Comprehensive analysis of epidemiological

(By the class of the locomotor system) and environmental data

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ABSTRACT

The article describes the newly diagnosed incidence of the musculoskeletal system in the regions of the Republic of Kazakhstan (East Kazakhstan region) with the identification of risk levels, mapping, correlation of environmental factors and clinical and laboratory data on osteopenia diagnostics with the Omnisense-7000. A high incidence rate was detected in the Borodulikha district, close to the former Semipalatinsk nuclear test site and in the industrial city of Ridder, the center of the mining and metallurgical industry (zinc, lead, precious metals). To assess the risk of morbidity, an integrated approach is needed in assessing the factors of the hygienic, social, epigenemic environment.

Keywords: mapping, epidemiology, health, ecology, risk assessment

INTRODUCTION

Medico-ecological mapping as a general approach to the study of ecological features of territories in conjunction with techno-genic and anthropogenic load makes it possible to establish patterns of the effect of environmental pollution on the formation of pathology among the population of the regions. This can serve as a rationale for the development of preventive and recreational activities for the population, and plan the sequence of intervention by state institutions and local self-government bodies in addressing the rehabilitation and recovery of these territories [1, 2]. Carrying out stratification and ranking of territories by prevalence of pathology also allows the approach of revealing the dependence of indicators of population health and social and economic disadvantage of territories [3]. Medical-geographical mapping is performed on the basis of generalization of medical statistics, mainly in small scales, image methods for nosoareals - quality background. Cartograms can be formed on the basis of intensive morbidity indicators, the dynamics of changes in incidence in percent, methods of degrees of spatial clustering, with the analysis of "hot" and "cold points" with different statistical significance. The actual spread of diseases (the subject of nosogeographic mapping) may differ from the spread of specific risk factors, since the analysis of relationships should be based on the identification, if not all, of as many related factors as possible stratification and their integrated assessment in a ratio [4].

The constant interest in mapping the newly diagnosed incidence and prevalence of diseases is conditioned by two goals, first, monitoring the spatial effects of local disease risks, and secondly, investigating the relationship between morbidity and environmental agents. In modeling health effects, in particular mapping diseases, an ecological error can be observed because the relationship between the total incidence in the areal units and the average impact on these units is different from the relationship between the case of individual morbidity and the individual impact associated with it. Typically, populations at risk and morbidity (for example, case counts) are observed over areal units that are data linked to a block. The exposure data for various factors is usually a set of values from the monitoring site that are point data. Sometimes the discrepancy between the two types of data does not allow us to detect connections between the latter and the former. With an environmental error, a model approach or modeling of the exposure surface at the block level and the prediction of exposure at each block are applicable [5].

Diseases of the musculoskeletal system, like age-dependent diseases, are an important public health problem, in particular, osteoporosis is the most common metabolic bone disease. For more than 120 years, scientists and experts have been engaged in the problem of involute and metabolic changes in bone tissue, but the scale of the epidemic of this disease is growing exponentially [6, 7].

Purpose of work – carrying out medical and ecological mapping according to the newly diagnosed incidence of diseases of the musculoskeletal system and connective tissue in the regions of the Republic of Kazakhstan (RK) in conjunction with risk factors.

Materials and methods of research. The sources of information about the newly diagnosed incidence of the entire population of the Republic of Kazakhstan were the data obtained by the regional Republican centers of electronic health for the period between 2000 and 2015. The tertiary scale was used for mapping (with three levels: high, medium and low), when it was constructed, the average annual incidence rates were taken, with the lowest ($217.9\%_{ooo}$) and the highest ($6303.3\%_{ooo}$) rates for Kazakhstan. Hygienic and social indicators affecting the incidence rate were obtained from the Department of Statistics of the Republic of Kazakhstan. Statistical processing of the obtained results was carried out with the help of Statistica-10.

Results and discussion. Among the studied 14 regions of Kazakhstan, the level of newly diagnosed incidence of the musculoskeletal system (MSS), between 2000-2015 the East Kazakhstan region (EKR) was estimated as average (2852%). High incidence rates in the East Kazakhstan region were detected in Ridder and Borodulikha district (66 rural settlements) with a significant excess of the average regional level (Figure 1). The average level is registered in the cities of Ust-Kamenogorsk, Semipalatinsk and Kurchatov, as well as in five districts of the region (Abay, Glubokovsky, Zharma, Kurchum and Ulan) with a reliable national level (table 1, figure 2). In the remaining nine districts, a low incidence rate was observed.

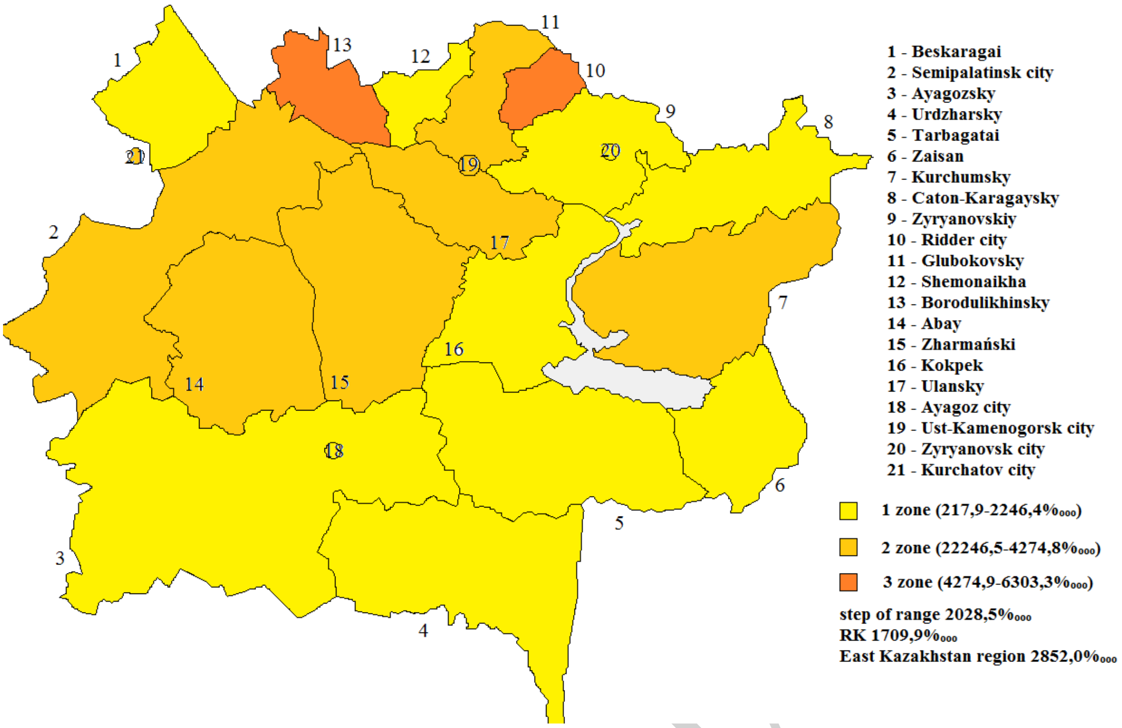

Figure 1 - Cartogram of the newly diagnosed incidence of the musculoskeletal system in the East Kazakhstan region.

Table 1 - Mean annual for the first time detected morbidity of the musculoskeletal system of the whole population in% of EKR for 2000-2015.

№	Regions	M±m	CI 95%	min	max	RA RK	RA region
1	Ust-Kamenogorsk city	2986,6±63,0*	2894,1-3079,2	2584,8	3331,9	1,7	1,0
2	Kurchatov	2543,1±318,5*	2074,9-3011,4	410	4177,3	1,5	0,9
3	Ridder	4601,3±259,7*^{x}	4219,5-4983,0	3536,5	5898,9	2,7	1,6
4	Semipalatinsk	3491,9±282,0*^{x}	3077,4-3906,4	2041,4	4729,5	2,0	1,2
5	Abay	2841,5±468,6*	2152,6-3530,4	907,8	5440	1,7	1,0
6	Ayagoz	1887,6±131,6	1694,2-2081,1	1190	2569,5	1,1	0,7
7	Beskaragai	1596,4±120,0	1420,0-1772,8	1035	2247,9	0,9	0,6
8	Borodulikhinsky	6303,3±377,3*^{x}	5748,6-6857,9	4475,3	8320,3	3,7	2,2
9	Glubokovsky	3039,8±202,5*	2742,1-3337,5	1852,5	3867,2	1,8	1,1
10	Zharmański	2985,4±229,2*	2648,4-3322,3	1720	4088,5	1,7	1,0
11	Zaisan	1934,3±154,6	1707,0-2161,5	1209,6	2731,1	1,1	0,7
12	Zyryanovskiy	1873,5±220,0	1550,0-2197,0	1270	4202,2	1,1	0,7
13	Kokpek	2096,4±231,5	1756,1-2436,6	955,8	3738	1,2	0,7
14	Kurchumsky	2437,5±241,5*	2082,5-2792,5	1429,7	4280	1,4	0,9
15	Caton-Karagaysky	1702,3±167,0	1456,9-1947,7	870	2556,9	1,0	0,6
16	Tarbagatai	1966,3±98,2*	1822,0-2110,7	1656,3	2665,6	1,1	0,7
17	Ulansky	2369,8±138,2*	2166,6-2573,0	1729,5	3644,9	1,4	0,8
18	Urdzharsky	2034,2±156,3*	1804,4-2264,0	1390	3041,6	1,2	0,7
19	Shemonaikha	1703,0±180,9	1437,0-1969,0	835,9	2861,4	1,0	0,6
20	East Kazakhstan region	2852,0±80,7*	2733,3-2970,7	2450,7	3289,7	1,7	
21	RK	1709,9±46,4	1641,6-1778,1	1503,4	2024,4		

Note: * - a significant excess of the RK level, x - a significant excess of the area indicator

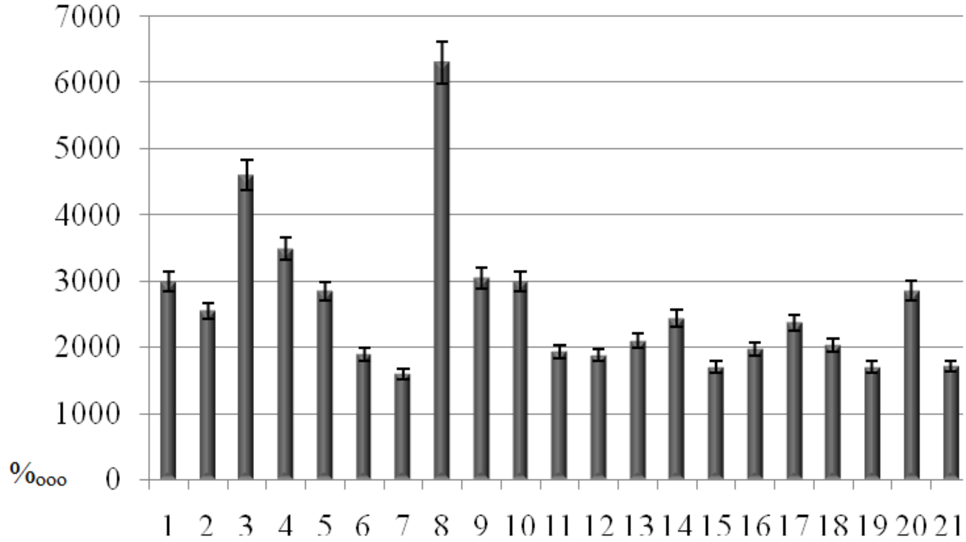

Figure 2 - Average annual incidence of the whole population in% 000 in the EKR for 2000-2015.
Note: 1 - Ust-Kamenogorsk, 2 - Kurchatov, 3 - Ridder, 4 - Semipalatinsk, 5 - Abay, 6 - Ayagoz, 7 - Beskaragai, 8 - Borodulikhinsky, 9 - Glubokovsky, 10 - 12, Zyryansky, 13 - Kokpeksky, 14 - Kurchumsky, 15 - Katon-Karagai, 16 - Tarbagatai, 17 - Ulan, 18 - Urdzharskiy, 19 - Shemonaikha district, 20 - East Kazakhstan region, 21 - the Republic of Kazakhstan

Over the course of 15 years of observation in the region, there was no significant increase in morbidity, although in several regions the increase was significant (Table 2). The greatest increase in MSS diseases was observed in Kurchatov (6 times), Zharma and Katon-Karagai districts (2.3-2.4 times). In Abay, Kurchum and Shemonaikha, by 76.9%, 61.1% and 42.6% over 15 years, there was a decrease in the incidence of MSS in the population.

Table 2 - Dynamics of the primary incidence of the whole population by the disease class of MSS in%ooo according to the EKR

№	2000/ 2001	2002/ 2003	2004/ 2005	2006/ 2007	2008/ 2009	2010/ 2011	2012/ 2013	2014/ 2015	Rate of decrease / increase in%
1	2870	3153,1	3197,8	2989	2584,8	2857,5	3019,2	3029	+8,6
	2830,3	2679,6	3331,9	2945	3134,6	2916,7	3130,8	3116,9	
2	410	2894,7	2294,4	4177,3	2132,1	2729	2823,3	2895,9	↑ 6 times
	516,1	2244,9	3879,4	2259,6	3278,5	2887,1	2804,6	2463,1	
3	4740	5591,4	4573,3	4148,5	3851,2	3536,5	4928,9	5898,9	+17,0
	5851,5	3996,8	3995,1	3898,2	3555,2	4442,1	5066,4	5546,3	
4	2470	3906,5	4729,5	4423,8	3963	3898,7	2928,8	2041,4	-11%
	2932,2	3822,2	4300,5	4600,8	3779,6	3353,5	2522,3	2197,7	
5	5440	5081,4	3600	3360,3	3192,4	1927,6	907,8	1158,6	-76,9
	4241,4	3623,5	3822,6	2934,2	2484,1	1312	1118,3	1259,2	
6	1190	1402,8	2071,7	2569,5	2406,4	2259,8	1780,9	1587	+41,7
	1362,7	2236,9	1958,3	2201,2	2190,4	1558,1	1740,1	1686,4	
7	1620	1777,4	1035	1291,5	1511,6	2244,2	2247,9	1761,8	-13,6
	1525,9	1396,2	1176,9	1360,8	1255,9	2118,4	1819,4	1399,1	

8	5340	6403,1	4565,3	6434,2	8063,9	7557,3	6592,5	6515,1	+7,7
	5034	4475,3	5138,2	6975,9	8320,3	6894,4	6792,2	5750,4	
9	1960	2980,3	3560,5	3701,9	3204,6	3128,3	2594,9	2415,9	+21,9
	1852,5	3491,6	3793,5	3867,2	3271,2	3228,7	3197,9	2388,5	
10	1720	4088,5	2177,9	2972,1	2191,5	3548,3	3314,4	3902	↑ 2,3 times
	2479,1	2906,9	2461,5	2615,4	2630,6	3178,6	3603,9	3975,6	
11	1880	1804,6	2731,1	2376,8	2046,7	2063,6	1784,9	1209,6	-31,1
	1750,6	2474	2643	2065,7	1297,2	2148,1	1376,4	1296,2	
12	1270	4202,2	1518,9	1874,9	1528	2080,5	1990,5	1667,7	+4,9
	1702,6	1592,7	1395,4	2171	2168,8	1751,2	1729,6	1331,9	
13	2290	2347,6	2046,5	2681,8	3738	1733,7	1615,6	955,8	-52,1
	2267,3	1691,8	2337,9	2809,2	2750,7	1915,3	1263,4	1097,1	
14	4280	2895,5	2815,2	2495,6	2338,9	2192,9	1678,8	1556,7	-61,1
	3296,3	3099,8	2675,8	2542,4	2115,3	1922,9	1429,7	1664,1	
15	870	1432,6	1772,2	1310,1	1267,8	2047,5	2493,8	2300,4	↑ 2,4 times
	1267,3	1494,1	1090,5	1753,8	1357,9	2556,9	2159,8	2062,2	
16	1980	1757,5	1905	1690,4	1665,8	1995,7	2342,6	2525,2	-9,8
	1811,6	2003,2	1888,9	1656,3	1720,5	2067,3	2665,6	1785,5	
17	2000	2574,4	2547,6	2392,3	2689,2	2229,7	2525,3	1913,7	-13,5
	2157,9	3644,9	2299,6	2226,8	2207,5	2553,8	2224,9	1729,5	
18	1390	3041,6	2491,3	1502,7	1491,3	2673,2	2304,6	2005,7	+31,4
	1639,9	2430,8	1990,8	1427,4	1896,2	2151,2	2284,4	1826	
19	2140	2861,4	1567	1592,9	1091,1	835,9	1839,4	1459,6	-42,6
	2769,9	2015	1520,4	1430	1140,8	1867,2	1889,6	1227,7	
20	2450,7	3289,7	3129,9	3083,8	2851,8	2993,3	2786,1	2514,5	+1,2
	2595,8	2865,5	3035,7	3091	2897,7	2854,1	2713,8	2479,1	
21	1546,4	2024,4	1871,3	1773,3	1748,6	1718,1	1603,7	1503,4	+5,5
	1561,6	1799,9	1836,1	1800,7	1774,1	1616	1549	1631,7	

Note: 1 - Ust-Kamenogorsk, 2 - Kurchatov, 3 - Ridder, 4 - Semipalatinsk, 5 - Abay, 6 - Ayagoz, 7 - Beskaragai, 8 - Borodulikhinsky, 9 - Glubokovsky, 10 - 12, Zyryansky, 13 - Kokpeksky, 14 - Kurchumsky, 15 - Katon-Karagai, 16 - Tarbagatai, 17 - Ulan, 18 - Urdzharskiy, 19 - Shemonaikha district, 20 - East Kazakhstan region, 21 - the Republic of Kazakhstan.

When examining adults (16-79 years) in Ust-Kamenogorsk, the share of people with osteopenia and osteoporosis was 35.4%. Osteoporosis (according to the T-index of the radius) in the group of young people was found in 6.71%, in the working age group (30-59 years) – in 44.3%, among the elderly (60-79 years) - in 48.99 %. The prevalence of osteopenia among people at different age groups was 8.93%, 60.71% and 30.36%, respectively. Osteoporosis of the tibia among young people was found in 4.6% of the examined, among those of working age - in 59.77% and among the elderly - in 35.63%. Osteopenia was diagnosed, respectively, in 9.26%, in 56.79% and in 33.95% of individuals. In the cities of Central, Western and Southern Kazakhstan: Ekibastuz, Aktau, Stepnogorsk, Karaganda, Taraz, the proportions of normal indices for ostendusitometry were higher than in Ust-Kamenogorsk and amounted to 32.5% - 59.7%. According to a number of researchers, osteopenia and osteoporosis are more often diagnosed (1.5 times) in children from regions with a polluted environment. At the same time, molecular genetic data indicate the role and genetic component in the pathogenesis of osteopenic syndrome [8]. It is known that living in contaminated areas determines a lower level of alkaline bone phosphatase. High calcium intake (more than 5000 mg / week) can reduce the risk of osteopenia in areas with air pollution [9].

Scientists have found that environmental pollution by heavy metals (lead, zinc, copper and cadmium), air pollution by carbon monoxide and nitrogen dioxide can lead to a decrease in bone density [10, 11]. The high sclerotin level found by immunohistochemistry correlates with the accumulation of heavy metals found in the bones of patients with osteoporosis, which indicates a molecular relationship between the accumulation of heavy metals and the violation of bone metabolism at the cellular, molecular and epigenetic levels. The atmospheric pollution index was 9 cu in Ust-Kamenogorsk city during the year 2017, the standard index was 5-10 cu, and the highest frequency was 20-49%, which characterizes the level of atmospheric air pollution as high. In comparison with the year 2016 the level of air pollution increased. In Ridder, similar indicators were equal to 5, 3 and 5%, respectively [12]. The industrial city of Ridder is the center of the mining and metallurgical industry (with extraction of zinc, lead and precious metals). The Borodulikha district with a high incidence rate is a nearby area to the Semipalatinsk nuclear test site, the Zhezkent ore mining and processing complex, engaged in the extraction of polymetallic ores, and a number of processing enterprises operate in the region. Between the level of morbidity of the population's MSS and the number of enterprises that increased pollutant emissions in the East Kazakhstan region and Ust-Kamenogorsk, a positive relationship of a moderate degree was revealed. For the period between 2000 and 2015. The number of enterprises polluting the environment increased 2.1 times in the region (from 235 to 499), in Ust-Kamenogorsk from 89 to 125 (by 40.4%). The volume of pollutants discharged from all stationary sources of pollution in the EKR in 2015 amounted to 1696763.9 tons (5.6% of the volume in the Republic of Kazakhstan), while the amount of pollutants thrown without treatment was 93475.9 tons (5.5% of the volume of pollutants). The volume of emissions polluting the atmosphere of the East Kazakhstan region amounted to 127160.03 tons (7.5% of the volume of pollutants). For a number of selected pollutants, a scoping assessment was made (Table 3). In regions with high and medium incidence rates, high and medium levels of contamination for one or another component have been identified. Attention is drawn to the high levels of oxides of sulfur and nitrogen, hydrogen sulfide, ammonia and hydrocarbons in the air of Ust-Kamenogorsk. A slightly less gassed atmosphere in Semipalatinsk, but here there is a high level of finely divided dust. Finely-dispersed PM-5 dust is present in the air atmosphere of Borodulikha, Beskaragai, Zharma and Zaisan districts.

Table 3 - Assessment of pollution levels in the EKR

Regions	NO_2	PM-10	PM-5	CO	H_2S	SO_2	NH_3	C_xH_x
Ust-Kamenogorsk city	3	1	1	3	3	3	3	3
Kurchatov	1	1	1	1	1	1	1	1
Ridder	1	3	1	1	1	1	1	1
Semipalatinsk	2	3	3	3	1	1	3	2
Abay	1	1	1	1	1	1	1	1
Ayagoz	1	1	1	1	2	1	1	1
Beskaragai	1	1	2	1	1	1	1	1
Borodulikhinsky	1	1	3	1	1	1	1	1
Glubokovsky	1	1	1	1	1	1	1	1
Zharmański	1	1	2	1	1	1	1	1
Zaisan	1	1	2	1	1	1	1	2

Zyryanovskiy	3	1	1	1	1	1	1	1
Kokpek	1	1	1	1	1	1	1	1
Kurchumsky	1	1	1	1	1	1	1	1
Caton-Karagaysky	1	1	1	1	1	1	1	1
Tarbagatai	1	1	1	1	1	1	1	1
Ulansky	1	1	1	1	1	1	3	1
Urdzharsky	1	1	1	1	3	1	1	1
Shemonaikha	1	2	1	1	1	1	1	1

The share of workers employed in hazardous working conditions in EKR in 2007-2016. Amounted to 27.8%, in conditions with high dust and gas content - 14.2%, with heavy physical labor - 6.3%. The level of prevalence of occupational morbidity for the period between 2007-2016, in the East Kazakhstan region was 211.9 per 10 thousand workers, of which 12.5% are attributed to diseases of the musculoskeletal system.

Causes of a high level of MSS diseases can also be factors of a metabolic nature. Thus, in 2008 the Kazakh Academy of Nutrition studied the level of consumption of dairy food products (g / day) among the population. It was low (155 g / day for men, 146 g / day for women), which is a significant risk factor for osteoporosis [13]. We have identified a reverse moderate relationship between the consumption of dairy products in residents in the EKR and their morbidity in the musculoskeletal system. During the years 2000 to 2015, consumption of dairy products in the region increased by 22.2% (from 122.4 liters per capita per year to 149.6 liters), especially in those with incomes below the subsistence minimum (1.6 times).

CONCLUSION

High levels of morbidity in age-dependent diseases of the musculoskeletal system in the regions of the Republic of Kazakhstan and osteopenia revealed in ultrasound-osteodensitometry corresponded to high levels of anthropogenic pollution of atmospheric air recorded at the stations of environmental monitoring. The direct moderate degree of correlation between the environmental pollution indices and MSS incidence and the inverse moderate degree of correlation between the consumption of dairy products and diseases of MSS has been revealed. For an integrated assessment of the incidence risk, an integrated approach (hygienic, social and epigenetic) is needed in the assessment of factors, also needed is a creation of a program module for the scoring of risk factors with correlation analysis.

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