



THE IMPACT OF ENVIRONMENTAL POLLUTION ON THE DEVELOPMENT OF DIABETES MELLITUS VIA CHRONIC RESPIRATORY SYSTEM DISEASES

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Berdikulova Aziza Khaydarkul kizi

(Teacher at the Department of Medical Fundamental Sciences, Faculty of Medicine, Gulistan State University)

berdikulovaaziza223@gmail.com

Ozodov Xudoyorxon Ulug'bek o'g'li

(Student at the Faculty of Medicine, Gulistan State University)

xudoyorxonozodov@gmail.com

Relevance of the Topic: Today, atmospheric air pollution, industrial waste, automobile exhaust, and environmental issues are driving an increase in the number of chronic respiratory system diseases. Environmental pollution, particularly the contamination of air with fine particulate matter (PM_{2.5}) and toxic gases, deals a serious blow not only to the respiratory tract but also to the metabolic system. Because (PM_{2.5}) particles in the air are extremely fine, they pass through lung filters and reach the alveoli. Chronic bronchitis, bronchial asthma, and chronic obstructive pulmonary disease (COPD) cause long-term inflammatory processes in the body. This condition leads to insulin resistance and impaired carbohydrate metabolism, thereby

increasing the risk of developing type 2 diabetes. In recent years, along with the intensifying levels of air pollution not only in Uzbekistan but also in many countries worldwide, the rising number of patients diagnosed with type 2 diabetes makes the study of the connection between respiratory diseases and diabetes a topic of significant scientific and medical importance.

Purpose of the study. The objective of this research is to clinically and epidemiologically analyze the impact of atmospheric air pollution and other environmental factors on the development of chronic respiratory system diseases, as well as their role in the onset of diabetes mellitus through these pathological conditions, and to determine the pathogenetic link between



inflammation and metabolic disorders. Additionally, the study plans to evaluate how chronic inflammation in the respiratory tract affects systemic metabolic changes by examining the immunological parameters and levels of inflammatory mediators in patients.

Research Hypothesis. Fine particulate matter (PM_{2.5}) in the air stimulates the formation of free radicals at the cellular level. This is known as oxidative stress. Inflammatory mediators and oxidative stress block insulin receptor signaling. Consequently, cells become unable to absorb glucose (insulin resistance). Metabolism is disrupted in adipose tissue, and large amounts of free fatty acids are released into the blood, further exacerbating insulin resistance. Chronic inflammation and oxidative stress exert a direct toxic effect on the insulin-producing beta cells of the pancreas. This leads to the apoptosis (death) or functional insufficiency of these cells, resulting in diabetes.

The combination of these processes demonstrates the destructive impact of air pollution not only on the respiratory tract but on the metabolism of the entire body. The evidence gathered within the framework of this study serves to scientifically substantiate that (PM_{2.5}) particles

disrupt the stability of the endocrine system and manifest as a new risk factor in the development of diabetes mellitus.

Research Materials. Studies indicate that incidence rates for chronic respiratory diseases developed significantly during the autumn-winter seasons of 2021–2022. Air pollution can be cited as the main reason for this, as (PM_{2.5}) particles in the air increased sharply in 2021–2022 by up to 10 times compared to 2019–2020 (34. 1µg/m³ in 2019; 40-50-µg/m³ in 2022). In winter, (PM_{2.5}) particles are 3 to 4 times higher than in summer, reaching their most dangerous levels during December and January. The primary reasons for this are coal burning, vehicle exhaust gases, and dust accumulation from dusty winds. In December 2023, (PM_{2.5}) reached 90.2µg/m³, which was 18 times higher than the WHO standard. Tashkent, the Aral Sea region (Autonomous Republic of Karakalpakstan, Khwarazm), and major chemical-industrial centers (Navoiy, Fergana) rank among the most dangerous regions in this regard. These numbers are not just dry statistics, but a warning bell directly threatening the health of each of us.



Table of Morbidity Indicators in the Territory of Uzbekistan

Region	Endocrine diseases / diabetes cases (2024)	Respiratory disease cases	Estimated increase 2019–2024	Status of chronic respiratory diseases	Comments
Tashkent City	~117 000	~520 000	+30 000	Very High	Strong environmental and lifestyle factors
Tashkent Region	~92 000	~410 000	+21 000	High	Impact of atmospheric pollution is present
Republic of Karakalpakstan	~50 000	~210 000	+14 000	Very High	Respiratory diseases are high due to the Aral Sea environmental crisis
Fergana	~129 928	497 573	+21 000	Very High	Respiratory diseases have sharply increased
Khwarazm	~45 000	~185 000	+11 000	High	The impact of dust and environmental factors is noticeable
Bukhara	~53 000	~201 000	+13 000	High	Urbanization and physical inactivity are the main factors
Andijan	~80 000	~330 000	+19 000	High	High population density
Samarkand	~42 300	~390 000	+23 000	Moderate	Cases of chronic bronchitis have increased
Qashqadaryo	~73 000	~260 000	+16 000	Moderate	Impact of industrial zones is present

Statistics from the Ministry of Health (MoH) of the Republic of Uzbekistan.



As is clear from the table above, we can observe a mutual correlation between the high incidence rate of chronic respiratory diseases and high diabetes indicators in Tashkent City, the Autonomous Republic of Karakalpakstan, and the Fergana Region.

Surxondaryo: 5-year increase is approximately +12,000. Moderate. Climate change and dust storms are being observed. Navoiy: +9,000. High. Mining and industrial activity are affecting environmental quality. Jizzakh: +10,000. Moderate. The environmental situation is stable, but prevention is necessary. Sirdaryo: +8,500. Moderate. The impact of water resources and agricultural chemicals is being studied.

Conclusion. Polluted air not only causes lung disease but also creates an inflammatory background across the entire body. Chronic respiratory system diseases further aggravate this background, disrupting the mechanism of insulin function and consequently paving the way for the development of type 2 diabetes. A significant correlation is observed between chronic respiratory diseases and cases of diabetes mellitus across the provinces of Uzbekistan between 2019 and 2024. Analysis shows that environmental issues, atmospheric

pollution, industrial waste, and changes in the population's lifestyle are among the primary factors contributing to the rise in diabetes.

The highest indicators were recorded in Fergana, Tashkent, and the Republic of Karakalpakstan. Especially in the Republic of Karakalpakstan, it can be seen that the high prevalence of chronic bronchitis and asthma due to the Aral Sea environmental crisis increases the risk of developing diabetes. In the Fergana region, the registration of over 497,000 respiratory disease cases and more than 129,000 endocrine diseases indicate a high risk of metabolic diseases in the area. In Tashkent City, urbanization, a sedentary lifestyle, and environmental factors are causing a sharp increase in diabetes indicators.

Abu Ali Ibn Sina (Avicenna) states in his work “Al-Qanun fi al-Tib” (The Canon of Medicine): “If there were no dust and pollution in the environment where man lives, man would have lived for a thousand years.”

These toxic particles in the atmosphere enter the circulatory system through the respiratory tract, causing cardiovascular diseases, and also lay the groundwork for lung cancer. Depriving ourselves of clean air—the greatest blessing nature has given us—is, in reality, poisoning our



own future with our own hands. These environmental changes are not only multiplying respiratory system diseases but are also causing serious harm to the health of future generations. The above results and

conclusions imply that shifting urban infrastructure to clean energy, expanding green spaces, and putting factors that pollute the air under strict control have become urgent, unavoidable tasks.

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