https://doi.org/10.55764/2957-9856/2026-1-127-135.12

MRNTI 76.01.11
UDC 614.1:519.23

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MULTIPARAMETRIC ASSESSMENT OF POPULATION HEALTH IN KYZYLORDA REGION BASED ON AN INTEGRAL INDICATOR

Abstract. The subject of the research is the assessment of the health of the population of the Kyzylorda region in the context of administrative districts using the integral indicator as a function. The aim of the study is to develop an algorithm for assessing the integral indicator of population health and the weighting coefficient by types of disease. The study used methods of system and comparative analysis, methods of mathematical and simulation modeling. The following results were obtained: an algorithm for assessing the integral indicator of population health and the weighting coefficient by types of disease were developed; testing of the proposed theoretical ideas was carried out using long-term official statistical data on health care of the Kyzylorda region for 2000-2022; the results obtained showed that there were no administrative districts with favorable integral indicators of population health in the Kyzylorda region during the study period. The developed algorithm and model for the integrated assessment of population health, applied in the monitoring mode, allow for understanding the regional characteristics of public health in the Kyzylorda region. The advantages of the method are the use of standard statistical parameters, the relative simplicity of obtaining results and their interpretation, as well as the possibility of adjustment depending on the objectives of the analysis.

Keywords: statistical indicators; integral health indicator; linear models; health status dynamics.

Introduction. The Syr Darya River drainage basin, originating in mountainous areas that are virtually unpolluted and low in mineralization, is supplemented upon reaching the plain by wastewater discharged into the rivers by industrial, municipal, and agricultural facilities. This has resulted in the formation of highly mineralized and highly concentrated water in the middle and lower reaches of the rivers, making it unsuitable for drinking water supply. Currently, the drainage basins of these river basins, which serve as spatial bases for population and environmental management, are experiencing severe anthropogenic activity, potentially impacting the livelihoods of people who have lived in these areas for centuries. These areas have entered an active stage of «succession», leading to environmental disruptions to the local environment. In this regard, the assessment of population health based on the integral indicator has become one of the pressing issues for conducting an in-depth analysis of the dynamics of population health indicators in spatial and temporal aspects in the lower reaches of the Syr Darya River, which are the spatial bases for the population of the Kyzylorda region.

Methodological foundations for the development of mathematical models of the integral indicator of population health, developed in the work of V. A. Medik, M. S. Tokmachev [1], B. F. Kiryanov [2], B. F. Kiryanov, M. S. Tokmachev [3], A. G. Kulak [4], M. B. Mustafayeva and Zh.S. Mustafayev [5-8] were used in the works of Yu. A. Shakirova [9], B. F. Kiryanov [10], A. V. Ramonova [11], G. I. Ibraimova, G. S. Dzhunusova [12], D. N. Begoun et al. [13] for classification and ranking of various territories according to the health status of the Russian Federation, the Kyrgyz Republic and the Republic of Kazakhstan.

The analysis of existing mathematical models for assessing the health of the population of the territory and the study of them in spatial and temporal aspects over the past thirty years at individual regional levels shows the need to study these medical and demographic processes in all catchment areas of river basins, which perform important environment-forming and ecological functions, in order to understand the results of anthropogenic activity in light of modern environmental problems.

The aim of the study is to assess the health of the population of the administrative districts of the Kyzylorda region based on an integral indicator.

Research materials and methods. State statistical reporting data from the Sagadat Kairbekova National Scientific Center for Health Development for the period 2000–2022 were used as the initial information for the integrated assessment of the health status of the population of the Kyzylorda region by administrative district.

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 (NRC_i), neoplasms (NAD_i), diseases of the genitourinary system UGD_i), diseases of the digestive system (GD_i) per 1,000,000 people and the mortality rate (NR_i) per 1,000 people.

The research methodology is based on the methodological approaches of Zh. S. Mustafayev and M. B. Mustafayeva aimed at developing an algorithm for calculating the integral indicator using the theory of regression-correlation analysis [5], the amplitude of the range of statistical indicators, the method of situation analysis, the theory of events and average values, allowing for an assessment of the medical and demographic status, both at the current moment and for the forecast period, based on an assessment of the change trend using linear trends.

Research results. On the expanded and modified methodology for calculating integrated indicators of population health, scientific and methodological approaches were determined for conducting an integrated assessment of the health of the population of the Kyzylorda region in the context of administrative districts in spatial and temporal aspects.

Within the framework of the research objective, based on the created research resource base, on statistical data on the incidence of the population registered for the first time in life (NRC_i), neoplasms (NAD_i), diseases of the genitourinary system (UGD_i), diseases of the digestive organs (GD_i) per 1,000,000 people and the mortality rate (NR_i) per 1,000 people for 2000-2022, an algorithm for its implementation was developed, consisting of two blocks: determining the weighting coefficient for types of morbidity and assessment of the integrated indicator of health of the territory's population.

The composition and structure of mathematical models for assessing the integral indicator of population health in a territory typically include a weighting coefficient reflecting the significance and relative importance of each type of disease. To determine the weighting coefficients, the methodological approach of M. B. Mustafayeva and Zh. S. Mustafayeva was used [5-8]. This approach is based on calculating average values and their relative significance, derived from the theory of mathematical statistics, that is, the range of statistical indicators, based on a research database created by the Sagadat Kairbekova National Scientific Center for Healthcare Development for 2000-2022.

To solve multi-criteria problems, various methods are used to transform the natural values of particular indicators for types of morbidity into a dimensionless indicator according to the following formula:

$$DIR_i = NIR_i / AMMR_i = NIR_i / [(1/n) \sum_{i=1}^{n} NIR_i \,], \quad (1)$$

where DIR_i – is the coded value of dimensionless indicators by type of morbidity, in the form of a modular coefficient; NIR_i – natural values of private indicators by types of morbidity; $AMMR_i$ – arithmetic mean values of particular indicators by types of morbidity; n – the number of years of presented natural values of particular indicators by types of morbidity.

Based on the parameter of relative dispersion of statistical indicators by types of morbidity, it is possible to determine the amplitude of the range of statistical indicators by type of morbidity according to the following formula:

$$ASDIR_i = [(DIR_{maxi} - DIR_{mini})/DIR_{maxi}] = \Delta DIR_i/DIR_{maxi}\,, \quad (2)$$

where DIR_{maxi} – maximum values of dimensionless indicators by types of morbidity for the period under review; DIR_{mini}– minimum values of dimensionless indicators by types of morbidity for the period under review; ΔDIR_i – amplitude the range of statistical indicators of the dimensionless indicator by type of morbidity for the period under review.

The weighting coefficient for types of morbidity, reflecting the significance and relative importance of each type of morbidity, is determined by the following formula:

$$WCPYI_i = ASDIR_i / \sum_{i=1}^{n} ASDIR_i\,, \quad (3)$$

where n_i – the number of indicators used by type of disease.

The proposed method for determining the weighting coefficient for types of disease was tested in assessing the health of the population of the Kyzylorda region by administrative districts (table 1).

Table 1 – Determination of weighting factors for types of morbidity in the context of administrative districts of the Kyzylorda region

Administrative regions	Types of morbidity				
	NRC_i	NAD_i	UGD_i	GD_i	NR_i
Aral	0.1526	0.3071	0.1827	0.2056	0.1519
Kazalinsky	0.1533	0.3084	0.1569	0.2194	0.1621
Karmakchinsky	0.1309	0.2649	0.2303	0.2351	0.1388
Zhalagashsky	0.1323	0.3264	0.1766	0.2675	0.0973
Syr Darya	0.1184	0.2919	0.2190	0.2513	0.1193
Shieliyinsky	0.1346	0.3318	0.1848	0.2353	0.1135
Zhanakurgan	0.1413	0.3168	0.1612	0.2246	0.1560
The city of Kyzylorda	0.1317	0.2667	0.1515	0.2962	0.1539
Kyzylorda region	0.1111	0.3511	0.1556	0.2489	0.1333

A multiparameter assessment of the health of the population of the Kyzylorda region based on an integral indicator involves the use of a single criterion based on the method for calculating the integral indicator of the health status of the population by M. B. Mustafayeva et al. [14], as a generalized indicator, which is an equation of one of the classical Pythagorean means or geometric mean, arising from the Euclidean measure, which simultaneously takes into account the complex influence of various factors and summarizes information on various aspects of the health status of the population.

The coded value of the dimensionless indicator for the types of morbidity (DIR_i) is reduced to the corresponding values of the reliability of the probability of occurrence of particular morbidity indicators according to a nonlinear function similar to the normal distribution function, that is, it is determined by the exponential function:

$$PDIR_i = exp[-\exp(-DIR_i)]\,, \quad (4)$$

where $PDIR_i$ is the probability of occurrence of particular indicators for types of morbidity in the territory.

The integral indicator of the population's health in a given territory is defined as the geometric mean of the probabilities of occurrence of specific indicators by types of morbidity in the territory, taking into account a weighting coefficient that reflects their significance and relative importance, according to the following expression:

$$SPDIR_i = \sqrt[n]{\prod_{i=1}^{n} PDIR_i \cdot WCPVI_i}\,, \quad (5)$$

where $SCDIR_i$ is the sum of the probabilistic occurrence of particular indicators for types of morbidity in the territory; $WCPYI_i$ – weighting coefficient for types of morbidity.

This methodological approach for assessing the integral indicator of population health in a territory allows us to translate the actual values of the parameters into a single dimensionless numerical Harrington

scale with fixed boundaries from 0 to 1 into five sub-ranges: [0; 0.2] – «very bad», [0.2; 0.37] – «bad», [0.37; 0.63] – «satisfactory», [0.63; 0.8] – «good», [0.8; 1] – «very good», displaying private quantitative scales in generalized scales of quality criteria [15].

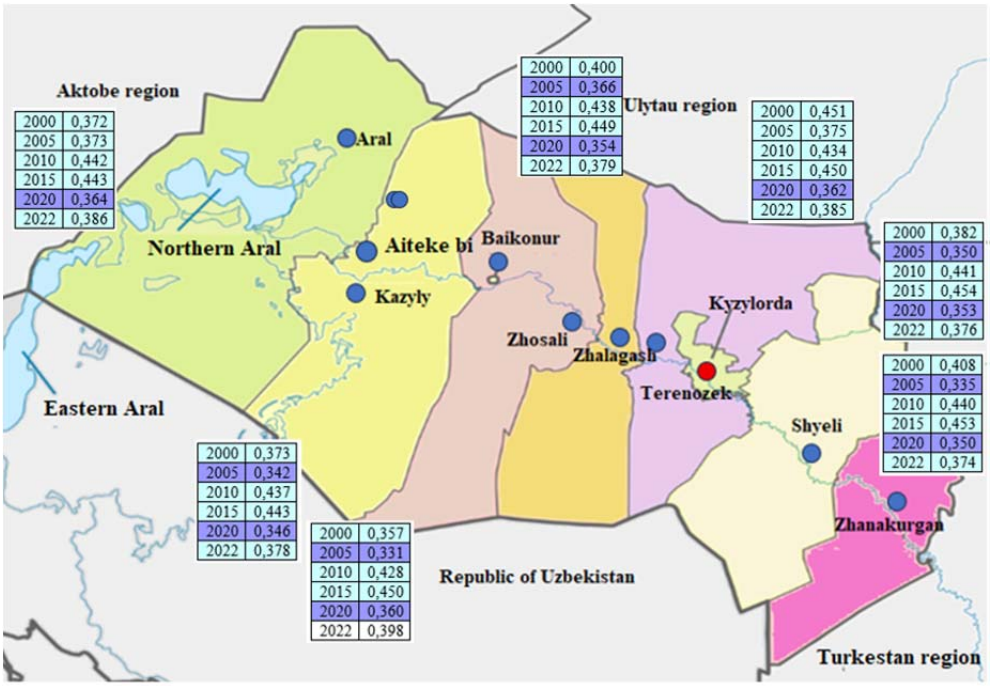
Based on the proposed methodology for calculating the integrated indicator of population health in the territory, which simultaneously takes into account the complex influence of various factors and summarizes information on various aspects of the health status of the population, their quantitative values were determined in the context of administrative districts of the Kyzylorda region in the period from 2000 to 2022, which was implemented in the Excel software shell (table 2).

Table 2 – An integrated indicator for assessing the health status of the population of the Kyzylorda region by administrative districts

Years	Administrative regions								Kyzylorda region
	Aral	Kazalinsky	Karmakchinsky	Zhalagashsky	Syr Darya	Shieliynskiy	Zhana-Kurgansky	city Kyzylorda	
2000	0.372	0.373	0.357	0.400	0.451	0.382	0.408	0.374	0.381
2001	0.372	0.395	0.407	0.386	0.396	0.349	0.379	0.374	0.370
2002	0.285	0.314	0.395	0.321	0.272	0.324	0.315	0.368	0.304
2003	0.304	0.297	0.261	0.335	0.317	0.307	0.358	0.390	0.323
2004	0.350	0.345	0.334	0.362	0.318	0.312	0.329	0.393	0.347
2005	0.373	0.342	0.331	0.366	0.375	0.350	0.335	0.264	0.328
2006	0.372	0.390	0.345	0.352	0.322	0.370	0.351	0.287	0.327
2007	0.350	0.356	0.402	0.307	0.388	0.407	0.320	0.402	0.355
2008	0.369	0.370	0.359	0.372	0.362	0.372	0.365	0.351	0.376
2009	0.427	0.424	0.417	0.434	0.421	0.431	0.422	0.413	0.438
2010	0.442	0.437	0.428	0.438	0.434	0.441	0.440	0.425	0.449
2011	0.456	0.458	0.457	0.465	0.460	0.466	0.460	0.450	0.473
2012	0.453	0.454	0.445	0.454	0.451	0.458	0.451	0.443	0.461
2013	0.462	0.457	0.456	0.461	0.459	0.463	0.456	0.453	0.468
2014	0.445	0.441	0.443	0.440	0.441	0.444	0.446	0.438	0.448
2015	0.443	0.443	0.450	0.449	0.450	0.454	0.453	0.446	0.455
2016	0.472	0.481	0.454	0.482	0.473	0.482	0.486	0.476	0.490
2017	0.353	0.352	0.364	0.346	0.353	0.348	0.354	0.371	0.348
2018	0.313	0.310	0.314	0.300	0.304	0.300	0.315	0.326	0.298
2019	0.316	0.307	0.317	0.301	0.305	0.300	0.308	0.328	0.300
2020	0.364	0.346	0.360	0.354	0.362	0.353	0.350	0.367	0.348
2021	0.375	0.372	0.385	0.380	0.376	0.372	0.373	0.390	0.369
2022	0.386	0.378	0.398	0.379	0.385	0.376	0.374	0.402	0.375

Calculations of the integrated indicator for assessing the health status of the population of Kyzylorda Oblast demonstrate significant spatial differentiation in quality of life both across the region as a whole and within administrative districts. An integrated assessment of population health across spatial and temporal aspects of Kyzylorda Oblast revealed that large administrative districts have approximately equal levels of integrated indicators. Most regions fell within the assessment range of 0.37–0.63 (satisfactory). The best integrated indicator value did not exceed 0.486, which is observed in the Zhanakurgan district, and the worst was within 0.285, which was observed in the Aralsk district.

It should be noted that the quantitative values of the integral indicator of population health in the Kyzylorda region, obtained in spatial and temporal aspects, broken down by administrative districts showed that out of 207 quantitative indicators, according to the Harrington scale, 89 are within the «poor» range, and 118 are «satisfactory», which allows us to identify the most problematic areas and determine the main development trends.



Map of the zoning of the Kyzylorda region by administrative districts based on the integrated indicator of population health

The integrated indicator of population health in a territory ($SPDIR_i$) is a specific value, which allows for its mapping and analysis of spatial changes. As part of the work to assess the integrated indicator of population health in the Kyzylorda $SPDIR_i$region by administrative district, a zoning map has been presented characterizing the health status of the population, based on a philosophical approach that involves the transition of quantitative changes. in qualitative (figures).

One of the tools for solving the problem of differentiating regions by the general level of health of the population can be a model of an integrated indicator, built on the basis of the main health indicators, which are annually published in the state statistical reporting of the State Enterprise on the Right of Economic Management «National Scientific Center for Health Development named after Sagadat Kairbekova» and on the basis of special indicators developed by individual regions of the Republic of Kazakhstan.

Discussion. The results of quantitative methods of assessing the weighting coefficients for types of morbidity in the Kyzylorda region, based on solving multi-criteria problems, made it possible to identify their practical significance in the context of administrative districts:

- In the Aral region, among the relatively high weighting coefficients, there are neoplastic diseases (NAD_i) - 0.3071 and diseases of the digestive system (GD_i) - 0.2056. The weighting coefficients for diseases registered for the first time in life (NR_i) are 0.1526, for diseases of the genitourinary system (UGD_i) - 0.1827, and the mortality rate (MR) is 0.1520.

- In the Kazalinsky district, relatively high weighting coefficients are observed for neoplastic diseases (NAD_i) - 0.3084 and diseases of the digestive system (GD_i) - 0.2194. The weighting coefficients for diseases registered for the first time in life (NRC_i) are 0.1533, for diseases of the genitourinary system (UGD_i) - 0.1569, and the mortality rate (NR_i) is 0.1621.

- In the Karmakshinsky district, relatively high weighting coefficients are noted for neoplastic diseases (NAD_i) - 0.2649, diseases of the genitourinary system (DGS) - 0.2303 and diseases of the digestive system (GD_i - 0.2351. The values for the NRC_i are 0.1309, and the mortality rate (NR_i) is 0.1388.

- In the Zhalagash district, relatively high weighting coefficients are observed for neoplastic diseases (NAD_i) - 0.3264 and diseases of the digestive system (GD_i) - 0.2675. The indicators for NRC_i are 0.1323, for UGD_i - 0.1766, the mortality rate (NR_i) is 0.0973.

- In the Syrdarya region, the weighting coefficients for neoplastic diseases (NAD_i) are 0.2919, for diseases of the genitourinary system (UGD_i) - 0.2190, for diseases of the digestive system (GD_i) - 0.2513. The values for the NRC_i are 0.1184, and the mortality rate (NR_i) is 0.11193.

- In the Shieli district, relatively high weighting coefficients are noted for neoplastic diseases (NAD_i) - 0.3318 and diseases of the digestive system (GD_i) - 0.2353. The indicators for NRC_i are 0.1346, for UGD_i - 0.1848, the mortality rate (NR_i) - 0.1135.

- In the territory of the Zhanakurgan district, relatively high weighting coefficients are characteristic of neoplastic diseases (NAD_i) - 0.3168 and diseases of the digestive system (GD_i) - 0.2246. The values for the NRC_i are 0.1413, for the UGD_i - 0.1612, the mortality rate (NR_i) - 0.1560.

- In the city of Kyzylorda, relatively high weighting coefficients are observed for neoplastic diseases (NAD_i) - 0.2667 and diseases of the digestive system (GD_i) - 0.2962. The indicators for NRC_i are 0.1317, for UGD_i - 0.1515, the mortality rate (NR_i) is 0.1539.

In general, in the Kyzylorda region, relatively high weighting coefficients are observed for neoplastic diseases (NAD_i) - 0.3511 and diseases of the digestive system (GD_i) - 0.2489. The weighting coefficients for diseases registered for the first time in life (NRC_i) are 0.1111, for diseases of the genitourinary system (UGD_i) - 0.1556, and the mortality rate (NR_i) is 0.1333.

The obtained results of the assessment of weighting coefficients for types of diseases in the Kyzylorda region in the context of administrative districts reflect the state of the environment, determined by the quality of surface water resources and atmospheric air, which perform important environmental functions for the population.

An analysis and assessment of the development of medical and demographic processes based on the time series of the integrated health indicator of the population of Kyzylorda Oblast by administrative district (Table 1) allows us to determine trends in their change over time. These trends were identified using the linear trend method and Microsoft software. Excel (Table 3).

Table 3 – Linear correlation model of the integral indicator of population health ($SPDIR_i$) of the Kyzylorda region by administrative districts

Administrative districts	Equation	Index determinations (R^2)
Aral	$SPDIR_i = 0{,}0018 \cdot SNY_i + 0{,}3637$	0.0477
Kazalinsky	$SPDIR_i = 0{,}0011 \cdot SNY_i + 0{,}3713$	0.0180
Karmakshinsky	$SPDIR_i = 0{,}0015 \cdot SNY_i + 0{,}3682$	0.0346
Zhalagashsky	$SPDIR_i = 0{,}0007 \cdot SNY_i + 0{,}3783$	0.0063
Syr Darya	$SPDIR_i = 0{,}0009 \cdot SNY_i + 0{,}3753$	0.0098
Shieliyinsky	$SPDIR_i = 0{,}0013 \cdot SNY_i + 0{,}3696$	0.0224
Zhanakurgan	$SPDIR_i = 0{,}0010 \cdot SNY_i + 0{,}3725$	0.0151
city Kyzylorda	$SPDIR_i = 0{,}0016 \cdot SNY_i + 0{,}3691$	0.0409
Kyzylorda region	$SPDIR_i = 0{,}0014 \cdot SNY_i + 0{,}3672$	0.0234

The results of research in the field of health care show (Table 2) that in the lower reaches of the Syr Darya River, within the Kyzylorda region, the integral indicator of population health ($SPDIR_i$) in the context of administrative districts, as a dynamic-stochastic process, can be represented by a regression equation of the following type:

$$SPDIR_i = 0{,}0018 \cdot SNY_i + 0{,}3637, \quad (6)$$

where $SPDIR_i$ is the integral indicator of population health; 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.

In equation (6), the first terms express the random component of population health development in spatial and temporal aspects, while the last term reflects the deterministic part of this process. This indicates the presence of a trend that is a function of time, which can serve as the basis for long-term forecasting of the state of healthcare in Kyzylorda Oblast by administrative district.

Based on the linear trend equation for the integral population health indicator ($SPDIR_i$), we can determine the minimum, maximum, and average arithmetic values, as well as the absolute growth ($AISI_i$), growth rate ($QRIUS_i$), and growth coefficient ($GRIUS_i$) of the studied indicators. These parameters allow

Table 4 – Statistical estimates of the trend of change in the integral indicator of population health by administrative districts of the Kyzylorda region of the Republic of Kazakhstan.

Administrative districts	Statistical characteristics			Statistical indicators		
	$SPDIR_i$		AVI_i	$AISI_i$	$QRIUS_i$	$GRIUS_i$
	max	min				
Aral	0.472	0.285	0.385	0.040	0.002	1.108
Kazalinsky	0.481	0.297	0.384	0.024	0.001	1.065
Karmakshinsky	0.457	0.261	0.386	0.033	0.001	1.089
Zhalagashsky	0.482	0.300	0.386	0.015	0.001	1.041
Syr Darya	0.473	0.272	0.386	0.020	0.001	1.053
Shieliyinsky	0.482	0.300	0.385	0.029	0.001	1.077
Zhanakurgan	0.486	0.308	0.385	0.022	0.001	1.059
city Kyzylorda	0.476	0.264	0.388	0.035	0.002	1.095
Kyzylorda region	0.490	0.298	0.384	0.031	0.001	1.084

us to identify the quantitative and qualitative characteristics of their change trends over a certain period of time (table 4).

An analysis of the dynamics of the integrated health indicator of the population of the Kyzylorda region by administrative district for the period 1932–2021 allows for a comprehensive assessment of the health status of the region's population in the current period:

- Aral region. The trend of change in the integral health indicator is positive: values vary from 0.372 to 0.386; arithmetic mean - 0.385; maximum - 0.472; minimum - 0.285. The absolute increase is – «+» 0.040, the growth rate is «+» 0.002, the growth coefficient is «+» 1.108 over 23 years.

- Kazalinsky district. The trend is positive: changes from 0.373 to 0.378; arithmetic mean - 0.386; maximum - 0.481; minimum - 0.297. Absolute increase – «+» 0.024, growth rate – «+» 0.001, growth coefficient – «+» 1.065 over 23 years.

- Karmakshinsky district. Positive trend: from 0.357 to 0.398; arithmetic mean - 0.386; maximum - 0.457; minimum - 0.261. Absolute increase – «+» 0.033, growth rate – «+» 0.001, growth coefficient – «+» 1.089 over 23 years.

- Zhalagash district. The trend is positive: from 0.400 to 0.379; arithmetic mean - 0.386; maximum - 0.482; minimum - 0.300. Absolute increase – «+» 0.015, growth rate – «+» 0.001, growth coefficient – «+» 1.041 over 23 years.

- Syrdarya district. The trend is positive: from 0.451 to 0.385; arithmetic mean - 0.386; maximum - 0.473; minimum - 0.272. Absolute increase – «+» 0.020, growth rate – «+» 0.001, growth coefficient – «+» 1.053 over 23 years.

- Shieli district. Positive trend: from 0.382 to 0.376; arithmetic mean - 0.385; maximum - 0.482; minimum - 0.300. Absolute increase – «+» 0.029, growth rate – «+» 0.001, growth coefficient – «+» 1.077 over 23 years.

- Zhanakurgan district. The trend is positive: from 0.408 to 0.374; arithmetic mean - 0.385; maximum - 0.486; minimum - 0.308. Absolute increase – «+» 0.022, growth rate – «+» 0.001, growth coefficient – «+» 1.059 over 23 years.

- The city of Kyzylorda. The trend is positive: from 0.304 to 0.402; arithmetic mean - 0.388; maximum - 0.476; minimum - 0.264. Absolute increase – «+» 0.035, growth rate – «+» 0.002, growth coefficient – «+» 1.095 over 23 years.

Overall, the trend in the Kyzylorda region is positive: from 0.381 to 0.375; arithmetic mean - 0.384; maximum - 0.490; minimum - 0.298. Absolute increase – «+» 0.031, growth rate – «+» 0.001, growth coefficient – «+» 1.084 over 23 years.

The resulting integrated health indicators for the Kyzylorda region's population, broken down by administrative district, are a valuable tool for assessing and forecasting the state of public health. They demonstrate the multidimensional nature of the data obtained and enable a comprehensive analysis of the territory, taking into account not only the absolute values of individual indicators but also the direction of their dynamics.

The statistical analysis of the main indicators of the state of health of the population and its integrated assessment of the Kyzylorda region by administrative districts, as well as the formulated conclusions, can serve as a tool for analyzing and forecasting the state of health of the population and be the most important guidelines for social policy and the healthcare system.

Conclusions. Based on the developed methodological approach, the created database and research results provide a ready-to-use tool for developing measures to ameliorate spatial differences in quality of life among the population of Kyzylorda Oblast across administrative districts. Furthermore, the database and research results can be updated and used by management and supervisory bodies to assess the integrated health indicator of the population; in particular, it can be used to annually determine quality of life rankings by district. A detailed analysis of the obtained calculated data in spatial and temporal aspects shows that the quantitative assessment of the quality of life can be improved to achieve greater objectivity by justifying a change in the number of morbidity indicators selected for assessment.

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ИНТЕГРАЛДЫҚ КӨРСЕТКІШ НЕГІЗІНДЕ ҚЫЗЫЛОРДА ОБЛЫСЫНДАҒЫ ХАЛЫҚ ДЕНСАУЛЫҒЫН КӨППАРАМЕТРЛІК БАҒАЛАУ

Аннотация. Зерттеу пәні - интегралдық көрсеткіш функциясын қолдана отырып, Қызылорда облысы халқының денсаулық жағдайын әкімшілік аудандар бойынша бағалау. Зерттеудің мақсаты - халық денсаулығын интегралдық көрсеткіші арқылы бағалаудың және аурудың түрі бойынша оның салмақтың көрсеткішін есептеу жүйесін әзірлеу. Зеттеуді жүргізу барысында жүйелік және салыстырмалы талдау әдістері, сондай-ақ математикалық және еліктеушілік үлгілері қолданылады.

Зерттеу барысында келесі нәтижелер алынды: халық денсаулығының бағалаудың интегралдық көрсеткішін және аурушаңдық түрлері үшін салмақтық көрсеткіштерді есептеудің әдістемелік жүйесі дайындалды; ұсынылған теориялық мақсаттар Қызылорда облысындағы 2000-2022 жылдар аралығындағы денсаулық сақтау бойынша ұзақ мерзімді ресми статистикалық деректерді пайдалана отырып тексерілді; алынған нәтижелер зерттеу кезеңінде Қызылорда облысы халқының денсаулық жағдайының қолайлы интегралдық көрсеткіштері бар әкімшілік аудандардың санының аз екенін көрсетті. Тұрақты бақалау режимінде қолданылатын халық денсаулығын кешенді бағалаудың әзірленген математикалық үлгілері мен есептеу жолдары Қызылорда облысындағы қоғамдық денсаулық сақтаудың аймақтық ерекшеліктерін түсінуге мүмкіндік береді. Қолданбалы әдістің артықшылықтары, ол стандартты статистикалық көрсеткіштерді пайдалану, нәтижелерді алудың және оларды түсіндірудің салыстырмалы қарапайымдылығы және талдау мақсаттарына байланысты түзету мүмкіндігі болып табылады.

Түйін сөздер: статистикалық көрсеткіштер; интегралдық денсаулық көрсеткіші; сызықтық теңдеу; денсаулық динамикасы.

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МНОГОПАРАМЕТРИЧЕСКАЯ ОЦЕНКА ЗДОРОВЬЯ НАСЕЛЕНИЯ КЫЗЫЛОРДИНСКОЙ ОБЛАСТИ НА ОСНОВЕ ИНТЕГРАЛЬНОГО ПОКАЗАТЕЛЯ

Аннотация. Исследованы оценки здоровья населения Кызылординской области в разрезе административных районов с использованием в качества функции интегрального показателя. Разработан алгоритм оценки интегрального показателя здоровья населения и весового коэффициента по видам заболеваемости. Использовались методы системного и сравнительного анализа, математического и имитационного моделирования. Разработан алгоритм оценки интегрального показателя здоровья населения и весового коэффициента по видам заболеваемости; апробации предложенных теоретических идей проводились с использованием многолетних официальных статистических данных здравоохранения Кызылординской области за 2000-2022 годы. Результаты показали, что административных районов, благоприятных по интегральным показателям состояния здоровья населения области в период исследования, не оказалось. Созданные алгоритм и модель интегральной оценки здоровья населения, применяемые в режиме мониторинга, позволяют ориентироваться в региональных особенностях общественного здоровья населения Кызылординской области. Достоинствами метода являются использование стандартных статистических параметров, относительная простота получения результатов и их интерпретации, а также возможность корректировки в зависимости от целей анализа.

Ключевые слова: статистические показатели, интегральный показатель здоровья, линейные модели, динамика состояния здоровья.