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«Central Asian Academic Research Center» LLP is pleased to announce that "News of NAS RK. Series of Geology and Technical sciences" scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of Geology and Technical Sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

«Орталық Азия академиялық ғылыми орталығы» ЖШС «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

ТОО «Центрально-азиатский академический научный центр» сообщает, что научный журнал "Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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IMPACT OF OIL AND GAS FIELDS ON ATMOSPHERIC AIR AND PUBLIC HEALTH IN ATYRAU REGION (A CASE STUDY OF ZHYLYOI DISTRICT)

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Abstract. The oil industry has a greater and more diverse negative impact on the environment than any other sector of the fuel and energy complex. These effects are most evident during the extraction, processing, and transportation of hydrocarbons. This study is relevant due to the need to assess the impact of oil and gas activities on air quality and public health in Zhylyoi District, Atyrau Region, where large volumes of hydrocarbons are produced. The research aims to analyze the influence of oil and gas fields on atmospheric air quality and the health of the local population. To assess air pollution, data from field studies using specialized equipment and monitoring methods were used. The focus was on harmful substances such as carbon dioxide, sulfur dioxide, nitrogen oxides, and other toxic compounds released by oil extraction and processing enterprises. Results from laboratory and

field studies were analyzed to identify links between air pollution and the health of Zhylyoi residents. Data on harmful substance concentrations formed the basis for further study of environmental impacts on morbidity and mortality in the region. The practical value of this research lies in its use for developing measures to reduce environmental and health risks from oil and gas activities, as well as improving environmental monitoring and public health systems in Zhylyoi District.

Key words: health, fields, primary morbidity, environmental factors, atmospheric air pollution

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АТЫРАУ ОБЛЫСЫНДАҒЫ МҰНАЙ-ГАЗ КЕН ОРЫНДАРЫНЫҢ АТМОСФЕРАЛЫҚ АУАҒА ЖӘНЕ ХАЛЫҚ ДЕНСАУЛЫҒЫНА ӘСЕРІ (ЖЫЛЫОЙ АУДАНЫНЫҢ МЫСАЛЫНДА)

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Аннотация. Мұнай өнеркәсібі қоршаған ортаға тигізетін кері әсерлердің тереңдігі мен әртүрлілігі жағынан отын-энергетика кешенінің басқа барлық салаларынан асып түседі. Бұл әсерлер, әсіресе, мұнай өнімдері мен көмірсутек шикізатын өндіру, өңдеу, дайындау және тасымалдау барысында ерекше байқалады. Атмосфералық ауаға таралатын зиянды заттардың шоғырлануы халықтың денсаулығына тікелей әсер етеді. Осыған байланысты, Атырау облысының Жылыой ауданында орналасқан мұнай-газ кен орындарының атмосфералық ауа сапасына және тұрғындар денсаулығына әсерін бағалау – өзекті мәселе болып табылады. Аталған аймақта көмірсутек шикізатының ірі қорлары шоғырланған, және мұнда көптеген мұнай өндіруші және

өңдеуші кәсіпорындар жұмыс істейді. Зерттеудің негізгі мақсаты – Жылыой ауданындағы мұнай-газ өндіру нысандарының атмосфералық ауаның ластануына және жергілікті халықтың денсаулығына ықпалын зерттеу. Бұл мақсатқа қол жеткізу үшін далалық зерттеулердің нәтижелері пайдаланылды, олар арнайы экологиялық мониторинг құралдары мен әдістері арқылы жүргізілді. Атмосфералық ауаның ластану деңгейі көмірқышқыл газы, күкірт диоксиді, азот оксидтері және басқа да мұнай өнеркәсібі қызметі нәтижесінде ауаға таралатын улы заттардың концентрациясы бойынша анықталды. Зертханалық және далалық зерттеулер нәтижелері жүйеленіп, Жылыой ауданы халқының денсаулығы мен ауаның ластану деңгейі арасындағы байланысты анықтау үшін кешенді талдау жүргізілді. Бұл деректер аймақ тұрғындарының аурушаңдығы мен өлім-жітім көрсеткіштеріне қоршаған ортаның жағымсыз әсерін бағалауға мүмкіндік берді. Зерттеудің практикалық маңыздылығы – алынған нәтижелерді мұнай-газ кәсіпорындарының экологиялық салдарын азайтуға бағытталған шаралар әзірлеуде, халықтың денсаулығын қорғауға арналған бағдарламалар дайындауда және Жылыой ауданында қоршаған ортаны бақылау жүйесін жетілдіруде қолдану мүмкіндігімен айқындалады.

Түйін сөздер: денсаулық, кен орындары, алғашқы аурушаңдық, экологиялық факторлар, атмосфералық ауаның ластануы

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ВОЗДЕЙСТВИЕ НЕФТЕГАЗОВЫХ МЕСТОРОЖДЕНИЙ НА АТМОСФЕРНЫЙ ВОЗДУХ И ЗДОРОВЬЕ НАСЕЛЕНИЯ АТЫРАУСКОЙ ОБЛАСТИ (НА ПРИМЕРЕ ЖЫЛЫОЙСКОГО РАЙОНА)

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Аннотация. Нефтяная отрасль по глубине и многообразию негативных воздействий на окружающую среду превосходит все другие отрасли топливно-энергетического комплекса. Наиболее ощутимо эти воздействия проявляются в условиях добычи, подготовки, переработки и транспорта углеводородного сырья и нефтепродуктов. Актуальность темы обусловлена необходимостью оценки воздействия деятельности нефтегазовых месторождений на качество атмосферного воздуха и здоровье населения Жылыойского района Атырауской области, где сосредоточены крупные объёмы добычи углеводородов. Цель исследования — анализ влияния нефтегазовых месторождений на состояние атмосферного воздуха и здоровье населения Жылыойского района. Для оценки степени загрязнения атмосферного воздуха использовались данные полевых исследований, проведённых с применением специализированных приборов и методов экологического мониторинга. Анализ загрязнённости воздуха осуществлялся по содержанию вредных веществ, таких как углекислый газ, диоксид серы, оксиды азота и другие токсичные соединения, выбрасываемые в атмосферу в результате работы нефтедобывающих и перерабатывающих предприятий. Результаты лабораторных и полевых исследований были собраны и проанализированы для выявления взаимосвязи между уровнем загрязнения воздуха и здоровьем населения Жылыойского района. Полученные данные о концентрации вредных веществ в атмосфере стали основой для дальнейшего анализа влияния экологических факторов на заболеваемость и смертность населения региона. Практическая ценность исследования заключается в возможности использования его результатов для разработки мер по снижению негативного воздействия нефтегазовых предприятий на окружающую среду и здоровье населения, а также для совершенствования системы экологического мониторинга и охраны общественного здоровья в Жылыойском районе.

Ключевые слова: здоровье, месторождения, первичная заболеваемость, экологические факторы, загрязнение атмосферного воздуха

Introduction. The current state of public health is influenced not only by socio-economic conditions but also by environmental factors, particularly in industrialized regions. Atyrau Region, and specifically the Zhylyoi District, represents one of Kazakhstan's major oil-producing areas (Yessenamanova et al., 2021). The rapid development of the oil and gas industry is accompanied by a substantial anthropogenic impact on the environment, which directly affects morbidity rates and key demographic indicators (Khatatbeh et al., 2020). Over the past years, negative trends have been recorded in the medical and demographic situation of the Zhylyoi District. Despite the ongoing increase in the birth rate, there is a rise in both infant mortality and overall mortality rates, which indicates a deterioration in

the health status of the population. Simultaneously, there is a documented increase in primary morbidity, particularly diseases of the respiratory system and malignant neoplasms, the development of which is associated with atmospheric air pollution (Baiduvaliev et al., 2022).

The present study is aimed at a comprehensive assessment of medical and demographic indicators, as well as the structure of primary morbidity among the population of the Zhylyoi District for the period from 2020 to 2023, taking into account the influence of environmental factors. The analysis of the obtained data will make it possible to identify key issues requiring priority attention and to justify the need for effective measures in the field of public health protection and environmental safety (Koshim et al., 2022).

One of the key indicators of the impact on the natural environment is the health status of the population. According to assessments by experts from the World Health Organization (WHO), there are five categories of population health responses to environmental pollution: increased mortality, increased morbidity, the presence of functional changes exceeding normal levels, functional changes within normal limits, and a relatively safe health status (Gulis et al., 2021).

In connection with the intensive development of the Caspian oil and gas fields, the health issues of the population in environmentally disadvantaged regions attract particular attention from both scientists and practitioners in the field of public health (Ryskalieva et al., 2023).

The northeastern part of the Caspian region includes the Zhylyoi District of Atyrau Region. However, to date, the damage to public health in this area has not been determined, and the patterns of formation of key health indicators for the population of the region, such as demographic indicators and primary morbidity rates, have not been identified (Nursaule et al., 2022).

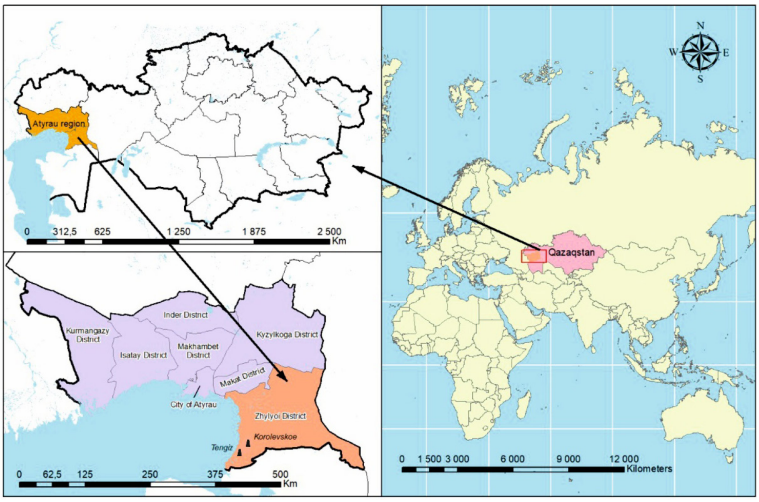

Figure 1. Map of the research area of Zhylyoi district, Atyrau region (Source: Author, developed in the ArcGIS program.10.8).

Atyrau Region, as is well known, is located in the western part of Kazakhstan on the Caspian Depression and borders the West Kazakhstan, Mangystau, and Aktobe regions, as well as the Astrakhan Region of the Russian Federation. The administrative center of Atyrau Region is the city of Atyrau (Tokbergenova et al., 2025). The Zhylyoi District is located in the southeastern part of Atyrau Region, was established on January 17, 1928, and is situated on the northeastern coast of the Caspian Sea. The average population density is 2.9 people per square kilometer. As of January 1, 2023, the population was 86,370. The majority of the district lies within the Caspian Depression and covers an area of 29,400 square kilometers. The landscape of the territory is flat. The Emba River flows through the territory of the Zhylyoi District. The largest oil fields of the region, Tengiz and Korolevskoye, are localized within the Zhylyoi District, in the northeastern Caspian zone of Western Kazakhstan. The district borders the Mangystau Region to the south and the Aktobe Region to the east. The administrative center of the district is the city of Kulsary, which was founded in 1939. The distance to the regional center is 230 km. The boundary of the regional center, the city administration of Atyrau, is located more than 350 km northwest of the industrial site. The nearest settlements include the village of Kosshagyl, located 85 km to the northeast of the Tengizchevroil (TCO) facilities, and further east, the village of Maykomgen. The village of Borankul is located 82 km to the southeast of the industrial site. The nearest distance to the Caspian Sea is 20-25 km (Aliye et al., 2024; Nursaule et al., 2022).

The climate is temperate, sharply continental, with significant annual and diurnal temperature variations. There is a small amount of precipitation and high evaporation rates. January is the coldest month, with average temperatures ranging from - 9 to -12 degrees Celsius (Tokbergenova et al., 2025). The winter period is characterized by unstable weather patterns. Clear, cold days can suddenly change to thaws, accompanied by overcast and windy weather. The snow cover is unstable and shallow. In January and February, strong winds may cause snowstorms. Spring is the shortest period of the year. Temperature increases occur rapidly, with the soil drying quickly. The warm and dry period may be accompanied by dust storms (Vorobyov, et al., 2021). The summer is long and hot. The average air temperature in July is +23 to +25 degrees Celsius. This period is characterized by mostly clear and sunny weather. Weather forecasts indicate rare, short rain showers, which are typically of a torrential nature. Hail is possible on certain days. The highest recorded temperature has reached +45.7 degrees Celsius. Autumn begins in mid-September, with cool and sunny weather establishing. The first frosts are observed from mid-October (Bolatova, et al., 2025). Annually, precipitation ranges from 180 to 200 mm, with the majority occurring during the warmer period. Wind patterns and the condition of the underlying surface determine the number of days with dust storms. In the studied area, the number of days with dust storms is relatively low—13 days per year. Dust storms are most frequent in the spring, with a recurrence of 2-3 days per month in March and April (Information bulletin, 2024).

The territory of the Zhylyoi District, with its heightened potential for atmospheric air pollution, is characterized by high natural dustiness and low precipitation washout capacity. At the same time, a distinctive feature of the local climate is the active wind activity both at the surface level and at higher altitudes, which prevents the development of unfavorable meteorological conditions such as calms and temperature inversions, thus contributing to the dispersion of pollutants within the region's air basin.

Tengizchevroil LLP is located on the territory of 2 oil fields - Tengiz field and Korolevskoye field. Tengiz and Korolevskoye oil fields are located on the north-eastern coast of the Caspian Sea in Western Kazakhstan, within Zhylyoi district of Atyrau region. Currently, 286 wells have been drilled in the Tengiz field and 1 well is under drilling, of which: 230 producing wells, 25 gas injection wells, 2 observation wells and 30 abandoned wells (Ryskalieva et al., 2023).

At Tengiz and Korolevskoye, the configuration of oil wellhead equipment is identical. TCO produces several types of end products from its raw materials. Most of them are stabilized oil. Associated gases include dry gas (fuel gas) and liquefied hydrocarbon gases (propane and butane).

At TCO facilities, air emissions come primarily from the combustion of:

- raw gas flaring;
- fuel gas in turbines, furnaces and boilers, thermal oxidizers;
- from combustion of diesel fuel in diesel generators.

The main products of gas combustion are: sulfur dioxide, carbon oxide, nitrogen oxides. The leading sources of emissions of specific substances - hydrogen sulfide and mercaptans - are flares. The primary volume of emissions of these substances is formed as a result of incomplete combustion of hydrocarbon gases (HCGs). In addition to the aforementioned sources, hydrogen sulfide and mercaptans are released into the atmosphere due to leaks in the technological equipment and the oil collection system (Kanbetov et al., 2023).

The subject of this study is the population of the Zhylyoi District of Atyrau Region, Republic of Kazakhstan. The work focuses on medical and demographic indicators (birth rate, mortality rate, natural population growth, infant mortality), as well as primary morbidity indicators, with a particular emphasis on respiratory diseases and malignant neoplasms. Special attention is given to the impact of environmental factors associated with industrial activities, particularly atmospheric air pollution, on the health of the population in the region from 2020 to 2023 (Shaimbetov et al., 2020).

The purpose of this study is a geographical analysis of the medical and demographic situation and primary morbidity of the population of the Zhylyoy district of Atyrau region in the period from 2020 to 2023. The study examines geographical and environmental factors affecting public health, with particular attention to the effects of atmospheric air pollution caused by the region's oil production activities. The study is aimed at identifying the territorial characteristics

of the health of the population of the Zhylyoi district and determining the impact of geographical factors on the state of health in industrially stressed regions.

The theoretical and methodological basis of the study is grounded in the approaches and research methods of domestic scholars in the field of medical geography: A.A. Shoshin (1962), V.I. Rusanov (1973, 2004), S.V. Ryashchenko (1977, 2000, 2012), S.A. Kurolap (1997, 2000), A.A. Keller, V.I. Kuvakin (1998), I.A. Khlebovich (1999, 2000, 2001), S.M. Malkhazova (2001, 2005), B.B. Prokhorov (2001, 2005, 2012), I.V. Arkhipova (2006), K.R. Amrin (2006, 2013), U.I. Kenesaryev (1992), N.Zh. Zhakashev (1994), Tynybaev B.G. (2005), M.D. Diarov (2015), and others.

Materials and methods. The study used data on the medical and demographic situation and primary morbidity of the population of Zhylyoi district of Atyrau region for the period from 2020 to 2023. The main source of information was official statistical data provided by the Ministry of Health of the Republic of Kazakhstan, as well as data from local medical institutions, including information on morbidity, mortality and environmental situation (Vinnikov et al., 2021).

The following methods were applied in the work:

Statistical data analysis - processing and systematization of statistical information about the state of public health, the dynamics of morbidity and mortality, as well as demographic indicators (fertility, mortality, natural increase) (Gudinova et al., 2023).

Geographical analysis - covers a comprehensive study of the geographical location of the study area, its relief and climatic characteristics. Special attention is paid to the causes of the spread of morbidity, as well as the influence of environmental and climatic factors, which allows to identify patterns in their relationship (Khatatbeh et al., 2020).

Method of environmental risk assessment - to analyze the relationship between air pollution and morbidity, the methodology of environmental risk assessment based on the level of pollutants and their impact on human health was used (Bissengaliyeva et al., 2023; Yessenamanova et al., 2021). The level of air pollution in the Zhylyoi district was assessed based on the results of field studies conducted using specialized equipment and methods of environmental monitoring. Air pollution was analyzed in terms of the concentration of harmful emissions, such as carbon dioxide, sulfur dioxide, nitrogen oxides, and other toxic substances released into the atmosphere as a result of the activities of oil extraction and processing enterprises.

The results of laboratory and field studies were collected and analyzed to identify the relationship between the level of air pollution and health of the population of Zhylyoi district. The obtained data on the concentration of harmful substances in the atmosphere became the basis for further analysis of the influence of environmental factors on morbidity and mortality of the population of the region. In order to assess the real levels of exposure and health risk to the population, models of dispersion

of pollutants in the atmospheric air of the region were used, which allowed to perform calculations of predicted annual average and maximum concentrations and, accordingly, to make an assessment of chronic and acute exposure.

The dispersion calculations of pollutant emissions into the atmosphere were performed using the software package ERA-GAZ v3.0, with the "ERA-Mean" module (LLC NPP "Logos-Plus", Novosibirsk, Russia). The software package is approved by the Main Geophysical Observatory named after A.I. Voeykov (St. Petersburg, Russia). Medical and demographic indicators and data on primary morbidity of the population of Zhylyoi district for 2020-2023 were analyzed. The medical and demographic situation in the district is characterized by high birth rate, population growth and high level of natural increase due to increased birth rate. However, there is an increased mortality and morbidity of the population, especially the infant mortality rate has relatively increased. The levels and trends of primary morbidity - respiratory diseases including primary morbidity of chronic and unspecified bronchitis, bronchial asthma and neoplasms, the development of which, according to the methodology of risk assessment, depends on air pollution, have been analyzed.

To assess the population indicators in the studied region, data from official statistics for the years 2020-2023 were analyzed. According to the data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, the population of the Atyrau region as of the beginning of 2024 was 704,074 people, with 389,872 residing in urban areas and 314,202 in rural areas.

According to Yu.P. Lisitsyn (2012), a specific criterion for assessing fertility is used in demographic studies, which allows both quantitative and qualitative characterization of the reproductive behavior of the population. This approach includes the analysis of indicators of general and specific fertility, the total fertility rate, as well as assessments of population reproduction in the context of medical-demographic and socio-economic conditions. The application of the criterion proposed by Lisitsyn enables a more accurate diagnosis of fertility trends, identification of factors influencing its changes, and the justification of demographic policy directions aimed at stabilizing and increasing the population.

Results. Thus, a fertility rate between 15 and 25 live births per 1,000 people (‰) is considered a medium fertility level. A rate below 15‰ is classified as low fertility, while a rate above 25‰ is considered high. As seen in Table 1, the fertility rate in the Zhylyoy district for the years 2020-2023 corresponds to a high level, with an average of 28.57±0.5 ‰ live births per 1,000 people. The fertility rates for the district are significantly higher than the regional averages.

Table 1. Demographic Indicators of the Zhylyoi District.

The number at the beginning of 2022.	Total population growth	Including		The number at the beginning of 2023.	For the billing period	
		Natural growth	Migration balance		growth rate, in percent	Average number
The entire population						
85327	1 043	1 861	-818	86 370	1,22	85 849
Urban population						
64 887	1 076	1 421	-345	65 963	1,66	65 425
Rural population						
20 440	-33	440	-473	20 407	-0,16	20 424
Birth rates of the population, per 1000 people, ‰						
2020	2021	2022	Average values		Standard deviation	
29,05	28,08	25,99	28,57		0,5	
Mortality rates of the population, per 1000 people, ‰						
2020	2021	2022	Average values		Standard deviation	
6,26	6,80	4,31	6,53		0,3	
Indicators of natural population growth, per 1000 people, ‰						
2020	2021	2022	Average values		Standard deviation	
22,79	21,28	21,68	22,04		0,8	
Infant mortality rates, per 1,000 live births, ‰						
2020	2021	2022	Average values		Standard deviation	
8,21	6,30	4,01	7,26		1,0	

Note: – Compiled by the author based on materials from the Atyrau branch of the RSE "Republican Center for Electronic Health" of the Ministry of Healthcare of the Republic of Kazakhstan.

Further, the analysis of mortality of the population is carried out. Mortality is one of the two main sub-processes of population reproduction, in which the actual demographic processes occurring with the population and affecting the growth rate of its number are generalized. Mortality depends on a large number of biological and social factors (natural-climatic, genetic, economic, etc.).

Mortality rate in Zhylyoi district for the period 2022-2023 increased from 4.31 to 7.44 cases per 1,000 people, amounting to an average of 6.53±0.4‰.

Thus, the population increased due to positive natural increase with high birth rate. The results of laboratory chemical studies aimed at determining the level of atmospheric air pollution, as well as the analysis of concentrations of chemical toxic substances affecting human health were investigated and analyzed. According to the results of the conducted risk assessment, the identified priority pollutants in the emissions of oil and gas production facilities were critical with respect to respiratory organs.

Table 2. The Impact of Certain Toxic Substances on the Human Body.

Substances	**CAS Substances**	**ARfC, мг/м3**	**Critical organs and systems**
1. Nickel oxide	1313-99-1	0,003	respiratory organs, the circulatory system

2. Hydrogen sulfide	04.06.7783	0,1	respiratory organs
3. Sulfuric acid	7664-93-9	0,1	respiratory organs
4. Ethyl Mercaptan	75-08-1	0,1	respiratory organs
5. Formaldehyde	50-00-0	0,048	respiratory organs, organs of vision
6. Sodium hydroxide	1310-73-2	0,005	respiratory organs, organs of vision
7. Orthophosphoric acid	7664-38-2	0,2	respiratory organs
8. Acetaldehyde	75-07-0	0,115	глаза, mucous membranes
9. Nitrogen dioxide	10102-44-0	0,47	respiratory organs
10. Sulfur dioxide	7446-09-5	0,66	respiratory organs

As part of the assessment of the impact of chemical substances on human health, particular attention is paid to compounds with pronounced toxicity and the potential to cause acute or chronic pathological changes. Hydrogen sulfide (H_2S) is a highly toxic gas that inhibits cellular respiration enzymes, particularly in the tissues of the central nervous system. Its effects manifest as acute hypoxia, convulsions, and can lead to respiratory paralysis and death upon short-term exposure to high concentrations. Sulfuric acid (H_2SO_4) is a powerful corrosive agent capable of causing coagulative necrosis of tissues upon direct contact, as well as chemical burns of the respiratory tract upon inhalation. Systemic exposure may lead to disruptions in the body's acid-base balance. Nickel oxide (NiO) is a compound known for its carcinogenic and allergenic properties. When inhaled, it can induce chronic inflammation of the respiratory tract and contribute to the development of malignant neoplasms through interactions with the DNA of epithelial cells. Orthophosphoric acid (H_3PO_4), despite being relatively weaker compared to other mineral acids, can cause irritation of the skin and mucous membranes at high concentrations, and, with prolonged exposure, may lead to disturbances in mineral metabolism.

Thus, the aforementioned chemical substances pose a serious threat not only to workers who are directly exposed to them in industrial settings, but also to the broader population, particularly under conditions of anthropogenic stress and environmental pollution. Exposure to substances such as formaldehyde, hydrogen sulfide, nickel oxide, and vapors of strong acids contributes to the rising incidence of diseases among the population, especially those affecting the respiratory system. According to epidemiological studies, regions with elevated levels of industrial toxicant emissions show increased rates of chronic bronchitis, bronchial asthma, allergic rhinitis, and obstructive pulmonary diseases. Elderly individuals are particularly sensitive to the effects of these substances, as they more frequently experience exacerbations of respiratory conditions, decreased pulmonary function, and a heightened risk of developing bronchopulmonary pathologies.The adverse impact of these compounds on the respiratory organs of the population is primarily due to their ability to cause irritation, inflammation, sensitization, and damage to the respiratory epithelium. This highlights the urgent need to strengthen sanitary and hygienic monitoring and to implement effective environmental protection measures.

In studies examining the impact of environmental pollution on public health, morbidity is often used as a primary indicator. Morbidity serves as the most characteristic and officially registered response of the population to the harmful effects of environmental pollutants. This indicator more accurately reflects the organism's response to adverse environmental influences. Official statistics account for the established population of patients (Adeola, 2020).

Discussions. In general, for the analyzed period in Zhylyoi district the following dynamics of primary morbidity was observed: from 2020 to 2021 the growth of the index from 48 354,6 to 54 979,8 cases per 100 thousand population (‰00) was registered, in 2022 a slight decrease to 50 556,2‰00 was registered, but in 2023 the increase to the level of 54 649,8‰00 was again noted (National Statistics RK., 2024).

In the structure of primary morbidity of the whole population of Zhylyoi district, the leading classes of morbidity in 2022 were diseases of respiratory organs - 27.1% of all diseases, injuries and poisonings - 8.5%, diseases of circulatory system - 8.4%, blood diseases - 8.2% and diseases of genitourinary system - 7.9%. These 5 classes of diseases accounted for 61.1% of all diseases.

Official data presented in statistical collections "Population health of Atyrau region and activities of health care organizations for 2020-2023" were used for calculations. Analysis of the level and trends of primary morbidity for all diseases showed that in general primary morbidity for the study period in Zhylyoi district in dynamics from 2020 to 2021 increased from 48354.6 to 54979.8 cases per 100 thousand population (‰00), and by 2022 a decrease to 50557.4(‰00), in 2023 an increase to 54649.8(‰00) was registered. (Table 1, Figure 2).

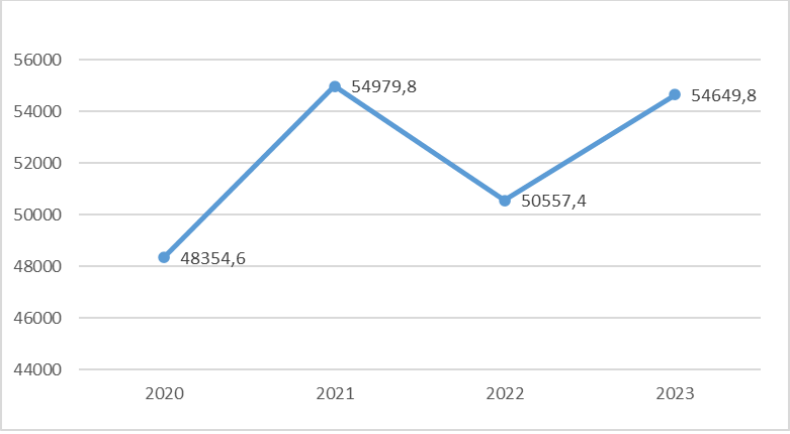

Figure 2. Dynamics of Primary Morbidity from All Diseases Among the Population in 2020–2023 (per 100,000 population, ‰00).

There was a sharp jump in the structure of primary morbidity among the entire population of Zhylyoi district for 2020-2023, which indicates significant changes in the epidemiologic situation during this period.

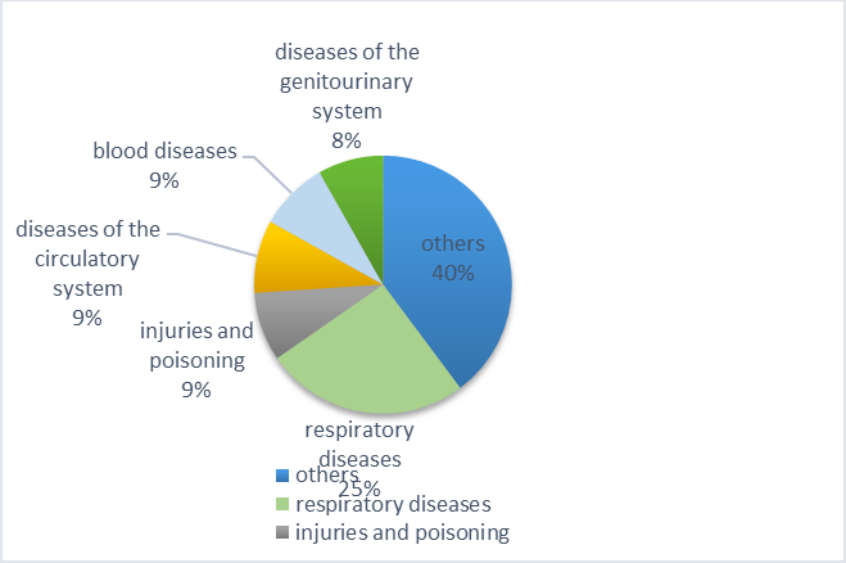

Figure 3. Structure of primary morbidity of population of Zhylyoi district for 2023.

The leading classes in 2023 were diseases of respiratory organs - 25% 13959,2‰00) of all diseases, injuries and poisonings - 9% (4710,4), diseases of circulatory system - 9% (4993,2), blood diseases - 9% (4749,6) and diseases of genitourinary system - 8% (4487,6). These 5 classes accounted for 60% of all diseases (Figure 3, Table 3).

Table 3. Morbidity Rates of the Total Population in Zhylyoi District for 2020–2023 (per 100,000 population).

	Disease class	**years**			
		2020	**2021**	**2022**	**2023**
1	in total	48354,6	54979,8	50556,2	54649,8
2	Infectious and parasitic diseases	2214,6	2551,9	2646,5	2933,6
3	Neoplasms	517,3	348,7	297	344
4	Diseases of the blood, hematopoietic organs, and individual disorders involving the immune mechanism	3464,9	3989,3	4129,3	4749,6
5	Endocrine diseases. eating disorders and metabolic disorders	604,3	713,9	750,2	879,7
6	Mental disorders and behavioral disorders	15,5	35,5	45,4	39,3
7	Mental disorders and behavioral disorders related to substance use	20,3	7,1	10,5	13,9
8	Diseases of the nervous system	2692,5	3062,6	3206,8	3645,9
9	Diseases of the eye and its appendages	1079,9	1102,8	1141,5	1270
10	Diseases of the ear and mastoid process	1247,9	406,6	1494,5	1647,5
11	Diseases of the circulatory system	3717,6	4115,7	4264,5	4993,2

12	Respiratory diseases	16595	19221,8	13717,1	13959,2
13	Diseases of the digestive system	3201,5	3523,6	3778,7	4297,1
14	Diseases of the skin and subcutaneous tissue	1884,4	2074,4	2209,7	2506,4
15	Diseases of the musculoskeletal system and connective tissue	1528	1769,5	1834,6	2003,1
16	Diseases of the genitourinary system	3597,2	3839,2	3989,6	4487,6
17	Congenital anomalies (malformations), deformities and chromosomal abnormalities	405,2	481,1	500,9	578,4
18	Injuries, poisoning, and some other effects of exposure to external causes	3914,2	4053,1	4287,8	4710,4

Note: – Compiled by the author based on materials from the Atyrau branch of the RSE "Republican Center for Electronic Health" of the Ministry of Healthcare of the Republic of Kazakhstan.

Analyzing the statistical data on morbidity in Zhylyoi district, presented in the above table, it can be noted that in the period from 2020 to 2023 there was a steady increase in the number of diseases among the population.

Primary morbidity of the adult population in the dynamics from 2020 to 2021 increased from 52696.7 to 58611.5 cases per 100 thousand population (‰00), and then by 2022 there was a decrease to 53645‰00, and 2023 increased by 57122.6‰00. (Figure 4).

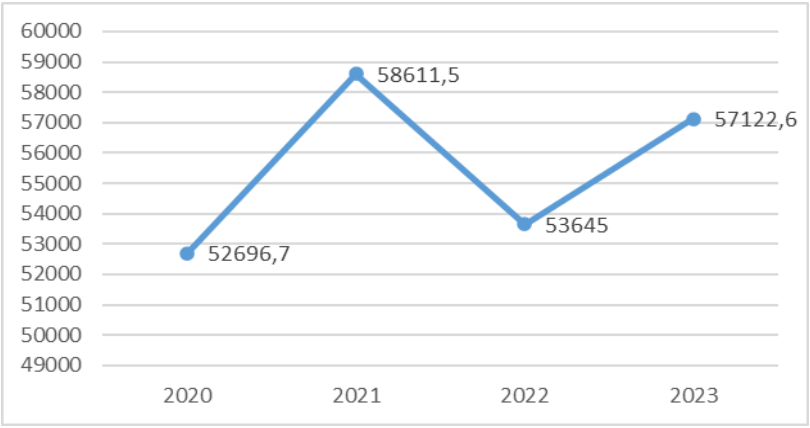

Figure 4. Dynamics of Primary Morbidity from All Diseases Among the Adult Population in 2020–2023 (per 100,000 adult population, ‰00).

In the structure of primary morbidity of adult population of Zhylyoi district, the leading classes in 2022 were diseases of respiratory organs - 14.0% (7500.3‰00) of all diseases, diseases of circulatory system - 13.4% (7174.9‰00), diseases of genitourinary system - 11.8% (6355.4‰00), blood diseases - 10.0% (5359.3‰00), injuries and poisonings - 8.1% (4321.6‰00).

Primary morbidity of adolescents of Zhylyoi district in the dynamics from 2020 to 2021 increased from 38715.9 to 44300.9 cases per 100 thousand adolescents (‰00), and then by 2022 there was a decrease to 41862.6‰00, and 2023 increased by 57299.3‰00 (Figure 5).

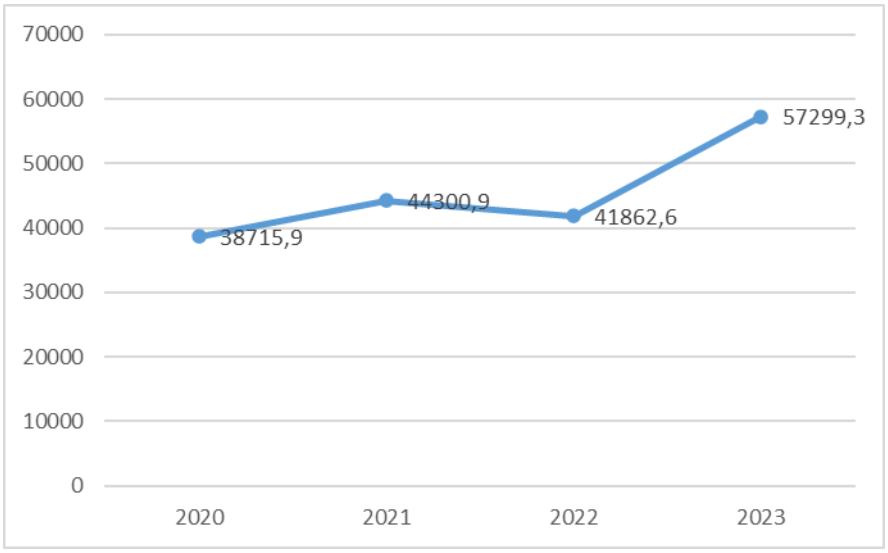

Figure 5. Dynamics of Primary Morbidity from All Diseases Among Adolescents in 2020–2023 (per 100,000 adolescents, ‰00)

In the structure of primary morbidity of adolescents of Zhylyoi district in 2022, the first five places were occupied by diseases of digestive organs - 22.7% (9495.5‰00), injuries and poisonings - 19.1% (8011.9‰00), diseases of respiratory organs - 16.4% (6870.6‰00), diseases of skin and subcutaneous tissue - 10.1% (4222.8‰00) and diseases of nervous system - 7.2% (3013.0‰00).

Primary morbidity in children, as in other age categories of the population, in the dynamics from 2020 to 2021 increased from 42733.6 to 49405.6 cases per 100 thousand population (â‰00), and then by 2022 there was a decrease to 46773.3‰00, in 2023 increased by 50254‰00. (Figure 6).

In the structure of primary morbidity of the child population of Zhylyoi district in 2022 the leading classes of diseases were diseases of respiratory organs - 53,0% (24767,5‰00), injuries and poisonings - 7,9% (3707,9‰00), blood diseases (mainly iron deficiency anemia) - 5,3% (2500,9‰00), diseases of digestive organs - 4,8% (2253,0‰00), infectious and parasitic diseases - 4,4% (2063,1‰00). These 5 classes accounted for 75.5% of all diseases (National Statistics RK 2024).

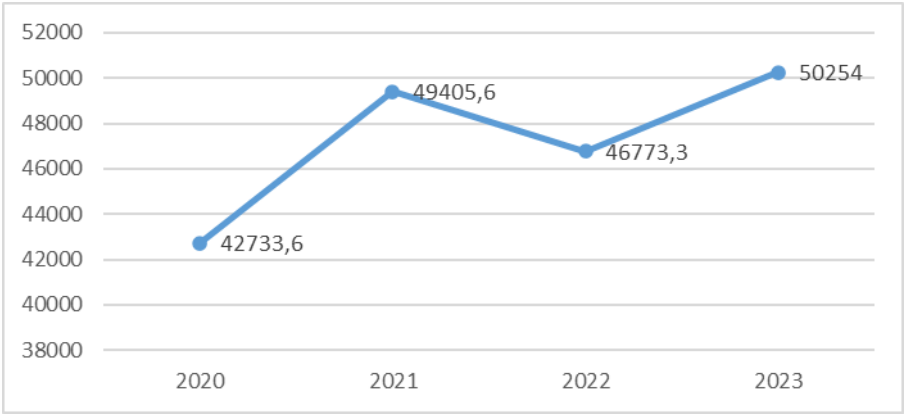

Figure 6. Dynamics of Primary Morbidity from All Diseases Among Children in 2020–2023 (per 100,000 children, ‰00)

To establish the possible impact of environmental quality on the health of the population, the data on primary morbidity of the population of Zhylyoi district on diseases, the level of which may depend on the emissions of pollutants into the air (respiratory diseases), as well as on neoplasms were analyzed.

Conclusion. Thus, an assessment of the state of health of the population of Zhylyoi district by medical and demographic indicators and primary morbidity for 2020-2023 is given. The level, structure and dynamics of primary morbidity of the population with all diseases were analyzed during the works. It should be emphasized that according to the results of the risk assessment, the impact of atmospheric air pollutants emitted by facilities of oil and gas enterprises of Zhyloi district, predominantly affects the respiratory organs. In addition, during the identification of hazardous substances in the composition of emissions, six compounds with carcinogenic properties were identified. At the same time, the data on primary morbidity of respiratory diseases, including chronic and unspecified bronchitis, bronchial asthma were also analyzed.

On the basis of the conducted analysis of statistical materials on indicators of health status of the population of Zhylyoi district we can make the following conclusions

- The medical and demographic situation in the period 2020-2023 is characterized by a high level of natural increase due to an increase in the birth rate.

- In the dynamics of primary morbidity from 2020 to 2021 there was an increase from 48354.6 to 54979.8 cases per 100 thousand population (‰00), and by 2022 there was a decrease to 50556.2‰00, in 2023 an increase to 54649.8(‰00). The same dynamics was observed in all age groups of population adults, adolescents and children.

leading classes of morbidity in 2023 were diseases of respiratory organs - 25% 13959,2‰00) of all diseases, injuries and poisonings - 9% (4710,4), diseases of circulatory system - 9% (4993,2), blood diseases - 9% (4749,6) and diseases of

genitourinary system - 8% (4487,6). These 5 classes accounted for 60% of all diseases.

Thus, the results obtained indicate the need to strengthen the monitoring of the health status of the population in the zone of influence of oil and gas production, to implement measures to reduce pollutant emissions and to carry out preventive measures with the participation of health and environmental protection authorities.

Based on the analysis of morbidity of the population of Zhylyoi district and the impact of factors associated with the activities of oil and gas enterprises, it seems appropriate to implement a set of measures aimed at reducing the risk to public health:

- Recommended to strengthen the system of monitoring of atmospheric air pollution in sanitary protection zones with the installation of automatic stations capable of detecting priority toxicants, including substances with carcinogenic properties. This will allow regular and objective assessment of the level of impact on the environment and public health.

- It is necessary to review and, if necessary, optimize the size of sanitary protection zones around oil and gas industry facilities, taking into account modern data on wind patterns, emission density and population density.

- Modern technologies should be introduced to reduce industrial emissions, including gas purification and VOC capture systems, followed by environmental audits of existing production facilities to ensure compliance with regulations.

- It is recommended to organize constant medical monitoring of residents living in areas with increased anthropogenic load, including regular medical check-ups, with a focus on diagnostics of respiratory diseases, allergic and oncological diseases.

- It is advisable to develop and implement a regional target program aimed at preventing and reducing morbidity associated with anthropogenic factors, including health improvement of vulnerable population groups (children, the elderly, workers of hazardous industries).

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