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THE IMPACT OF URBAN AIR POLLUTION ON HUMAN HEALTH

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Abstract. The impact of urban air pollution on human health. Komilova N., Egamkulov Kh., Hamroyev M., Khalilova Kh., Zaynutdinova D. *Atmospheric air can be polluted as a result of the ingress of various chemicals into it, which have a harmful effect on human health, causing an exacerbation of cardiovascular, airborne diseases, diseases of the gastrointestinal tract and the endocrine system, and exceeding the norms of dust content in the air leads to an increase in incidence of allergies and bronchial asthma. The relevance of the subject under study lies in the investigation of the sources of air pollution, as they lead to an increase in the degree of morbidity and mortality among the population. This, in turn, requires a radical change in the way people live, as well as the adoption of specific measures to ensure the reduction of air pollution. In this regard, the objective of this study was to perform a comprehensive analysis of the ecological and hygienic conditions of atmospheric air and evaluate its impact on human health due to pollution. The study incorporated empirical research methods such as empirical description and comparison to analyze emissions of pollutants, assess population morbidity rates, and conduct correlation and regression analyses. Official data from the State Committee of Uzbekistan on Statistics and scientific papers were utilized, alongside statistical analysis techniques and logical reasoning to investigate atmospheric air pollution and its impact on public health. The study analysed the indicators of emissions of pollutants into the atmosphere in the Republic of Uzbekistan as a whole and by regions. Furthermore, the paper provides a detailed analysis of the general morbidity of the population of the Republic of Uzbekistan and indicators of the incidence of cardiovascular diseases, based on which a correlation and regression analysis was performed. In addition, the morbidity rates of the population with diseases of the respiratory system and eye diseases throughout the Sirdaryo Region were analysed. The study revealed that Uzbekistan experiences high levels of environmental pollution, with a direct correlation found between atmospheric pollutants and the incidence of cardiovascular diseases, respiratory organ issues, and eye conditions. To protect*

the atmosphere, reducing pollutant emissions and implementing sustainable development principles, such as industrial modernization and the use of alternative energy sources, are necessary. The results highlight the importance of identifying pollutant types, their properties, and release conditions for effective pollution assessment. The practical significance of this study is to optimize the data of environmental monitoring of urban air pollution in the Republic of Uzbekistan, where in general there is a high level of pollutants in the atmosphere, which affects the health of the population.

Реферат. Вплив забруднення повітря міст на здоров'я людини. Комілова Н., Егамкулов Х., Хамроєв М., Халілова Х., Зайнутдінова Д. *Атмосферне повітря може забруднюватися в результаті потрапляння в нього різних хімічних речовин, які шкідливо впливають на здоров'я людини, викликаючи загострення серцево-судинних, респіраторних захворювань, хвороб шлунково-кишкового тракту та ендокринної системи, а перевищення норм вмісту пилу в повітрі призводить до зростання захворюваності на алергію та бронхіальну астму. Актуальність цієї теми полягає в дослідженні джерел забруднення атмосферного повітря, оскільки саме вони призводять до підвищення рівня захворюваності та смертності серед населення. Це, у свою чергу, вимагає докорінної зміни способу життя людей, а також вживання конкретних заходів щодо забезпечення зниження рівня забруднення атмосферного повітря. У зв'язку з цим метою дослідження було проведення комплексного аналізу еколого-гігієнічного стану атмосферного повітря та оцінка його впливу на здоров'я людини внаслідок забруднення. Для аналізу викидів речовин-забруднювачів, оцінки рівня захворюваності населення та проведення кореляційно-регресійного аналізу були використані емпіричні методи дослідження, такі як емпіричний опис і порівняння, а також кореляційно-регресійний аналіз. Для дослідження забруднення атмосферного повітря та його впливу на здоров'я населення були використані офіційні дані Державного комітету Узбекистану зі статистики та наукові праці, а також методи статистичного аналізу та логічних міркувань. У дослідженні проаналізовано показники викидів речовин-забруднювачів в атмосферу в цілому по Республіці Узбекистан та окремо по регіонах. Крім того, в роботі представлено детальний аналіз загальної захворюваності населення Республіки Узбекистан та показників захворюваності на серцево-судинні захворювання, на основі якого було проведено кореляційно-регресійний аналіз. Крім того, були проаналізовані показники захворюваності населення на хвороби органів дихання та хвороби очей по всій Сирдар'їнській області. Дослідження показало, що в Узбекистані спостерігається високий рівень забруднення навколишнього середовища, при цьому виявлено прямий зв'язок між забруднювачами атмосфери й захворюваністю на серцево-судинні захворювання, хвороби органів дихання та очей. Для захисту атмосфери необхідно скорочувати викиди речовин-забруднювачів і впроваджувати принципи сталого розвитку, такі як модернізація промисловості та використання альтернативних джерел енергії. Отримані результати під-креслюють важливість визначення типів речовин-забруднювачів, їхніх властивостей та умов викидів для ефективної оцінки забруднення. Практичне значення цього дослідження полягає в оптимізації даних екологічного моніторингу забруднення міського повітря в Республіці Узбекистан, де в цілому спостерігається високий рівень речовин-забруднювачів в атмосфері, що впливає на здоров'я населення.*

The atmosphere is an important shell protecting the Earth for millions of years. At the same time, atmospheric air pollution has an impact on the health of the population, which leads to pathological changes. Research by many scientists such as Liu et al. [1, 2] showed that the increased content of chemicals in the atmospheric air leads to an increase in the incidence of diseases including those of respiratory system, nervous system, blood circulation and haematopoiesis, malignant tumours, and other types.

Li et al. [3] noted that atmospheric air pollution by suspended solid particles alone can lead to an additional death of up to 21 thousand people per year. In areas with a high concentration of pollutants around stationary sources, such as industrial facilities, large transport hubs and highways, the level of diseases is higher due to the available sources. This situation is also relevant for the city of Gulistan, where the study was conducted. According to Barwise and Kumar [4], studies conducted for many years around the world indicate that there is a link between exposure to air pollution and the emergence of various health consequences.

According to Yakhshieva et al. [5], territories, because of their specifics, such as an increased amount of transport, fuel combustion, industry and large crowds of people, are places with a high concentration of pollutants. These problems manifest themselves with varying intensity throughout Uzbekistan. In addition, Adam et al. [6] note that in the conditions of climate change, the number of diseases transmitted by infections, rodents, seasonal distributors of diseases increase, the geographical areas of their distribution expand.

Iravani and Rao [7] noted that the ingress of various pollutants into the atmosphere leads to pathological processes and exacerbations in the human respiratory system, as well as to the development of diseases of the gastrointestinal tract and endocrine system. Studies by Degirmenci et al. [8] have indicated that among the population living near chemical enterprises, the incidence is 2-4 times higher, especially with diseases of the circulatory system, including myocardial infarction. It is noted that the number of hospitalized residents of such areas is several times higher than in other regions, where there are no industrial enterprises.

According to Yakhshieva et al. [5], 64% of emissions into the atmosphere in Uzbekistan account for vehicle emissions. The atmospheric air of the city of Tashkent, Andijan and Tashkent regions is considerably polluted compared to other regions. This is the case when a difficult environmental situation leads to the gradual development of numerous diseases in the population and an increase in mortality. This requires a radical change in the lifestyle of the population, the health system and the adoption of specific measures. A series of experimental studies conducted in Belgium showed that the correlation between lipophilic xenobiotics (foreign chemicals) and coronary heart disease is also the cause of many pathological conditions [9]. According to the American Heart Association, an increase in the number of dust particles smaller than 2.5 μm in the atmosphere for several hours a week can lead to an increase in mortality among the population [10].

Studies conducted in California, the USA, as well as in China have indicated that increased dust content in the atmosphere also leads to an increase in morbidity and mortality from heart failure, coronary heart disease, and stroke [11, 12]. Comparable studies were conducted in the countries of the Central American region for two years. For instance, in São Paulo, Brazil, 48 healthy non-smokers aged 35-55 years took part in the study, in areas with prominent levels of atmospheric pollution, they had considerable changes in heart rate, blood pressure, and stress conditions [13].

The purpose of this study was to conduct a comprehensive analysis of the ecological and hygienic state of atmospheric air to review the effects of its pollution on human health. The main objectives of this study: to investigate the air pollution of the Republic of Uzbekistan and the Sirdaryo Region in particular, its qualitative and quantitative indicators, to estimate the indicators of cardiovascular diseases, respiratory organs, eye diseases for people living in conditions of anthropogenic emissions into the atmosphere, as well as to consider measures to ensure the reduction of air pollution in large industrial cities.

MATERIALS AND METHODS OF RESEARCH

The theoretical framework of this study included the data of scientific papers on the impact of industry on urban air pollution and human health, respectively. To fulfil the purpose of this study, empirical research methods were used, namely empirical description (when recording data on urban air pollution and human health), as well as comparison (when comparing the impact of urban air pollution on human health). This study analyses the indicators of emissions of pollutants into the atmosphere in the Republic of Uzbekistan as a whole and by regions. When writing the article, data from the World Health Organization [14] was used. Furthermore, the study used official data from the State Committee of the Republic of Uzbekistan on Statistics [15] to record and analyse data on air pollution and human health. In addition, during the study, the general morbidity of the population of the Republic of Uzbekistan and indicators of the incidence of cardiovascular diseases of the population for 2000–2020 were analysed in detail, based on which a correlation and regression analysis was performed to determine the magnitude of reliability. In addition, the morbidity rates of the population with diseases of the respiratory system and eye diseases throughout the Sirdaryo Region were analysed, and measures to reduce the atmospheric air pollution level in large industrial cities were considered.

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

The study analysed the theoretical provisions of scientific papers of scientists on the interrelation of anthropogenic emissions with air pollution, as well as a systematic multifactorial analysis of the impact of the current situation on the health of the population, as a result of which the problem, purpose, and methods of the present study were identified, a research plan was drafted, the results obtained during the study were formed and analysed, and the conclusions were systematized. To achieve these goals, the following methods were used: dialectical method of scientific cognition, general scientific and special methods. Statistical analysis was used to analyse the air condition: the method of average and relative values, the method of generalization, comparative analysis to compare the data obtained for different years in the specified period. The study employed various methods of statistical analysis, including the calculation of average and relative values, comparative analysis, correlation and regression analysis, as well as observation and analysis methods based on input data and ratios. Pearson's r was computed to evaluate the linear correlation between the time series datasets of total pollutant emissions and morbidity rates for each disease category in SPSS software. The correlation coefficient scale ranges from -1 to 1, with 0 indicating no relationship, and strong positive or negative correlation closer to 1 or -1 respectively. The significance level was defined as $p < 0.05$. All data was checked for normality and homoscedasticity prior to analysis.

This approach allowed quantitative evaluation of the linkage between increasing industrial/transport emissions over time and changing patterns of population morbidity rates. The correlation and regression techniques demonstrated the significant predictive

relationship between air pollution and public health impacts. To generalize the study results, a logical method was used to investigate the state of atmospheric air pollution of the Republic of Uzbekistan. In addition, during the study, observation and analysis methods were used based on input data and ratios.

RESULTS AND DISCUSSION

Atmospheric air is polluted as a result of the ingress of solid, liquid or gaseous substances into it, which can have a harmful effect on human health, climate, wildlife, water, soil, or otherwise damage to the environment. The level of air pollution concentration is a direct consequence of the amount of pollutants released into the atmosphere and meteorological conditions. The transboundary influx of pollution from neighbouring countries and atmospheric physical and chemical changes are also important. These processes affect the development of the so-called pollution background, which is the result of establishing a state of dynamic equilibrium at a great distance from the source of emission and the range of occurrence of elevated concentrations in the zone of direct exposure to sources. According to experts of the World Health Organization [14], 23% of all diseases and 25% of all malignant tumours of all types are associated with environmental factors. In the Republic of Uzbekistan, there are about two thousand large and medium-sized industrial enterprises, which employ over 70 thousand people, these

are numerous factories, power plants, and industrial facilities. They pollute the air with fine dust and other fine solid particles that enter the atmosphere, as well as many dangerous by-products. Sources of pollution are caused by emissions into the atmosphere, which concentrate over 150 harmful substances, of which 50 are considered the most dangerous [16].

Nitrogen oxides, especially nitrogen dioxide, are among the main pollutants in the atmospheric air of large cities. A considerable amount of nitrogen oxide is produced by thermal power plants, metallurgical enterprises, large and small boiler houses, and motor vehicles. The adverse consequences of air pollution include, first of all, the occurrence of acid rain, unpleasant odours, smog, as well as the formation of an ozone hole or greenhouse effect. Acid rains contain sulphuric acid and contribute to an increase mortality and lung damage in infants, they also damage forests, which contribute to the natural purification of atmospheric air. Furthermore, acid rain causes the death of flora and fauna, soil degradation and even the destruction of buildings [4].

Based on the guidelines set by the World Health Organization, Uzbekistan's air quality is deemed to be moderately hazardous. The latest figures show that the country's yearly average PM2.5 concentration stands at 28 $\mu g/m^3$, surpassing the suggested limit of 10 $\mu g/m^3$ [14]. Table 1 presents the information on the emission of pollutants into the air for both the entire Republic of Uzbekistan and its individual regions.

Table 1

Emission of pollutants into the atmosphere in the Republic of Uzbekistan and by regions as a whole, thousand tonnes

Regions	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Republic of Uzbekistan	788.2	817.6	855.2	1162.1	975.1	1008.2	853.5	883.7	952.8	924.4	909
Republic of Karakalpakstan	23.5	19.5	25.8	26.7	32.8	30.6	37.7	34	37.2	28.9	31
Andijan Region	13.6	12.2	14.4	6.6	18.5	36.7	15.8	15.9	14.3	11.5	5
Sirdaryo Region	58.7	46.9	35.4	69.3	66.1	68.9	74.9	73.4	78.6	86.2	80.7
Jizzakh Region	17.3	14.1	17.2	37.2	70.2	63.4	5.2	11.8	4.3	3.4	3
Bukhara Region	71.7	61.7	50.7	51.9	55.6	58.5	63.8	74.8	69.1	37.1	45
Qashqadaryo Region	142.5	163	167	171.8	176.3	167.9	165.7	152.2	140.4	128.1	132
Navoiy Region	45.2	42.4	43.9	42.6	47	57.4	44.1	49.9	43.6	48.4	69
Surxondaryo Region	3.3	4.4	3.7	5.8	3.1	3.2	3.2	5.1	6.9	6.5	7
Samarkand Region	51.8	52.8	49.1	51.3	54.7	51.6	37.2	52.1	44.2	52.7	39
Fergana Region	42.8	73.5	40.2	38.4	38.9	103.2	60.1	53.2	49.6	50.5	47
Khorazm Region	4.9	4.9	6.2	6.3	5	5.2	9.2	7.1	7.2	6.8	7
Tashkent Region	280.3	290.4	372.3	619.2	370.6	318.7	302.9	336.6	397.9	430	425
Namangan Region	5.6	7	3.7	3.9	7.8	15.8	15.9	15.2	15.8	15	24
Tashkent city	27	24.8	25.6	31.1	28.5	27.1	33.1	15.3	74.5	33.7	29

Note. Source – State Committee of the Republic of Uzbekistan on Statistics [16].

As a result of the analysis of these indicators of the general morbidity of the population of Uzbekistan, a correlation and regression analyses were performed, according to which there is a tendency to increase in morbidity, the confidence value R=0.9518, which means that the model accurately describes the available data (Fig. 1).
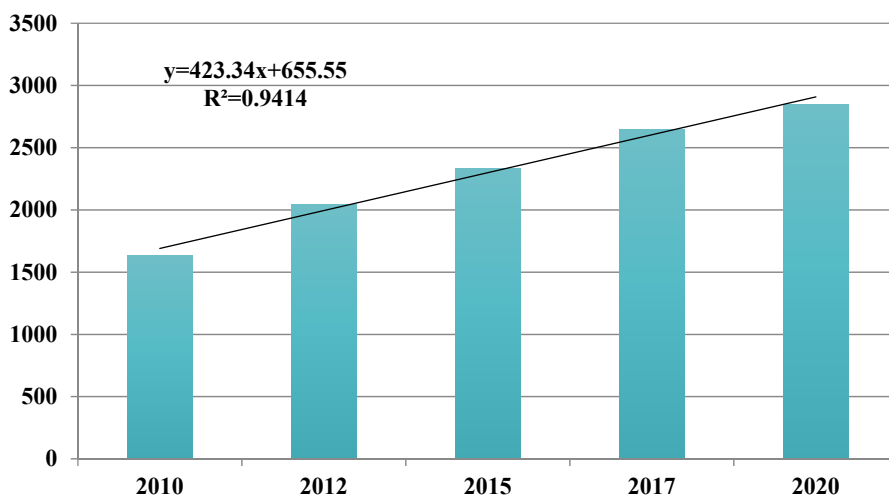
$$y=3711.4x+37583$$
$$R^2=0.9518$$
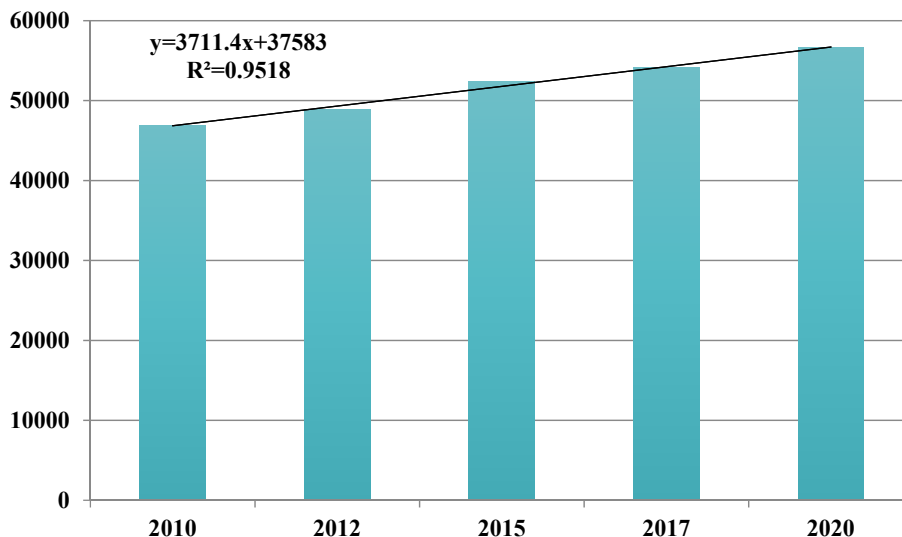
Source: State Committee of the Republic of Uzbekistan on Statistics [16].

Fig. 1. Indicators of the general morbidity of the population of Uzbekistan (for every 10 thousand inhabitants)

In addition, considering atmospheric pollution, the incidence of cardiovascular diseases (for every 10 thousand inhabitants) was analysed, and corresponding results were obtained, where, unfortunately, the incidence indicates a stable increase, and the confidence value R=0.9414 (Fig. 2).

$$y=423.34x+655.55$$
$$R^2=0.9414$$

Source: State Committee of the Republic of Uzbekistan on Statistics [16].

Fig. 2. Indicators of the incidence of cardiovascular diseases of the population of Uzbekistan (for every 10 thousand inhabitants)

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Thus, when analysing the incidence of cardio-vascular diseases during the study, it becomes evident that these indicators have increased in recent years. Specifically, in Uzbekistan in 2000, the incidence of cardiovascular diseases by 2020 increased from 1209 to 2851 per 10 thousand inhabitants, which is an excess of 135.8%. Industrial enterprises operating in the city of Bekabad and thermal power plants in the city of Shirin supply toxic compounds to the Boyovut, Yangiyer, and Xovos regions, and the Bekabad wind, due to its high speed, lifts into the environment and contributes to the transfer of various dust particles, which leads to an increase in the incidence of bronchial asthma, allergic conjunctivitis and rhinitis, sore throat.

Air pollution primarily damages children, the elderly and chronically ill people, disrupts the work of all systems and organs, but it affects the respiratory system faster and the hardest. Exposure to elevated concentrations of pollutants (particulate matter, nitrogen dioxide) is associated with an exacerbation of asthma symptoms and chronic obstructive pulmonary disease. The human respiratory system, even though

it is prepared to capture and release harmful air particles, has this mechanism weakened due to the prolonged influence of irritants. Furthermore, the smallest dust can pass through the lungs into the bloodstream, and any such contamination damages tissues from the respiratory mucosa to the alveoli and weakens the human immune system. Prolonged exposure to irritants causes chronic inflammation, leading to irreversible changes in the respiratory system. Analysing the incidence rates of the population of the Sirdaryo region and the city of Gulistan with respiratory diseases, unfortunately, it is worth noting their considerable increase over the years: in 2021 alone, there was a slight decrease in the incidence in all regions (Fig. 3). Correlational analysis suggests a strong positive correlation (Pearson correlation coefficient value r=0.8981) between the emission of pollutants and the morbidity rate due to respiratory diseases in the Sirdaryo Region from 2015 to 2020. This means that as the emissions increased, the morbidity rates also tended to increase.
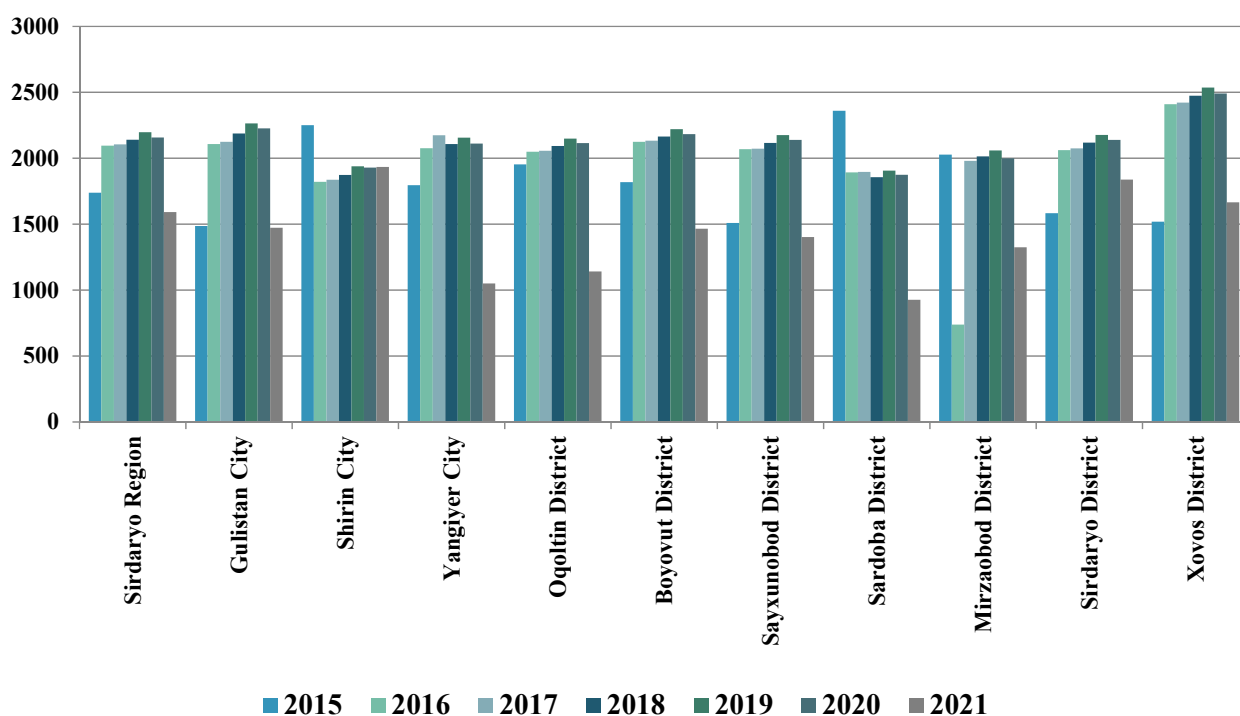

Fig. 3. Indicators of morbidity of the population of the Sirdaryo Region with respiratory diseases (for every 10 thousand inhabitants)

Special attention is paid to the indicators of morbidity of the population of the region with eye diseases to control the wind regime. The Sirdaryo Region is considered an oasis of desert development, which is based on groundwater lying close to the surface of the earth, which leads to salinization of the surface. The

salts carried out by dust from the soil by local winds adversely affect the retina of the human eye, causing eye diseases such as conjunctivitis, cataracts, glaucoma, etc. The cornea of the eye is the most sensitive structure to environmental factors, and the eyes themselves are protected from potentially harmful

external substances only by a thin layer of precorneal tear film, and therefore the human eye is very susceptible to the adverse effects of air pollution. In this regard, this study also paid special attention to the indicators of morbidity of the population of the Sirdaryo Region with eye diseases (Table 2). The Pearson correlation coefficient for the relationship between eye disease indicators and pollutant emissions is 0.9477.

T a b l e 2

Indicators of morbidity of the population of the Sirdaryo Region with diseases of the eye and its appendages (per 10 thousand inhabitants)

	2015	2016	2017	2018	2019	2020	2021
Sirdaryo Region	121.8	160.6	161.3	234.9	272.7	267.4	337
Gulistan city	104.3	161.5	162.8	240	448.2	440.7	190.3
Shirin city	158.3	140.1	141.3	205.4	653.2	649.7	2,339.6
Yangiyer	126	159.3	159.4	231	236.7	231.8	861.9
Districts							
Oqoltin	137.3	157.3	157.8	230	236.5	231.5	477.8
Boyovut	127.7	162.6	163.4	236.9	243.6	239.4	249.8
Sayxunobod	106	158.6	158.9	232.4	239.5	235.4	242.2
Gulistan	108.8	162.6	163.5	237.3	241.6	235.3	337.6
Sardoba	165.7	145	145.3	204	209.5	206	235.2
Mirzaobod	142.2	63	151.6	221.6	227.5	221	176.8
Sirdaryo	111.1	158	159	232.8	239	234.3	243.3
Xovos	106.7	184.6	185.6	271.9	279.1	274.2	283.6

The data obtained indicate a large increase in eye diseases and its appendages in the region: from 121.8 cases per 10 thousand inhabitants in 2015 to 337 in 2021. The same trend is observed in Gulistan: 108.8 cases per 10 thousand inhabitants in 2015 and 337.6 – in 2021. Thus, analysing the air quality and morbidity indicators of the population in the Republic of Uzbekistan, it can be concluded that at the regional and state levels it is necessary to develop environmental measures to improve air quality, which will contribute to reducing the development of morbidity of the population. To this end, it is necessary to carry out targeted measures to reduce emissions that cause considerable air pollution, especially in large industrial cities. In addition, to solve the problem of reducing the level of atmospheric air pollution, it is necessary to do the following:

✓ strengthen control over emissions polluting the atmosphere produced by large and medium-sized industrial facilities operating in cities; modernize machines, machine tools, and other equipment at industrial enterprises, establish strict compliance with expiration dates;

✓ improve the infrastructure of the inner-city transport system, increase the requirements for compliance with the standards of toxicity of vehicle emissions;

✓ implement measures in cities related to the transition to less harmful, environmentally friendly modes of transport;

✓ establish strict control of the regulatory authorities over the activities of equipment for cleaning from impurities and gases, compliance with the requirements for permissible emissions pursuant to recommended standards, introduce comprehensive measures for the protection of atmospheric air;

✓ implement priority measures exercised by industrial production to regulate emissions in conditions when meteorological indicators do not meet hygienic requirements.

When placing industrial enterprises, it is necessary to focus on natural and environmental (terrain climate, weather, wind direction), economic and demographic (population density, demographic capacity, reef structure of the settlement) factors. It is also important to systematically carry out work to strengthen the "green nature" in cities and other settlements, create

a "green wall" around the city and develop a system of environmental education for people.

The impact of air pollution on human health has been noticed for a long time, the vast majority of studies in this area were created in the last quarter of a century, and a significant part of them – in the last decade. Furthermore, the subject of environmental pollution, including atmospheric air pollution, is very interdisciplinary in nature and requires the assimilation of certain knowledge from areas that are sometimes very distant from medicine. Statistics indicate that the amount of pollutants emitted and captured from stationary sources in the republic has increased slightly in recent years. The results of many studies have shown that among workers employed in the mining industry, as well as in the construction sector, there is an increase in indicators of various diseases. This is evidenced by the results of a sociological survey of workers working in unfavourable working conditions [1, 2, 12].

According to many scientists, such as Dong et al. [17] and Ulpiani [18], air pollution has two sources: a smaller part is associated with natural phenomena, such as sandy winds or volcanic eruptions, and most of it is associated with human activities, such as transport, heating, agriculture, or industry. Inhaling one or more of these pollutants has short-term health effects, such as symptoms of irritation of the eyes, nose and throat, as well as long-term – cardiovascular, airborne diseases, diseases of the gastrointestinal tract and endocrine system, or even cancer. However, there is increasing evidence that exposure to air pollution is associated not only with these severe diseases, but also with other health consequences. These include type 2 diabetes, systemic inflammation, or mental disorders such as Alzheimer's disease and dementia.

The strong correlation found in this study between air pollutant emissions and increased morbidity aligns with findings from other studies conducted in Uzbekistan and other countries. For example, a study in Poland found a Pearson correlation coefficient of 0.91 between NO_2 levels and cardiovascular hospitalizations, very close to the 0.94 coefficient for pollutant emissions and cardiovascular disease incidence in this paper [19].

Research in Taiwan showed similarly high correlation between PM2.5 and respiratory illness. The coefficient of 0.8981 for respiratory disease and emissions in Sirdaryo Region is comparable. However, Wang et al. [20] founds a weaker correlation of 0.71 for respiratory disease, suggesting there may be additional factors at play in that Taiwan study.

The study correlates with the opinion of Adam et al. [6], who claim that the following substances can be detected in urban air due to emissions from various sources: oxides of sulphur and nitrogen, hydrocarbons (mainly from oil refineries and automobile exhausts), as well as carbon monoxide, heavy metals (from automobile exhausts, industry, metallurgical plants) and organic compounds (mainly chemical industry), as well as dust and soot. However, the contribution of individual substances to the overall air pollution is not the same everywhere. In developed countries, sulphur is no longer as important a pollutant as it used to be. The concentration of pollutants in the air (which occurs as a result of the intake of pollutants) determines the air quality.

Yujing et al. [21] also note in their studies that cities suffer from air pollution due to poor road planning and heavy car traffic, and reducing their use leads to a decrease in air pollution and an improvement in human health. Therefore, an essential role is played by measures for planning urban areas and greening infrastructure to encourage physical activity and reduce air pollution associated with vehicle emissions.

The global adverse consequences of air pollution are, for instance, an increase in the greenhouse effect or an ozone hole. Smog and acid rain are the most well-known local effects, and they mainly affect people living in cities. Air pollution poses a threat to human health and can also lead to economic losses. In addition, according to Rapa et al. [22], air pollution affects the environment, e.g., it reduces biodiversity in some ecosystems and affects the growth of vegetation and crops. It also affects buildings, causing damage to cultural heritage.

It is important to note that air pollutants include not only greenhouse gases – mainly carbon dioxide, but also methane, nitrous oxide, etc., but they overlap in many ways, often interacting with each other. According to studies by Iravani and Rao [7], air pollution, dust, and noise, especially in cities, are the biggest and most direct threat to public health, examples of which were also reflected in the study.

According to many scientists, such as Lipsett et al. [11] and Brook et al. [10], today there is no doubt that too high concentrations, especially of fine dust, contribute to disease and premature death. Dust is substances that, due to their small size, can penetrate deep into the respiratory organs, transporting dangerous chemical compounds. Substances carried by solid particles, such as polycyclic aromatic hydrocarbons and heavy metals, tend to accumulate in the body. The longer a person is exposed to breathing polluted air, the more harmful substances have entered their body and the greater their risk of developing diseases caused by these substances, which is also reflected in the study.

In addition, U. Gehring et al. [23] give examples of evidence of the existence of a link between the level of air pollution in cities and adverse consequences for human health. One of the most toxic air pollutants is benzopyrene, which has a high carcinogenicity, and it is also mutagenic, i.e., it can cause changes in the structure of genes. It accumulates in the body, penetrating it mainly through the lungs along with dust, damaging the adrenal glands, liver, immune, and circulatory systems. Another confirmation of the study, which investigated the effect of polluted air on the development of asthma and respiratory diseases, is given in the papers of G.J. Holst et al. [24]. Scientists prove that adults are more prone to experience serious breathing problems on days when the level of air pollution is high, and prolonged exposure to smog and harmful substances can worsen asthma symptoms and cause its acute attacks [25, 26, 27].

Considering the mentioned studies of the authors, as well as the conducted research, human health and ecosystem health are inextricably linked. A human needs clean air, water, and food every day to function. At the same time, when people live and work in a polluted environment, health issues gradually arise. It is important to note that the most vulnerable members of society suffer the most from environmental stressors. Socially disadvantaged communities are at greater risk of pollution. Poor people, children, the elderly and sick people suffer more than others from environmental health risks. Therefore, the purpose of nature conservation is not only to protect the planet, it is primarily a concern for the health and well-being of humanity itself and future generations, and the prevention of air pollution is a public health measure.

As it was found, the release of pollutants into the atmosphere in the Republic of Uzbekistan and by regions, unfortunately, is characterized by high rates of environmental pollution, and this is predicted to tend to increase, which is confirmed by the correlation and regression analysis. Therefore, it is important to make decisions to ensure the reduction of anthropogenic and transport emissions, to implement the principles of sustainable development. Air pollution can be reduced in various ways, including by modernizing industrial enterprises and thermal modernization of buildings, abandoning small coal-fired boilers, improving transport infrastructure by building bypass roads to reduce heavy transport in cities, using alternative energy sources such as wind, water, or solar energy on a large scale. Therefore, an effective fight against air pollution requires decisive action from all sectors contributing to the emissions of pollutants: agriculture, transport, energy, industry.

CONCLUSIONS

1. This study found high correlation coefficients between air pollutant emissions and morbidity rates for several diseases in Uzbekistan. The analysis showed a 0.9414 correlation between emissions and cardiovascular disease, 0.8981 for respiratory disease, and 0.9477 for eye disease morbidity in Sirdaryo Region from 2015-2020. These strong correlations demonstrate that increased air pollution could be linked directly to rising incidence of multiple health conditions affecting the population of Uzbekistan.

2. Over the 2000-2020 period examined, concerning upward trends were identified in population morbidity rates. Cardiovascular disease incidence increased 135.8%, while respiratory illness rose markedly in Sirdaryo Region between 2015-2021. These rises in morbidity align with the increasing pollution levels, indicating a need for interventions to combat air quality issues to improve public health.

3. Based on these data demonstrating tangible links between air pollutants and health impacts, reducing emissions should be a priority. Implementation of sustainable development policies, including industrial modernization, increased use of clean energy sources, and enhancing air quality monitoring, is critical to mitigate the rise in morbidity attributable to air pollution. Decisive action must be taken by regulatory agencies and major pollution sources like industry and transportation to curb emissions and protect human health in Uzbekistan.

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