28.9 mg/dL, P=0.016). Non-fasting TG levels were also significantly higher than fasting levels within the T2DM group (150.9±74.8 vs. 132.4±64.7 mg/dL, P<0.001), whereas TC, LDL-C, and HDL-C levels were significantly lower in the non-fasting state (P<0.001). However, no clinically significant difference was observed between T2DM cases and controls in non-fasting TG levels (150.9±74.8 vs. 149.4±70.3 mg/dL, P=0.024), with the statistical significance being marginal and of limited clinical relevance. No statistically significant association was observed between diabetes duration and fasting lipid levels (P>0.05).

Conclusions: T2DM patients in Aden, Yemen, demonstrate clinically relevant diabetic dyslipidemia, particularly characterized by postprandial triglyceride elevation within the diabetic group. Although fasting sampling remains preferable when accurate triglyceride assessment is required, non-fasting lipid testing may represent a practical alternative for routine measurement of TC and LDL-C and may improve feasibility of cardiovascular risk assessment in diabetic care.

Keywords: Fasting, Non-Fasting, Lipid Profile, Dyslipidemia, Type 2 Diabetes Mellitus, Yemen, Cardiovascular Risk

**Key Messages**

**What was known before?**

- Dyslipidemia is a well-established complication of T2DM and a major contributor to atherosclerotic cardiovascular disease.
- International guidelines and consensus statements have suggested that non-fasting lipid testing may be a practical alternative for routine cardiovascular risk screening, particularly for total cholesterol and LDL-C.
- However, no previous published data existed comparing fasting and non-fasting lipid profiles among patients with T2DM in Yemen, creating uncertainty among clinicians regarding the interpretation and clinical utility of non-fasting lipid results in this population.

**What this study adds?**

- This is the first study in Yemen to provide comparative data on fasting and non-fasting lipid profiles among patients with T2DM and healthy controls.

- The study demonstrates that while non-fasting TG levels are significantly elevated compared to fasting levels within the T2DM group, the difference in non-fasting TG between T2DM patients and controls is clinically minimal despite marginal statistical significance.
- Non-fasting testing is a practical alternative for TC and LDL-C measurement, while fasting remains essential for accurate triglyceride assessment.
- The study emphasizes the critical distinction between statistical significance and clinical relevance, particularly when absolute differences are small.

**Impact/Implications**

- These findings provide locally relevant evidence to guide clinical practice in Yemen and similar resource-limited settings, supporting individualized approaches to lipid monitoring.
- Non-fasting lipid testing can improve patient convenience, enhance compliance with cardiovascular risk assessment, and reduce the risk of hypoglycemia in diabetic patients.
- The results encourage clinicians to interpret lipid profiles in the context of both statistical and clinical significance, avoiding overreliance on P-values alone.
- This study establishes a foundation for future larger-scale and multicenter research across Yemen and the Middle Eastern region.

# Introduction

Dyslipidemia is a common metabolic abnormality characterized by elevated triglycerides (TG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and reduced high-density lipoprotein cholesterol (HDL-C) [1]. It is a hallmark complication of Diabetes Mellitus (DM), a complex heterogeneous disorder defined by persistent hyperglycemia [2, 3]. DM disrupts the metabolism of carbohydrates, lipids, and proteins, with Type 1 and Type 2 being the most prevalent forms [4, 5].

Diabetic dyslipidemia arises from insulin deficiency or resistance, which disrupts enzymatic pathways in lipid metabolism [6, 7]. This leads to increased hepatic lipid synthesis, elevated free fatty acids, and altered concentrations of very-low-density lipoprotein (VLDL-C), LDL-C, and HDL-C particles [8, 9]. The laboratory diagnosis of this condition relies on the lipid profile (TC, TG, HDL-C, LDL-C), which is routinely measured after an 8–12 hour fast [10].

However, prolonged fasting is particularly challenging for patients with type 2 diabetes mellitus, the elderly, and children [11]. Consequently, recent studies and consensus statements have suggested that non-fasting lipid testing is reliable for assessing average lipid levels, with the exception of TG which remains more variable [12, 13].

The European Atherosclerosis Society (EAS) and the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) joint consensus statement highlighted that non-fasting lipid profiles are clinically sufficient and practically superior for routine cardiovascular risk screening, as postprandial lipid changes are generally minor and reflect real-life physiological states [15]. Postprandial lipid profiles also offer greater patient convenience and prevent hypoglycemia, especially in patients with diabetes [15, 16].

Type 2 diabetes mellitus (T2DM) is accompanied by a complex metabolic disturbance involving glucose and lipid metabolism. Diabetic dyslipidemia represents a major contributor to the increased risk of atherosclerotic cardiovascular disease among individuals with T2DM. The characteristic lipid abnormalities include elevated triglyceride-rich lipoproteins, increased production of VLDL, qualitative changes in LDL-C particles, and reduced HDL-C. These alterations are primarily driven by insulin resistance, enhanced free fatty acid flux to the liver, impaired lipoprotein lipase activity, and defective clearance of postprandial lipoprotein particles [8, 9, 17, 18].

Assessment of lipid profile is a fundamental component of cardiovascular risk evaluation in patients with diabetes. Traditionally, lipid measurements have been performed after an overnight fast; however, this requirement may create practical challenges, including reduced patient convenience, delayed clinical decision-making, and potential risk of hypoglycemia in patients receiving glucose-lowering therapy. Accumulating evidence indicates that non-fasting lipid testing can provide clinically meaningful information, particularly for total cholesterol and LDL-C, while triglyceride interpretation requires consideration of the postprandial state [15, 16].

Despite increasing international evidence, limited information is available from Middle Eastern populations, and no previous published study has directly compared fasting and non-fasting lipid profiles among patients with T2DM in Yemen. Establishing local evidence is important because dietary patterns, healthcare access, metabolic characteristics, and disease management practices may influence lipid responses. Therefore, the present study aimed to

compare fasting and non-fasting lipid profiles among patients with T2DM and healthy individuals in Aden, Yemen.

# Subjects and Methods

## Study Design and Population

An analytical case-control study was conducted on 120 individuals, comprising 60 clinically diagnosed patients with type 2 diabetes mellitus (cases) and 60 age- and sex-matched healthy individuals (controls) at Algamhouria Teaching Hospital in Aden, Yemen, during the period from 5 August 2025 to December 2025. The patients were selected from the diabetic clinic, outpatient department, and indoor admitted patients. The healthy control individuals were also selected from the same setting, the majority of whom were patient companions.

## Sample Size Calculation

The sample size was determined using the formula for comparing two independent means:

$n = (Z\alpha/2 + Z\beta)^2 \times (\sigma_1^2 + \sigma_2^2) / (\mu_1 - \mu_2)^2$

Where:

· $Z\alpha/2 = 1.96$ (for 95% confidence level, $\alpha = 0.05$)

· $Z\beta = 0.84$ (for 80% power, $\beta = 0.20$)

· $\sigma$ = estimated standard deviation of triglyceride levels (approximately 30 mg/dL, based on previous studies)

· $\mu_1 - \mu_2$ = estimated mean difference in triglyceride levels between fasting and non-fasting states (approximately 18 mg/dL, based on Talal et al. [19])

The calculated minimum sample size was 52 participants per group. To compensate for potential missing data, incomplete responses, or protocol deviations, we enrolled 60 participants per group, yielding a total sample size of 120 participants (60 cases and 60 controls). This sample size provides sufficient statistical power (80%) to detect clinically relevant differences in lipid parameters.

## Inclusion and Exclusion Criteria

Diabetic patients were included based on a confirmed clinical diagnosis of type 2 diabetes for at least one year. Controls were healthy individuals with no personal history of diabetes, dyslipidemia, or cardiovascular disease. Participants with known liver, renal, or thyroid

diseases, pregnant women, and those on lipid-lowering therapy were excluded from the study.

## Data and Sample Collection

Data on demographic characteristics (age, sex) and clinical history, including diabetes duration, were collected using a pre-designed questionnaire from a previous study conducted in India [20]. This questionnaire was modified and adapted for this study. Clarity, validity, and reliability of this collection tool were pre-tested using a pilot study.

For the fasting group, 5 mL of venous blood was collected after an overnight fast of 10–12 hours. For the non-fasting group, blood was collected 2–4 hours after a regular meal. Blood samples were drawn into gel clot activator tubes, allowed to clot at room temperature, centrifuged at 3000 rpm for 10 minutes, and the separated serum was analyzed immediately for fasting blood glucose (FBG) and lipid profile (TC, TG, and HDL-C) using fully automated clinical chemistry analyzers (Cobas c311, Roche Diagnostics, Germany), according to manufacturer's instructions. LDL-C level was calculated using the Friedewald formula.

## Statistical Analysis

Data were analyzed using SPSS statistical software (version 28). Continuous variables such as age were expressed as median ± interquartile range (IQR) due to abnormal distribution of this variable. FBG and lipid profiles were normally distributed and therefore expressed as Mean ± Standard Deviation (SD). Comparison between two groups was performed using independent t-test, while paired t-test was used for within-group comparisons. Correlation analysis was performed using Spearman's coefficient. A p-value of less than 0.05 was considered statistically significant. Association between duration of diabetes and fasting lipid profile was determined using Analysis of Variance (ANOVA).

## Results

Among the 120 participants, including 60 patients with type 2 diabetes mellitus and 60 healthy controls, participants had comparable demographic characteristics. The median age was 52 years in both the T2DM and control groups, with IQR values of 15.8 and 17.5 years,

respectively. Most participants were older than 50 years (55.0% of cases and 53.3% of controls). Females represented 55.0% of both groups, and the majority of participants were married (81.7% of cases and 90.0% of controls) (Table 1).

Table 1. Distribution of cases and controls according to demographic characteristics.

| Item | Category | Case | | Control | |
|---|---|---|---|---|---|
| | | No. | % | No. | % |
| Age groups/years | <50 | 27 | 45.0 | 28 | 46.7 |
| | ≥50 | 33 | 55.0 | 32 | 53.3 |
| Sex | Male | 27 | 45.0 | 27 | 45.0 |
| | Female | 33 | 55.0 | 33 | 55.0 |
| Marital status | Single | 11 | 18.3 | 6 | 10.0 |
| | Married | 49 | 81.7 | 54 | 90.0 |
| Median age/years | | 52 | | 52 | |
| IQR/years | | 15.8 | | 17.5 | |

Regarding the comparison of fasting serum glucose levels between cases and controls, the mean fasting glucose level was significantly higher among patients with type 2 diabetes mellitus (154.14±48.03 mg/dL) compared with controls (86.81±11.6 mg/dL) (P<0.001) (Table 2).

Table 2. Comparison of fasting serum glucose level between case and control groups

| Test | Normal values | Group | Mean ± SD | P-value |
|---|---|---|---|---|
| Glucose | 65–100 mg/dL | Case | 154.14±48.03 | <0.001 |
| | | Control | 86.81±11.6 | |

P value < 0.05 considered statistically significant.

Table 3 compares fasting lipid parameters between patients with type 2 diabetes mellitus and controls. Fasting total cholesterol levels were significantly higher among cases compared to controls (P=0.016). TG and LDL-C levels were not statistically significant (P>0.05). HDL-C levels showed borderline significance (P=0.050).

Table 3. Comparison of fasting lipid profiles between case and control groups

| Lipid profile test | Normal values | Group | Mean ± SD | P-value |
|---|---|---|---|---|
| TC | <200 mg/dL | Case | 179.7±39.2 | 0.016 |
| | | Control | 172.5±28.9 | |
| TG | 30–200 mg/dL | Case | 132.4±64.7 | 0.301 |
| | | Control | 131.0±57.2 | |
| LDL-C | Less than 150 mg/dL | Case | 124.0±42.7 | 0.108 |
| | | Control | 118.6±25.9 | |

| | | | | |
|---|---|---|---|---|
| HDL-C | 40–58 mg/dL | Case | 45.2±10.8 | 0.050 |
| | | Control | 44.8±10.4 | |

P value < 0.05 considered statistically significant.

Table 4 compares non-fasting lipid profiles between cases and controls. Non-fasting triglyceride levels showed a marginal statistical difference between groups (P=0.024), though the clinical significance of this difference is limited given the small absolute difference between mean values (150.9 vs. 149.4 mg/dL). TC, LDL-C, and HDL-C levels did not demonstrate a significant difference (P>0.05).

Table 4. Comparison of non-fasting lipid profiles between case and control groups

| Lipid profile test | Normal values | Group | Mean ± SD | P-value |
|---|---|---|---|---|
| TC | 140–200 mg/dL | Case | 171.2 ± 36.8 | 0.147 |
| | | Control | 169.1±28.2 | |
| TG | 30–200 mg/dL | Case | 150.9 ± 74.8 | 0.024* |
| | | Control | 149.4 ± 70.3 | |
| LDL-C | Less than 150 mg/dL | Case | 117.6 ± 42.1 | 0.078 |
| | | Control | 122.0 ± 30.8 | |
| HDL-C | 40–58 mg/dL | Case | 44.4 ± 13.2 | 0.124 |
| | | Control | 43.7 ± 10.1 | |

*P value < 0.05 considered statistically significant. *Marginal significance with limited clinical relevance.

Table 5 demonstrates the comparison between fasting and non-fasting lipid profiles among patients with type 2 diabetes mellitus. Non-fasting TG levels were significantly higher than fasting TG levels, whereas TC, LDL-C, and HDL-C concentrations were significantly lower in the non-fasting state (P<0.001).

Table 5. Comparison of fasting and non-fasting lipid profiles within the case group

| Lipid profile test | Normal values | State | Mean ± SD | P-value |
|---|---|---|---|---|
| TC | 140–200 mg/dL | Fasting | 179.7±39.2 | <0.001 |
| | | Non-fasting | 171.2 ± 36.8 | |
| TG | 30–200 mg/dL | Fasting | 132.4±64.7 | <0.001 |
| | | Non-fasting | 150.9 ± 74.8 | |
| LDL-C | Less than 150 mg/dL | Fasting | 124.0±42.7 | <0.001 |
| | | Non-fasting | 117.6 ± 42.1 | |
| HDL-C | 40–58 mg/dL | Fasting | 45.2±10.8 | <0.001 |
| | | Non-fasting | 44.4 ± 13.2 | |

P value < 0.05 considered statistically significant.

Table 6 shows the comparison of fasting and non-fasting lipid profiles among healthy controls. Compared with fasting controls, non-fasting controls showed significantly higher TG levels, whereas TC and HDL-C levels were significantly lower (P<0.001). LDL-C levels showed a slight increase that was statistically significant (P<0.001).

Table 6. Comparison of fasting and non-fasting lipid profiles within the control group

| Lipid profile test | Normal values | State | Mean ± SD | P-value |
|---|---|---|---|---|
| TC | 140–200 mg/dL | Fasting | 172.5±28.9 | <0.001 |
| | | Non-fasting | 169.1±28.2 | |
| TG | 30–200 mg/dL | Fasting | 131.0±57.2 | <0.001 |
| | | Non-fasting | 149.4 ±70.3 | |
| LDL-C | Less than 150 mg/dL | Fasting | 118.6±25.9 | <0.001 |
| | | Non-fasting | 122.0±30.8 | |
| HDL-C | 40–58 mg/dL | Fasting | 44.8±10.4 | <0.001 |
| | | Non-fasting | 43.7 ± 10.1 | |

P value < 0.05 considered statistically significant.

Table 7 describes the relationship between duration of diabetes and fasting lipid profile parameters among patients with type 2 diabetes mellitus. Lipid values varied across diabetes duration categories; however, these results were not statistically significant (P>0.05).

Table 7. Duration of diabetes among cases and fasting lipid profile

| Duration | TC (mean±SD) | TG (mean±SD) | LDL-C (mean±SD) | HDL-C (mean±SD) |
|---|---|---|---|---|
| <1 year | 182.4±33.1 | 122.7±71.4 | 127.2±34.5 | 42.1±3.9 |
| 1–5 years | 183.5±25.6 | 120.9±51.5 | 127.3±28.2 | 48.7±12.1 |
| 6–10 years | 158.6±34.0 | 143.5±63.4 | 99.0±39.0 | 41.5±10.6 |
| 10 years | 185.2±51.3 | 164.7±78.9 | 132.2±50.3 | 42.5±9.9 |
| P value | 0.321 | 0.186 | 0.189 | 0.181 |

P value < 0.05 considered statistically significant.

# Discussion

This study provides novel comparative data regarding fasting and non-fasting lipid profiles among patients with T2DM and healthy individuals in Aden, Yemen. Our findings confirm that diabetic dyslipidemia in Yemeni patients is characterized by significant perturbations in lipid parameters, particularly postprandial triglyceride elevation within the diabetic group, with notable variations that carry practical clinical implications. In our data, fasting TC levels were significantly higher among fasting patients compared to fasting controls (P=0.016), and HDL-C levels showed borderline significance (P=0.050).

Several studies have revealed significant associations between all lipid profiles among fasting patients [11, 21, 22]. The differences observed between studies may be explained by variations in dietary composition before sampling, duration of diabetes, glycemic control, medication use, ethnicity, and sample characteristics. Therefore, the interpretation of non-fasting lipid profiles should consider patient-specific factors rather than relying only on fasting status.

In the present study, TG levels were marginally higher among non-fasting patients compared with controls (P=0.024). However, the absolute difference between the two groups was minimal (150.9 vs. 149.4 mg/dL), suggesting limited clinical significance. This finding was consistent with a similar study conducted in India [22]. Different studies have revealed significant increases in levels of TG, TC, and LDL-C and significant decreases in HDL-C levels among non-fasting patients [11, 21-23]. The non-fasting triglyceride levels significantly increased following meal intake due to chylomicron secretion and altered clearance in insulin-resistant states [11, 20, 23]. Mechanistically, diabetic dyslipidemia leads to defective lipoprotein lipase (LPL) activity, impaired clearance of triglyceride-rich lipoproteins, and elevated postprandial lipemia, which directly explains the marked postprandial increase in TG observed within the diabetic patients in our study [12, 24].

This finding demonstrates that diabetes was associated with significant disturbances in lipid metabolism, characterized mainly by increased TG level within the diabetic group, while TC, LDL-C, and HDL-C levels were significantly lower in the non-fasting state compared to fasting within the same groups. Jain et al. reported that the level of serum TG is commonly increased among non-fasting patients [22]. Pyadala recorded increases in levels of TG, TC, LDL-C and low HDL-C levels among non-fasting patients [21]. Rajendran et al. and Taskinen observed significantly lower baseline total cholesterol and higher protective HDL-C in non-diabetic controls compared to diabetic patients [17, 25]. The decrease in most lipid profiles in the non-fasting state may be attributed to fluid intake resulting in blood dilution, while increases may result from intake of fatty foods [26].

The current data demonstrated that the non-fasting control group had significantly higher TG levels compared with the fasting control group (P<0.001). Two studies conducted among Nigerian and Indian healthy adults showed significant increases in TG levels among non-fasting adults [27, 28]. An extensive population study demonstrated a decrease in most serum

lipid profile levels among non-fasting individuals, except TG level [29]. This may be attributable to standard postprandial lipid absorption and delayed transit of chylomicron remnants [21, 30]. In healthy controls with intact insulin sensitivity, postprandial TG clearance is more efficient compared to diabetic cases, but temporary postprandial increases in TG remain physiological responses to dietary fat ingestion [22, 31].

Regarding the diabetic patients, our study showed significantly higher TG levels in the non-fasting state compared to the fasting state. This result agreed with that done in India and Nepal [21, 32]. The TG level is very sensitive to food intake [28], thereby fasting is necessary for accurate assessment of this lipid parameter.

As regards healthy individuals, significantly higher TG levels were shown among non-fasting individuals. Ghildiyal et al. reported significantly higher TG levels among Indian healthy controls [28]. Food intake, especially fatty food, may contribute to the increase in TG levels among non-fasting individuals [28]. The increase in LDL-C levels in our study may be partly attributable to the calculation of values using the Friedewald formula rather than direct measurement, which is known to be less accurate when TG levels are elevated.

The duration of diabetes showed no statistically significant association with any of the fasting lipid profiles, including TC, TG, LDL-C, or HDL-C ($P>0.05$). Jain et al. revealed that long duration of diabetes increases lipid abnormalities [22]. A study performed in India noticed that dyslipidemia was high among patients who were newly diagnosed [25]. The lack of a statistically significant association in this study may be attributed to variations in glycemic control, treatment strategies for diabetes, dietary habits, and physical activity, which were not controlled for in this analysis.

## Strengths and Limitations

### Strengths

This study is the first case-control investigation in Yemen to compare fasting and non-fasting lipid profiles among T2DM patients, providing pioneer local evidence for clinical practice. Matching controls by age and sex minimized confounding bias, and blood samples were analyzed using standardized automated chemistry analyzers.

### Limitations

This study has some limitations. The sample size, though adequate for initial analysis, was relatively modest. We did not standardize the composition of the meal consumed before non-fasting blood sampling, which could introduce variability in postprandial TG levels and represents a significant limitation. Furthermore, we did not measure glycated hemoglobin (HbA1c) and other parameters like ApoB or lipoprotein (a) which could provide a more comprehensive lipid assessment. Finally, as a single-center study in Aden, the generalizability of our findings to other populations in Yemen may be limited.

## Conclusions

In this case-control study from Aden, Yemen, patients with T2DM showed significant alterations in lipid metabolism, with a prominent increase in non-fasting triglyceride levels compared with fasting levels within the diabetic group. The findings support the clinical usefulness of non-fasting lipid assessment for selected lipid parameters, especially TC and LDL-C, while emphasizing that fasting samples remain valuable and necessary for accurate triglyceride evaluation. These findings provide locally relevant evidence and support individualized approaches to lipid monitoring and cardiovascular risk stratification in patients with T2DM.

## Abbreviations

***ANOVA:*** Analysis of Variance
***ASCVD:*** Cardiovascular disease
***DM:*** Diabetes Mellitus
***EAS:*** European Atherosclerosis Society
***EFLM:*** European Federation of Clinical Chemistry and Laboratory Medicine
***FBG:*** fasting blood glucose
***HbA1c:*** glycated hemoglobin
***HDL-C:*** high-density lipoprotein cholesterol
I***QR:*** Interquartile range
***LDL-C:*** Low-density lipoprotein cholesterol
S***D:*** Standard Deviation
***T2DM:*** Type 2 diabetes mellitus
***TC:*** Total cholesterol
***TG:*** Triglycerides
***VLDL***-C: Very-low-density lipoprotein

## Acknowledgments

The authors gratefully acknowledge all diabetic patients and healthy control individuals who participated in this study and contributed their time and valuable information.

## Declarations

### Ethics Approval and Consent to Participate

Ethical approval for this study was obtained from the Medical Research Ethics Committee (MREC), Faculty of Medicine & Health Sciences, University of Science and Technology, Aden, Yemen, No. (UST-ETH-2026-0061), Date: 1/8/2025. The study was performed in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants (cases and controls) before data and sample collection.

### Consent for Publication

Not applicable.

#### Clinical Trial Number

Not applicable.

### Availability of Data and Materials

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

### Competing Interests

The authors declare no competing interests.

### Funding

The authors have no support or funding to report.

### Authors' Contributions

ANMG, NTA, and SMMD supervised the study, performed analysis, and final manuscript editing. AAA, NMO, SFA, NAM, ATA, HAAM, EWMA and NAA contributed to data collection and manuscript drafting. ANMG, NTA, SMMD, and ATA also contributed to the advanced statistical analysis and reference management. All authors read and approved the final manuscript.

# References

1.Mosca S, Araújo G, Costa V, Correia J, Bandeira A, Martins E, et al. Dyslipidemia diagnosis and treatment: risk stratification in children and adolescents. J Nutr Metab. 2022;2022:1083321.

2. Jaiswal M, Schinske A, Pop-Busui R. Lipids and lipid management in diabetes. Best Pract Res Clin Endocrinol Metab. 2014;28(3):325-338.

3. Tremblay J, Hamet P. Environmental and genetic contributions to diabetes. Metabolism. 2019;100:153952.

4. Ozder A. Lipid profile abnormalities seen in T2DM patients in primary healthcare in Turkey: a cross-sectional study. Lipids Health Dis. 2014;13:183.

5. Zaccardi F, Webb DR, Yates T, Davies MJ. Pathophysiology of type 1 and type 2 diabetes mellitus: a 90-year perspective. Postgrad Med J. 2016;92(1084):63-69.

6. Toren E, Burnette KS, Banerjee RR, Hunter CS, Tse HM. Partners in crime: beta-cells and autoimmune responses complicit in type 1 diabetes pathogenesis. Front Immunol. 2021;12:756548.

7. Mukhtar Y, Galalain A, Yunusa U. A modern overview on diabetes mellitus: a chronic endocrine disorder. Eur J Biol. 2020;5(2):1-4.

8. Wu L, Parhofer KG. Diabetic dyslipidemia. Metabolism. 2014;63(12):1469-1479.

9. Chen SC, Tseng CH. Dyslipidemia, kidney disease, and cardiovascular disease in patients with type 2 diabetes mellitus. Rev Diabet Stud. 2013;10(2-3):88-100.

10.Yanai H. Diagnosis of secondary hyperlipidemia due to diabetes. Rinsho Byori. 2016;64(5):508-512.

11.Suryabhan LL, Chandrashekhar MI, Ratnendra RS, Prerna DN. A comparative study on the fasting and the postprandial dyslipidaemia in type 2 diabetes mellitus. J Clin Diagn Res. 2013;7(4):627-630.

12. Garvey WT, Kwon S, Zheng D, Shaughnessy S, Wallace P, Hutto A, et al. Effects of insulin resistance and type 2 diabetes on lipoprotein subclass particle size and concentration determined by nuclear magnetic resonance. Diabetes. 2003;52(2):453-462.

13.Holven KB, van Lennep JR. Sex differences in lipids: a life course approach. Atherosclerosis. 2023;379:117270.

14. Steen DL, Umez-Eronini AA, Guo J, Khan N, Cannon CP. The effect of fasting status on lipids, lipoproteins, and inflammatory biomarkers assessed after hospitalization for an acute coronary syndrome: insights from PROVE IT-TIMI 22. Clin Cardiol. 2018;41(1):68-73.

15. Nordestgaard BG, Langsted A, Mora S, Kolovou G, Baum H, Bruckert E, et al. Fasting is not routinely required for determination of a lipid profile: clinical and laboratory implications including flagging at desirable concentration cut-points—a joint consensus statement from the European Atherosclerosis Society and European Federation of Clinical Chemistry and Laboratory Medicine. Eur Heart J. 2016;37(25):1944-1958.

16. Liu MM, Peng J, Cao YX, Guo YL, Wu NQ, Zhu CG, et al. The difference between fasting and non-fasting lipid measurements is not related to statin treatment. Ann Transl Med. 2021;9(5):380.

17.Taskinen MR. Diabetic dyslipidaemia: from basic research to clinical practice. Diabetologia. 2003;46(6):733-749.

18.Tomkin GH, Owens D. Diabetes and dyslipidemia: characterizing lipoprotein metabolism. Diabetes Metab Syndr Obes. 2017;10:333-343.

19. Talal N, Alidrisi HA, Mansour AA. Comparison between measuring of lipid profile in fasting and non-fasting states: A cross-sectional study from Iraq. Shiraz E-Med J. 2020;21(5):e94208.

20. Chahal J, Gupta S, Chawla SP, Grewal H. Comparative study on fasting and postprandial lipid profile in type 2 diabetes mellitus. J Family Med Prim Care. 2021;10(3):1288-1293.

21.Pyadala N. Fasting and postprandial lipid profile in type 2 diabetes mellitus: A comparative study. Int J Contemp Med Surg Radiol. 2018;3(1):161-165.

22. Jain HR, Shetty V, Singh GS, Shetty S. A study of lipid profile in diabetes mellitus. Int J Sci Stud. 2016;4(9):55-60.

23. Praliya RS, Gupta S, Adya CM, Thakur N, Saini S. A study of correlation of postprandial lipid profile with carotid intima media thickness in type-II diabetes mellitus. J Assoc Physicians India. 2020;68(4):45-49.

24. Wali VV, Patil SS. A comparative study on the fasting and postprandial dyslipidaemia in type 2 diabetes mellitus. Int J Res Med Sci. 2016;4(6):2200-2204.

25. Rajendran B, Mallampati SR, Hakkim S. Lipid profile in type 2 diabetes mellitus: a case-controlled study. Int J Adv Med. 2019;6(2):350-354.

26. Dipankar S, Pawar S. Comparison of fasting and non-fasting lipid profile in young healthy adults. Int J Clin Exp Physiol. 2019;6(1):8-10.

27. Orimadegun BE, Afolabi FO, Tijani BA. Comparison of fasting and non-fasting lipid profile in Nigerian adults. Int J Res Med Sci. 2025;13(2):587.

28. Ghildiyal S, Anjankar AP, Kute PK. Comparison between fasting and non-fasting sample for the determination of serum lipid profile. J Evol Med Dent Sci. 2020;9(14):1122-5.

29. Sidhu D, Naugler C. Fasting time and lipid levels in a community-based population: a cross-sectional study. Arch Intern Med. 2012;172(22):1707-1710.

30. Puthenveedu DK, Ravindran S. A comparative study on the fasting and post prandial lipid levels as a cardiovascular risk factor in patients with type 2 diabetes mellitus. IAIM. 2017;4(8):72-76.

31.Chakraborty M, Singh P, Dsouza JM, Pethusamy K, Thatkar PV. Fasting and postprandial lipid parameters: A comparative evaluation of cardiovascular risk assessment in prediabetes and diabetes. J Family Med Prim Care. 2020;9(1):287-292.

32. Suwal R, Maharjan BR, Bashyal R, Maharjan S, Paudyal BP. Comparison of fasting and non-fasting lipid profile in type 2 diabetes mellitus: an observational study. 2026;66-70.