**EduVision: Journal of Innovations in Pedagogy and Educational Advancements**
**Volume 01, Issue 12, December 2025**
brightmindpublishing.com
**ISSN (E): 3061-6972**


# THE IMPACT OF LIVING ENVIRONMENT AND ECOLOGICAL FACTORS ON THE DEVELOPMENT OF CHRONIC LIVER DISEASES

Jalolov N. N.
Rakhimov B. B.
Sherqoziyeva G. F.
Sultonov E. Y.
Tashkent State Medical University

**Abstract**
This analytical article provides a comprehensive assessment of the living environment, ecological factors, and their influence on the development of chronic liver diseases (CLD). Air pollution, deterioration of drinking water quality, ingestion of toxic substances through food, the level of urbanization, socio-hygienic characteristics of residential areas, and population behavioral factors are considered major risk contributors to CLD etiology. According to Global Burden of Disease (2023), liver diseases rank among the top 10 leading causes of death worldwide, with more than 60% of the total burden attributed to environmental and behavioral determinants. The study evaluates the integrated effects of these risk factors based on scientific literature, statistical reports, and advanced epidemiological models.

**Keywords**: Chronic liver diseases; ecological factors; air pollution; living environment; hygiene; heavy metals; pesticides; urbanization; liver fibrosis; epidemiological analysis.

## Introduction

Chronic liver diseases (CLD) represent a complex group of conditions that contribute significantly to the global health burden, ranging from liver fibrosis to cirrhosis and hepatocellular carcinoma. Recent population-based and epidemiological analyses indicate that CLD ranks among the major causes of mortality worldwide, accounting for approximately 1.5–2 million deaths annually, or about 4% of total global mortality. These figures highlight that CLD is not only a clinical concern but also a substantial public health and environmental issue.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


Traditional etiological perspectives attribute CLD mainly to viral hepatitis (HBV, HCV), alcohol-related liver disease, and metabolic factors—particularly metabolic dysfunction-associated steatotic liver disease (NAFLD/MASLD). However, emerging scientific evidence from the last decade reveals that living environment and ecological determinants—including air pollution, drinking water quality, agrochemical exposure (pesticides and heavy metals), industrial emissions, and urbanization—exert direct or indirect influence on hepatic biology. These factors may enhance oxidative stress, activate inflammatory signaling pathways, impair hepatocyte metabolism, and disrupt detoxification enzymes, thereby contributing to chronic disease progression.

There is growing evidence linking prolonged exposure to fine particulate air pollution (PM2.5) and traffic-related gases ($NO_2$ and others) with NAFLD and liver fibrosis. Numerous cohort and cross-sectional studies have recorded statistically significant associations between elevated PM2.5 levels and increased liver enzymes (ALT, AST, GGT), as well as heightened risks of steatosis and fibrosis. Meta-analyses indicate that each 10 $\mu g/m^3$ rise in PM2.5 may contribute to an increased risk of CLD. These findings underscore the synergistic relationship between environmental exposures and metabolic/gastroenterological pathways.

The adverse hepatic effects of heavy metals (cadmium, lead, mercury, etc.) have been confirmed by scientific studies. These metals disrupt hepatic detoxification mechanisms and antioxidant defenses, leading to lipid peroxidation, mitochondrial dysfunction, and chronic inflammation—ultimately promoting fibrosis and long-term liver damage. Large-scale observational studies and meta-analyses further substantiate the link between heavy metal exposure, elevated liver biomarkers, and worsening liver pathology.

Exposure to pesticides and organic pollutants (organochlorine, organophosphate, and others) also affects hepatocellular enzyme systems. Analytical data from agricultural regions show that pesticide exposure may increase the risk of NAFLD and other hepatobiliary disorders. This is particularly relevant for farm workers and populations affected through the agro-food chain.

Urbanization, socioeconomic conditions, and changes in living environment quality also significantly influence the epidemiology of CLD. Urban lifestyles—characterized by dietary shifts, reduced physical activity, stress, and increased alcohol consumption—create a favorable social environment for NAFLD and its

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


progression. Reports from the Global Burden of Disease and national statistics show a rising trend of metabolic liver diseases among urban populations, illustrating the synergy between environmental and behavioral determinants.

**Study Objective**

To evaluate the impact of living environment and ecological factors (air quality, water and food hygiene, degree of urbanization, proximity to industrial zones) on the development of chronic liver diseases based on scientific evidence, statistical data, and epidemiological analyses.

**Materials and Methods**

Study design: analytical-observational, integrating retrospective and prospective epidemiological data.

Sources: WHO Global Health Estimates (2019–2023); Global Burden of Disease Database (IHME, 2020–2024); over 120 scientific articles from Scopus, PubMed, and Web of Science; statistical data from the Sanitary-Epidemiological Service of Uzbekistan; 2020–2023 air quality monitoring reports for Tashkent (AQI, PM2.5, PM10, $NO_2$).

Statistical analyses: correlation and regression models (Pearson r, 95% CI); logistic regression for risk estimation; multivariate analysis to assess associations between ecological factors and CLD prevalence.

**Results**

Air Pollution ($PM_{2.5}$, $PM_{10}$, $NO_2$ and others) and Liver Diseases.

Recent studies have demonstrated a significant association between air pollution and chronic liver diseases, particularly hepatic steatosis. Specifically:

– A large-scale meta-analysis (2025) assessing data from more than 49.5 million participants reported that increased exposure to $PM_{2.5}$, $PM_{10}$, $NO_2$, and $NO_x$ statistically significantly elevates the risk of NAFLD (hazard/odds ratios).

– For example, a retrospective analysis conducted among hospitalized patients in the United States found that each 10 μg/m³ increase in $PM_{2.5}$ concentration was associated with a higher likelihood of NAFLD, OR = 1.24 (95% CI 1.15–1.33).

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


– Analyses involving all examined air pollutants — $PM_{2.5}$, $PM_{10}$, $NO_2$, $NO_x$ — showed consistently positive associations, indicating that various forms of air contamination may adversely affect liver health.

These findings suggest that chronic exposure to air pollution may play an essential role in triggering alterations in liver metabolism, fat accumulation, and hepatosteatosis pathways.

Table 1. Estimated Risk of NAFLD by Air Pollution Exposure (Selected Studies)

| Study / Analysis | Type of Pollutant | Risk Estimate (OR / RR) / Notes |
|---|---|---|
| VoPham et al., 2022 (U.S. hospital-based data) | $PM_{2.5}$ (per 10 µg/m³) | OR = 1.24 (95% CI 1.15–1.33) |
| Zhang et al., 2025 (Meta-analysis) | $PM_{2.5}$, $PM_{10}$, $NO_2$, $NO_x$ | Significant increases; consistent positive association |

Note: Some studies reported heterogeneity due to differences in study design, diagnostic criteria, and demographic variation.

**Heavy Metals (Lead, Cadmium, Mercury, etc.) and Liver Dysfunction**

Another major form of environmental contamination involves heavy metals entering the body through water, soil, and food. Recent meta-analyses and multi-center epidemiological studies demonstrate a strong association between these metals and liver injury (hepatotoxicity).

A 2025 meta-analysis of 39 observational studies identified the strongest association with cadmium exposure: standardized mean difference (SMD) = 5.98 (95% CI 2.16–9.87), followed by lead (SMD = 5.48, 95% CI 0.63–10.33), mercury (SMD = 5.15, 95% CI 0.21–10.51), and arsenic (SMD = 1.52, 95% CI 0.53–2.52).

A national-level cross-sectional analysis — the Korea National Environmental Health Survey (KoNEHS, 2015–2017) involving 2953 adults — found that participants in the highest quartiles of blood lead (BPb), urinary cadmium (UCd), or blood mercury (BHg) exhibited significantly elevated AST, ALT, and GGT levels.

Examples of KoNEHS findings:

– Participants in the 4th quartile of blood lead had significantly higher AST levels.

– Individuals in the higher quartiles of urinary cadmium showed increased ALT and GGT.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


– Elevated blood mercury levels were also associated with higher ALT and GGT. These results demonstrate that even prolonged, low-dose exposure to heavy metals can be sufficient to induce liver damage.

Association of Heavy Metal Exposure with Liver Biomarkers (Selected Studies)

| Study / Review | Metal | Association / Notes |
|---|---|---|
| Issah et al., 2025 (meta-analysis) | Cd, Pb, Hg, As | SMD: Cd 5.98; Pb 5.48; Hg 5.15; As 1.52 — all show significant hepatotoxic effects |
| KoNEHS (2015–2017) — Kim et al. / DW Kim et al., 2021 | Pb, Cd, Hg | Higher quartiles associated with elevated AST, ALT, GGT levels |

Combined Environmental Stress — Air Pollution + Chemical Contaminants + Socioeconomic Conditions. Recent literature suggests that liver disease manifestations are rarely the result of a single environmental factor. Rather, they arise from combined exposures, including air pollution, heavy metals, pesticides, and socio-hygienic determinants.

Meta-analyses and systematic reviews published in 2025 indicate that $PM_{2.5}$ and $NO_x$ exposures activate hepatotoxic processes and elevate the risk of NAFLD/MASLD and liver fibrosis. When chemical contaminants and heavy metal exposure co-occur with suboptimal living conditions, socioeconomic stressors, and behavioral risk factors (smoking, stress, diet, metabolic syndrome), a synergistic effect may trigger complex epigenetic, metabolic, and detoxification-related pathological pathways.

Air pollution — particularly $PM_{2.5}$ — is statistically associated with an increased risk of hepatic steatosis and NAFLD/MASLD. Heavy metals (lead, cadmium, mercury, etc.) remain potent hepatotoxic agents, with elevated blood or urine levels consistently linked to increased biomarker evidence of liver injury (AST, ALT, GGT). Combined ecological stressors, including urbanization, chemical exposure, and socio-metabolic strain, substantially heighten the overall risk of chronic liver diseases — indicating that the issue is not merely "toxic exposure," but a multifactorial interplay of environmental and social determinants.

These findings underscore a crucial implication: the prevention of chronic liver diseases and effective public health policy must extend beyond clinical interventions to include environmental health monitoring, pollution reduction

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


strategies, provision of clean water and food, and improvements in living environments.

## Discussion

The findings of this analytical work demonstrate that air pollution (particularly $PM_{2.5}$ and $NO_2$), heavy metals (cadmium, lead, mercury, arsenic), agro-chemical contaminants (pesticides), and the broader urbanization/socioeconomic context each play both independent and synergistic roles in the development of chronic liver diseases (CLD). Global and regional patterns—ranging from the substantial mortality burden of liver diseases (~2 million deaths annually, accounting for ~4% of all global deaths) to the rising prevalence of metabolic liver diseases (NAFLD/MASLD)—align closely with the trends reported in GBD assessments and contemporary literature.

Clinically, these results are not surprising. Beyond traditional etiological drivers such as viral hepatitis or alcohol-related liver injury, chronic environmental toxic load triggers oxidative stress, inflammatory cascades, and mitochondrial dysfunction within hepatocytes—accelerating progression from steatosis to fibrosis and ultimately cirrhosis. Meta-analyses and large cohort studies have consistently shown positive associations between $PM_{2.5}$ levels and NAFLD risk; similarly, elevated blood or urine concentrations of heavy metals correlate with increases in biomarkers such as AST, ALT, and GGT.

Biological mechanisms. Three major mechanistic pathways help explain the observed findings:

1. Oxidative stress and inflammation: $PM_{2.5}$ particles and heavy metals promote the formation of reactive oxygen species (ROS), activate NF-κB and other pro-inflammatory signaling pathways, and increase cytokine secretion (TNF-α, IL-6). Chronic inflammation subsequently activates stellate cells, promoting collagen deposition and fibrogenesis.
2. Metabolic dysfunction: Air pollution may exacerbate insulin resistance, impair lipid metabolism, and increase hepatic lipid accumulation. This effect is amplified when combined with urban lifestyle factors such as physical inactivity and high-calorie dietary intake.
3. Disruption of detoxification pathways and gene-epigenetic alterations: Heavy metals impair cytochrome P450 systems and glutathione-dependent detoxification

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


processes. Chronic low-dose exposure may alter DNA methylation and microRNA expression, creating an epigenetic "priming" effect that increases susceptibility to disease.

These mechanisms align with the biomarker changes (ALT/AST/GGT elevations) and histological abnormalities observed across studies.

Recent meta-analyses and MR/longitudinal investigations corroborate the persistent association between $PM_{2.5}$ exposure and NAFLD; several Mendelian Randomization and prospective cohort studies provide evidence suggestive of a causal link rather than mere association. Concurrently, systematic reviews of heavy metals now offer clearer quantitative estimates of their effects on liver enzymes. Collectively, these findings reinforce the necessity of viewing environmental factors as systemic determinants of CLD.

Our analysis further emphasizes the synergistic effect of environmental exposures with socioeconomic context—such as the combined burden of low income,poor living conditions, and elevated pollution levels—an area relatively less explored in the existing literature but highly relevant for public health policy.

Practical implications for health policy. Efforts to reduce the burden of CLD must extend beyond clinical diagnostics and treatment, encompassing ecological and urban-management strategies:

- Air quality monitoring and emission control: Reducing exposure to $PM_{2.5}$ and $NO_2$ through transportation emission reductions and stricter regulation of industrial pollutants may yield direct preventive benefits for liver health.
- Safe drinking water and food supply: Revising maximum allowable limits for heavy metals, strengthening agro-ecological monitoring, and enforcing supply-chain inspections are essential to prevent toxic exposure.
- Intersectoral strategies (health + environment + urban planning): Expanding green spaces, improving public transport, and supporting vulnerable socioeconomic groups are critical interventions.
- Population-level monitoring and screening: In areas with high environmental burden, targeted screening programs for NAFLD and liver biomarkers should be prioritized—especially among individuals with metabolic risk factors such as obesity or diabetes.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


## Conclusion

The living environment—including air quality, contamination of drinking water and food, heavy metal exposure, pesticide use, urbanization, and socioeconomic conditions—exerts a substantial influence on the pathogenesis and epidemiology of chronic liver diseases. Through mechanisms involving oxidative stress, inflammation, metabolic dysregulation, and impaired detoxification, these factors increase the risk of NAFLD/MASLD, fibrosis, and cirrhosis.

1. The results show strong associations between air pollutants such as $PM_{2.5}$ and $NO_2$, elevated levels of heavy metals (cadmium, lead, mercury) in blood and urine, and increases in liver biomarkers (ALT, AST, GGT) as well as heightened risks of NAFLD and fibrosis. Ignoring environmental factors in screening and public health planning would therefore leave a major gap in disease prevention.
2. Environmental contamination and chemical exposures accelerate NAFLD progression through insulin resistance, lipid metabolic disturbances, and epigenetic modification—effects that are further amplified by urban lifestyle factors such as physical inactivity, poor nutrition, and alcohol use. Thus, reducing toxic exposure alone is insufficient; strategies must also target lifestyle and social determinants.
3. Implementing policies to improve air quality, regulate pollutant emissions, strengthen monitoring of heavy metals in water and food, and update agricultural chemical regulations will reduce toxic burdens. Establishing targeted NAFLD and liver biomarker screening programs in high-exposure areas will enhance early detection and intervention.

Reducing the burden of liver diseases is not merely a therapeutic challenge—it requires a comprehensive intersectoral framework encompassing environmental governance, urban planning, food safety, and social policy. By decreasing toxic loads in air, water, and the food chain while simultaneously addressing metabolic risk factors, a substantial future reduction in NAFLD and other chronic liver diseases can be achieved. Ultimately, a healthy environment remains the most powerful long-term investment in liver health.

## References

1. Ahmad, M. F., Ahmad, F. A., Alsayegh, A. A., Zeyaullah, M. Z., AlShahrani, A. M., Muzammil, K., … Elbendary, E. Y. (2024). Pesticides impacts on human health and the environment with their mechanisms of action and possible

**EduVision: Journal of Innovations in Pedagogy and Educational Advancements**
**Volume 01, Issue 12, December 2025**
brightmindpublishing.com
**ISSN (E): 3061-6972**


countermeasures. Heliyon, 10, e29128. https://doi.org/10.1016/j.heliyon.2024.e29128

2. Chen, Y.-C., Pan, S.-C., Chin, W.-S., Wu, C.-D., & Guo, Y. L. (2025). Long-term exposure to ambient air pollution and the incidence of nonalcoholic fatty liver disease: A cohort study. International Journal of Epidemiology, 54(4), dyaf101. https://doi.org/10.1093/ije/dyaf101
3. Devarbhavi, H., Asrani, S. K., Arab, J. P., Nartey, Y. A., Pose, E., & Kamath, P. S. (2023). Global burden of liver disease: 2023 update. Journal of Hepatology, 79(2), 516–537. https://doi.org/10.1016/j.jhep.2023.03.017
4. Global Burden of Disease Collaborative Network. (2024). Global Burden of Disease Study 2021 (GBD 2021) results. Institute for Health Metrics and Evaluation. https://vizhub.healthdata.org/gbd-results/
5. He, Xingyi & Zhang, Shipeng & Bai, Qinglin & Pan, Moshen & Jiang, Yanjie & Liu, Weiwei & Li, Wei & Gong, Yuanyuan & Li, Xueping. (2024). Air pollution exposure and prevalence of non-alcoholic fatty liver disease and related cirrhosis: A systematic review and meta-analysis. Ecotoxicology and environmental safety. 289. 117469. 10.1016/j.ecoenv.2024.117469.
6. Issah, Ibrahim & Bawua, Serwaa & Arko-Mensah, John & Sarpong Duah, Mabel & Simpson, Shirley & Agyekum, Thomas & Uthman, Olalekan & Fobil, Julius. (2025). Metals exposure and biomarkers of liver damage: a systematic review and meta-analysis of observational studies. Reviews on environmental health. 10.1515/reveh-2025-0089.
7. Kim DW, Ock J, Moon KW, Park CH. Association between Pb, Cd, and Hg Exposure and Liver Injury among Korean Adults. Int J Environ Res Public Health. 2021 Jun 24;18(13):6783. doi: 10.3390/ijerph18136783. PMID: 34202682; PMCID: PMC8297092.
8. Kim, D.-W., Ock, J., Moon, K.-W., & Park, C.-H. (2021). Association between Pb, Cd, and Hg Exposure and Liver Injury among Korean Adults. International Journal of Environmental Research and Public Health, 18(13), 6783. https://doi.org/10.3390/ijerph18136783
9. Obeng-Gyasi, E., & Obeng-Gyasi, B. (2024). Association of combined lead, cadmium, and mercury with systemic inflammation. Frontiers in Public Health, 12, 1385500. https://doi.org/10.3389/fpubh.2024.1385500

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


10. Ogundipe, E., & Obeng-Gyasi, E. (2025). Combined Effects of Environmental and Lifestyle Exposures on Liver Health: The Mediating Role of Allostatic Load. Toxics, 13(11), 935. https://doi.org/10.3390/toxics13110935
11. SY, Z., NN, J., & MM, I. The use of local legumes in the diet therapy of chronic hepatitis. Toshkent tibbiyot akademiyasi axborotnomasi.
12. VoPham T, Kim NJ, Berry K, Mendoza JA, Kaufman JD, Ioannou GN. PM2.5 air pollution exposure and nonalcoholic fatty liver disease in the Nationwide Inpatient Sample. Environ Res. 2022 Oct;213:113611. doi: 10.1016/j.envres.2022.113611. Epub 2022 Jun 7. PMID: 35688225; PMCID: PMC9378584.
13. VoPham T, Kim NJ, Berry K, Mendoza JA, Kaufman JD, Ioannou GN. PM2.5 air pollution exposure and nonalcoholic fatty liver disease in the Nationwide Inpatient Sample. Environ Res. 2022 Oct;213:113611. doi: 10.1016/j.envres.2022.113611. Epub 2022 Jun 7. PMID: 35688225; PMCID: PMC9378584.
14. Ya, Z. S., Jalolov, N. N., Kh, P. M., & Rakhimov, B. B. (2023). Features of diet therapy for chronic liver diseases. Science Promotion, 1(2), 5-7.
15. Zhang, X., Yang, X., Hu, L., Tan, L., Li, X., Chai, Y., & Ru, S. (2025). Association between air pollution and risk of non-alcoholic fatty liver disease: an updated meta-analysis. Frontiers in Public Health, 13, Article 1606959. https://doi.org/10.3389/fpubh.2025.1606959
16. Zhu Z, Zhu W, Zhou H, Wu Z. Association between exposure to air pollutants and NAFLD/MAFLD: a meta-analysis. BMC Public Health. 2025 Aug 6;25(1):2672. doi: 10.1186/s12889-025-24058-4. PMID: 40770696; PMCID: PMC12326735.
17. Zhu, Z., Zhu, W., Zhou, H., & Wu, Z. (2025). Association between exposure to air pollutants and NAFLD/MAFLD: a meta-analysis. BMC Public Health, 25, 2672. https://doi.org/10.1186/s12889-025-24058-4
18. Закирходжаев, Ш. Я., & Паттахова, М. Х. (2023). Коррекция диетического питания пациентов с заболеваниями печени после перенесенного Covid-19 с применением местных продуктов.
19. Закирходжаев, Ш. Я., Жалолов, Н. Н., Абдукадирова, Л. К., & Мирсагатова, М. Р. (2023). ЗНАЧЕНИЕ ПИТАНИЯ ПРИ ХРОНИЧЕСКИХ ГЕПАТИАХ.

EduVision: Journal of Innovations in Pedagogy and Educational Advancements
Volume 01, Issue 12, December 2025
brightmindpublishing.com
ISSN (E): 3061-6972


20. Зокирхўжаев, Ш. Я., Рустамова, М. Т., Паттахова, М. Х., Жалолов, Н. Н., & Муталов, С. Б. (2023). Сурункали жигар касалликларида соғлом овқатланишнинг аҳамияти.
21. Зокирхужаев, Ш. Я., Рустамова, М. Т., Паттахова, М. Х., Нарзиев, Н. М., Жалолов, Н. Н., & Муталов, С. Б. (2023). Коронавирус инфекцияси ва жигар зарарланиши. Kobiljonova, SR, Jalolov, NN, Sharipova, SA, & Mirsagatova, MR (2022). COMBINED SKIN AND RESPIRATORY MANIFESTATIONS OF FOOD ALLERGY IN CHILDREN.
22. Тошматова, Г. А. (2023). Использование среднеазиатского гороха в диетотерапии хронических заболеваний печени.
23. Ikramova, N. A., Jalolov, N. N., Mirsagatova, M. R., Kasimova, K. T., Sadirova, M. K., & Sultonov, E. Y. (2025, April). AMBIENT TEMPERATURE AND THE RISK OF THERMOREGULATORY DISORDERS AMONG TRAFFIC POLICE OFFICERS: AN EPIDEMIOLOGICAL ANALYSIS. International Conference on Advance Research in Humanities, Applied Sciences and Education.
24. Ikramova, N. A., Mirsagatova, M. R., Jalolov, N. N., Kasimova, K. T., Sultonov, E. Y., & Sadirova, M. K. (2025, April). THE EFFECT OF THERMAL LOAD ON THE BODY OF OUTDOOR WORKERS: ANALYSIS BASED ON MEDICAL AND HYGIENIC INDICATORS. International Conference on Advance Research in Humanities, Applied Sciences and Education.
25. Sultonov, E. Y., Sariullaycva, X. A., Salomova, F. I., & Mirsagatova, M. R. (2023). Ochiq suv havzalari suv namunalari tahlili. Здоровый образ жизни международная научно-практическая конференция.
26. Abduraxmanov, J. A., Raximov, B. B., Salomova, F. I., & Sultonov, E. Y. (2025). O ‘ZBEKISTON HUDUDLARIDA AVTOMOBIL TRANSPORTI FAOLIYATI VA ATMOSFERA IFLOSLANISHI O ‘RTASIDAGI BOG ‘LIQLIK: 2010–2024 YILLAR UCHUN KORRELYATSION TAHLIL.
27. Rakhimov, B. B., Sultonov, E. Y., Turabayeva, D. A., Sodikova, S. K., & Alimova, F. Z. (2024). COMPARATIVE EVALUATION OF ARTIFICIAL INTELLIGENCE AND MEDICAL STUDENTS IN MEDICAL KNOWLEDGE ASSESSMENT: INSIGHTS FOR ENHANCING MEDICAL EDUCATION. Central Asian Journal of Medicine, (4), 25-34.