Original Article

Pathological and Biochemical Implications of Fasting on Lipid Profile Alterations in Healthy Individuals

Fakhra Noureen[1], Nida Khaliq[2], Anum Usman[1], Rubina Shafi[1], Adnan Riaz[3] and Yusra Leghari[3]

ABSTRACT

Objective: This study aims to investigate the impact of fasting on the lipid profile of healthy individuals.
Study Design: Cohort study
Place and Duration of Study: This study was conducted at the conducted at The Department of Pathology Medical College, Bannu KPK from 1st February, 2023 to 10th January, 2024.
Methods: A cohort of 100 healthy volunteers, aged 18-40 years, were enrolled in this observational study. Participants underwent fasting for a period of 12 hours, after which blood samples were collected to measure lipid parameters, including total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides, and very-low-density lipoprotein (VLDL). Baseline lipid profiles were also obtained for comparison.
Results: A total of 100 healthy participants (50 males and 50 females) successfully completed the fasting protocol. The mean age was approximately 31.4 ± 6.7 years, and the average BMI was initially measured at 24.4 ± 2.2 kg/m².The mean TC level significantly decreased from 193.6 ± 27.4 mg/dL to 179.3 ± 26.9 mg/dL ($p < 0.001$).TG levels were notably reduced, dropping from 148.2 ± 32.5 mg/dL to 132.1 ± 29.7 mg/dL ($p < 0.01$).LDL-C levels moderately decreased from 117.5 ± 23.1 mg/dL to 110.2 ± 22.8 mg/dL ($p = 0.03$). HDL-C levels slightly but significantly increased, rising from 47.9 ± 8.8 mg/dL to 52.4 ± 8.3 mg/dL ($p = 0.04$).The LDL/HDL ratio noticeably improved, decreasing from 2.54 to 2.15 ($p < 0.01$), which strongly suggests a reduced risk of atherogenesis.
Conclusion: In conclusion, fasting was found to significantly improve lipid profiles and modestly reduce weight and BMI in healthy individuals. These results clearly highlight fasting's potential as a non-pharmacologically driven strategy for lipid regulation and cardiovascular risk reduction. Future studies should be carefully designed to explore long-term outcomes and thoroughly investigate underlying physiological mechanisms.

Key Words: Lipid Profile, Pathological, Alterations

Citation of article: Noureen F, Khaliq N, Usman A, Shafi R, Riaz A, Leghari Y. Pathological and Biochemical Implications of Fasting on Lipid Profile Alterations in Healthy Individuals. Med Forum 2025;36(7):40-43. doi:10.60110/medforum.360708.

INTRODUCTION

Voluntary abstention from diet and drink for set durations, has traditionally been practiced both spiritually and medically. In recent years, various fasting protocols—such as intermittent fasting (IF), prolonged fasting, and Ramadan fasting, particularly on lipid metabolism. Alterations in lipid profiles during fasting in healthy individuals have been increasingly considered significant due to their potentially serious implications for cardiovascular disease prevention and metabolic regulation.[1-3]

It has frequently been reported that fasting may result in significantly reduced triglycerides (TG), has been noticeably elevated.[4–6] Shifts in lipid markers during religious (e.g., Ramadan) and therapeutic fasting regimens have consistently been confirmed through meta-analyses and observational studies[7–9]. For instance, atherogenic lipoprotein subclasses have been substantially reduced and lipid ratios markedly improved, suggesting that cardio-protective effects may potentially be achieved through long-term or intermittent fasting .[10]

However, consistent benefits have not always been reported. In some investigations, LDL-C or TC levels have been temporarily increased during fasting, likely due to the mobilization of stored fats or altered hepatic lipid metabolism[11]. Furthermore, discrepancies between fasting and non-fasting lipid profiles have been widely debated, especially since lipid measurements have been shown to vary only minimally between the two states in large population cohorts.[12]

Complex physiological responses to fasting have been clearly highlighted in animal models and mechanistic

1. Department of Pathology / Community Medicine[2] / Pathology[3], Al Nafees / Akhtar Saeed Medical Collage, Rawalpindi.

Correspondence: Dr. Fakhra Noureen, Assistant Professor Chemical Pathology, Akhtar Saeed medical college Rawalpindi.
Contact No: 0321853088
Email: drfakhranoureen@outlook.com

Received: January, 2025
Reviewed: February, 2025
Accepted: March, 2025

human studies, including markedly enhanced lipolysis, significantly altered lipoprotein particle size, hormonally driven shifts, and changes in hepatic lipid handling.[13] Although these mechanisms are typically regarded as adaptive in the short term, pathological lipid responses may occasionally be triggered under prolonged fasting or specific metabolic conditions.[14]

Due to the rapidly growing popularity of fasting as a health and lifestyle strategy, it has become increasingly important to evaluate not only its metabolic advantages but also its potentially adverse consequences on lipid metabolism in healthy individuals. In this article, current findings will be critically synthesized, biological mechanisms thoroughly explored, and the clinical significance of fasting-induced lipid alterations comprehensively examined.

METHODS

A prospective cohort study was systematically conducted to evaluate the effects of fasting on lipid profiles in healthy adults. Ethical approval was formally obtained from the Institutional Review Board, and written informed consent was duly secured from all participants prior to enrollment.

Participant Selection: A total of 100 healthy individuals (50 males and 50 females), aged between 18 and 50 years, were carefully enrolled. Participants were meticulously selected based on predefined criteria to ensure overall health and to eliminate potential confounding variables.

Inclusion Criteria

- Individuals aged 18–50 years
- Body Mass Index (BMI) within 18.5–24.9 kg/m²
- No prior diagnosis of metabolic, cardiovascular, or endocrine disorders
- Not receiving any lipid-altering medications
- Non-smokers and non-alcohol users
- Willingness to comply with the protocol was clearly confirmed

Exclusion Criteria

- Diagnosed with dyslipidemia, diabetes, or cardiovascular disease
- Pregnant or lactating women were immediately excluded
- Participants using statins or steroids were automatically disqualified
- Irregular sleep or eating patterns were noted and considered
- Participants unwilling to adhere were promptly removed from the study

Fasting Protocol: A standardized intermittent fasting protocol (16:8 method) was consistently followed over a four-week period.

- Food intake was strictly limited to an 8-hour daily window
- During fasting hours, only permissible non-caloric fluids were carefully consumed
- Physical activity was generally maintained, but vigorous exercise during fasting was deliberately avoided

Anthropometric parameters were accurately recorded at baseline and after 4 weeks. Measurements were consistently taken using standardized techniques:

- Body weight
- Height
- BMI
- Waist circumference

RESULTS

A total of 100 healthy participants (50 males and 50 females) successfully completed the fasting protocol. The study participants were approximately 31.4 ± 6.7 years old on average, representing a relatively young adult population. This age group is typically considered metabolically active and readily responsive to lifestyle or therapeutic interventions. Their Body Mass Index (BMI) was initially recorded at 24.4 ± 2.2 kg/m², placing most individuals comfortably within the normal weight range, according to WHO standards. This generally suggests a healthy baseline status, indicating the absence of obesity-related complications.

Following the intervention, whether dietary, lifestyle-based, or therapeutic, lipid profiles were significantly altered. Total cholesterol (TC) levels notably decreased from 193.6 ± 27.4 mg/dL to 179.3 ± 26.9 mg/dL ($p < 0.001$), which **s**trongly reflects a reduced cardiovascular risk. Similarly, triglyceride (TG) levels markedly declined from 148.2 ± 32.5 mg/dL to 132.1 ± 29.7 mg/dL ($p < 0.01$), clearly suggesting improved lipid metabolism. Low-density lipoprotein cholesterol (LDL-C), commonly known as "bad cholesterol," was moderately lowered from 117.5 ± 23.1 mg/dL to 110.2 ± 22.8 mg/dL ($p = 0.03$), potentially reducing the risk of atherogenic plaque formation.

Conversely, high-density lipoprotein cholesterol (HDL-C), or "good cholesterol," slightly but significantly increased from 47.9 ± 8.8 mg/dL to 52.4 ± 8.3 mg/dL ($p = 0.04$), beneficially influencing cardiovascular protection. Additionally, the LDL/HDL ratio noticeab**ly** improved, declining from 2.54 to 2.15 ($p < 0.01$), strongly indicating reduced atherogenic risk. Collectively**,** the lipid parameters favorably changed, clearly reflecting the positively directed impact of the intervention on cardiovascular health.

Table No.1: Baseline Characteristics of Study Participants

Parameter	Mean ± SD
Number of Participants	100 (50 males, 50 females)
Age (years)	31.4 ± 6.7
Body Mass Index (BMI) (kg/m²)	24.4 ± 2.2
Body Weight (kg)	69.6 ± 10.5

Table No.2: Lipid Profile Changes Pre- and Post-Fasting

Lipid Parameter	Baseline Mean ± SD (mg/dL)	Post-Fasting Mean ± SD (mg/dL)	p-value
Total Cholesterol (TC)	193.6 ± 27.4	179.3 ± 26.9	< 0.001
Triglycerides (TG)	148.2 ± 32.5	132.1 ± 29.7	< 0.01
LDL Cholesterol (LDL-C)	117.5 ± 23.1	110.2 ± 22.8	0.03
HDL Cholesterol (HDL-C)	47.9 ± 8.8	52.4 ± 8.3	0.04
LDL/HDL Ratio	2.54	2.15	< 0.01

Table No.3: Anthropometric Changes Pre- and Post-Fasting

Parameter	Baseline Mean ± SD	Post-Fasting Mean ± SD	p-value
Body Weight(kg)	69.6 ± 10.5	65.9 ± 10.2	< 0.001
Body Mass Index (BMI) (kg/m²)	23.3 ± 2.2	22.7 ± 2.0	< 0.001

Table No.4: Gender-Based Differences in Lipid Profile Changes

Lipid Parameter	Males (Mean Change±SD)	Females (Mean Change±SD)	Significance
Increase in HDL-C (mg/dL)	+4.0 ± 1.5	+5.2 ± 1.7	Not significant
Reduction in TG (mg/dL)	-18.0 ± 5.3	-14.5 ± 4.9	Not significant

DISCUSSION

Impact of fasting on lipid metabolism in healthy individuals was clearly demonstrated, resulting in notably favorable alterations in lipid profiles and modestly reduced body weight and BMI. These findings strongly align with previous research, where structured fasting interventions have consistently been reported to improve cardio metabolic health, even in individuals without pre-existing metabolic disorders.

Lipid profile reduced following the fasting period. Similar outcomes have been frequently documented in earlier studies, in which fasting was shown to effectively promote lipid mobilization and enhance fatty acid oxidation, thereby substantially lowering circulating lipid levels.[15] The observed decrease in TG levels may be attributed to hepatic triglyceride synthesis being considerably suppressed, along with lipolysis being actively enhanced during caloric restriction.[16]

This improvement, along with the reduction in LDL-C, markedly enhanced the LDL/HDL ratio, a key indicator of cardiovascular risk. Thus, fasting was shown to beneficially lower harmful lipids while simultaneously improving protective ones, suggesting the development of an overall atheroprotective profile.[17]

Due to the rapidly growing popularity of fasting as a health and lifestyle strategy, it has become increasingly important to evaluate not only its metabolic advantages but also its potentially adverse consequences on lipid metabolism in healthy individuals. In this article, current findings will be critically synthesized, biological mechanisms thoroughly explored, and the clinical significance of fasting-induced lipid alterations comprehensively examined

Body weight and BMI were also significantly reduced, which further supports the idea that fasting can positively influence energy balance and metabolism. Although weight loss was relatively modest, it likely contributed to the lipid profile improvements, given that adiposity has been strongly linked with dyslipidemia.[18]

In gender-based analysis, both males and females consistently exhibited similar trends in lipid changes. A slightly greater increase in HDL-C was noticeably seen in females, while a more pronounced TG reduction was evidently found in males. However, these differences were not statistically significant and may have been partially influenced by hormonal or physiological factors in lipid metabolism.[19]

Collectively, the findings clearly suggest that fasting, when carefully implemented in a supervised setting, can favorably modulate lipid profiles in healthy individuals. These results strongly support the use of fasting as a preventive health strategy, especially since even slightly improved lipid markers can substantially reduce long-term cardiovascular risk.[20] The duration of fasting was relatively short, and long-term outcomes were not examined. Dietary intake during non-fasting periods was not strictly controlled, which may have potentially influenced results. Furthermore, additional metabolic markers such as insulin sensitivity or inflammation were not assessed, which could have greatly enriched the analysis. Complex physiological responses to fasting have been clearly highlighted in animal models and mechanistic human studies, including markedly enhanced lipolysis, significantly altered lipoprotein particle size, hormonally driven shifts, and changes in hepatic lipid handling .[21] Although these mechanisms are typically regarded as adaptive in the short term, pathological lipid responses may occasionally be triggered under prolonged fasting or specific metabolic conditions.[22]

CONCLUSION

In conclusion, fasting was found to significantly improve lipid profiles and modestly reduce weight and

BMI in healthy individuals. These results clearly highlight fasting's potential as a non-pharmacologically driven strategy for lipid regulation and cardiovascular risk reduction. Future studies should be carefully designed to explore long-term outcomes and thoroughly investigate underlying physiological mechanisms.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Fakhra Noureen, Nida Khaliq, Anum Usman
Drafting or Revising Critically:	Rubina Shafi, Adnan Riaz, Yusra Leghari
Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No.51 ASMC/ERC/2023 Dated 15.01.2023

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