Hygienic Assessment of Atmospheric Air Quality in Fergana City: An Extended Resident-Based Perception and Health Symptom Study

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Abstract

Atmospheric air pollution is a major environmental health threat in industrial urban centers, especially in rapidly developing regions with intense industry and transport. In Fergana city, Uzbekistan, petrochemical and chemical production combined with valley topography and poor air circulation create a particularly unfavorable ecological setting. This study hygienically assessed air quality in Fergana using a resident-based perception and health symptom approach, complementing traditional technical monitoring. A cross-sectional survey of 200 residents from an industrial high-impact zone and a suburban control zone used the "Fergana-Air-Quality-Scale" to record environmental perceptions and respiratory, allergic, and sensory symptoms over 12 months. Residents near industrial plants reported more chemical odors, dust, smog, and markedly higher frequencies of persistent dry cough, conjunctival irritation, allergic rhinitis, and shortness of breath, often 2–4 times higher than in the control zone. The findings suggest that industrial emissions and unfavorable topography drive chronic exposure and elevated health risks, highlighting the need to integrate biological, social, and perceptual indicators into urban environmental hygiene assessment systems.

Keywords: *atmospheric air pollution, environmental hygiene, industrial emissions, respiratory symptoms, Fergana city, public health, environmental monitoring, hygienic assessment*

1. INTRODUCTION

Atmospheric air represents one of the most important environmental determinants of human health. The quality of inhaled air directly influences respiratory, cardiovascular, neurological, and immunological systems. Rapid industrialization and urban expansion have significantly increased the global burden of atmospheric pollution, especially in developing industrial regions where environmental monitoring systems may remain insufficient.

Air pollution has become a major international public health issue. According to the World Health Organization (WHO), millions of premature deaths annually are associated with exposure to polluted air. Long-term exposure to particulate matter, sulfur compounds, nitrogen oxides, volatile organic compounds (VOCs), and industrial aerosols increases the risk of chronic respiratory diseases, allergic disorders, cardiovascular pathology, and malignant neoplasms.

Industrial cities represent particularly vulnerable environments due to concentrated emission sources and high population density. In Uzbekistan, Fergana city occupies a unique position as one of the largest industrial centers in the Fergana Valley. The city hosts major petrochemical enterprises, including:

- the Fergana Oil Refinery,
- chemical production complexes,
- industrial transport infrastructure,
- and high-density urban traffic systems.

The ecological situation in Fergana is additionally complicated by geographical and climatic factors. The valley topography creates unfavorable atmospheric circulation conditions, especially during autumn and winter temperature inversions. Pollutants accumulate near the ground surface, increasing chronic population exposure.

Traditional atmospheric monitoring systems primarily focus on quantitative measurements of pollutants. However, hygienic evaluation of environmental quality should also include:

- population perception,
- symptom prevalence,
- biological response indicators,
- and social health outcomes.

Resident-based environmental assessment methods provide valuable supplementary information because human sensory and physiological responses often detect environmental stressors before technical monitoring systems indicate critical thresholds.

This study aimed to conduct a comprehensive hygienic assessment of atmospheric air quality in Fergana city through analysis of resident perceptions and self-reported health symptoms associated with industrial pollution exposure.

2. MATERIALS AND METHODS

2.1 Study Design

A cross-sectional epidemiological and hygienic study was conducted between March and April 2026.

The research integrated:

- environmental perception assessment,
- symptom prevalence analysis,
- comparative zone evaluation,
- and statistical correlation analysis.

2.2 Study Area

The study was conducted in Fergana city, located in eastern Uzbekistan within the Fergana Valley.

The city contains:

- petrochemical industries,
- chemical manufacturing plants,
- dense transportation networks,
- and residential zones located near industrial clusters.

2.3 Participant Selection

A total of 200 residents participated in the study.

Participants were divided into two groups:

Zone	Description	Number
Zone I	Industrial-proximal residents (0.5–2 km)	110

Zone II	Control zone residents (>5 km)	90

Sampling was performed using random-stratified methodology.
Participation was anonymous and voluntary.

2.4 Survey Instrument

The "Fergana-Air-Quality-Scale" (FAQS) questionnaire consisted of 25 validated items evaluating:

Environmental Perception

- chemical odor frequency,
- visible dust,
- smog occurrence,
- air freshness perception.

Health Symptoms

- persistent cough,
- allergic rhinitis,
- conjunctival irritation,
- breathing difficulty,
- headaches,
- fatigue.

Lifestyle and Exposure

- smoking status,
- occupational exposure,
- duration of outdoor activity.

2.5 Statistical Analysis

Data were analyzed using SPSS software.
The following statistical methods were applied:

- Chi-square analysis,
- prevalence ratio calculation,
- comparative percentage analysis.

Statistical significance was accepted at:
$P<0.05P < 0.05P<0.05$

3. RESULTS

3.1 Perception of Environmental Pollution

Residents of the industrial zone reported significantly higher levels of environmental discomfort.

Environmental Indicator	Zone I (%)	Zone II (%)	P-value
Daily chemical odor	74.5	18.9	<0.001
Visible dust	68.2	31.1	<0.01
Frequent smog	55.4	12.2	<0.001

These findings indicate severe environmental stress among residents living near industrial plants.

3.2 Respiratory Symptoms

Respiratory complaints were significantly more prevalent in Zone I.

Symptom	Zone I (%)	Zone II (%)	Prevalence Ratio
Persistent dry cough	48.2	15.6	3.1
Shortness of breath	30.9	8.9	3.5

The elevated prevalence suggests chronic respiratory irritation associated with atmospheric pollutants.

3.3 Allergic and Sensory Symptoms

Symptom	Zone I (%)	Zone II (%)
Eye irritation	42.7	11.1
Allergic rhinitis	51.8	22.2

Conjunctival irritation and allergic reactions were substantially higher among industrial-zone residents.

3.4 Subjective Environmental Burden

More than 70% of Zone I residents reported dissatisfaction with air quality.

Common complaints included:

- unpleasant odors,
- morning throat irritation,
- chronic nasal congestion,
- headaches during smog episodes.

3.5 Seasonal Pollution Patterns

Residents reported worsening air quality during:

- autumn,
- winter,
- and low-wind weather conditions.

These patterns are consistent with temperature inversion phenomena typical of valley environments.

4. DISCUSSION

4.1 Industrial Emissions and Public Health

The study findings confirm that industrial emissions significantly affect nearby residential populations.

The petrochemical and chemical industries of Fergana emit:

- sulfur dioxide,
- nitrogen oxides,
- particulate matter,
- volatile organic compounds.

These pollutants are known respiratory irritants and may produce chronic inflammatory effects.

4.2 Valley Topography and Pollution Accumulation

The Fergana Valley creates unfavorable conditions for atmospheric dispersion.

Temperature inversions trap pollutants near ground level, resulting in prolonged exposure among urban residents.

This phenomenon explains the high prevalence of odor perception and respiratory symptoms.

4.3 Biological Indicators of Environmental Stress

The study supports the concept of residents as “biological sensors” of environmental pollution.

Human sensory and physiological responses often reveal ecological stress earlier than stationary monitoring systems.

Therefore, hygienic assessment should include:

- population surveys,
- symptom mapping,
- and community-based monitoring systems.

4.4 Respiratory and Allergic Risks

The significantly elevated prevalence of respiratory symptoms suggests chronic airway irritation.

Long-term exposure may increase the risk of:

- chronic bronchitis,
- asthma,
- chronic obstructive pulmonary disease (COPD),
- allergic disorders.

4.5 Urban Environmental Hygiene Challenges

The ecological situation in Fergana reflects broader environmental hygiene problems observed in rapidly industrializing cities.

Key contributing factors include:

- outdated industrial technologies,
- insufficient gas filtration systems,
- increasing traffic intensity,
- weak green infrastructure.

4.6 Comparison with International Research

The findings correspond with studies conducted in industrial cities worldwide.

Research from industrial regions demonstrates similar associations between:

- industrial proximity,
- environmental perception,
- and respiratory health deterioration.

5. CONCLUSION

The atmospheric air quality in Fergana city remains a significant environmental and public health concern.

Residents living near industrial areas experience:

- increased respiratory symptoms,
- allergic disorders,
- sensory irritation,
- and chronic environmental discomfort.

The study demonstrates that resident-based hygienic assessment methods provide valuable information complementing traditional environmental monitoring systems.

REFERENCES

1. Uzbekistan Journal of Hygiene. Impact of Chemical Emissions on Health. 2024.
2. Elsevier – Atmospheric Science. Topographical Traps and Air Pollution. 2025.

3. PubMed Central. Respiratory Health Assessment in Industrial Hubs. 2023.
4. Tukhtamatov, R. X., & Ermanov, R. T. (2023). The Role of Proper Diet in a Healthy Lifestyle. *International Journal of Integrative and Modern Medicine*, *1*(3), 25-32.
5. Тохтаматов, Р. Х. (2024, November). ГИСТО-МОРФОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ В ТКАНИ ЛЁГКИХ ПРИ COVID-19. In *Russian-Uzbekistan Conference* (Vol. 1, No. 1).
6. Ulugbek, M. (2025). THE IMPORTANCE OF HYGIENIC ASSESSMENT OF THE IMPACT OF ATMOSPHERIC AIR POLLUTION ON PUBLIC HEALTH (ON THE EXAMPLE OF THE CITY OF FERGANA). *SHOKH LIBRARY*, *1*(12).
7. o‘g‘Li X., Ravshan T. About Weapons Of Mass Destruction //Ethiopian International Journal Of Multidisciplinary Research. – 2024. – T. 11. – C. 436-441.
8. Avazovich, A. A., & Muhammadkadirovich, M. U. (2025, December). HYGIENIC ASSESSMENT OF THE LEVEL OF ATMOSPHERIC AIR POLLUTION. In *London International Monthly Conference on Multidisciplinary Research and Innovation (LIMCMRI)* (Vol. 3, No. 1, pp. 471-473).
9. Мараимов, У. М. (2024, December). ОСНОВЫ ГИГИЕНЫ ЗДОРОВОГО ОБРАЗА ЖИЗНИ. In *Russian-Uzbekistan Conference* (pp. 186-188).
10. Baxtiyor, S., & Raximjon, Z. (2025, December). THE IMPACT OF ATMOSPHERIC AIR POLLUTION ON POPULATION LIFESTYLE: A PUBLIC HEALTH PERSPECTIVE. In *London International Monthly Conference on Multidisciplinary Research and Innovation (LIMCMRI)* (Vol. 3, No. 1, pp. 401-402).
11. Sharobidinovna, A. D., & Baxtiyor, S. (2022). ORGANIZMDAGI SUV BALANSINING SALOMATLIK UCHUN AHAMIYATI. *SO ‘NGI ILMIY TADQIQOTLAR NAZARIYASI*, *5*(1), 69-72.
12. Axmadaliev, R. U., Turdiev, S. M., Abduvalieva, F. T., & Soliyev, B. (2023). Study and evaluation of negative factors affecting employees’ health of glass manufacturing enterprises in Ferghana Region. In *BIO Web of Conferences* (Vol. 65, p. 05023). EDP Sciences.
13. Бокижонов, Ф. А. (2025). ГИГИЕНИЧЕСКАЯ ОЦЕНКА ЗДОРОВЬЯ РАБОТНИКОВ ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА ФЕРГАНСКОЙ ДОЛИНЫ. *Журнал гуманитарных и естественных наук*, (24), 31-34.
14. Mukhammadova, G. Q., Kodirova, M. M., & Boqijonov, F. A. (2024). The effect of industrial enterprises on atmospheric air. *British Journal of Global Ecology and Sustainable Development*, *28*, 5-9.
15. Avazovich, A. A., & Muhammadkadirovich, M. U. (2025, December). HYGIENIC ASSESSMENT OF THE LEVEL OF ATMOSPHERIC AIR POLLUTION. In *London International Monthly Conference on Multidisciplinary Research and Innovation (LIMCMRI)* (Vol. 3, No. 1, pp. 471-473).
16. Boqijonova, N. F. (2025). SURUNKALI YURAK ISHEMIK KASALLIGINI OLDINI OLISH VA UNI REABILITATSIYA QILISH TIZIMINI TAKOMILLASHTIRISH. *Журнал гуманитарных и естественных наук*, (24), 13-16.
17. Boqijonova, N. F. (2025). BIOCHEMICAL DIAGNOSTICS IN THE DIAGNOSIS OF CORONARY ARTERY DISEASE. *Zamonaviy tibbiyot jurnali (Журнал современной медицины)*, *11*(4), 914-916.
18. *Абдусаломов, А. (2025). FAMILIARIZE YOURSELF WITH THE MAIN DOCUMENTS IN THE FIELD OF HYGIENE AND MEDICAL ECOLOGY. Международный мультидисциплинарный журнал исследований и разработок, 1(4), 298-303.*
19. *Baxtiyor, S., & Raximjon, Z. (2025, December). THE IMPACT OF ATMOSPHERIC AIR POLLUTION ON POPULATION LIFESTYLE: A PUBLIC HEALTH PERSPECTIVE. In London International Monthly Conference on Multidisciplinary Research and Innovation (LIMCMRI) (Vol. 3, No. 1, pp. 401- 402*