

Date: 15th June-2026

**MAJOR LIPIDS OF BLOOD PLASMA AND DISORDERS OF LIPID
METABOLISM: BIOCHEMICAL MECHANISMS, CLINICAL
MANIFESTATIONS, AND MODERN PERSPECTIVES**

J.Tashaliyeva

Central Asian Medical University Clinical residents

Abstract: Blood plasma lipids play a fundamental role in energy homeostasis, cellular integrity, hormone synthesis, and intercellular communication. The major plasma lipids include triglycerides, cholesterol, phospholipids, and free fatty acids, which circulate in association with specialized lipoprotein particles. Proper regulation of lipid metabolism is essential for maintaining physiological balance and preventing metabolic diseases. Disturbances in lipid metabolism contribute significantly to the development of atherosclerosis, cardiovascular disease, obesity, diabetes mellitus, metabolic syndrome, non-alcoholic fatty liver disease, and inherited lipid disorders. The pathogenesis of these conditions involves complex interactions among genetic factors, hormonal regulation, nutritional status, and environmental influences. Recent advances in molecular biology, lipidomics, and precision medicine have expanded understanding of lipid metabolism and improved diagnostic and therapeutic approaches. This review discusses the composition and physiological functions of plasma lipids, mechanisms of lipid transport, major disorders of lipid metabolism, and contemporary strategies for prevention and treatment.

Keywords: plasma lipids, cholesterol, triglycerides, phospholipids, lipoproteins, dyslipidemia, atherosclerosis, lipid metabolism.

Introduction

Lipids are essential biological molecules involved in numerous physiological processes. They serve as major energy reserves, structural components of cellular membranes, signaling molecules, and precursors for steroid hormones and bile acids. Since most lipids are hydrophobic, their transport in blood plasma requires specialized carrier systems known as lipoproteins.[1,2,3,4,5,6]

Blood plasma contains several classes of lipids that are continuously exchanged between tissues and organs. Their concentrations are tightly regulated through coordinated metabolic pathways involving the liver, adipose tissue, intestine, endocrine organs, and vascular system. Disruption of lipid homeostasis can result in severe metabolic abnormalities and chronic diseases.[7,8,9,10,11]

The increasing prevalence of obesity, diabetes mellitus, and cardiovascular diseases worldwide has intensified scientific interest in lipid metabolism and its disorders.[12,13,14]

Composition of Blood Plasma Lipids

Blood plasma contains four major classes of lipids.

Triglycerides

Triglycerides are esters formed from glycerol and three fatty acids.



Date: 15th June-2026

They represent:

The primary storage form of energy

The major lipid component of adipose tissue

An important source of metabolic fuel

Triglycerides transported in plasma originate from:

Dietary fats

Hepatic synthesis

Elevated plasma triglycerides are associated with increased cardiovascular risk and pancreatitis.[15,16,17]

Cholesterol

Cholesterol is a sterol essential for cellular function.

Its biological roles include:

Maintaining membrane fluidity

Steroid hormone synthesis

Vitamin D production

Bile acid formation

Approximately 70–80% of plasma cholesterol is transported as cholesterol esters.

Both excessive and deficient cholesterol levels may adversely affect health.[18,19]

Phospholipids

Phospholipids are major structural components of biological membranes.

Important phospholipids include:

Phosphatidylcholine

Phosphatidylethanolamine

Sphingomyelin

Phosphatidylserine

Functions include:

Membrane formation

Lipoprotein structure stabilization

Cell signaling regulation

Free Fatty Acids

Free fatty acids circulate bound primarily to albumin.

They serve as:

Immediate energy substrates

Precursors of bioactive molecules

Components of membrane lipids

The concentration of free fatty acids increases during fasting, exercise, and stress.[20,21,22]

Lipoproteins and Lipid Transport

Because lipids are insoluble in water, plasma transport depends upon lipoproteins.

Lipoproteins consist of:

Triglycerides

Cholesterol





Phospholipids

Apolipoproteins

These complexes facilitate lipid transport between tissues.[23,24,25]

Classification of Plasma Lipoproteins

Chylomicrons

Functions:

Transport dietary triglycerides

Deliver absorbed lipids from intestine to tissues

Chylomicrons are the largest and least dense lipoproteins.

Very-Low-Density Lipoproteins (VLDL)

Synthesized in the liver.

Functions:

Transport endogenous triglycerides

Deliver lipids to peripheral tissues

Intermediate-Density Lipoproteins (IDL)

Represent metabolic intermediates generated during VLDL degradation.

Low-Density Lipoproteins (LDL)

LDL particles contain high concentrations of cholesterol.

Functions:

- Deliver cholesterol to tissues
- Support membrane synthesis
- Participate in hormone production

Excessive LDL accumulation contributes to atherosclerosis.

High-Density Lipoproteins (HDL)

HDL performs reverse cholesterol transport.

Functions include:

Removal of excess cholesterol

Delivery of cholesterol to the liver

Protection against atherosclerosis

HDL is commonly referred to as “protective cholesterol.”

Physiological Functions of Plasma Lipids

Plasma lipids perform diverse biological functions.

Energy Production

Fatty acids provide substantial amounts of ATP through β -oxidation.

One gram of lipid yields approximately 9 kcal of energy.[26,27,28]

Structural Functions

Lipids maintain:

Cell membrane integrity

Membrane fluidity

Organelle stability

Endocrine Functions

Lipids serve as precursors for:



Cortisol

Aldosterone

Estrogens

Testosterone

Signaling Functions

Bioactive lipid mediators regulate:

Inflammation

Immune responses

Blood coagulation

Cellular growth

Overview of Lipid Metabolism

Lipid metabolism includes:

1. Digestion
2. Absorption
3. Transport
4. Storage
5. Utilization
6. Excretion

These processes are regulated by enzymes, hormones, and genetic factors.[29,30,31]

Regulation of Lipid Metabolism

Insulin

Insulin promotes:

- Lipogenesis
- Triglyceride synthesis
- Fat storage

It inhibits lipolysis.

Glucagon

Glucagon stimulates:

Lipolysis

Fatty acid oxidation

Particularly during fasting.

Epinephrine

Epinephrine mobilizes stored lipids during stress and exercise.

Thyroid Hormones

Thyroid hormones increase lipid turnover and energy expenditure.

Abnormal thyroid function frequently alters plasma lipid concentrations.

Disorders of Lipid Metabolism

Disorders of lipid metabolism may be inherited or acquired.

They are collectively referred to as dyslipidemias.

Hyperlipidemia

Hyperlipidemia is characterized by elevated plasma lipid concentrations.

Date: 15th June-2026



Major forms include:

Hypercholesterolemia

Hypertriglyceridemia

Mixed dyslipidemia

Common causes:

Obesity

Diabetes mellitus

Hypothyroidism

High-fat diets

Genetic mutations

Hypercholesterolemia

Hypercholesterolemia results from elevated cholesterol levels.

Familial Hypercholesterolemia

An inherited disorder caused by defects in:

LDL receptors

ApoB protein

PCSK9 pathway

Clinical manifestations include:

Premature atherosclerosis

Tendon xanthomas

Coronary artery disease

Hypertriglyceridemia

Elevated triglyceride levels may result from:

Obesity

Insulin resistance

Alcohol consumption

Genetic disorders

Severe hypertriglyceridemia increases the risk of acute pancreatitis.

Hypolipidemia

Hypolipidemia is characterized by abnormally low lipid levels.

Causes include:

Malnutrition

Hyperthyroidism

Liver disease

Genetic disorders

Although less common than hyperlipidemia, it may impair cellular function and hormone synthesis.[32,33,34]

Atherosclerosis

Atherosclerosis is the most clinically significant consequence of dyslipidemia.

The disease develops through:

1. Endothelial injury
2. LDL infiltration

Date: 15th June-2026

3. Oxidative modification
4. Foam cell formation
5. Plaque development

Progressive plaque growth may result in:

Coronary artery disease

Stroke

Peripheral arterial disease

Obesity and Lipid Metabolism

Obesity is associated with profound alterations in lipid homeostasis.

Common abnormalities include:

Elevated triglycerides

Increased LDL cholesterol

Reduced HDL cholesterol

These changes contribute to metabolic syndrome and cardiovascular disease.

Diabetes Mellitus and Dyslipidemia

Diabetes mellitus profoundly influences lipid metabolism.

Typical diabetic dyslipidemia includes:

- Hypertriglyceridemia
- Increased small dense LDL particles
- Reduced HDL cholesterol

These abnormalities accelerate vascular complications.

Non-Alcoholic Fatty Liver Disease

Non-alcoholic fatty liver disease (NAFLD) is characterized by excessive triglyceride accumulation in hepatocytes.

Risk factors include:

Obesity

Type 2 diabetes

Insulin resistance

Dyslipidemia

NAFLD has become one of the most common chronic liver diseases worldwide.

Diagnostic Evaluation of Lipid Disorders

Assessment of lipid metabolism includes:

Lipid Profile

Total cholesterol

LDL cholesterol

HDL cholesterol

Triglycerides

Additional Biomarkers

Apolipoprotein B

Lipoprotein(a)

High-sensitivity C-reactive protein

Molecular testing may be indicated in inherited disorders.



Date: 15th June-2026

Prevention and Treatment

Effective management includes lifestyle modification and pharmacological intervention.

Lifestyle Measures

Healthy diet

Weight reduction

Physical activity

Smoking cessation

Pharmacological Therapy

Statins

Reduce cholesterol synthesis.

Fibrates

Lower triglyceride concentrations.

PCSK9 Inhibitors

Enhance LDL clearance.

Omega-3 Fatty Acids

Reduce hypertriglyceridemia.

Early intervention significantly reduces cardiovascular risk

Future Perspectives

Modern lipid research increasingly focuses on:

Lipidomics

Precision medicine

Gene therapy

RNA-based therapeutics

Artificial intelligence-assisted risk prediction

These approaches may revolutionize the diagnosis and treatment of lipid disorders.[35,36]

Conclusion

Blood plasma lipids are essential for energy metabolism, membrane structure, endocrine regulation, and cellular signaling. Their transport through lipoproteins ensures efficient distribution throughout the body. Disturbances in lipid metabolism represent major risk factors for cardiovascular disease, obesity, diabetes mellitus, and liver disorders. Advances in molecular biology and clinical lipidology have improved understanding of these conditions and facilitated development of effective preventive and therapeutic strategies. Continued research is necessary to further reduce the global burden of lipid-related diseases.

REFERENCES:

- 1.Nelson DL, Cox MM. Lehninger Principles of Biochemistry. 8th Edition.
- 2.Murray RK et al. Harper's Illustrated Biochemistry. 32nd Edition.
- 3.Voet D, Voet JG. Fundamentals of Biochemistry. 5th Edition.
- 4.Ferrier DR. Lippincott Illustrated Reviews: Biochemistry.



Date: 15th June-2026

5. Goldstein JL, Brown MS. Regulation of Cholesterol Metabolism. Cell.
6. Makhamatov, U., Malikov, N., Po'latov, S., Yusupov, M., Ibragimov, U., Kenjayeva, X., & Umarov, S. (2026). ORGANIZING HEALTHY AND SAFE NUTRITION IN NON-COMMUNICABLE DISEASES. *Shokh Articles Library*, 1(1).
7. [SOG'LOM TURMUSH TARZINI TASHKIL ETISHNI DOLZARB MUAMMOLARI VA ULARNING YECHIMLARI](#). M .Ashurova, U Maxamatov, X Xaitov, S Yakubov, U Ibragimov. SCIENTIFIC ASPECTS AND TRENDS IN THE FIELD OF SCIENTIFIC RESEARCH 3 (33), 57-61
8. [Flatulence in Children and Adolescents and its Prevention](#). U Shoirjonovich, KM Abdulkhamidovna. European Journal of Innovation in Nonformal Education 2 (1), 83-85
9. [Its Importance for The Health of the Child and Mother](#). HA Akhunjonova, US Makhamatov, KM Saydullayeva, KO Khojimatov, ...Journal of clinical and preventive medicine 2, 61-64
10. [HISTOSTRUCTURE OF THE GASTRIC MUCOUS MEMBRANE OF RATS WITH A SINGLE PROTEIN DIET](#). S Salomov, XM Aliyev, PP Rakhmanov, MD Ashurova, US Makhamatov. EUROPEAN JOURNAL OF MODERN MEDICINE AND PRACTICE 2 (4), 14-16
11. [Platelet deficiency disease among children and adolescents and measures to prevent it](#). KMA Makhamatov U.Sh. Eurasian Medical Research Periodical, 37-39
12. [Food Poisoning and Its Prevention and Disposal Methods](#). XU Baxodirovna, MU Shoirjonovich. Мировая наука, 85-87
13. [Negative Consequences of Poor and Irregular Diet and Recommendations for Healthy Diet](#). MD Ashurova, US Maxamatov, UA Teshaboyev, KM Saydullayeva Ethiopian International Journal of Multidisciplinary Research 10 (11), 509-512
14. [Integral Helminthoses in Children and Their Etiological Factors](#). U Maxamatov, M Xabibullayeva. IQRO JURNALI 1 (2), 233-236
15. [CLINIC, DIAGNOSIS OF BOTULISM IN CHILDREN AND ADOLESCENTS OF SCHOOL AGE](#) MUS COURSE. World Bulletin of Public Health 18, 50-52
16. [Nutrition of Young Mothers and Recommendations](#). U Maxamatov, A Nematullayev, D Raimjonov, J Ikromov. Eurasian Journal of Medical and Natural Sciences 2 (6), 160-162
17. [Negative Consequences of More Eating and Recommendations on Eating](#) U Maxamatov, D Raimjonov, J Ikromov, A Nematullayev Евразийский журнал медицинских и естественных наук 2 (6), 156-159
18. [THE EFFECTIVENESS OF URGENT MEDICAL INSTRUCTIONS IN EMERGENCY STATIONS](#). MU Shoirjonovich, XU Baxodirovna Мировая наука, 37-40
19. [Determining the health of children and adolescents](#). M.D. Ashurova, U.Sh. Makhamatov, K.M. Saydullaeva, A.L Valiyev, F.I Isroilov. BIO Web of Conferences 65, 05029
20. [THE PLACE AND ROLE OF HEALTHY AND HIGH-QUALITY NUTRITION IN STUDENTS' MASTERY OF EDUCATIONAL ACTIVITIES](#)



Date: 15th June-2026

MD Ashurova. Ethiopian International Journal of Multidisciplinary Research 10 (11), 506-508

21. [Anemia Disease and Rational Nutrition in it](#). U Makhamatov IQRO 2 (2), 280-283

22. [Gigenic Bases of Optimization of Children and Comments Nursed in General Schools](#).

U Maxamatov. Web of Semantic: Universal Journal on Innovative Education 2 (3), 56-65

23. [Treatment of Triggerral Helmintosis in Children and Adolescents Using Folk Medicine](#).

U.Sh. Maxamatov. Univer Publishing

24. [Анализ пациентов с инфекцией COVID-19, роль микроэлемента цинка в организме человека и его роль в распространении и профилактике заболевания](#). УА Тешабоев, ХК Рузматова, УШ Махаматов, КМ Сайдуллаева

Экономика и социум, 374-381

25. [Vitamins and Human health](#). UB Xatamova, US Maxamatov. Мировая наука, 83-85

26. [OPTIMAL NUTRITION PROGRAM FOR CHILDREN: DEVELOPMENT AND IMPLEMENTATION](#). M Umidjon Modern World Education: New Age Problems–New solutions 1 (3), 70-72

27. [ОЖИРЕНИЕ И ЕГО ПОСЛЕДСТВИЯ](#). У Махаматов Научный Импульс 3 (26), 69-73

28. [EKSTRAGENITAL PATOLOGIYALAR, HOMILADORLIKNING O'ZARO BIR BIRIGA TA'SIRI VA BU HOLATDA OVQATLANISH TARTIBI](#)

U Maxamatov, D Abselyamov, X Kenjayeva, S Po'latov. MASTERS 3 (3), 5-10

29. [CARDIOVASCULAR DISEASES AND HYGIENIC PRINCIPLES OF HEALTHY NUTRITION](#). F Mamadaliyev, D Abselyamov, S Pulatov, K Kenjayeva, U Maxamatov. Journal of Multidisciplinary Sciences and Innovations 1 (2), 765-768

30. [EMERGENCY SITUATIONS RESPONSIBILITIES AND PREVENTION MEASURES](#). MU Shoirjonovich, XU Baxodirovna. Мировая наука, 33-36

31. [РАЗВИТИЕ ДИАБЕТА У БОЛЬНЫХ ИНФЕКЦИЕЙ COVID-19//Евразийский журнал медицинских и естественных наук.–2022](#)

УШ Махаматов. Т 2 (5), 13-18

32. [СТАНОВЛЕНИЕ МИКРОБИОЦЕНОЗА У НЕДОНОШЕННЫХ И НОРМАЛЬНОРОЖДЁННЫХ НОВОРОЖДЕННЫХ ДЕТЕЙ](#)

РМ Шерматов, УШ Махаматов. Актуальные научные исследования в современном мире, 76-79

33. [METABOLISM OF BASIC SUBSTANCES AND THEIR SIGNIFICANCE IN THE BODY](#). U Maxamatov, D Abselyamov. MODELS AND METHODS FOR INCREASING THE EFFICIENCY OF INNOVATIVE RESEARCH 4

34. Makhamatov U., Muslimakhon R. THE ROLE OF UNHEALTHY DIET IN THE PATHOGENESIS OF NON-COMMUNICABLE DISEASES //AMERICAN JOURNAL OF APPLIED MEDICAL SCIENCE. – 2025. – Т. 3. – №. 10. – С. 63-72.

35. Makhamatov U., Muslimakhon R. NUTRITION OPTIMIZATION IN OSTEOPOROSIS FOLLOWING COVID-19 //AMERICAN JOURNAL OF APPLIED MEDICAL SCIENCE. – 2025. – Т. 3. – №. 10. – С. 52-62.



Date: 15th June-2026

36. Maxamatov U., Muslimaxon R. SOG'LOM TURMUSH TARZI SALOMATLIK OMILI //AMERICAN JOURNAL OF APPLIED MEDICAL SCIENCE. – 2025. – T. 3. – №. 10. – C. 73-82.



International Conferences
Open Access | Scientific Online | Conference Proceedings

