ЭКОНОМИЧЕСКАЯ И СОЦИАЛЬНАЯ ГЕОГРАФИЯ

ECONOMIC AND SOCIAL GEOGRAPHY

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INFLUENCE OF HARMFUL ENVIRONMENTAL FACTORS ON THE RATE OF INCIDENCE OF CHILDREN IN KARAKALPAKSTAN

Abstract. Analysis of the main ecological and hygienic environmental factors affecting the incidence rates of children under 14 years of age in the Republic of Karakalpakstan in 2009-2018 found that the primary incidence of children under 14 years of age depends on the chemical pollution of water in open reservoirs in Northern ($r_{xy} = 0.69$), Central ($r_{xy} = 0.4$) zones and in general in the Republic of Karakalpakstan ($r_{xy} = 0.94$). Primary incidence in children under 14 years old in the Republic of Karakalpakstan with an average depended ($r_{xy} = 0.49$) on the chemical pollution of tap water and strongly depended in the second five-year period ($r_{xy} = 0.94$). The dependence was found in 3 districts of the Northern zone and 2 districts of the Southern zone. An explicit dependence of the dynamics of the primary incidence in children under 14 years of age on the chemical pollution of the water of wells was found in 2 districts of the Northern zone, 2 districts of the Southern zone. In the Central Zone, such dependence in the first five-year plan was of medium strength, in the second five-year plan - strong. The dependence of the average strength in the Republic of Karakalpakstan was revealed in the second five-year plan. The dynamics of primary incidence in children under 14 years of age had a dependence on the chemical pollution of the atmospheric air in the Kungrad district, in the Western zone, in the city of Nukus, Nukus, Khodjeyli districts, in the Central zone, in the Turtkul district of the Southern zone, as well as a strong dependence in the Republic of Karakalpakstan during the second five-year plan.

Key words: primary incidence, chemical pollution, water of open reservoirs, tap water, well water, atmospheric air, dependence, correlations.

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ВЛИЯНИЕ ВРЕДНЫХ ФАКТОРОВ ОКРУЖАЮЩЕЙ СРЕДЫ НА ДЕТСКУЮ ЗАБОЛЕВАЕМОСТЬ В КАРАКАЛПАКСТАНЕ

Аннотация. Анализ основных эколого-гигиенических факторов окружающей среды, влияющих на показатели заболеваемости детей до 14 лет в Республике Каракалпакстан, за 2009-2018 гг. показал, что первичная заболеваемость детей до 14 лет зависит от химического загрязнения воды открытых водоёмов в Северной ($r_{xy} = 0,69$), Центральной ($r_{xy} = 0,4$) зонах и в целом по Республике Каракалпакстан ($r_{xy} = 0,94$). Первичная заболеваемость детей до 14 лет в Республике Каракалпакстан в среднем зависела ($rxy = 0,49$) от химического загрязнения водопроводной воды и сильно зависела во второй пятилетке ($rxy = 0,94$). Зависимость выявлена в 3 районах Северной зоны и в 2 районах Южной зоны региона. Выявлена явная зависимость

динамики первичной заболеваемости детей до 14 лет от химического загрязнения воды колодцев в 2 районах Северной зоны и в 2 районах Южной зоны Каракалпакстана. В Центральной зоне региона такая зависимость в первом пятилетии исследуемого периода была средней силы, во втором пятилетии - сильной. Зависимость средней силы по Республике Каракалпакстан выявлена во втором пятилетии. Динамика первичной заболеваемости детей до 14 лет имела зависимость от химического загрязнения атмосферного воздуха в Кунградском районе (Западная зона), в г. Нукусе, Нукусском, Ходжейлийском районах (Центральная зона), в Туркульском районе (Южная зона), а также сильная зависимость в среднем по Республике Каракалпакстан в годы второго пятилетия.

Ключевые слова: первичная заболеваемость, химическое загрязнение, вода открытых водоемов, водопроводная вода, колодезная вода, атмосферный воздух, зависимость, корреляции.

Introduction and problem statement. At the Medical Institute of Karakalpakstan, scientific research continues to identify and assess certain qualitative indicators of environmental objects that lead to pollution of the human body and affect the formation of incidence levels in the child population of the Republic of Karakalpakstan (hereinafter - RK).

It seems to us that primary incidence indicators are more suitable for studying the influence of certain harmful environmental factors on the level of incidence in children, because many other factors, such as socio-economic, cultural and household factors, genetic factors, the level of medical care, the availability of medical personnel, etc., can affect the indicators of general incidence [1, 10, 11, 14].

Taking this circumstance into account, we have analyzed the indicators of primary incidence in children under 14 years of age in the RK for 2009-2018 in the context of districts [6, 7], by years and two five-year periods. The same principle has been applied in relation to the analysis of morbidity for other individual nosological forms of pathologies.

Study of the problem. The problems of the impact of the environment on the health of the population are widely covered in the world and in the scientific literature of Uzbekistan. Relatively more scientific research in this area has been devoted to the deterioration of the ecological situation as a result of environmental pollution [3, 6, 7, 12, 13].

The aim and objectives of the work. The aim of scientific research is to study the effect of pollution of environmental objects (water of open reservoirs - the Amudarya river and canals, tap and well water, atmospheric air, etc.) on the level of primary incidence in children under 14 years old in dynamics for 2009-2018. Administrative territories (cities, districts and zones) and population groups that are vulnerable to pollution are identified, and practical recommendations are developed to mitigate the effects of environmental pollution on children's health.

Materials and research methods. Statistical materials of the Ministry of Health of the RK and Republic of Uzbekistan (RUz), the Republican Center for State Sanitary-Epidemiological Surveillance of the RK (RC SSES RK), the laboratory complex of which has state certification and accreditation, were used.

The studies used epidemiological, hygienic and statistical research methods [2, 4, 5]. In order to increase the representativeness of the results obtained, the studied 10-year period is conventionally divided into 2 five-year plans: 2009-2013 and 2014-2018.

Taking into account significant socio-economic differences, the administrative territory of the RK is conditionally divided into 4 zones: into the Western zone (Muynak, Kungrad, Kanlykul and Shumanay districts), the Northern zone (Takhtakupyr, Karauzyak, Chimbay and Kegeyli districts), the Central zone (Nukus city, Nukus, Khodjeyli and Takhiatash districts), as well as the Southern zone (Amudarya Beruniy, Ellikkala and Turtkul districts).

Results. The analysis of indicators of the primary incidence of the child population of the RK for 2009-2018 in the context of districts and conventionally identified zones, its dynamics by years and two five-year periods (Table 1) showed that the average level of primary incidence in children per 1000 child population for 2016-2018 was in the RUz - 585.9, in the RK - 478.1 i.e. 22% lower than in RUz.

Table 1

Indicators of primary incidence in children under 14 years old per 100 000

City, districts	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Muynak	353.9	418.8	508.6	414.1	463.7	529.2	544.4	473.8	354.3	499.9
Kungrad	533.9	469.6	487.4	458.0	427.5	400.6	347.2	449.2	**1823.6**	462.0
Kanlykul	508.4	341.4	623.5	457.4	402.1	476.7	550.8	430.7	190.7	451.0
Shumanay	270.7	331.4	574.8	458.5	456.5	463.5	459.0	**962.4**	**948.6**	**834.3**
Western zone	416.7	390.7	548.6	447.0	437.5	467.5	475.4	579.0	**829.3**	561.8
Takhtakupyr	483.5	554.9	**688.9**	637.1	654.4	658.9	**683.1**	688.2	366.4	**735.5**
Karauzyak	**670.7**	587.6	**771.5**	**994.3**	657.5	**689.2**	593.5	412.4	548.1	398.4
Chimbay	208.2	270.6	237.7	208.6	168.7	174.4	194.4	421.7	**892.3**	477.8
Kegeyli	537.3	554.4	402.4	393.0	297.3	287.7	334.1	507.5	379.7	494.6
Northern zone	474.9	491.9	525.1	558.3	444.5	452.6	451.3	507.5	546.6	526.6
Nukus city	292.7	299.9	281.5	280.3	303.0	411.4	393.8	283.5	283.7	289.5
Nukus district	414.7	475.0	511.5	467.9	392.4	425.5	504.2	541.1	281.2	555.9
Khodjeyli	589.6	538.4	494.0	548.3	451.9	339.9	359.6	431.9	606.8	318.7
Takhiatash	542.1	470.0	600.0	568.6	x	x	x	x	122.3	396.5
Central zone	459.8	445.8	471.8	466.3	382.4	392.3	419.2	418.8	323.5	390.2
Amudarya	345.5	421.8	574.8	**663.8**	498.4	376.0	388.2	**631.9**	**969.3**	557.4
Beruni	512.0	579.5	**641.0**	**669.3**	**700.1**	**694.4**	**735.4**	482.9	617.1	459.1
Ellikkala	240.3	367.0	367.1	395.9	348.7	514.3	511.7	**673.9**	533.5	**688.9**
Turtkul	**614.2**	**639.2**	570.1	**639.0**	620.2	**652.1**	605.9	523.6	538.8	436.2
Southern zone	428.0	501.9	544.3	599.2	541.9	559.2	560.3	578.1	**664.7**	535.4
RK	430.9	450.5	478.4	493.8	446.4	461.6	460.2	490.1	470.3	473.9

Note: x-Takhiatash was included in the Khodjeyli district
Source: Statistical collections of the Institute of Health and Medical Statistics of the Ministry of Health of the Republic of Karakalpakstan [16]

At present, the provision of the population of the RK with centralized water supply is about 60%, the rest of the population uses water from open reservoirs and well water, mainly in the winter months. One third of the wells has a mineralization of up to 3 mg/l, another third - from 3 to 6 mg/l (suitable for economic purposes) and the remaining one third - over 6 mg/l - unsuitable for drinking and household purposes. Well mineralization depends on proximity to freshwater open water.

We have studied the dynamics of the chemical pollution of water in open reservoirs by districts and zones of the RK for 2009-2018, for the subsequent determination of its impact on the primary incidence of children (Table 2).

The level of chemical pollution of water in open reservoirs is increasing over the years, especially in the northern and southern zones of the RK.

Comparison of the dynamics of indicators of primary incidence in children under 14 years old (inclusive) of the RK for 2009-2018 with indicators of chemical pollution of water in open reservoirs showed the following results.

In general, in the RK, the primary incidence in children under 14 years of age for the studied period directly depended on the chemical pollution of water in open reservoirs with an average correlation strength according to the Pearson method [9, 15] ($r_{xy} = 0.49$) and had a strong dependence in the second (2014-2018) five-year period ($r_{xy} = 0.94$), which is clearly shown in Figure 1.
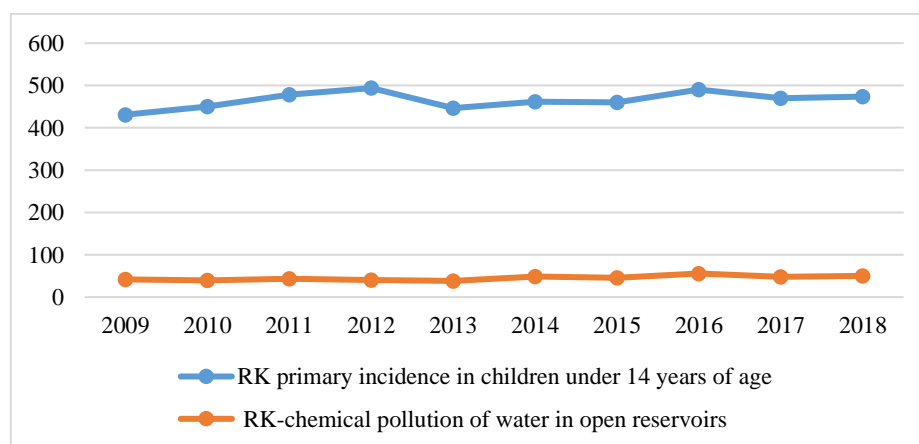
Percentage of water samples from open reservoirs that do not meet hygienic requirements in terms of chemical indicators for 2009-2018

City, districts	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Muynak	60.8	24.3	19.4	8.3	16.7	36.9	29.9	17.0	18.2	10.6
Kungrad	25.4	30.1	37.3	48.8	41.3	7.6	0.9	28.3	20.2	32.0
Kanlykul	73.5	100	100	100	100	100	96.4	100	100	100
Shumanay	29.4	30.8	36.9	33.3	36.2	28.2	31.3	31.7	30.1	45.8
Western zone	47.3	46.3	48.4	47.6	48.6	43.2	39.6	44.3	42.1	47.1
Takhtakupyr	100	72.5	100	100	100	100	100	100	100	100
Karauzyak	46.0	42.9	31.0	35.8	31.2	23.3	36.8	22.5	26.0	27.3
Chimbay	4.8	15.3	13.6	6.3	1.5	9.6	19.8	18.8	12.6	15.5
Kegeyli	11.1	20.0	0.0	0.0	26.3	36.4	71.4	75.0	94.0	76.6
Northern zone	40.5	37.7	36.2	35.5	39.8	42.3	57.0	54.1	58.2	54.9
Nukus city	23.1	12.2	37.5	27.3	31.4	24.7	41.9	40.8	45.1	41.4
Nukus district	75.0	50.0	77.8	52.2	100	77.8	13.0	95.0	100	84.3
Khodjeyli	20.7	28.9	12.9	10.3	14.3	21.9	30.2	31.5	49.5	51.4
Takhiatash	16.3	0.0	43.3	36.4	x	x	x	x	75.0	21.0
Central zone	33.8	22.8	42.9	31.6	48.6	41.5	28.4	55.8	67.4	49.5
Amudarya	72.2	89.9	97.3	5.8	30.6	78.0	81.1	77.5	73.6	63.5
Beruni	69.0	51.0	82.0	83.6	90.3	59.1	63.3	78.0	26.7	69.0
Ellikkala	20.0	83.3	95.8	0.0	85.7	25.7	40.9	37.8	100	100
Turtkul	100	82.9	100	100	100	91.7	70.0	87.0	100	100
Southern zone	65.3	76.8	93.8	47.4	76.7	63.6	63.8	70.1	75.1	83.1
RK	41.9	39.4	43.5	31.3	38.3	48.7	45.4	55.8	47.9	49.9

Source: Materials of laboratory control of environmental objects of the Republican Center of SSES of the Ministry of Health of the RK [8]

Western zone. The dynamics of the levels of primary incidence in children under 14 years of age in the Muynak district in 2009-2018 had a direct and average dependence (r_{xy} = 0.47) on the chemical pollution of open water bodies. The dependence between these indicators in the Shumanay district in the first five-year period was strong (r_{xy} = 0.94), and weakened in the second five-year period (r_{xy} = 0.30). In the western zone in the first five-year period, the dependence was of medium strength (r_{xy} = 0.69).
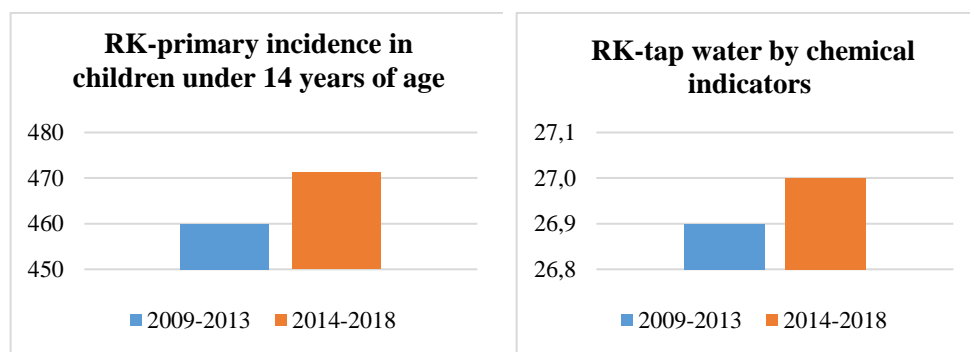

Fig. 1. Dynamics of indicators of primary incidence in children under 14 years old and % of non-normative water samples from open reservoirs by chemical indicators for 2009-2018 in the RK

Northern zone. The dynamics of the levels of primary incidence in children under 14 years of age in the Karauzyak district over a 10-year period had an average strength ($r_{xy} = 0.34$) dependence on the chemical pollution of water in open reservoirs. A similar dependence took place in the Chimbay district in the 1st five-year period ($r_{xy} = 0.30$), but in the second five-year period it increased significantly ($r_{xy} = 0.96$). The dependence of the average strength ($r_{xy} = 0.53$) between these indicators in the second five-year period took place in the Kegeyli district.

Central zone. The dynamics of the levels of primary incidence in children under 14 years old in the Khodjeyli district in the first five-year period (2009-2013) had a direct and medium-strength dependence ($r_{xy} = 0.32$) on the chemical pollution of water in open reservoirs, in the second five-year period ($r_{xy} = 0.4$).

Southern zone. The dynamics of the levels of primary morbidity in children under 14 years of age in the Beruni district in the first five-year period (2009-2013) had a direct and strong dependence ($r_{xy} = 0.73$) on the chemical pollution of water in open reservoirs. A medium-strength dependence between these indicators took place in the Ellikkala district in the second five-year period ($r_{xy} = 0.31$).

An explicit dependence of the dynamics of primary incidence on the chemical pollution of tap water when comparing two five-year plans can be traced in the RK (Fig. 2).

Fig. 2. Dynamics of primary incidence indicators for children under 14 years old per 100 000 people and % of non-normative samples of tap water by chemical indicators for 2009-2013 and 2014-2018 in RK.

Western zone. The dynamics of the levels of primary incidence in children under 14 years of age in the Muynak district in 2014-2018 had a direct and medium-strength dependence ($r_{xy} = 0.5$) on the chemical pollution of tap water. The dependence between these indicators in the Kanlykul district was strong and amounted to ($r_{xy} = 0.71$).

The dynamics of the levels of primary incidence in children under 14 years old in the Kungrad district in the first five-year period (2009-2013) had a direct and medium-strength dependence ($r_{xy} = 0.41$) on the chemical pollution of tap water.

Northern zone. The dynamics of the levels of primary incidence in children under 14 years of age in the Takhtakupyr district over a 10-year period had an average strength ($r_{xy} = 0.41$) dependence on the chemical pollution of tap water. A similar dependence took place in this area in the first ($r_{xy} = 0.41$) and second five-year plans ($r_{xy} = 0.47$).

The primary incidence in children under 14 years old in the Chimbay district in the first five-year period (2009-2013) had a direct and strong dependence ($r_{xy} = 0.77$) on the chemical pollution of tap water. The dependence of the average strength ($r_{xy} = 0.4$) between these indicators in the first five-year period took place in the Kegeyli district.

Central zone. The dynamics of the levels of primary incidence in children under 14 years of age in the Khodjeyli district in the first five-year period (2009-2013) had a direct and medium-strength dependence ($r_{xy} = 0.6$) on the chemical pollution of tap water.

Southern zone. The primary incidence in children under 14 years old in the Amudarya district in the first five-year period (2009-2013) had a direct and medium-strength dependence

($r_{xy} = 0.38$) on the chemical pollution of tap water. The primary incidence in children under 14 years of age in the Turtkul district over a 10-year period had an average strength ($r_{xy} = 0.38$) dependence on the chemical pollution of tap water. A strong dependence between these indicators took place in this area in the second five-year period ($r_{xy} = 0.79$).

The dynamics of the levels of primary incidence in children under 14 years of age in the RK over a 10-year period had a medium-strong dependence ($r_{xy} = 0.49$) on the chemical pollution of tap water. A direct and strong dependence between these indicators took place in the RK in the second five-year period ($rxy = 0.94$).

Consequently, the chemical pollution of tap water influenced the primary incidence of children under 14 years of age in the Kungrad district of the Western zone, Takhtakupyr, Chimbay and Kegeyli districts of the Northern zone, in the Khodjeyli district of the Central zone and the Amudarya, Turtkul districts of the South zone of the RK and in the whole of the RK.

Logical reasoning allows us to put forward presume that 40% of the population of the RK, using highly mineralized water from open reservoirs and wells for drinking, is more at risk of diseases.
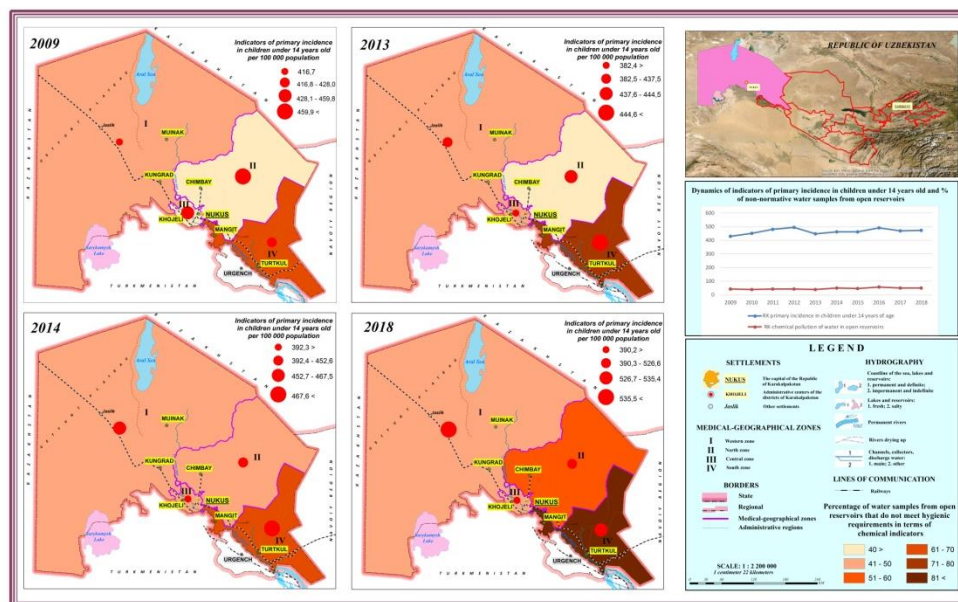
Fig. 3. Map of the influence of harmful environmental factors on the rate of incidence of children in the Republic of Karakalpakstan.

Map compiled by the authors

Western zone. A direct average strength dependence of the dynamics of primary incidence on the chemical pollution of water in wells in the first five-year period (2009-2013) was revealed in the Kungrad district ($r_{xy} = 0.34$).

Northern zone. A direct strong dependence of the dynamics of primary incidence on the chemical pollution of water in wells in the first five-year plan (2009-2013) was revealed in the Chimbay ($r_{xy} = 0.74$) and Kegeyli ($r_{xy} = 0.86$) districts.

Central zone. A direct average strength dependence of the dynamics of primary incidence on the chemical pollution of well water in the first five-year period (2009-2013) was revealed in the Khodjeyli district ($rxy = 0.6$). In general, in the Central zone, a direct average strength of the dependence of the dynamics of primary incidence on the chemical pollution of water in wells in the first five-year period ($r_{xy} = 0.49$) and a strong dependence in the second five-year period ($r_{xy} = 0.86$) were revealed.

Southern zone. A direct average strength dependence of the dynamics of primary incidence on the chemical pollution of water in wells in the second five-year plan (2014-2018)

was revealed in the Amudarya ($r_{xy} = 0.42$) and a strong dependence in the Ellikkala ($r_{xy} = 0.85$) districts.

The dynamics of the levels of primary incidence in children under 14 years of age as a whole in the RK had an average strength of dependence ($r_{xy} = 0.4$) on the chemical pollution of well water in the second (2014-2018) five-year period.

Comparison of the dynamics of indicators of primary incidence in children under 14 years of age in the RK for 2009-2018 with indicators of chemical pollution of atmospheric air showed the following results:

Western zone. A direct strong dependence of the dynamics of primary incidence in children under 14 years of age on the chemical pollution of the atmospheric air in the second five-year period (2013-2018) was revealed in the Kungrad district ($r_{xy} = 0.72$). The direct average strength dependence of the dynamics of primary incidence rates in children under 14 years of age in the first five-year period (2009-2018) with indicators of chemical pollution of atmospheric air took place in the Western zone ($r_{xy} = 0.64$).

The direct average strength dependence of the dynamics of primary incidence in children under 14 years of age with indicators of chemical pollution of atmospheric air over a 10-year period ($r_{xy} = 0.35$) in the first (2009-2018) five-year period ($r_{xy} = 0.57$) took place in Nukus city. In the Nukus district, the dependence of these indicators for 10 years was ($r_{xy} = 0.31$), in the first five-year period ($r_{xy} = 0.65$) and in the second it became strong ($r_{xy} = 0.74$). The dependence of the average strength was revealed in the first five-year plan in the Khodjeyli district ($r_{xy} = 0.37$), and in the Central zone - in the second five-year plan ($r_{xy} = 0.31$).

Southern zone. A strong dependence of the dynamics of indicators of primary incidence in children under 14 years of age with indicators of chemical pollution of atmospheric air was revealed in the first five-year plan in the Turtkul district ($r_{xy} = 0.84$).

In general, in the RK, a strong dependence of the dynamics of primary incidence rates in children under 14 years of age with indicators of chemical pollution of atmospheric air was revealed in the second five-year plan ($r_{xy} = 0.90$).

Conclusion. 1. The level of primary incidence in children under 14 years of age in the RK is lower than in the whole of the RUz.

2. However, the level of primary incidence in children under 14 years of age in the RK for the 10-year period 2009-2018 has an upward trend. The level of chemical pollution of water in open reservoirs also tends to grow, especially in the northern and southern zones of the RK.

3. Primary incidence in children under 14 years of age in the RK for a 10-year period directly depended on the chemical pollution of water in open reservoirs, the same dependence was found in the Muynak, Shumanay districts and in the Western zone as a whole. A similar relationship was established in the Karauzyak, Kegeyli and Chimbay districts of the Northern zone, in the Khodjeyli district of the Central zone and the Beruni, Ellikkala districts of the South zone. The primary incidence in children under 14 years of age depends on the chemical pollution of water in open reservoirs in the Northern, Central and Southern zones of the RK.

4. Chemical pollution of tap water influenced the primary incidence of children under 14 years of age in the Kungrad district of the Western zone, Takhtakupyr, Chimbay and Kegeyli districts of the Northern zone, in the Khodjeyli district of the Central zone and Amudarya, Turtkul districts of the Southern zone of the RK and in general in the RK.

5. A clear dependence of the dynamics of primary incidence in children under 14 years of age on the chemical pollution of well water was found in the Chimbay, Kegeyli districts of the Northern zone, in the Khodjeyli district of the Central zone, in the Amudarya and Ellikkala districts of the Southern zone. On the whole, in the Central Zone, such dependence in the first five-year period was moderately strong, and in the second five-year period - strong.

The primary incidence in children under 14 years of age in the whole RK had an average strength of dependence on the chemical pollution of well water in the second five-year period.

6. The dynamics of primary incidence in children under 14 years of age depended on the chemical pollution of the atmospheric air in the Kungrad district and in the Western zone

itself, in the city of Nukus, Nukus, Khodjeyli districts and in the Central zone itself, in the Turtkul district of the Southern zone.

In the RK, a strong dependence of the primary incidence of children under 14 years of age on the indicators of chemical pollution of the atmospheric air was revealed in the second five-year plan.

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