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ASSESSMENT OF POPULATION HEALTH IN THE LOWER REACH OF THE SYRDARYA RIVER IN SPATIAL AND TEMPORAL DIMENSIONS

Abstract. Current studies of public health in Kyzylorda region, located in the lower reaches of the Syrdarya River within a zone of technogenic pollution, are based on medical–statistical approaches using linear trend methods. These methods provide a scientific basis for understanding the spatial and temporal dynamics of population health. Using data from the statistical collection "Health of the Population of the Republic of Kazakhstan and the Activities of Health Care Organizations" (Department of Medical and Statistical Analysis, National Scientific Center for Health Development named after Sagadat Kairbekova), covering the years 2000-2022, an electronic database was compiled for the population health of Kyzylorda region by administrative districts. A statistically grounded assessment of morbidity parameters across districts, conducted with linear trend analysis in Microsoft Excel, revealed both positive and negative trends over the study period. The resulting functional equations of morbidity dynamics in the form of linear trends provide a scientific foundation for forecasting the socio-ecological potential of the region.

Keywords: population health, linear trend, tendency, changes, research base, dynamics, assessment.

The catchment area of river basins, as a spatial basis for population and nature management, has served as a powerful stimulus for socio-economic development for thousands of years. However, the desire to use the potential power of water to the maximum for the unlimited development of industry and agriculture contributed to the violation of the basic principles of parity in water use between society and nature. As a result, river waters coming from mountainous areas, which are practically unpolluted and weakly mineralized, when reaching the plain, are supplemented by wastewater discharged into rivers by industrial, municipal and agricultural facilities, which has caused the formation of increased mineralization and high concentrations of harmful chemical elements in the middle and lower reaches of rivers and unsuitable for use for drinking water supply. In this regard, an in-depth analysis of the dynamics of population health indicators in spatial and temporal aspects in the catchment areas of river basins is necessary to form the main directions in matters of protection and improvement of the ecological and epidemiological safety of regional water use systems.

The purpose of the study is to evaluate trends of change health of the population of the Kyzylorda region in spatial and temporal aspects in the context of administrative districts located on the catchment areas of the lower reaches of the Syr Darya River, adequately reflecting the real medical and social situation of the region.

There are lots of works that attempt to assess the health of the population in spatial and temporal aspects, among which the following should be highlighted: L. Kilimova, O. Lusikova [1], D. Nevado-Peña, V.-R. López-Ruiz and J.-L. Alfaro-Navarro [2], E. G. Koroleva, S. K. Rahimbek, S. S. Tupova [3], C. Beletsioti, D. Niakas [4], L. V. Khripach, O. V. Budarina, E. V. Zheleznyak, T. D. Knyazeva, A. K. Makovetskaya, Z. I. Koganova, Z. F. Sabirova, Z. V. Shipulina [5] , M. Karabaev and G. S. Qosimova [6], A. N. Ogurtsova, V. V. Dmitrieva, N. V. Kaledin [7], M. Morales-Vazquez, M. Juda, M. Roerig, S. Allin [8], which assess the health of the population based on medical statistics in the countries of Belgium , Great Britain, Germany, France, Switzerland (Western European countries), Bulgaria, Poland, Russia, Romania, Slovakia (Eastern European countries), Canada, Uzbekistan, Kazakhstan, the Republic of Bashkortostan, Greece, Australia and the USA, using medical-statistical integral indicators.

One of the fundamental directions in assessing the health of the population is the methodological approach developed in the works of BG Ilyasov, V. V. Martynov, I. B. Gerasimova, E. A. Makarova, E. Sh. Zakieva [9], A. A. Pomerantseva, A. N. Starkin, E. V. Chervyakova [10], S. A. Antrofikova, V. N. Vasin, A. V. Kulikova, F. I. M. Sebikhova [11], B. N. Kotiv, I. A. Budko, I. A. Ivanova, I. Yu. Trosko [12], R. Haneef, M. Tijhuis, R. Thié baut *et al.* [13], related to the use of artificial intelligence, where logical and mathematical models for quantitative assessment of the integral level of physical health of the population are based on correlation analysis, characterizing the relationship between health and socio-economic characteristics and quality of life indicators.

Assessment of the health of the population of the Kyzylorda region in local conditions related to social, environmental and economic aspects is considered in the works of M. Zh. Burlibaeva, D. M. Burlibaeva, E. Zh. Murtazina, A. S. Murtazina, S. S. Seitova [14, 15], R. Yu. Tokmaganbetova, A. U. Makanova [16], E. N. Kuandykova [17], K. Z. Sakieva [18], B.G. Mukasheva [19], A.K. Ibraeva, A. U. Amanbaeva, L. S. Batyrbekova, A. O. Gazizova, E. N. Alekseva [20], G. A. Miyanova [21], where studies of the health status of the population of the regions are disparate and are devoted to diseases of individual organs and systems, which, as a rule, are associated with individual unfavorable factors of the living environment of the population in individual populated areas.

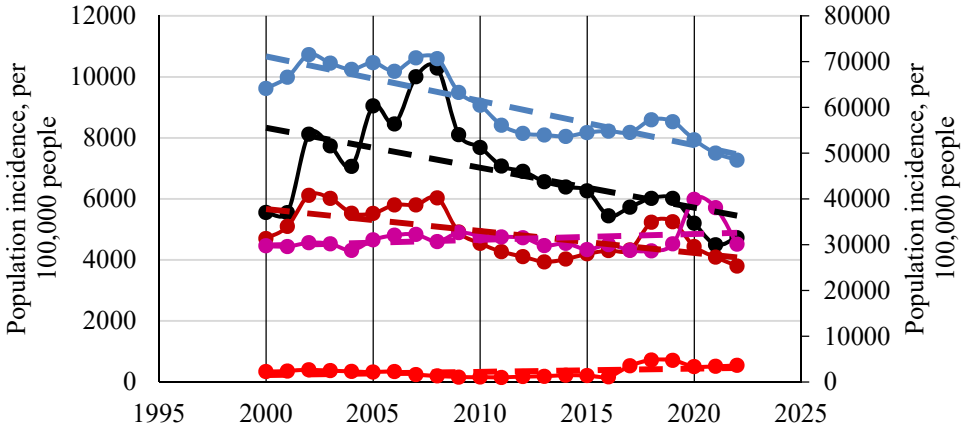
Materials and methods. To create a research base on the health of the population, the data of the statistical collection «Health of the population of the Republic of Kazakhstan and the activities of health care organizations» of the Department of Medical and Statistical Analysis of the RSE on the Right of Economic Management «National Scientific Center for Health Development named after Sagadat Kairbekova» for the period 2000-2022 were used.

The selection of population health indicators for analysis was carried out on the basis of data from approved annual reporting forms generated by the Republican State Enterprise on the Right of Economic Management «Republican Center for Electronic Healthcare» of the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan, which include population morbidity registered for the first time in life (*PFIL*), neoplasms (*NT*), diseases of the genitourinary system (*DGS*), diseases of the digestive system (*DSG*) per 1,000,000 people and the mortality rate (*MR*) per 1,000 people.

To illustrate the created databases in the context of administrative districts by types of morbidity, graphs for the Kyzylorda region were constructed in the form of a fragment using the Microsoft Excel program (figure).

The research methodology is based on theoretical approaches and practical methods of statistical research adopted in assessing trends in changes in the factors under study using the linear trend equation.

Results. In the conditions of increasing scale of human economic activity in the catchment areas of the Syr Darya River basin, carried out over a long period of time within the Kyzylorda region of the Republic of Kazakhstan, processes of significant degradation of natural complexes have formed, such as the emergence of a new Aralkum desert as a result of the drying up of the Aral Sea, which in turn has become a source of aerosol transfer of pollutants and deterioration of hydrological runoff, unsuitable for use in drinking water supply of the population, polluted with chemicals as a result of discharge of untreated wastewater by industrial and municipal facilities, as well as discharge of collector-drainage



Graph of changes in the incidence of the population of the Kyzylorda region for 2000-2022 (incidence of the population registered for the first time in life (1 – right ordinate), neoplasms (2), diseases of the digestive system (3) and diseases of the genitourinary system (4) and mortality (5)

water from irrigated areas located in the upper and middle reaches of the river, affecting the life of the population living in this territory for centuries.

As a result, in the lower reaches of the Syr Darya River in the Kyzylorda region, a process of «triple impact» on the life of the population is taking place: from the northwest to the southeast, the sands of the Aralkum desert are advancing, from the southeast to the northwest along the river bed, there is a deterioration in the hydrological flow unsuitable for drinking water supply and the use of agricultural products with an increased content of nitrates, and in connection with this, there is a need to study the health of the population in spatial and temporal aspects in order to identify their territorial differences, and on the basis of in-depth medical and environmental studies to identify the relationship between diseases and the quality of the natural environment.

The most effective tool for systemic analysis of medical and ecological processes can be special mathematical models that reflect the relationships between their structural and dynamic variables, in the form of linear trend equations:

$$NP_i = \alpha \cdot SNY_i + b; PH_i = \alpha \cdot SNY_i + b,$$

where NP_i – population, thousand people; PH_i – incidence rate per 100,000 people; α – regression coefficient; b – indicator characterizing the increase in the next value of the time series; SNY_i – period number or ordinal number of the year.

Based on the construction of graphs by types of morbidity in the context of administrative districts of the Kyzylorda region using a linear trend in the Microsoft Excel program, a medical and demographic model of population health was obtained (table 1).

Table 1 – Regression-correlation model of medical and demographic indicators of the population of the Kyzylorda region by administrative districts and the city of Kyzylorda

Administrative regions	Equation	Determination index (R^2)
1	2	3
Population size (NP_i), per 1000 people		
Aral	$NP_i = 0{,}5446 \cdot SNY_i + 67{,}7780$	0.9508
Kazalinsky	$NP_i = 0{,}4009 \cdot SNY_i + 69{,}1370$	0.9782
Karmakshinsky	$NP_i = 0{,}4072 \cdot SNY_i + 45{,}5700$	0.8535
Zhalagashsky	$NP_i = -0{,}3082 \cdot SNY_i + 41{,}9460$	0.6785
Syr Darya	$NP_i = -0{,}0438 \cdot SNY_i + 39{,}5820$	0,1666
Shieliinsky	$NP_i = 0{,}4972 \cdot SNY_i + 72{,}5250$	0.9034
Zhanakurgan	$NP_i = 0{,}8416 \cdot SNY_i + 65{,}8660$	0.8298
City of Kyzylorda	$NP_i = 7{,}5883 \cdot SNY_i + 156{,}5500$	0.9538
Kyzylorda region	$NP_i = 11{,}6620 \cdot SNY_i + 502{,}4800$	0.9687

Continuation of table 1

1	2	3
Population morbidity (PM_i) per 100,000 people		
Aral	$PM_i = -178{,}35 \cdot SNY_i + 18838{,}0$	0.3124
Kazalinsky	$PM_i = -161{,}35 \cdot SNY_i + 16608{,}0$	0.3250
Karmakshinsky	$PM_i = -225{,}56 \cdot SNY_i + 25140{,}0$	0.4238
Zhalagashsky	$PM_i = -148{,}83 \cdot SNY_i + 16716{,}0$	0.3785
Syr Darya	$PM_i = -145{,}68 \cdot SNY_i + 15736{,}0$	0.3099
Shieliinsky	$PM_i = -138{,}03 \cdot SNY_i + 14712{,}0$	0.3845
Zhanakurgan	$PM_i = -104{,}78 \cdot SNY_i + 12585{,}0$	0.2863
City of Kyzylorda	$PM_i = -195{,}05 \cdot SNY_i + 21665{,}0$	0.4145
Kyzylorda region	$PM_i = -971{,}44 \cdot SNY_i + 72126{,}0$	0.7568
Neoplastic diseases (*DNP*) per 100,000 people		
Aral	$DNP_i = 5{,}1645 \cdot SNY_i + 112{,}8600$	0.1548
Kazalinsky	$DNP_i = 4{,}4132 \cdot SNY_i + 89{,}7190$	0.1697
Karmakshinsky	$DNP_i = 6{,}6200 \cdot SNY_i + 122{,}8600$	0,1926
Zhalagashsky	$DNP_i = 4{,}5590 \cdot SNY_i + 78{,}5700$	0.2073
Syr Darya	$DNP_i = 4{,}6162 \cdot SNY_i + 85{,}2190$	0,1887
Shieliinsky	$DNP_i = 3{,}8377 \cdot SNY_i + 73{,}8690$	0,1833
Zhanakurgan	$DNP_i = 3{,}5050 \cdot SNY_i + 61{,}6790$	0.2033
City of Kyzylorda	$DNP_i = 5{,}8837 \cdot SNY_i + 114{,}3700$	0.1845
Kyzylorda region	$DNP_i = 10{,}3560 \cdot SNY_i + 218{,}0100$	0.1634
Diseases of the genitourinary system ($DGSNP_i$) per 100,000 people		
Aral	$DGSNP_i = -67{,}781 \cdot SNY_i + 5346{,}60$	0.2657
Kazalinsky	$DGSNP_i = -107{,}72 \cdot SNY_i + 9329{,}00$	0.2869
Karmakshinsky	$DGSNP_i = -45{,}432 \cdot SNY_i + 3434{,}50$	0,1950
Zhalagashsky	$DGSNP_i = -48{,}191 \cdot SNY_i + 6095{,}10$	0.1564
Syr Darya	$DGSNP_i = -81{,}279 \cdot SNY_i + 4091{,}20$	0.4436
Shieliinsky	$DGSNP_i = -78{,}212 \cdot SNY_i + 5561{,}00$	0.3250
Zhanakurgan	$DGSNP_i = -80{,}662 \cdot SNY_i + 5353{,}50$	0.2677
City of Kyzylorda	$DGSNP_i = -67{,}503 \cdot SNY_i + 5143{,}70$	0.5138
Kyzylorda region	$DGSNP_i = -71{,}869 \cdot SNY_i + 5736{,}00$	0.4074
Diseases of the digestive system ($DDSP_i$) per 100,000 people		
Aral	$DDSP_i = -128{,}870 \cdot SNY_i + 7961{,}60$	0.3211
Kazalinsky	$DDSP_i = -374{,}640 \cdot SNY_i + 22826{,}0$	0.3985
Karmakshinsky	$DDSP_i = -107{,}690 \cdot SNY_i + 5916{,}40$	0,1764
Zhalagashsky	$DDSP_i = -206{,}140 \cdot SNY_i + 11086{,}0$	0.3782
Syr Darya	$DDSP_i = -59{,}247 \cdot SNY_i + 4091{,}20$	0,0709
Shieliinsky	$DDSP_i = -112{,}640 \cdot SNY_i + 6285{,}20$	0.5379
Zhanakurgan	$DDSP_i = -144{,}800 \cdot SNY_i + 8737{,}90$	0.3798
City of Kyzylorda	$DDSP_i = -55{,}142 \cdot SNY_i + 3488{,}00$	0.2440
Kyzylorda region	$DDSP_i = -130{,}86 \cdot SNY_i + 8460{,}90$	0.3135
Crude death rate (per 1000 people)		
Aral	$GCMP_i = -0{,}1183 \cdot SNY_i + 8{,}6130$	0,6600
Kazalinsky	$GCMP_i = -0{,}0451 \cdot SNY_i + 7{,}4316$	0.1185
Karmakshinsky	$GCMP_i = -0{,}0516 \cdot SNY_i + 7{,}7408$	0,1610
Zhalagashsky	$GCMP_i = -0{,}0086 \cdot SNY_i + 6{,}2726$	0,0118
Syr Darya	$GCMP_i = -0{,}0035 \cdot SNY_i + 6{,}3407$	0.0024
Shieliinsky	$GCMP_i = -0{,}0412 \cdot SNY_i + 6{,}7896$	0.2401
Zhanakurgan	$GCMP_i = -0{,}0530 \cdot SNY_i + 6{,}0464$	0.2535
City of Kyzylorda	$GCMP_i = -0{,}1311 \cdot SNY_i + 8{,}8857$	0.6181
Kyzylorda region	$GCMP_i = -0{,}0668 \cdot SNY_i + 7{,}5031$	0,1750

Based on the equation of the linear trend of the studied (PH_i) indicator, it is possible to determine the absolute increase, the growth rate and the growth coefficient of the studied indicators, which have a sufficiently high physical and mathematical meaning (table 2):

- absolute increase is determined by the formula:

$$AISI_i = SIEP_i - SIBP_i = \alpha \cdot (EPUR_i - BPUR_i) = \alpha \cdot (EPUR_i - 1),$$

where is $EPUR_i$ −the duration or end of the period under consideration; $BPUR_i$ is the beginning of the period under consideration: $BPUR_i = 1 = const$;

- the growth rate is calculated using the formula:

$$QRIUS_i = AISI_i / EPUR_i = [\alpha \cdot (EPUR_i - 1)] / EPUR_i;$$

- the growth coefficient of the studied indicator ($GRIUS_i$) is determined by the following formula:

$$GRIUS_i = (\alpha \cdot EPUR_i + b)/(\alpha + b).$$

Table 2 – Statistical estimates of the trend of change in the type of disease by administrative districts of the Kyzylorda region of the Republic of Kazakhstan

Administrative regions	Statistical indicators of the trend of change in incidence over time		
	$AISI_i$	$QRIUS_i$	$GRIUS_i$
1	2	3	4
Population size (NP_i), per 1000 people			
Aral	11,981	0.521	1,175
Kazalinsky	8,820	0.383	1,127
Karmakshinsky	8,958	0.389	1,195
Zhalagashsky	-6,780	-0.295	0.837
Syr Darya	-0.964	-0.042	0.976
Shieliinsky	10,938	0.476	1,150
Zhanakurgan	18,515	0.805	1,278
City of Kyzylorda	166,943	7,258	2,017
Kyzylorda region	256,564	11,155	1,499
Population morbidity (PM_i) per 100,000 people			
Aral	-3923,700	-170,596	0,790
Kazalinsky	-3549,700	-154,335	0.784
Karmakshinsky	-4962,320	-215,753	0.801
Zhalagashsky	-3274,260	-142,359	0.802
Syr Darya	-3204,960	-139,346	0.794
Shieliinsky	-3036,660	-132,029	0.792
Zhanakurgan	-2305,160	-100,224	0.815
City of Kyzylorda	-4291,100	-186,570	0,800
Kyzylorda region	-21371,680	-929,203	0,700
Neoplastic diseases (*DNP*) per 100,000 people			
Aral	113,619	4,940	1,963
Kazalinsky	97,090	4,221	2,031
Karmakshinsky	145,640	6,332	2,125
Zhalagashsky	100,298	4,361	2,207
Syr Darya	101,556	4,415	2,130
Shieliinsky	84,429	3,671	2,087
Zhanakurgan	77,110	3,353	2,183
City of Kyzylorda	129,441	5,628	2,076
Kyzylorda region	227,832	9,906	1,998
Diseases of the genitourinary system ($DGSNP_i$) per 100,000 people			
Aral	-1733,182	-75,356	0.671
Kazalinsky	-2369,840	-103,037	0.743

Continuation of table 2

1	2	3	4
Karmakshinsky	-999,504	-43,457	0.705
Zhalagashsky	-1060,202	-46,096	0.825
Syr Darya	-1788,138	-77,745	0.554
Shieliinsky	-1720,664	-74,811	0.686
Zhanakurgan	-1774,564	-77,155	0.663
City of Kyzylorda	-1485,066	-64,568	0.707
Kyzylorda region	-1581,118	-68,744	0.721
Diseases of the digestive system ($DDSP_i$) per 100,000 people			
Aral	-2835,140	-123,267	0.638
Kazalinsky	-8242,080	-358,351	0.633
Karmakshinsky	-2369,180	-103,008	0.595
Zhalagashsky	-4535,080	-197,177	0.583
Syr Darya	-1303,434	-56,671	0.677
Shieliinsky	-2478,080	-107,743	0.599
Zhanakurgan	-3185,600	-138,504	0.629
City of Kyzylorda	-1213,124	-52,745	0.647
Kyzylorda region	-2878,920	-125,170	0.654
Crude death rate (MP_i) per 1000 people			
Aral	-2,603	-0.113	0.694
Kazalinsky	-0.992	-0.043	0.866
Karmakshinsky	-1,135	-0.049	0.852
Zhalagashsky	-0.189	-0.008	0.970
Syr Darya	-0.077	-0.003	0.988
Shieliinsky	-0.906	-0.039	0.866
Zhanakurgan	-1,166	-0.051	0.805
City of Kyzylorda	-2,884	-0.125	0.671
Kyzylorda region	-1,470	-0.064	0.802

The analysis of the dynamics of medical and ecological processes in the administrative districts of the Kyzylorda region for 2000-2022, located in the zone of unloading hydrochemical flows of the Syr Darya River basin, shows that the development of morbidity is characterized not only by a stochastic component. They also have a deterministic component in the form of a trend, which is confirmed by the system of equations of linear trends obtained as a function dependent on time. As follows from the results of statistical assessments, the tendency of change in the type of morbidity in the context of administrative districts of the Kyzylorda region is characterized by multidirectional (positive and negative) trends (table 2).

The obtained linear equations (table 1) allow us, first of all, to estimate how the dynamic average long-term value changes by types of morbidity for the considered calculation period, and according to the results of our study, we observe positive trends , where their absolute growth increases from 8.820 to 256.564 per 100,000 people, the growth rate from 0.383 to 11.155 per 100,000 people and the growth coefficient from 1.127 to 2.017 , due to the increase in the population in all administrative districts, except for the Zhalagash and Syrdarya districts, where negative trends are observed.

Accordingly, the identified unidirectional negative trends for 2000-2022 in all administrative districts of the Kyzylorda region for the incidence of the population registered for the first time in life (PM_i), diseases of the genitourinary system ($DGSNP_i$), diseases of the digestive system ($DDSP_i$) and the mortality rate of the population (MP_i) show an improvement in the medical and ecological condition in the storage zones of the hydrochemical runoff of the Syr Darya River (Table 2) and their functional equations (table 1) can serve as a basis for predicting changes in morbidity over time.

Of particular interest is the preservation of the unidirectional positive trends of neoplasms (DNP) in all administrative districts of the Kyzylorda region, where their absolute growth increases from 77.11 to 145.64 per 100,000 people, the growth rate from 3.353 to 6.332 per 100,000 people and the growth

coefficient from 1.963 to 2.207 along the river basins towards the mouth, which requires the need to study their cause-and-effect relationship.

To identify the cause-and-effect relationships between the water pollution index (WPI_i) and water mineralization (WM_i) with neoplastic diseases in the context of administrative districts of the Kyzylorda region by constructing their graphs, an equation of a linear trend was obtained using the (DNP) Microsoft program Excel (table 3):

$$DNP = \alpha_i \cdot WM_i + b_i \text{ And } DNP = \alpha_i \cdot WPI_i + b_i,$$

where $\alpha = tga$is the angular coefficient of regression; $b$is the ordinate of the deviation of the straight line from the zero point of the graph.

Table 3 – Dependence of the level of neoplasm disease (DNP) on the pollution index (WPI_i) and water mineralization (WM_i) in the context of administrative districts of the Kyzylorda region

Administrative regions	Equation	Determination index (R^2)
Dependence of the level of neoplasm disease (DNP) on water mineralization (WM_i), mg/l		
Aral	$DNP = 0{,}3342 \cdot WM_i - 349{,}3100$	0.5447
Kazalinsky	$DNP = 0{,}2457 \cdot WM_i - 251{,}1800$	0.4816
Karmakshinsky	$DNP = 0{,}3193 \cdot WM_i - 217{,}5300$	0.4665
Zhalagashsky	$DNP = 0{,}2345 \cdot WM_i - 180{,}3600$	0.5227
Syr Darya	$DNP = 0{,}2965 \cdot WM_i - 245{,}3700$	0.5449
Shieliinsky	$DNP = 0{,}1511 \cdot WM_i - 27{,}8450$	0.3114
Zhanakurgan	$DNP = 0{,}1694 \cdot WM_i - 64{,}6100$	0,6490
City of Kyzylorda	$DNP = 0{,}2893 \cdot WM_i - 197{,}5500$	0.4797
Dependence of the level of neoplasm disease (DNP) on the water pollution index (WPI_i)		
Aral	$DNP = 137{,}8900 \cdot WPI_i - 71{,}4690,$	0.5811
Kazalinsky	$DNP = 107{,}8500 \cdot WPI_i - 48{,}8710,$	0.5879
Karmakshinsky	$DNP = 124{,}8100 \cdot WPI_i - 42{,}4080,$	0.5368
Zhalagashsky	$DNP = 87{,}3930 \cdot WPI_i - 39{,}8420,$	0,6300
Syr Darya	$DNP = 117{,}1800 \cdot WPI_i - 77{,}6650,$	0.8108
Shieliinsky	$DNP = 44{,}1230 \cdot WPI_i - 18{,}1110,$	0.5827
Zhanakurgan	$DNP = 229{,}0400 \cdot WPI_i - 194{,}7300,$	0.6525
City of Kyzylorda	$DNP = 125{,}5800 \cdot WPI_i - 56{,}6840,$	0.7133

When assessing the dependence of the incidence of neoplasms (DNP) on water mineralization (WM_i) and the water pollution index (WPI_i) , data on the water quality of the Syr Darya River at the hydrological posts of Shardara, Kyzylorda and Kazaly were used, given in the annual reports of the «Aral-Syr Darya Basin Inspection for the Rational Use and Protection of Water Resources» of the Water Resources Committee of the Ministry of Water Management and Irrigation of the Republic of Kazakhstan for the period 2000-2020 [22].

The conducted studies to assess the direction and intensity of the trend of change by types of morbidity in the context of administrative districts of the Kyzylorda region demonstrated the possibility of using regression-correlation equations as a generalizing characteristic in the construction of mathematical medical-demographic models, where the integral indicator acts as a quality criterion.

Discussion. Analysis and evaluation of the medical and ecological situation in the administrative districts of the Kyzylorda region, based on types of morbidity, is of regional significance and is characterized by multidirectional (positive and negative) trends, differing in intensity along the Syr Darya River, directed towards the mouth of the river.

The presented results of the quantitative assessment of integral levels by types of morbidity in the administrative districts of the Kyzylorda region for 2000-2022 showed that in most cases there is a negative trend in the incidence of the population (PM_i), registered for the first time in life, diseases of the genitourinary system ($DGSNP_i$), digestive organs ($DDSP_i$) and mortality of the population (MP_i), where

the growth rate fluctuates from 0.583 to 0.988, this may be due to the introduction of preventive and corrective measures aimed at maintaining public health with changed qualities of natural resources and the subsequent environmental disturbances in the living environment of the population living in the Aral Sea region.

However, studies devoted to the study of neoplasm disease (DNP) among the population of the Kyzylorda region for 2000-2022 showed that they have a positive growth trend with statistical significance, since in all administrative districts the growth rate is in the range from 1.963 to 2.207, which indicates the presence of a negative impact on the life of the population of catastrophic changes in the natural environment in connection with the Aral syndrome.

The obtained functions in time, characterizing the development trends of medical and ecological processes, confirming the existence of a statistical relationship between the quality of the natural environment and types of morbidity in the context of administrative districts of the Kyzylorda region, were the main hypothesis of this study.

Conclusion. In modern conditions, taking into account the characteristics of the medical and statistical components of the living environment of the Kyzylorda region in the context of administrative districts and the city of Kyzylorda, located in the lower reaches of the Syr Darya River, related to technogenically disturbed zones, is one of the necessary conditions for knowledge about the health status of the population in spatial and temporal aspects.

A study of the health of the population of the Kyzylorda region by administrative districts and the city of Kyzylorda based on statistical data for the period from 2000 to 2022 using a linear trend showed that, for the period under review, there are generally multidirectional (positive and negative) trends.

At the same time, negative trends for 2000-2022 in all administrative districts of the Kyzylorda region in terms of morbidity of the population registered for the first time in life (PM_i), diseases of the genitourinary system ($DGSNP_i$), diseases of the digestive system ($DDSP_i$) and the mortality rate of the population (MP_i), as well as a positive trend in the incidence of neoplasms (DNP), show multidirectional trends in their change, and do not prove an improvement in the medical and ecological state in the storage zones of the hydrochemical runoff of the Syr Darya River (table 2), and their functional equations (table 1) can only serve as a basis for predicting changes in morbidity over time.

The presented results of the dependence of neoplasm incidence (DNP) on water mineralization (WM_i) and water pollution index (WPI_i) fully reflect the relationships between the quantitative and qualitative aspects of the process under study and provide valuable information necessary for analysis in spatial and temporal aspects.

A statistically substantiated assessment of the parameters of population morbidity in the context of administrative districts of the Kyzylorda region, discovered in the period from 2000 to 2022, as well as multidirectional positive and negative trends (trends) and their functional equations in the form of linear trends serve as a scientific basis for forecasting the socio-ecological potential of the region, due to the impact of a complex of environmental factors and the lifestyle of the population.

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СЫРДАРИЯ ӨЗЕНІНІҢ ТӨМЕНГІ САЛАСЫНДАҒЫ ХАЛЫҚТЫҢ ДЕНСАУЛЫҒЫН КЕҢІСТІК-УАҚЫТТЫҚ КӨЗҚАРАСТА БАҒАЛАУ

Аннотация. Қазіргі кезеңде, техногендік ластану аймағына кіретін Сырдария өзенінің төменгі ағысында орыналасқан Қызылорда облысының тұрғындарының денсаулығын зерттеу, халық денсаулығының қалыптасу сипаттамаларын кеңістіктік және уақыттық өлшемінде, ғылыми түрғыда негіздеуді қамтамасыз ететін,

медициналық-статистикалық тәсілдің, сызықтық трендтерін қолдануға негізделген. Экономикалық басқару құқығындағы Медициналық-статистикалық талдау департаментінің «Сағадат Қайырбекова атындағы денсаулық сақтауды дамытудың ұлттық ғылыми орталығы» РМК дайындаған «Қазақстан Республикасы халқының денсаулығы және денсаулық сақтау ұйымдарының қызметі» статистикалық жинағы 2000-2022 жылдар аралығының негізінде Қызылорда облысының әкімшілік аудандарының деңгейінде, халық денсаулығының электрондық ғылыми-зерттеу деректер базасы құрылды. Қызылорда облысының әкімшілік аудандарының деңгейінде халықтың денсаулық көрсеткіштерін қарастырылып отырған кезеңде, Microsoft Excel бағдарламасында сызықтық трендтерін пайдалана отырып, статистикалық тәсілдерге негіздеп бағалау көрсеткендей, бір тұтастай алғанда аурушаңдықтың дамуы көп бағытты оң және теріс өзгерістер байқалады және олардың сызықтық трендтер түріндегі функционалдық теңдеулері аймақтың әлеуметтік-экологиялық әлеуетін болжау үшін ғылыми негіз ретінде қызмет етеді.

Түйін сөздер: халық денсаулығы, сызықтық тенденция, тенденция, өзгерістер, зерттеу базасы, динамика, бағалау.

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ОЦЕНКА ЗДОРОВЬЯ НАСЕЛЕНИЯ В НИЗОВЬЯХ РЕКИ СЫРДАРИЯ В ПРОСТРАНСТВЕННЫХ И ВРЕМЕННЫХ АСПЕКТАХ

Аннотация. Современные исследования здоровья населения Кызылординской области, проживающего в низовье реки Сырдария, относящейся к зоне техногенного загрязнения, базируются на медико-статистическом подходе с использованием методов линейного тренда, обеспечивающих научное обоснование особенностей формирования здоровья населения в пространственных и временных аспектах. На основе статистического сборника «Здоровье населения Республики Казахстан и деятельность организаций здравоохранения» Департамента медико-статистического анализа РГП на ПХВ «Национальный научный центр развития здравоохранения имени Сагадат Каирбековой» в 2000-2022 годы создана электронная база исследования по здоровью населения Кызылординской области в разрезе административных районов. Статистически обоснованная оценка параметров заболеваемости населения в разрезе административных районов Кызылординской области с использованием линейного тренда в программе Microsoft Excel показала, что за рассматриваемый период в целом наблюдаются разнонаправленные положительные и отрицательные тенденции (тренды) развития заболеваемости и их функциональные уравнения в виде линейных трендов служат научной основой для прогнозирования социально-экологического потенциала региона.

Ключевые слова: здоровье населения, линейный тренд, тенденция, изменения, база исследования, динамика, оценка.