ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Modern Features of Epidemiology of Opisthorchiasis in the Republic Of Kazakhstan.

Nazira Beysenbiyeva*, Gulsara Imambayeva, Dinagul Bayesheva, Bakhyt Kosherova, Elena Koloss, Gulsimzhan Turebayeva, and Mazhit Shaydarov.

Astana Medical University, Department of infectious diseases, Beibitshilik Str., 49A, 010000 Astana, Kazakhstan

ABSTRACT

An article is considered the retrospective analysis of spatio-temporal features of disease incidence of opisthorchiasis in the Republic of Kazakhstan for 2009 - 2014. In spite of dynamic decrease of the disease incidence among all population, it is established that for the studied period there is remained the stable level for the first time diagnosed opisthorchiasis. The drafted cartogram of disease incidence of opisthorchiasis among the population of the Republic shows a spatial distribution of the given pathology in separate territories. The revealed medical and geographical features of disease incidence are recommended to be used at carrying out of the purposeful measures for further decrease in the given pathology in Kazakhstan.

Keywords: Opisthorchiasis, Opisthorchis felineus, the water basins of Kazakhstan, prevalence of Opisthorchiasis.

**Corresponding author*

INTRODUCTION

Opisthorchiasis – is the feral herd infection, caused by trematodes (Opisthorchis felineus), which parasitize in bile ducts of a liver and pancreatic duct of the human, pets (cats, dogs) and wild mammals (foxes, minks, etc.). According to A.I. Paltsev's opinion (1995), Kazakhstan is characterized by the circulation of the two types of trematodes (Shidertinskaya and Siberian) (Paltsev, 1995).

The first data on existence of an opisthorchiasis in the territory of Kazakhstan were described in K.I. Scriabin's thesis (1916), who studying in Aulie-Ata town (nowadays Zhambyl) infectiousness by helminthes of various animals, found Siberian liver fluke at a domestic cat. In 1925 the helminthological expedition, working under the leadership of N.P. Popov in Aktyubinsk and Kyzyl-Orda regions, was found Opisthorchiasis at dogs and cats. In 1941-1942 it was registered 67 cases of diseases with opisthorchiasis at Pavlodar population (1,4% from total number of surveyed) (Belozerov, *et al*., 1981). In 1929 it was revealed by the researches of expedition under the leadership of K. I. Scriabin a wide spread of an opisthorchiasis in the Irtysh basin, where so far there is remained the high level of fish infectiousness (80-90%) Opisthorchis felineus larvae (Fattakhov, 1996). Vigorous economic activity promoted to increase in the territory of parasitosis spread. So, in 1960 the channel between the Irtysh and Nur Rivers connected the Ob-Irtysh focus of an opisthorchiasis with Nurinskiy (Belozerov, *et al*., 1981; Mudriy, 2003; Akhrem – Akhremovich, 1960; Babkin, 1969).

A certain popularity among helminthologists and health workers was gained by the Shiderty river, where it was established that 100% infectiousness of minnows, which was provided with the water vole, and the for first time it could be confirmed an assumption of E.M. Pavlovskiy about a possibility of circulation of the causative agent of an opisthorchiasis in the nature without participation of the human.

Broad clinical and epidemiological investigation was begun with introduction in the USSR of the target complex program "Opisthorchiasis" in 1980. It was found out that Opisthorchiasis has extremely wide spread among the population and the domestic carnivorous animal, breeding in the endemic region. So, the infectiousness of local population in separate regions was reached 85–95%, cats — 100%, dogs — 27–50%, pigs̆ — 40% (Belozerov, *et al*., 1981).

Thus, in spite of significant achievements in studying of epidemiology and prevention of an opisthorchiasis, disease incidence of the given pathology is remained so far. In this regard, research of regional features of epidemic process of given parasitosis and improvement of approaches to opisthorchiasis prevention is actual in the conditions of Kazakhstan (Amirgaliyev, *et al.,* 2002).

The purpose of our research was studying of spatio-temporal features of disease incidence of opisthorchiasis in the Republic of Kazakhstan (2009 - 2014).

Research problems were: 1) studying of disease incidence of opisthorchiasis of the population of Kazakhstan; 2) determination of temporal tendencies taking into account ecological zones and administrative-territorial division of the Republic; 3) drawing up of a disease incidence cartogram of given parasitosis among people in various medical and geographical regions of the country.

MATERIALS AND METHODS

Materials of the state registration about opisthorchiasis patients, the International classification of diseases – B.66 (ICD – B.66), were the main sources of information at performing of this theme. There are applied the summary reporting forms No. 1, No. 2 of the Ministry of Healthcare of the Republic of Kazakhstan (MH RK) from 2009 to 2014 and also data of Agency of the Republic of Kazakhstan on population statistics from 2009 to 2014 (Kayyrbekova, *at el.*, 2010; Kayyrbekova, *at el.*, 2011; Kayyrbekova, *at el.*, 2012; Kayyrbekova, *at el.*, 2013; Kayyrbekova, *at el.*, 2014; Kayyrbekova, *at el.*, 2015).

It was applied the methods of modern medicobiological statistics:

1) analysis of extensive indicators;
2) analysis of intensive indicators;

3) analysis of time series (average geometrical indicators (M), average annual rates of increase /decrease ($R_{inc/decr}$, %));

4) 95% - confidential interval (CI) 1,96×SE (CI).

DISCUSSION

For the first time in the Republic there were registered 6708 cases of an opisthorchiasis During the period from 2009 to 2014 (Table 1).

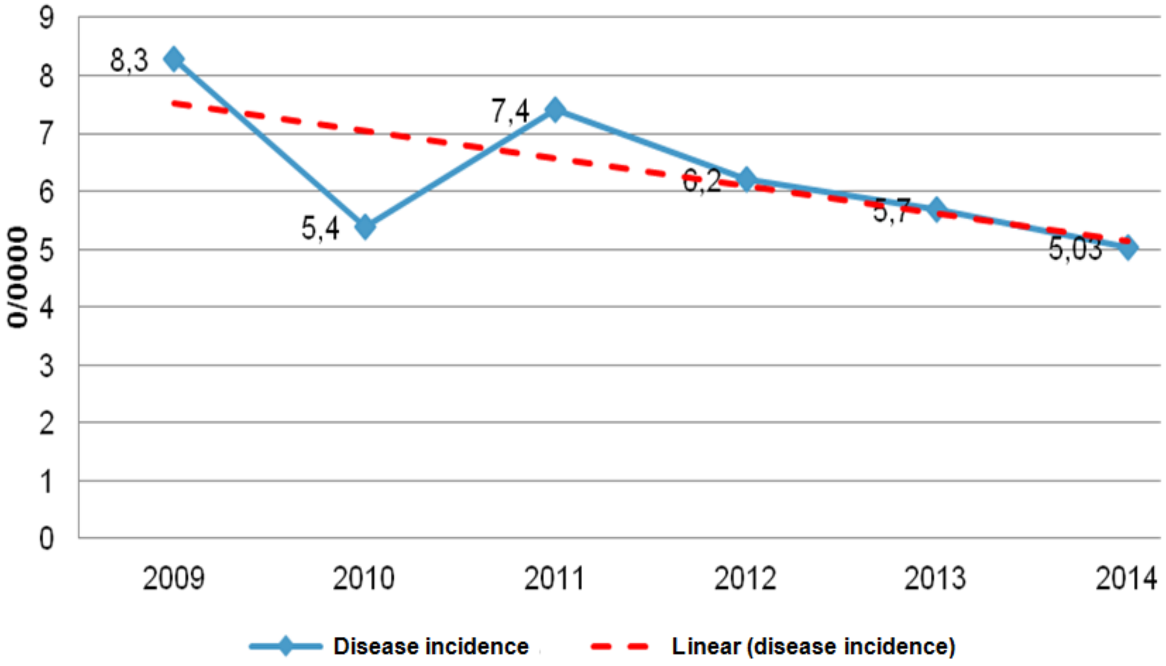
The highest extensive rate of disease incidence of opisthorchiasis was determined in Pavlodar region (55,75%); the high specific weight of patients was come to light in the West Kazakhstan region (10,06%) and in Astana city (15,31%). Low values are determined in Kostanay (6,4%), Akmola (4,62%), Karaganda (3,1%), the North Kazakhstan (2,45%) and the East Kazakhstan (1,94%) areas. In such regions as, Aktyubinsk (0,15%), Almaty (0,05%) and Jambyl (0,03%) areas, and also Almaty city (0,11%) there were registered solitary cases of diseases from other places (Table 1). There were not noted the cases of an opisthorchiasis during the studied period at Mangystau, the South Kazakhstan, Kyzylorda and Atyrau areas.

Table 1: Number of patients, who were first registered with opisthorchiasis in Kazakhstan and its regions for 2009-2014

Area / city	Total	
	Abs.	%
Pavlodar area	3740	55,75
Astana city	1027	15,31
the Western Kazakhstan area	675	10,06
Kostanay area	429	6,4
Akmola area	310	4,62
Karaganda area	208	3,1
the North Kazakhstan area	165	2,45
the East-Kazakhstan area	130	1,94
Aktobe area	10	0,15
Almaty city	8	0,11
Almaty area	4	0,05
Zhambyl area	2	0,03
the Republic of Kazakhstan	6708	100

For 2009-2014 the average annual indicator of disease incidence of opisthorchiasis among all population of Kazakhstan was made $12{,}24 \pm 0{,}86^0/_{0000}$ (95% of CI=$10{,}56$-$13{,}92^0/_{0000}$) (Fig. 1).

It was noted that 95% of CI indicators of disease incidence of opisthorchiasis in the specified years were not superimposed at each other, distinctions of indicators were statistically significant ($p<0{,}05$), i.e. there are objective factors, influencing on decrease in given indicator in dynamics. The analysis of the aligned indicators of disease incidence was showed a tendency to decrease, and average annual rate of a decrease was made R_{decr} = – 48,16%.



$$T_{decr} = -48,16\%$$

Fig. 1: Dynamics of morbidity rate of opisthorchiasis among total population of Kazakhstan for 2009-2014 (on 100 000 of population).

As a result of the conducted research, we were noted the regional features of disease incidence of opisthorchiasis of the population of Kazakhstan. Low indicators of disease incidence of opisthorchiasis of people were determined in Aktobe (0,20±0,08$^0/_{0000}$, 95% CI=0,04–0,36$^0/_{0000}$), Almaty (0,03±0,03$^0/_{0000}$, 95% CI= –0,03-0,09$^0/_{0000}$) and Zhambyl (0,03±0,020$^0/_{0000}$, 95% CI=0–0,06$^0/_{0000}$) areas, and also in Almaty city (0,08±0,03$^0/_{0000}$, 95% CI=0,015–0,145$^0/_{0000}$ (table 2)).

Average values of an infestation of the population were determined in Kostanay (8,08±0,30$^0/_{0000}$, 95% CI=7,48–8,68$^0/_{0000}$), Akmola (6,8±0,43$^0/_{0000}$, 95% CI=6,02–7,58$^0/_{0000}$), Karaganda (2,53±0,07$^0/_{0000}$, 95% CI=2,38–2,68$^0/_{0000}$), the North Kazakhstan (4,15±0,65$^0/_{0000}$, 95% CI=2,87–5,43$^0/_{0000}$) and the East Kazakhstan (1,54±0,10 $^0/_{0000}$, 95% CI=1,33–1,75$^0/_{0000}$) areas.

The high level of disease incidence of opisthorchiasis of the population was noted in the West Kazakhstan area (18,2±0,93$^0/_{0000}$, 95% CI=16,37–20,03$^0/_{0000}$) and Astana city (23,25±4,27$^0/_{0000}$, 95% CI=14,88–31,62$^0/_{0000}$). The maximum disease incidence of opisthorchiasis at all population was registered in the Pavlodar area – 83,08±6,36$^0/_{0000}$ (95% CI=70,58–95,58$^0/_{0000}$).

The analysis of 95% of CI disease incidence of opisthorchiasis at all population on the territorial indication was revealed in the area where they were not superimposed at each other. So, regions with indicators, which were below than republican value of disease incidence, were statistically significantly ($p<0,05$) lower, than in regions with values above of republican, i.e. there were objective reasons, influencing on indicators of disease incidence of opisthorchiasis at all population (Table 2).

It was noted, as in regions with values below and above of the republican indicator of disease incidence of opisthorchiasis there are 95% of CI, which were not superimposed at each other, i.e. the difference was estimated as statistically significant (p<0,05).

Table 2: Average annual morbidity rate of opisthorchiasis among total population according to the areas of Kazakhstan for 2009-2014

Area / city	Disease incidence, $^{0}/_{0000}$		$R_{inc/decr}$, %
	M±m	95% of CI	
Akmola area	6,8±0,43	6,02-7,58	+19,18
Kostanay area	8,08±0,30	7,48-8,68	+16,9
Aktobe area	0,20±0,08	0,04-0,36	+15,7
Almaty area	0,03±0,03	-0,03-0,09	0
Zhambyl area	0,03±0,020	0-0,06	0
Almaty city	0,08±0,03	0,015-0,145	0
the Western Kazakhstan area	18,2±0,93	16,37-20,03	-1,84
the East-Kazakhstan area	1,54±0,10	1,33-1,75	-3,05
Astana city	23,25±4,27	14,88-31,62	-6,3
Karaganda area	2,53±0,07	2,38-2,68	-13,7
Pavlodar area	83,08±6,36	70,58-95,58	-15,6
the North Kazakhstan area	4,15±0,65	2,87-5,43	-24,5
the Republic of Kazakhstan	12,24±0,86	10,56-13,92	-48,16

The indicators of disease incidence of opisthorchiasis at all population on medical and geographical areas in dynamics had various tendencies. Trends of the aligned indicators of disease incidence of opisthorchiasis had a tendency to growth in the following areas: Akmola (R_{inc} = +19,18%), Kostanay (R_{inc} = +16,9%), Aktobe (R_{inc} = +15,7%). Trends of disease incidence in other regions had a tendency to decrease, at the same time average annual rates of decrease of the aligned indicators varied from R_{decr} = −1,84% in the West Kazakhstan area to R_{decr} = −24,5% in the North Kazakhstan area (Table 2).

One of types of a spatial assessment of disease incidence of a parasitic infection is the perspective epidemiological method – the medical and geographical cartogram, allowing for health authorities to carry out purposeful treatment-and-prophylactic measures. For drawing up of cartograms of disease incidence of opisthorchiasis there were determined the levels, presented in Table 3.

Table 3: Scales of cartograms of disease incidence of opisthorchiasis in Kazakhstan for 2009-2014

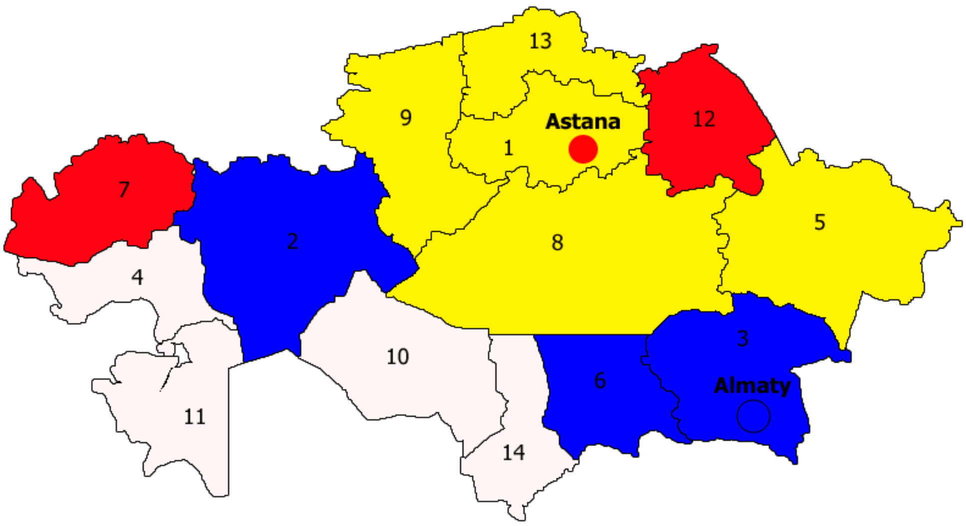
Incidence	Total population
Low	to $0,08/_{0000}$
Average	from 1,54 to $8,08^{0}/_{0000}$
High	from $12,24^{0}/_{0000}$ and above

Cartograms of disease incidence of opisthorchiasis in various medical and geographical zones of the republic (figure 2) were made on the basis of the above-stated scales.

Regions with low indicators (to $0,08^{0}/_{0000}$) are Almaty area ($0,03^{0}/_{0000}$), Zhambyl area ($0,03^{0}/_{0000}$), Aktobe area ($0,20^{0}/_{0000}$), and also Almaty city ($0,08^{0}/_{0000}$).

Regions with average indicators (from 1,54 to $8,08^{0}/_{0000}$) are the East Kazakhstan area ($1,54^{0}/_{0000}$), Karaganda area ($2,53^{0}/_{0000}$), the North Kazakhstan area ($4,15^{0}/_{0000}$), Akmola area ($6,8^{0}/_{0000}$), Kostanay area ($8,08^{0}/_{0000}$).

Regions with high indicators (from $12,24^{0}/_{0000}$ and above) are the West Kazakhstan area ($18,2^{0}/_{0000}$), Pavlodar area ($83,08^{0}/_{0000}$), and also Astana city ($23,25^{0}/_{0000}$) (Fig. 2).



To $0,08^{0}/_{0000}$ | From 1,54 to $8,08^{0}/_{0000}$ | From $12,24^{0}/_{0000}$ and above | It is not registered

Areas: 1. Akmola; 2. Aktobe; 3. Almaty; 4. Atyrau; 5. the East-Kazakhstan; 6. Zhambyl; 7. the Western Kazakhstan; 8. Karaganda; 9. Kostanay; 10. Kyzylorda; 11. Mangystau; 12. Pavlodar; 13. the North Kazakhstan; 14. the South Kazakhstan

Fig. 2: Cartogram of disease incidence of opisthorchiasis according to Administrative areas of the Republic of Kazakhstan for the period 2009-2014

According to our opinion, nonhomogeneous distribution of disease incidence of opisthorchiasis in the Republic of Kazakhstan is connected with several factors, such as, the feature of life cycle of opistorchises, which takes place in organisms of alternate host (fish of carp breeds and mollusks of Bithynia), that is defined a high risk of infection of the people, living in the natural centers of given parasitosis; prevalence of alternate hosts of helminthiasis in the reservoirs, located in the territory of the Republic; a big area of the country, including 9 water basins:

• the river Irtysh and its inflows (4,2 thousand km), Bukhtarminsk, Ust-Kamenogorsk and Shulbinsk reservoirs are the Irtysh river basin (Takenov, *at el.,* 2004).

• The river Ishim with a number of large inflows such as Koluton, Zhabay, Tersakkan, Akan-Burluk and Iman-Burluk are the Ishimsk river basin (245 thousand sq.km). It is had about 1717 km of the territory of the Akmola and the North Kazakhstan areas (Takenov, *at el.,* 2004; Kosherova, *at el*, 2009).

• The Ural-Caspian river basin (415 thousand sq.km) has the Ural River (236 thousand sq.km), Volga River 13,4 cubic km, Uil, Sagiz, Emba – 15,2 cubic km (Takenov, *at el.,* 2004; Sarsenbekov, *at el.,* 2003).

• The Nur-Sarysusk basin has: the Nur, Sherubaynura, Ulkenkundyzdy and Akbastau and Sarysu rivers; the Lakes Tengiz and Karasor; the Channel named after K. Satpayev. In the territory of the Nur-Sarysusk river basin there are about 2000 lakes and more than 400 artificial reservoirs (Takenov, *at el.,* 2004; Kusainova, *at el.,* 2009).

• The Tobol-Turgay basin (214 thousand sq.km) has the rivers: Tobol, Sytasty, Ayat, Uy, Ubagan, 8 reservoirs. Within the basin there are more than 5 thousand lakes (Takenov, *at el.,* 2004; Atshabarov, *at el.,* 2012).

Fig. 3: Cartogram of disease incidence of opisthorchiasis according to the water basins of the Republic of Kazakhstan for 2009-2014

As it was shown by a cartogram of the water basins of the Republic of Kazakhstan, the regions with high (from $12,24^0/_{0000}$ and above) and average (from 1,54 to $8,08^0/_{0000}$) indicators of disease incidence of opisthorchiasis are located in the territory of the Irtysh, Ishim and Tobol-Turgay water basins, which is included Pavlodar area ($83,08^0/_{0000}$), the East Kazakhstan area ($1,54^0/_{0000}$), Karaganda area ($2,53^0/_{0000}$), the North Kazakhstan area ($4,15^0/_{0000}$), Akmola area ($6,8^0/_{0000}$), Kostanay area ($8,08^0/_{0000}$). At the same time, the Ural-Caspian river basin - the West Kazakhstan area ($18,2^0/_{0000}$) can be refered to the regions with a high disease incidence, excepting Aktobe area ($0,20^0/_{0000}$). These water basins are located in the northwest and northeast areas of the country and they are components of two largest natural focuses of an opisthorchiasis in the world – Ob-Irtysh and Volga-Kamsk (figure 3). Feature of ecology of these water basins is high contamination of alternate and final hosts of Opisthorchidaes.

The Nur-Sarysu water basin can be refered to the regions with low indicators (to $0{,}08^0/_{0000}$) – Almaty area ($0{,}03^0/_{0000}$), Zhambyl area ($0{,}03^0/_{0000}$). Disease incidence of the population in these regions, in our opinion, is connected generally with introduced cases.

In the largest cities of the republic such as Astana ($23{,}25^0/_{0000}$) and Almaty ($0{,}08^0/_{0000}$) there are features of epidemiological process, which need to be considered at carrying out of anti-epidemic measures. It is generally observed in Almaty city the introduced cases of opisthorchiasis without tendency to decrease in disease incidence in long-term dynamic observation, connected with increase in migratory and trade and economic processes. It is revealed in Astana city both introduced cases, and contamination of the local population, living in the Ishim water basin.

Opisthorchiasis is not registered in the Aral-Syr Darya, Balkhash-Alakol, Shu-Talass, Ural-Caspian river basins.

CONCLUSION

Thus, in spite of the dynamic decrease in level of disease incidence of opisthorchiasis of all population from 2009 to 2014, there is remained a stable level for the first time diagnosed people with this parasitic disease in the Republic of Kazakhstan.

The originality of the natural environment of the Republic of Kazakhstan, features of the hydrological regime are provided steady functioning of the focuses of an opisthorchiasis. It is caused by considerable contamination of fish with larvas of causative agent, big specific weight of fish of the minnow family (a carp, the bream, a crucian, an ide, Amur ide, a roach, a tench, a carp (*Cyprinus carpio*)) in a food ration of the population of the Eastern, Northern and Central Kazakhstan, diagnostic suspicion of doctors and improvement of methods of diagnosing of helminthiasises (Zhumabekova, 2009).

Thus, the cartogram of disease incidence of opisthorchiasis among the population of the republic is indicated on the different levels of spread of given parasitosis within our country and it is revealed more accurately a spatial distribution in separate territories. The revealed medical and geographical features of disease incidence of opisthorchiasis are recommended to be used at carrying out of purposeful measures for further decrease in this pathology in Kazakhstan. At the same time it is necessary to consider the changes of indicators of disease incidence of opisthorchiasis in regions, which were occurred in dynamics.

REFERENCES

[1] Akhrem – Akhremovich, R.M., 1960. Clinical picture and treatment of an opisthorchiasis. Works of the 2nd All-Union Conference 30/06-2/07, Medgiz, Omsk, Russia, Pages: 64-79.

[2] Amirgaliyev, N.A., Ismakhanov Kh.K., 2002. Ecological condition of the main fishing reservoirs of Kazakhstan. Herald of Science S.Seifullin Kazakh Agro Technical University, Astana, Kazakhstan, Vol.3, No.6, Pages: 102.

[3] Atshabarov, N.B. Badashev E.A. Ilyichev D.M., etc., 2012. "Dynamics of the conditions of hydrochemical toxicological parameters in the Ertis transboundary river and nature of their transformations". Water industry of Kazakhstan, The scientific and informational journal, Owner and publisher: Association of Legal Entities (ALE) "Association of the hydroeconomic enterprises and organizations of Kazakhstan", Almaty, Kazakhstan, Vol. 12 (50).

[4] Babkin, L.T., 1969. To a question of pathogenicity of lamblia and the Siberian fluke. Scientific works. “Science” publishing house, Alma-Ata, Kazakhstan, Pages: 35.

[5] Belozerov, E.S., Shuvalova E.P., 1981. Opisthorchiasis. Medicine. L., Russia, Pages: 128.

[6] Fattakhov, R.G., 1996. Ecology of parasitic systems of opisthorchid flukes of the Ob-Irtysh basin in the conditions of an anthropogenic transformation of the environment (on the example of Opisthorchis felineus Rivolta, 1884; Metorchis bilis Braun, 1890 and Metorchis xanthosomus Creplin, 1846): Abstract of doctoral thesis of Doctor of Biological Science. Publishing house of the Tyumen State University, Tyumen, Russia, Pages: 16.

[7] https://en.wikipedia.org/wiki/Category:Lakes_of_Kazakhstan

[8] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors, 2010. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2009". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, VI chapter, Pages: 190.

[9] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors, 2011. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2010". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, VIII chapter, Pages: 364.

[10] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors, 2012. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2011". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, VII chapter, Pages: 223.

[11] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors, 2013. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2012". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, VII chapter, Pages: 276.

[12] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors, 2014. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2013". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, IX chapter, Pages: 295.

[13] Kayyrbekova, S.Z., Mussinov S.R., Bayzhunusov E.A. and co-authors., 2015. "Population health of the of the Republic of Kazakhstan and activity of the healthcare organizations in 2014". Ministry of Healthcare of the Republic of Kazakhstan, Statistical yearbook, “Apelsin” LLP Publishing house, Astana, Kazakhstan, X chapter, Pages: 309.

[14] Kosherova, B.N., Kusainova A.S., Syzdykov M.S., Bayesheva D.A., Alisheva G.L., 2009. Epidemiological characteristic of fish opisthorchiasis on the example of the Akmola region reservoirs. Medicine and ecology, Karaganda State Medical Academy Printing house, Karaganda, Kazakhstan, No. 3, Pages: 29-32.

[15] Kusainova, A.S., Kosherova B.N., Alisheva G.L., Bayesheva D.A., Syzdykov M.S., 2009. Epidemiological features of an opisthorchiasis in the Central Kazakhstan. Valueology, Astana, Kazakhstan, No. 2, Pages: 146-148.

[16] Mudriy, I.V., 2003. Ecological and hygienic aspects of pollution of the soil. Hygiene and sanitation. Moscow, Russia, №1, Pages: 32.

[17] Paltsev, A.I., 1995. Pathology of digestive organs at a chronic opisthorchiasis: pathomorphism, clinical picture, diagnostics, treatment and prevention: Abstract of doctoral thesis of Doctor of medicine. Printing house: Medical information analytical center of management of health care of administration of the Novosibirsk region, Novosibirsk, Russia, Pages: 51.

[18] Sarsenbekov, T.T, Kozhakov A.E., 2003. Monograph: Management of water resources and water quality of the transboundary rivers, Publishing house: "Atamura", Almaty, Kazakhstan, Pages: 56.

[19] Takenov, Zh., Natalya Panchenko, Sarsembekov T., 2004. Reference book "Water resources of Kazakhstan in the new millennium", “Firm Kiyik” LLP, Almaty, Kazakhstan, Chapter 1. Water resources of Kazakhstan, Pages: 17.

[20] Zhumabekova, B.K., 2009. Fish parasites of the Kazakhstan’s Pre-Irtysh: Abstract of doctoral thesis of Doctor of Biological Science, Almaty, Kazakhstan, Pages: 40.