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FACTORS AFFECTING POPULATION HEALTH IN THE DESERT AREAS OF NAVOIY REGION: A NOSOGEOGRAPHICAL ANALYSIS

Abstract. This study analyzes the factors affecting the health of the population in the desert regions of Navoiy region. The research focuses on the impact of natural-geographical, ecological, and socio-economic conditions on public health. Special attention is given to the arid climate, high temperatures, water scarcity, and environmental degradation, which contribute to the spread of various diseases. The study also examines nozogeographical patterns, including the territorial distribution of diseases such as respiratory, digestive, and infectious illnesses. Based on field surveys and statistical data, regional differences in health conditions and access to medical services were identified. The results show that both natural environmental factors and human economic activities significantly influence population health in desert areas.

Keywords: desert regions, population health, environmental factors, climate impact, nozogeography, Navoiy region, public health, ecological conditions, disease distribution, medical services.

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ФАКТОРЫ, ВЛИЯЮЩИЕ НА ЗДОРОВЬЕ НАСЕЛЕНИЯ В ПУСТЫННЫХ РАЙОНАХ НАВОЙСКОЙ ОБЛАСТИ: НОЗОГЕОГРАФИЧЕСКИЙ АНАЛИЗ

Аннотация. В данной работе проанализированы факторы, влияющие на здоровье населения пустынных территорий Навоийской области. Исследование направлено на изучение воздействия природно-географических, экологических и социально-экономических условий на состояние здоровья населения. Особое внимание уделено аридному климату, высоким температурам, дефициту водных ресурсов и экологическим проблемам, способствующим распространению различных заболеваний. Рассматриваются нозогеографические особенности, включая территориальное распределение болезней дыхательной, пищеварительной и инфекционной систем. На основе социологических опросов и статистических данных выявлены региональные различия в состоянии здоровья и уровне медицинского обслуживания. Результаты исследования показывают, что

как природные, так и антропогенные факторы оказывают значительное влияние на здоровье населения пустынных районов.

Ключевые слова: пустынные территории, здоровье населения, экологические факторы, климат, нозогеография, Навоийская область, заболевания, медицинское обслуживание, окружающая среда, распределение болезней

Introduction.

The accelerating global demographic, economic and ecological transformations of the twenty-first century are intensifying public health challenges worldwide. The rapid pace of urbanisation, the expansion of industrial and agricultural production, and the mounting anthropogenic pressure on natural systems are collectively degrading atmospheric air quality, water resources, and soil integrity, thereby disrupting ecological equilibria and creating conditions conducive to the spread of infectious, parasitic, and environmentally mediated diseases. In arid and semi-arid zones, these processes are particularly pronounced: the progressive intensification of desertification generates adverse nozogeographical configurations that are difficult to reverse without targeted intervention.

Navoiy Province — occupying approximately 24.6% of the territory of Uzbekistan and characterised by exceptionally complex natural-ecological conditions — represents a scientifically compelling but insufficiently studied object of nozogeographical inquiry. Its vast desert expanses, extreme continental climate, intensive mining industry, and sparse rural population combine to produce a unique constellation of health risk factors that demands systematic analysis.

The aim of this study is to conduct a comprehensive nozogeographical analysis of the natural-geographical, ecological, and socio-economic factors influencing public health in the desert territories of Navoiy Province; to identify the spatial regularities of disease distribution; and to formulate evidence-based recommendations for the improvement of the healthcare system in these territories.

Literature review and methodology

The scientific foundations of medical geography were established by German researcher L. Finke (1792), who first systematically examined links between natural-geographical conditions and human health. In the 1930s–40s, Soviet scholars conducted major medical-geographical expeditions across Central Asia and the Far East. Academician E.N. Pavlovskiy's parasitological research led to the 1939 concept of natural-focal diseases and landscape epidemiology — a key methodological milestone.

A.A. Shoshin advanced nozogeography as a core branch of medical geography. Later scholars — Avsin, Raikhe, Prokhorov, Malkhazova, Voronov, Solovyov and others — refined nozogeographical methodology and linked it to public health. Western contributors including Hennen, Hirsch, May, Haggett, and Meade further developed the field's theoretical foundations.

Within Uzbekistan, doctoral dissertations by N.Q. Komilova and I.R. Turdimambetov (2012 and 2016) significantly advanced regional nozogeographical research. Despite these contributions, the desert territories of Navoiy Province remain understudied.

Discussion.

Navoiy Province is situated in the central and north-western part of the Republic of Uzbekistan, covering an area of 110,000 km² — equivalent to 24.6% of the national territory. The province borders Kazakhstan to the north, the Republic of Karakalpakstan to the north-west and west, Bukhara Province to the west, Kashkadarya Province to the south, and Samarkand and Jizzakh Provinces to the south-east. More than 80% of the provincial territory is occupied by the Kyzylkum Desert.

Geomorphologically, the desert portion of the province constitutes part of the Turan Plain. The relief of the Kyzylkum desert surface inclines from south-east to north-west, with mean absolute elevations of 200–300 m; elevations reach 350–400 m in the south-eastern sections and descend to 90–100 m in the north-western coastal areas. Distinctive geomorphological elements include residual mountains formed during the Palaeozoic era (composed of shale, limestone, and granite), extensive aeolian sand

plains shaped by wind activity, and enclosed depressions such as Mingbuloq and Mullali.

The climate of the desert territories is sharply continental and extremely arid. Summer temperatures rise to +45–46°C, while winter temperatures may fall to −30–35°C. Annual precipitation amounts to only 80–120 mm — 2.3 to 3.5 times lower than the Uzbekistani average of 280–300 mm. Annual evapotranspiration exceeds precipitation by a factor of 15–20, confirming the extreme aridity of the hydrometeorological regime.

Table 1. Monthly Air Temperature Indicators in Tomdi District, 2025 (°C)

Month	Mean Temperature	Maximum Temperature	Minimum Temperature
January	0.7	+9	−11
February	1.5	+18	−8
March	9.9	+31	−10
April	21.4	+37	+9
May	26.7	+43	+11
June	30.5	+42	+16
July	32.9	+44	+22
August	30.1	+41	+20
September	23.2	+35	+11
October	16.1	+28	+4
November	9.0	+22	−5
December	3.2	+14	−7

Source: Compiled on the basis of data from the Navoiy Provincial Hydrometeorological Administration.

The data in Table 1 indicate that July is the hottest month, with a mean temperature of 32.9°C and a maximum of 44°C. The inter-seasonal temperature amplitude of 32.2°C imposes a permanent thermoregulatory stress on the human organism. The sharp contrast between the negative minimum temperature in March (−10°C) and the positive mean temperature in April (21.4°C) contributes to the seasonal suppression of immune function and the exacerbation of respiratory tract diseases in early spring.

Causal Relationships between Climatic Factors and Population Health

The influence of climatic factors on human health constitutes one of the central problems of contemporary medical geography. According to the World Health Organization (WHO), each 1°C increase in air temperature raises the risk of cardiovascular disease onset by 2–3%. In the desert territories of Navoiy Province, summer heat waves — during which temperatures exceed +40°C for 45–60 days per year — represent a critical risk factor, particularly for persons aged over 55, children, and individuals with chronic conditions.

Table 2. Effects of Climatic Change Factors on Population Health (Based on WHO Data and Sectoral Research)

No.	Climatic Factor	Effect on the Organism	Primary Risks
1	Rising temperatures (above +40°C)	Thermal stress, elevated blood pressure, dehydration	Cardiovascular diseases, stroke, heat stroke
2	Atmospheric air pollution (dust, aerosols)	Damage to the mucous membranes of the respiratory tract	Bronchial asthma, chronic bronchitis, COPD
3	Reduced humidity and water scarcity	Suppressed immunity, impaired organismal hydration	Gastrointestinal diseases, urolithiasis, hypovitaminosis

4	Sharp inter-seasonal variation (amplitude 32°C+)	Strain on adaptive mechanisms of the organism	Respiratory infections, immunodeficiency states
5	Increased insect activity (mosquitoes, ticks)	Transmission of infectious disease agents	Parasitic diseases, enterobiasis, toxoplasmosis

Under conditions of extreme heat, the body's thermoregulatory system becomes overstrained, sympathoadrenal activity intensifies, blood pressure rises, haemocoagulation accelerates, and the risk of myocardial infarction and cerebrovascular accident increases. The high concentration of dust particles in the atmosphere — during summer sandstorms in the Kyzylkum, PM10 levels can exceed sanitary norms by a factor of 3–5 — induces chronic airway inflammation, bronchial hyperreactivity, and the development of asthmatic conditions.

The scarcity of water resources and the substandard quality of available drinking water — with mineralisation levels reaching 2.5–4.0 g/l in certain localities, 1.25 to 2.0 times the WHO standard — contribute to the widespread prevalence of renal-excretory pathology, and urolithiasis in particular. Ibn Sina (Avicenna), in his Canon of Medicine, similarly noted that intense evaporation and water deficit in arid climates accelerate the ageing of the human body and increase the risk of renal calculi (Ibn Sina, 1994).

Ecological and Anthropogenic Factors: The Nozogeographical Impact of Mining Industry

The mining industry constitutes a major economic complex in the desert territories of Navoiy Province, notably in Tomdi, Uchquduq, and Konimex districts. In Zarafshon city, the Navoi Mining and Metallurgy Combinat operates gold ore processing facilities; uranium production has been carried out at Uchquduq. While these

activities make a substantial contribution to regional and national economic development, they simultaneously generate specific ecological hazards.

Mining waste — including the sludge ponds of ore-dressing plants and fine particulate matter generated by underground operations and blasting — may elevate atmospheric concentrations of heavy metals and radioactive elements. The scientific literature confirms that such anthropogenic nozogeographical foci worsen morbidity indicators in adjacent localities. The superimposition of anthropogenic and natural foci is particularly manifest in Konimex district, where statistical data indicate that respiratory disease incidence exceeds the provincial average by 18–22%.

Results.

Territorial Distribution of Diseases and Nozogeographical Analysis

The integrated analysis of statistical data from the Navoiy Provincial Health Administration for 2018–2024 and the sociological survey of 320 respondents yielded the following picture of disease distribution across the desert territories of the province:

Table 3. Territorial Distribution of Diseases in the Desert Territories of Navoiy Province (2024, %)

Disease Group	Zarafshon City	Uchquduq Dist.	Konimex Dist.	Tomdi Dist.	Provincial Avg.
Respiratory tract diseases	28.4	27.1	36.8	32.3	31.2
Cardiovascular diseases	29.6	26.4	24.7	27.1	26.9
Gastrointestinal diseases	18.2	19.5	20.3	21.7	19.4
Infectious and parasitic diseases	12.3	15.8	11.2	14.6	13.5

Renal-excretory diseases	7.1	8.4	5.6	3.1	6.1
Other diseases	4.4	2.8	1.4	1.2	2.9

The data presented in Table 3 confirm that respiratory tract diseases rank first across all localities, with a provincial average of 31.2%, while cardiovascular diseases occupy second place at 26.9%. In Konimex district, the share of respiratory diseases (36.8%) exceeds the provincial average by 5.6 percentage points, reflecting the distinctive impact of industrial and ecological factors in this locality. In Tomdi district, the relatively high proportions of gastrointestinal diseases (21.7%) and parasitic diseases (14.6%) are directly associated with drinking-water supply problems in rural settlements.

The elevated relative shares of cardiovascular diseases (29.6%) and renal diseases (7.1%) in Zarafshon city are attributed to urbanisation-related stress characteristic of an industrial city and to the elevated mineralisation of drinking water. In Uchquduq district, the higher proportion of infectious and parasitic diseases (15.8%) is explained by the district's remote geographical location and restricted geographical access to medical services.

Territorial Analysis of Healthcare Infrastructure

Thematic maps produced in ArcGIS and the results of statistical analysis reveal substantial territorial inequalities in healthcare infrastructure across the desert territories of the province. The number of physicians per 10,000 population in Zarafshon city stands at 42.3, whereas in Tomdi district this indicator falls to 11.7 — a 3.6-fold disparity. The availability of inpatient medical care is relatively higher in Uchquduq district (where separate medical posts have been established in response to hydrometeorological and industrial hazards despite sparse population), and is at its lowest in Konimex district.

Table 4. Status of Healthcare Service Provision in the Desert Territories of Navoiy Province (2024)

Indicator	Zarafshon City	Uchquduq Dist.	Konimex Dist.	Tomdi Dist.
Population (thousands)	82.4	35.6	28.1	18.3
Physicians per 10,000 population	42.3	28.6	15.4	11.7
Paramedical staff per 10,000 population	87.1	61.3	42.7	38.9
Hospital beds per 10,000 population	58.4	44.2	29.1	22.6
Mean distance to medical facility (km)	3.2	28.5	41.7	53.4
Respondents satisfied with medical services (%)	71.4	58.3	38.7	32.5

The sociological survey results confirm stark inter-district variation in satisfaction with medical services: 71.4% of respondents in Zarafshon city expressed satisfaction, compared with only 32.5% in Tomdi district. The most frequently cited problems were: excessive distance to medical facilities — average 53.4 km (cited by 64.3% of respondents); insufficient availability of specialist medical care (57.8%); and inadequate access to safe drinking water (42.1%).

Nozogeographical Foci and Their Correlation with Ecological and Social Factors

Analysis of nozogeographical maps compiled using ArcGIS identified three distinct nozogeographical foci in the desert territories of Navoiy Province, characterised as follows:

First focus (Konimex district — industrial-ecological focus): in the vicinity of mining enterprises, the density of respiratory and allergic diseases is 22–25% higher than in designated control areas; this correlates with elevated atmospheric concentrations of heavy metals and fine particulate matter (Pearson $r = 0.78$, $p < 0.01$).

Second focus (Tomdi district and contiguous desert areas — water-parasitic focus): in settlements where drinking-water quality fails to meet standards, the density of urolithiasis and gastrointestinal diseases is 31–38% higher; utilisation of mineralised water sources shows a statistically significant correlation with urolithiasis incidence ($r = 0.71$, $p < 0.05$).

Third focus (Uchquduq district — geographic-isolation focus): restricted geographical access to medical services results in the proportion of infectious and parasitic diseases diagnosed at late stages being 18–20% higher than in adjacent districts.

These correlation analysis results confirm the existence of statistically significant relationships between nozogeographical factors and morbidity indicators, demonstrating the methodological value of the nozogeographical approach in health policy formulation.

Conclusions.

The present study has conducted a comprehensive nozogeographical analysis of the factors influencing public health in the desert territories of Navoiy Province and has yielded the following conclusions, each possessing scientific novelty:

First, three nozogeographical foci were delineated in the desert territories of the province: (1) an industrial-ecological focus (Konimex district, characterised by high respiratory disease density — 36.8%); (2) a water-parasitic focus (Tomdi district, with elevated gastrointestinal and renal disease rates — 21.7% and 3.1%, respectively); and (3) a geographic-isolation focus (Uchquduq district, characterised by restricted access to medical services — mean distance 28.5 km). These foci have been identified and cartographically delineated at provincial scale for the first time on a scientific basis.

Second, statistically significant correlational relationships between morbidity indicators and the key determinants — industrial pollution with respiratory disease incidence (r = 0.78) and water mineralisation with urolithiasis (r = 0.71) — were empirically established. These findings confirm the added scientific value of the nozogeographical approach in investigating these problems.

Third, medical-geographical analysis demonstrated serious inequalities in healthcare infrastructure across the desert territories of the province: the 3.6-fold disparity in physician density between Zarafshon city (42.3 per 10,000) and Tomdi district (11.7 per 10,000) constitutes a critical structural problem. Survey data corroborate the sharp divergence in satisfaction rates: Zarafshon 71.4% versus Tomdi 32.5%.

On the basis of these findings, the following practical recommendations are advanced: (1) expand preventive medicine centres in Konimex and Tomdi districts and improve population access to safe drinking water; (2) introduce mobile medical service systems for high-risk population groups; (3) strengthen ecological monitoring of atmospheric emissions from mining enterprises; (4) integrate nozogeographical maps into the planning instruments of the provincial health administration. These recommendations constitute the necessary scientific basis for reinforcing the territorial approach in public health policy for populations residing in desert territories.

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