Volume 4, Issue 3, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

COMPARATIVE STUDY OF TOTAL CHOLESTEROL AND TRIGLYCERIDES IN OBESE AND NON-OBESE PERSONS

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DOI: https://doi.org/10.5281/zenodo.21406130

Keywords
Obesity, Non-obese, Total Cholesterol, Triglycerides, Lipid Profile, Dyslipidemia, Cardiovascular Risk

Article History
Received: 01 January 2026
Accepted: 28 February 2026
Published: 10 March 2026

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Abstract

This comparative cross-sectional study aimed to evaluate and compare total cholesterol and triglyceride levels in obese and non-obese individuals and to determine the association between obesity and dyslipidemia. A total of 72 participants aged 23-85 years were included and categorized into obese and non-obese groups based on BMI classification. Lipid profile parameters were analyzed using standard biochemical methods, and data were statistically evaluated.

The findings revealed that obese individuals had significantly higher mean levels of total cholesterol and triglycerides compared to non-obese individuals. Overall, lipid values were elevated above optimal ranges, particularly in the obese group, indicating a more atherogenic lipid profile. Triglyceride levels showed greater variability, suggesting stronger sensitivity to obesity-related metabolic changes. The results confirm that obesity is strongly associated with dyslipidemia and adverse lipid metabolism. The study concludes that obesity significantly influences lipid profile disturbances, increasing the risk of cardiovascular diseases such as coronary artery disease and atherosclerosis. Regular monitoring of lipid levels, along with lifestyle modification strategies including dietary control, physical activity, and weight management, is essential for prevention and early intervention.

The results demonstrate a clear and statistically significant difference in lipid profiles between obese and non-obese individuals. Obesity is strongly associated with elevated total cholesterol and triglyceride levels, supporting its role as a major risk factor for dyslipidemia and cardiovascular disease.

INTRODUCTION

Obesity has emerged as a major global public health challenge, strongly associated with increased morbidity, mortality, and disability-adjusted life years (DALYs). In 2021 alone, obesity-related conditions contributed to approximately 3.71 million deaths and 129 million DALYs worldwide, reflecting its growing impact on global health systems (Awedew et al., 2024). Over the past two decades, obesity-related disease burden has increased by more than 15%, highlighting its rapid escalation as a leading modifiable risk factor for non-communicable diseases (Z. Wang et al., 2025).

Obesity is not limited to adults; its rising prevalence among children and adolescents increases the risk of lifelong metabolic complications, including type 2 diabetes, cardiovascular diseases, and certain cancers (Lister et al., 2023). Beyond health consequences, obesity imposes a significant economic burden due to increased healthcare costs, reduced productivity, and long-term disability (Sun et al., 2022).

A key mechanism linking obesity to cardiovascular disease is dysregulated lipid metabolism. Obesity is

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ISSN: (e) 3007-1607 (p) 3007-1593

strongly associated with dyslipidemia, characterized by elevated total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL), and reduced high-density lipoprotein (HDL) levels (Sucato et al., 2024). These lipid abnormalities contribute to atherosclerosis, coronary artery disease (CAD), stroke, and metabolic syndrome.

Triglycerides play a central role in energy storage and metabolism, while cholesterol is essential for cell membrane structure and hormone synthesis. However, excessive lipid accumulation—particularly elevated TG and TC—contributes to endothelial dysfunction, inflammation, and plaque formation in arteries (Xu et al., 2023). Obesity further exacerbates this process by increasing free fatty acid release, hepatic triglyceride synthesis, and VLDL production, resulting in an atherogenic lipid profile (Vekic et al., 2023).

Given the strong association between obesity and lipid abnormalities, assessing and comparing lipid profiles in obese and non-obese individuals is crucial for early risk identification and prevention of cardiovascular diseases. This study aims to evaluate and compare total cholesterol and triglyceride levels between obese and non-obese individuals to better understand obesity-related metabolic risk.

Extensive research has demonstrated a strong relationship between obesity and altered lipid metabolism. A comparative study by Navajas-Porras et al. (2025) reported significantly higher lipid abnormalities in obese individuals compared to non-obese controls, confirming the impact of obesity on dyslipidemia.

Similarly, Jesi et al. (2025) emphasized the importance of anthropometric and biochemical assessment in identifying metabolic risk factors associated with obesity. Their findings suggest that increased body mass index (BMI) is closely linked with abnormal lipid profiles.

Passos et al. (2023) found a positive correlation between BMI and serum lipid levels, particularly triglycerides ($r = 0.42$, $p < 0.001$), indicating that triglycerides are more sensitive to changes in adiposity than total cholesterol. Gender-based differences were also reported, with stronger lipid-BMI associations observed in females (Mohammadi et al., 2024).

Obesity-induced dyslipidemia is primarily driven by increased free fatty acid release from adipose tissue, leading to enhanced hepatic triglyceride synthesis and VLDL secretion (Xiang et al., 2024). This metabolic disruption results in elevated TG, increased LDL, and reduced HDL levels, forming an atherogenic lipid profile.

Studies also highlight that lipid profile abnormalities significantly increase the risk of cardiovascular disease, myocardial infarction, and stroke (Hasebe & Hasebe, 2022). Furthermore, low HDL and high TG levels are strongly associated with increased mortality and metabolic syndrome (Mørland et al., 2023).

Comparative studies consistently report higher total cholesterol and triglyceride levels in obese individuals compared to non-obese populations (Zare et al., 2025). These findings confirm that obesity is closely linked with dyslipidemia and increased cardiovascular risk.

Aims and Objectives

1. To determine and analyze mean levels of total cholesterol and triglycerides in obese individuals to assess obesity-related lipid alterations.
2. To measure and establish baseline mean levels of total cholesterol and triglycerides in non-obese individuals for comparative analysis.
3. To compare the prevalence of abnormal lipid profiles between obese and non-obese individuals and evaluate their association with dyslipidemia risk.

Research Questions

1. Is there a significant difference in total cholesterol levels between obese and non-obese individuals?
2. Is there a significant difference in triglyceride levels between obese and non-obese individuals?
3. Are obese individuals more likely to exhibit abnormal lipid profiles compared to non-obese individuals?

Research Methodology

1. Research Design

A comparative cross-sectional study design will be used to assess and compare lipid profile parameters (total cholesterol and triglycerides) between obese and non-obese individuals.

2. Study Setting

The study will be conducted in the Department of Biochemistry at Noble Hospital, Lahore, which is

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ISSN: (e) 3007-1607 (p) 3007-1593

equipped with standardized biochemical analysis facilities.

3. Study Duration

Data collection will be conducted over a defined period starting from January 2021, allowing adequate time for recruitment and laboratory analysis.

4. Study Population

The study population will include adults aged 20–70 years of both genders. Participants will be categorized into obese and non-obese groups based on BMI classification.

5. Inclusion Criteria

- Age 20–70 years
- Overnight fasting individuals
- Written informed consent

6. Exclusion Criteria

- Pregnant or lactating women
- Patients on lipid-lowering medications (statins, fibrates, PCSK9 inhibitors, etc.)
- Individuals with acute illness or hospitalization in last 2 months
- Known familial hyperlipidemia or renal disease

7. Sampling Technique and Sample Size

A consecutive non-probability sampling technique will be used. Sample size will be calculated using standard epidemiological formulas based on expected prevalence of dyslipidemia, with a 5% margin of error.

8. Data Collection Procedure

Clinical Data

- Demographics (age, gender)
- Medical history
- Anthropometric measurements (weight, height, BMI)

Laboratory Analysis

Fasting blood samples will be collected and analyzed for:

- Total cholesterol
- Triglycerides
- HDL-C
- LDL-C
- VLDL

All analyses will be performed using automated biochemical analyzers.

9. Data Analysis

Data will be analyzed using SPSS.

- Descriptive statistics: mean, standard deviation
- Inferential tests: independent t-test, ANOVA, chi-square test
- Correlation: Pearson/Spearman testA p-value < 0.05 will be considered statistically significant.

10. Ethical Considerations

- Ethical approval from Institutional Review Board (IRB)
- Informed written consent from participants
- Confidentiality and data protection ensured
- Data used strictly for academic purposes

RESULTS

4.1 Descriptive Statistics of Study Variables

Table 4.1: ***Frequency Distribution of Categorical Variables (N = 72)***

Variable	Category	n (%)
Gender	Male	29 (40.3)
	Female	43 (59.7)
Fasting Status	Fasting	24 (33.3)
	Non-fasting (Random)	48 (66.7)
Obesity Status	Obese	21 (29.2)
	Non-Obese	51 (70.8)

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ISSN: (e) 3007-1607 (p) 3007-1593

Variable	Category	n (%)
Age Group (years)	23–34	17 (23.6)
	35–46	24 (33.3)
	47–58	16 (22.2)
	59–70	12 (16.7)
	74–85	3 (4.2)

Interpretation

The sample consisted of 72 participants, with a higher proportion of females (59.7%) than males (40.3%). Most samples were non-fasting (66.7%), which is relevant as triglyceride levels may be affected by feeding status. Regarding obesity status, non-obese participants (70.8%) outnumbered obese participants (29.2%). The majority of participants were middle-aged adults, with the largest group in the 35–46-year category (33.3%).

4.2 Descriptive Statistics of Lipid Profile

Table 4.2: ***Descriptive Statistics of Age and Lipid Parameters (N = 72)***

Variable	Mean	SD	Min	Max	Skewness
Age (years)	45.33	13.93	23	85	0.49
Total Cholesterol (mg/dL)	196.76	35.11	153	342	1.82
Triglycerides (mg/dL)	177.63	74.04	90	515	2.06

The mean age of participants was 45.33 years. The mean total cholesterol level (196.76 mg/dL) falls in the borderline-high range, while mean triglycerides (177.63 mg/dL) exceed the desirable level (<150 mg/dL). Both lipid variables showed strong positive skewness, indicating the presence of higher extreme values in a subset of participants, particularly among obese individuals.

4.3 Normality Test of Study Variables

Table 4.3: ***Tests of Normality (Kolmogorov–Smirnov and Shapiro–Wilk)***

Variable	K–S p	S–W p	Normal Distribution
Age	.200	.057	Yes
Total Cholesterol	.043	<.001	No
Triglycerides	<.001	<.001	No

Age was normally distributed; however, both total cholesterol and triglycerides significantly violated normality assumptions ($p < .001$). Therefore, lipid variables were non-parametric in nature, indicating that non-parametric tests are more appropriate for group comparisons.

4.4 Comparison of Lipid Profile Between Obese and Non-Obese Groups

Table 4.4: ***Comparison of Total Cholesterol and Triglycerides Between Obese and Non-Obese Participants***

Variable	Group	Mean	SD	Test Value	p-value
Total Cholesterol (mg/dL)	Obese	212.84	38.92	Mann–Whitney U	<.001
	Non-Obese	190.12	31.74		
Triglycerides (mg/dL)	Obese	214.56	82.31	Mann–Whitney U	<.001
	Non-Obese	161.08	61.45		

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ISSN: (e) 3007-1607 (p) 3007-1593

A statistically significant difference was observed between obese and non-obese groups for both lipid parameters. Obese individuals showed higher mean total cholesterol and triglyceride levels compared to non-obese individuals. The results indicate a strong association between obesity and dyslipidemia, confirming that obesity is linked with an adverse lipid profile. Key results are:

- Obese individuals had **higher total cholesterol levels** than non-obese individuals.
- Obese individuals showed **significantly elevated triglyceride levels**.
- Lipid variables were **non-normally distributed**, requiring non-parametric analysis.
- Obesity was strongly associated with **dyslipidemia and an atherogenic lipid profile**.

DISCUSSION

The present study aimed to compare total cholesterol and triglyceride levels between obese and non-obese individuals and to examine the association between obesity and dyslipidemia. The findings demonstrated a clear and statistically significant difference in lipid profile parameters between the two groups, with obese individuals showing higher levels of both total cholesterol and triglycerides compared to non-obese participants.

The observed elevation in lipid levels among obese individuals is consistent with the established understanding that obesity is strongly associated with metabolic dysregulation and altered lipid metabolism. Excess adiposity increases the release of free fatty acids from adipose tissue, which enhances hepatic triglyceride synthesis and very-low-density lipoprotein (VLDL) production, ultimately leading to hypertriglyceridemia and elevated cholesterol levels (Xiang et al., 2024; Vekic et al., 2023). This metabolic pathway explains the atherogenic lipid profile commonly observed in obese populations.

The present findings are supported by Navajas-Porras et al. (2025), who also reported significantly higher total cholesterol and triglyceride levels in obese individuals compared to non-obese controls, confirming the direct impact of obesity on lipid abnormalities. Similarly, Zare et al. (2025) found that obese participants had consistently elevated lipid parameters, reinforcing the association between increased body mass index (BMI) and dyslipidemia.

In addition, Passos et al. (2023) identified a significant positive correlation between BMI and triglyceride levels ($r = 0.42$, $p < 0.001$), suggesting that triglycerides are more sensitive to changes in adiposity than total cholesterol. This aligns with the present study, where triglycerides showed a comparatively stronger increase in obese individuals, indicating their potential role as an early metabolic indicator of obesity-related risk.

The current results also correspond with Mohammadi et al. (2024), who reported stronger lipid–BMI associations in females, suggesting possible gender-related metabolic differences in lipid regulation. Although the present study had a higher proportion of female participants, both genders exhibited increased lipid levels in the obese category, supporting the overall consistency of obesity-related dyslipidemia across populations.

From a physiological perspective, obesity-induced dyslipidemia is characterized by increased VLDL production, reduced HDL concentration, and formation of small dense LDL particles, all of which contribute to a pro-atherogenic state (Roy et al., 2023). These lipid abnormalities promote endothelial dysfunction, inflammation, and plaque formation, ultimately increasing the risk of cardiovascular diseases such as coronary artery disease, stroke, and myocardial infarction (Hasebe & Hasebe, 2022).

The present study further supports the findings of Sucato et al. (2024), who emphasized that routine lipid profile abnormalities—particularly elevated triglycerides and total cholesterol—are strong predictors of cardiovascular risk. Similarly, Mørland et al. (2023) highlighted that elevated triglycerides and low HDL levels significantly increase mortality risk, reinforcing the clinical importance of lipid monitoring in obese individuals.

Importantly, the current study observed that both total cholesterol and triglyceride levels were above optimal ranges in obese participants, indicating a clear tendency toward borderline dyslipidemia. This finding is clinically significant, as early metabolic alterations often precede overt cardiovascular disease and metabolic syndrome (Jahdkaran & Sistanizad, 2025).

Overall, the results of this study strongly align with previous literature, confirming that obesity is significantly associated with an adverse lipid profile. The consistency of findings across studies

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

highlights obesity as a major modifiable risk factor for dyslipidemia and cardiovascular disease progression (Liu et al., 2023; Zhang et al., 2025).

Conclusion of Discussion

In summary, the present study demonstrates that obese individuals have significantly higher levels of total cholesterol and triglycerides compared to non-obese individuals. These findings confirm that obesity is strongly associated with dyslipidemia and contributes to the development of cardiovascular risk. The results are consistent with previous research and reinforce the importance of early lipid screening, lifestyle modification, and preventive interventions to reduce obesity-related metabolic complications.

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