Global Insights in Biomedical & Multidisciplinary Research (GIBMR)
Volume 01, Issue 01, March-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

Magnesium Deficiency In The Human Body And Its Impact On Human Health

Fayziyeva Nodira Alisherovna
Assistant of the Department of Biomedical Engineering, Informatics and Biophysics, Tashkent State Medical University
Abdumutalibova Dilnozaxon Xolmatovna
1st-year student, Group 111 "B", Faculty of General Medicine No.1, Tashkent State Medical University

Article History

Received: 22th January, 2026

Accepted: 28th February, 2026

Abstract

This article provides a comprehensive analysis of the physiological role of magnesium as a vital macroelement in the human body and examines the pathological consequences associated with its deficiency. Magnesium is involved in numerous enzymatic processes, including ATP-dependent reactions, protein synthesis, and nucleic acid metabolism. It plays a fundamental role in maintaining neuromuscular excitability, cardiovascular stability, and metabolic homeostasis. Recent epidemiological data indicate an increasing prevalence of magnesium deficiency due to inadequate dietary intake, chronic stress exposure, environmental influences, and various systemic disorders. The article evaluates the principal etiological factors, underlying pathophysiological mechanisms, clinical manifestations, and preventive approaches related to hypomagnesemia. Emphasis is placed on the importance of nutritional balance and lifestyle modification in sustaining optimal magnesium status and preventing long-term health complications.

Keywords: magnesium homeostasis, hypomagnesemia, enzymatic activity, metabolic regulation, neuromuscular function, cardiovascular health, micronutrient deficiency, prevention strategies

Volume 01, Issue 01, March-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

Introduction

Mineral homeostasis is essential for the proper functioning of the human organism. Among biologically significant macroelements, magnesium plays a central regulatory role in intracellular biochemical processes. It is the second most abundant intracellular cation and a structural component of numerous enzymatic systems.Total body magnesium content in adults averages 24 g, predominantly localized in bone tissue and skeletal muscles. Only a small fraction circulates in extracellular fluid, making early detection of deficiency challenging. Contemporary dietary patterns characterized by refined foods and reduced micronutrient density have contributed to a gradual decline in magnesium intake worldwide.The clinical relevance of magnesium deficiency extends beyond classical neuromuscular symptoms, influencing systemic inflammation, endothelial function, and metabolic balance.

Physiological Functions of Magnesium

Magnesium is indispensable for ATP-dependent reactions. Cellular energy metabolism requires magnesium-bound ATP complexes to drive biochemical processes. Without adequate magnesium, mitochondrial efficiency decreases, impairing energy production.Additionally, magnesium regulates transmembrane ion gradients by modulating sodium-potassium pumps and calcium channels. Through its antagonistic interaction with calcium, magnesium stabilizes excitable tissues and prevents excessive neuromuscular stimulation.Magnesium also supports nucleic acid stability and ribosomal function, thereby influencing protein synthesis and cellular replication.

Pathophysiological Mechanisms of Deficiency

Magnesium deficiency develops due to insufficient intake, impaired intestinal absorption, or excessive renal excretion. Chronic stress and elevated cortisol levels accelerate magnesium depletion through increased urinary loss.At the cellular level, deficiency leads to intracellular calcium accumulation, oxidative stress, and activation of inflammatory pathways. These mechanisms contribute to endothelial dysfunction, insulin resistance, and heightened cardiovascular risk.Long-term subclinical deficiency may remain asymptomatic while progressively disrupting metabolic regulation.

Clinical Implications

Neuromuscular System

Reduced magnesium concentrations increase neuronal excitability, resulting in muscle cramps, tremors, fasciculations, and in severe cases, tetany or seizures.

Cardiovascular System

Magnesium deficiency alters myocardial electrophysiology and may precipitate arrhythmias. It is also associated with increased vascular resistance and arterial hypertension. Epidemiological data suggest a correlation between low magnesium intake and elevated risk of ischemic heart disease.

Metabolic Disorders

Magnesium is essential for insulin signaling and glucose uptake. Hypomagnesemia is frequently observed in individuals with type 2 diabetes mellitus and metabolic syndrome.

Neuropsychological Effects

Emerging research links magnesium imbalance to anxiety, depressive disorders, and chronic fatigue due to its modulatory effects on neurotransmitter systems.

1.Biological Functions of Magnesium

1. Neuromuscular FunctionMagnesium regulates nerve and muscle activity by:
2. **Controlling calcium entry into neurons:** Magnesium acts as a natural calcium antagonist. Low magnesium increases neuronal excitability, causing tremors, cramps, or tetany.
3. **Supporting muscle contraction and relaxation:** Magnesium ensures smooth coordination of skeletal and cardiac muscles by balancing excitatory and inhibitory signals.
4. **Synaptic transmission:** Adequate magnesium levels maintain neurotransmitter release and prevent overstimulation of neuromuscular junctions.
5. **Clinical implications:** Deficiency can manifest as muscle weakness, spasms, fasciculations, and, in severe cases, seizures. Chronic low magnesium may contribute to restless leg syndrome and increased susceptibility to stress-induced fatigue.

2. Cardiovascular System

Magnesium plays a critical role in cardiovascular health by:

Stabilizing myocardial excitability: Magnesium deficiency increases the risk of arrhythmias and prolonged QT interval.**Regulating vascular tone:** It promotes vasodilation and helps maintain normal blood pressure. **Preventing**

Volume 01, Issue 01, March-2026
Available Online at: https://biomedglobe.com/index.php/gibmr
ISSN (Online): 3054-5900

atherosclerosis: Magnesium reduces oxidative stress and endothelial dysfunction, lowering the risk of plaque formation. **Clinical implications:** Hypomagnesemia is linked to hypertension, coronary artery disease, sudden cardiac death, and increased risk of stroke. Supplementation has been shown to improve endothelial function and reduce arrhythmia incidence.

3. Metabolic Function

Magnesium is essential in metabolism:**Glucose metabolism:** Magnesium activates key enzymes in glycolysis and enhances insulin receptor sensitivity, facilitating glucose uptake. **Energy production:** Magnesium forms complexes with ATP, making it biologically active for cellular energy-dependent processes. **Protein and nucleic acid synthesis:** Required for transcription and translation, magnesium deficiency slows tissue repair and cellular regeneration. **Clinical implications:** Chronic magnesium deficiency contributes to insulin resistance, metabolic syndrome, type 2 diabetes, and obesity-related complications.

4. Bone and Mineral Health

Magnesium supports bone mineralization by regulating calcium and vitamin D metabolism. Adequate magnesium levels ensure structural integrity of bone tissue and reduce risk of osteoporosis.**Clinical implications:** Low magnesium increases fracture risk and impairs bone remodeling.

5.Neuropsychiatric Health

Magnesium modulates NMDA receptors and GABAergic neurotransmission, influencing mood and cognition. Deficiency may lead to anxiety, depression, irritability, sleep disturbances, and impaired memory.

6.**Clinical implications:** Supplementation has been associated with reduced depressive symptoms and improved cognitive function in magnesium-deficient individuals.Risk FactorsMajor contributors to magnesium deficiency include:Diets low in whole grains and green vegetables Gastrointestinal malabsorption syndromes Chronic kidney disease Prolonged diuretic therapy Diabetes mellitus Alcohol overconsumption Persistent psychological stress Preventive StrategiesPrimary prevention involves maintaining adequate dietary intake through consumption of magnesium-rich foods such as legumes, nuts, seeds, whole grains, and leafy greens. Nutritional education and lifestyle modification remain fundamental public health measures.When dietary correction is insufficient, oral magnesium supplementation may be considered.

Clinical management should address underlying disorders contributing to magnesium loss.

Conclusion

Magnesium is a biologically indispensable macroelement that ensures metabolic efficiency, cardiovascular stability, and neuromuscular balance. Deficiency of this mineral represents a multifactorial condition with broad systemic consequences. Recognition of risk factors, early identification of deficiency, and implementation of preventive nutritional strategies are crucial for preserving long-term human health.

References

1. Gröber, U., Schmidt, J., & Kisters, K. (2015). Magnesium in prevention and therapy.
2. *Nutrients,* Volpe, S. L. (2013). Magnesium in disease prevention and overall health. *Advances in Nutrition*
3. Costello, R. B., Elin, R. J., & Rosanoff, A. (2016). Perspective: The case for an evidence-based reference interval for serum magnesium. *Advances in Nutritio*
4. 4.DiNicolantonio, J. J., O'Keefe, J. H., & Wilson, W. (2018). Subclinical magnesium deficiency: A principal driver of cardiovascular disease and a public health crisis.
5. Begali o'g, I. U. B. (2025). The Importance of Integration in General Education Schools and Theoretical Foundations for Developing Teaching-Oriented Integrative Software. *Multidisciplinary Journal of Science and Technology*, *5*(4), 641646.
6. Begali o'g, I. U. B., Malikovich, E. S., & Ahrorxonov, A. (2025). Tibbiyotda robototexnika: Jarrohlik sohasida qo'llanishi. *Multidisciplinary Journal of Science and Technology*, *5*(5), 878-884.
7. Begali o'g, I. U. B., & Mukarram, A. (2025). Kasalliklarning geografik tarqalishi xaritalari (GIS texnologiyalari). *Multidisciplinary Journal of Science and Technology*, *5*(5), 644-648.
8. Тиркашев, О. С., Мустаева, Г. Б., Брянцева, Е. В., & Матназарова, Г. С. (2023). Изучение клинических и эпидемиологических особенностей кори. *Science and education*, *4*(2), 420-428.
9. Матназарова, Г. С., & Неъматова, Н. У. (2018). Эпидемиолоическая ситуация по ВИЧ-инфекции в Республике Узбекистан. In *Материалы*

XXXIX Международной научно-практической интернет-конференции.-Переяслав-Хмельницкий (pp. 516-519).

10. Saidkasimova, N. S., Matnazarova, G. S., & Mirtazayev, O. M. (2018). Some epidemiological patterns of salmonellosis in Uzbekistan. *Biology and Medical problems*, *4*, 95-96.
11. Миртазаев, О. М., Матназарова, Г. С., & Магзумов, Х. Б. (2023). Зоонозный сальмонеллёз-болезнь цивилизации. *микробиологиянинг долзарб муаммолари» мавзусидаги республика илмий-амалий анжумани*, 132.
12. Kzar, H. H., Jasim, S. A., Kurbanova, S. Y., Al-Ghamdi, H. S., Al-Khafaji, F. A. H., Al-Gazally, M. E., ... & Alghamdi, M. A. (2023). The biomedical potential of polycaprolactone nanofibrous scaffold containing titanium oxide for wound healing applications. *International Journal of Microstructure and Materials Properties*, *16*(4), 278-291.
13. Нуралиев, Н. А., Сагдуллаева, Б. О., & Курбанова, С. Ю. (2016). Теоретические и практические основы санитарной микробиологии. *В журнале представлены материалы*, 101.
14. Nıshanova, Y., Juravlov, I., Kurbanova, S., & Salokhıddınov, M. (2020). Imaging of breast cancer associated with pregnancy.
15. 5.Rosanoff, A., Weaver, C. M., & Rude, R. K. (2012).
16. 6.Schwalfenberg, G. K., & Genuis, S. J. (2017). The importance of magnesium in clinical healthcare.
17. 7.de Baaij, J. H. F., Hoenderop, J. G. J., & Bindels, R. J. M. (2015). Magnesium in man: Implications for health and disease.
18. 8.Barbagallo, M., & Dominguez, L. J. (2010). Magnesium and type 2 diabetes.