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BEHAVIOURAL DETERMINANTS OF DIPHYLLOBOTHRIASIS IN SAKHA REPUBLIC'S POPULATION

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Diphyllobothriasis is an endemic disease for the Republic of Sakha (Yakutia), the prevalence of which remains at a high level (136.8 per 100,000 of the population in 2018). The study aims to analyse the behavioural factors contributing to the spread of diphyllobothriasis in Yakutia. The survey was carried out using social networks. The study involved 1021 people (815 women and 206 men) from Yakutsk and 32 municipal districts of the Republic of Sakha (Yakutia). The study showed among the population of the republic are preserved the traditions of eating raw fish and homemade salting fish. The part of the fish gets bypassing sanitary control. Technologies of homemade salting and cooking of fish are violated. The population is not well informed about the danger of infection with fish parasites and preventive measures.

We need the widespread introduction of wastewater disinfection technologies, improving the quality of treatment, monitoring fish products, conduct a qualitative helminthological examination of the population, verification of the effectiveness of deworming and inform the population about the methods for preventing parasitic infection.

Keywords: helminthiases, biohelminths, diphyllobothriasis, Yakutia, behavioural risk factors.

Diphyllobothriasis is a group of intestinal biohelminthoses, the causative agents of which are tape helminths of the class *Cestoidea, Diphyllobothrium (D.)* family. In the life cycle of helminth, copepods act as the first intermediate host, and fish as the second [8–10]. The final host is man, as well as some animals and birds that eat fish. About 14 out of more than 50 types of diphyllobotriids can be dangerous for humans [10]. Human infection occurs when eating fish with helminth larvae. Helminthiasis is found in many regions of the world, including North and South America, Europe, and Asia [10]. Parasites have epidemiological significance in Russia, Japan, and South America [1-3, 5-7]. According to experts, the number of people infected with tapeworms can reach 20 million in the world [10].

In Siberia and the Far East of Russia, according to Yastrebova V.K., the most common types of diphyllobotriids are *D. latum, D. dendriticum, D. klebanovskii (D. luxi), D. ditremum* [5]. *D. latum* is currently considered the main causative agent of human diphyllobothriasis. For the Sakha Republic, Diphyllobothriasis is an endemic disease (1318 cases of the disease or 136.8 per 100,000 of the population in 2018), as evidenced by a comparison of incidence rates in the subjects of the North-East of the Russian Federation. Thus, according to the territorial bodies of the Federal Service for the Oversight of Consumer Protection and Welfare (Rospotrebnadzor), in 2018, 160 cases of diphyllobothriasis were recorded in the Irkutsk Region, 102 in the Republic of Buryatia, 22 in the Sakhalin Region, 15 in the Jewish Autonomous Region and 12 in the Amur Region, 5 in the Primorsky Territory, 2 in the Chukotka Autonomous Region, and 1 in the Kamchatka Region. In 2018, diphyllobothriasis (25%) takes 2nd place in helminthiases general incidence in Yakutia, after enterobiosis (70%) [2].

The main factors determining the spread of helminthiases, including diphyllobothriasis, are the levels of socio-economic development of territories and sanitary and hygienic training of the population. Thus, the spread of invasion is facilitated by the tradition of using raw or semi-raw fish, as well as an increase in the market of poor-quality fish products due to the absence or low quality of wastewater treatment (at the sewage treatment facilities of the republic).

Research Objective – studying the behavioural factors contributing to the spread of diphyllobothriasis in the Sakha Republic.

Materials and Research Methods. For the analysis, we used the data of the reports "On the State of the Environment and Environmental Protection of the Sakha Republic in 2018 (https://minpriroda.sakha.gov.ru) and "On the State of Sanitary and Epidemiological Welfare of the Population in 2018" in the north-eastern regions of the Russian Federation (http://rospotrebnadzor.ru).

To assess the habits of the population contributing to the infection of diphyllobothriasis, a survey of available respondents was conducted using social networks. The study involved 1021 people (815 women and 206 men) from Yakutsk and 32 municipal districts of the Sakha Republic. The questionnaire included 16 questions devoted to various aspects of eating, cooking, and harvesting fish, as well as public awareness of measures to prevent infection with fish parasites.

Results. Analysis of the dynamics of morbidity of the population of the Sakha Republic by diphyllobothriasis over 15 years (2004-2018) showed a 2-fold decrease in rates from 264.9 to 136.8 per 100,000 population [2]. The true number of carriers of the parasite is probably significantly higher than official statistics. This is due to the lack of mandatory helminthological examinations, a pronounced clinical picture of infection, the over-the-counter selling of praziquantel (which is the drug of choice for diphyllobothriasis) and frequent self-medication among the population. Thus, the statistics reflect only cases of detection of diphyllobothriasis when visiting medical institutions and when examining maternity groups.

A survey to study consumer behaviour was conducted from May 25th, 2019 to June 9th, 2019. The main participants in the study were people of working age (Table). Of the respondents, 89% were born in Yakutia, 11% came from other regions of the Russian Federation. Of

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these, 758 people (74.2%) lived in the city of Yakutsk, the rest were representatives of 32 municipal districts of Yakutia.

Eating Habits. The survey showed that 83% (852) of respondents consume raw frozen fish (in the form of a sliced planer and other dishes), while 67% (691) consume home-salted fish.

When asked, "Where do you get frozen or salted fish?", respondents indicated various sources (including a combination of different sources). Thus, 337 respondents purchase fish at local markets, 283 – at stores, 95 – at supermarkets, while 15 get it themselves (fishing). Also, in 618 cases, respondents mentioned that they were sent (treated) by friends or relatives. Thus, it should be assumed that a significant part of the fish consumed by the population does not pass sanitary control. Another question was, "When purchasing fish, do you ask for documents certifying the quality of the fish (veterinary certificate, the conclusion of a veterinary and sanitary examination)?". 88.1% (900) of respondents answered negatively. Only 12% (121) said they were interested in this.

Typical Fish Storing and Cooking. 62% (639 people) of respondents said they salted fish in their families at home. Of these, in 75% (478) cases, the fish is lightly salted, in 25% (161) the fish is highly salted. At the same time, 115 respondents indicated that they salted the fish for several minutes or hours, 331 – during the period from 1 to 2 days, 190 – from 2 to 4 days, and 3 – 5 or more days. These results indicate that local fish salting violates processing technologies that ensure product safety.

When cutting fish, 35% (356) of respondents have seen parasite larvae at least once. Of these, 28 noted that they discarded the infected part of the fish and continued to cook the remaining parts. Only 15.6% of buyers return the fish with contaminants to the seller (the presence of inclusions, larvae, etc.). The remaining percentage throw away the infected fish.

Public Awareness of Hygienic Preventive Measures. When asked, "Can frozen fish be a source of helminth infection?", 60% (607) of respondents answered in affirmatively, while 24% (174) denied this possibility; 17% (240) did not have a definite opinion (figure). Also, about 40% of respondents do not know that objects used in cutting contaminated fish can be dangerous. It is likely that 80% of respondents taste the fish in the cooking process (frying, boiling, or baking). Last year, 69.8% of respondents underwent microscopic examination for helminth eggs (faeces analysis) was carried out during the last year.

Characteristics of Respondents

Group	n	%
Age, years	41	4.0
18-24	347	34.0
25-35	213	20.9
36-45	115	11.3
46-55	180	17.6
Over 55	125	12.2
Years spent in the Sakha Republic		
Under 5	37	3.6
5-9	22	2.2
10-14	6	0.6
15-20	26	2.5
Born in the Sakha Republic	904	88.5
Other	26	2.5

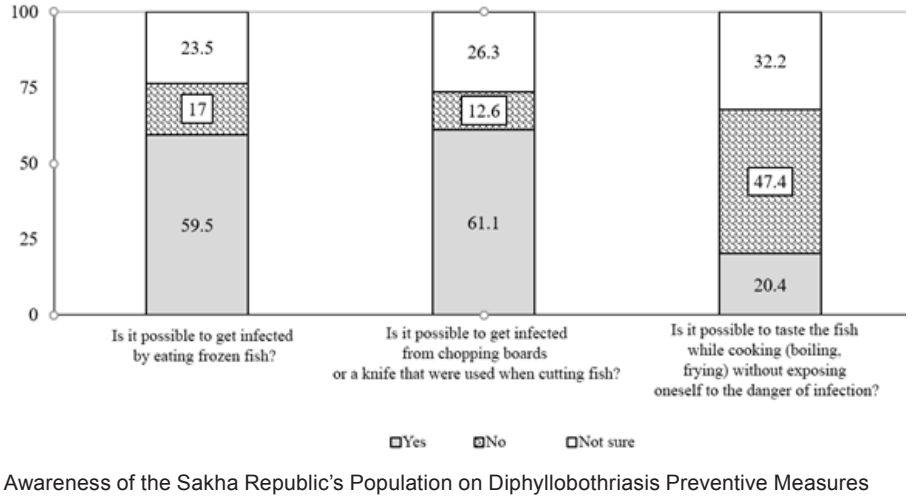
Thus, the survey results showed that among the population of the republic preserves its traditions of eating raw, home-salted fish. As a result, too often the fish ends up on the table bypassing sanitary control. When using at-home salting and cooking, our population violates fish processing technologies. The population is not well informed about the danger of infection with fish parasites and about the related preventive measures.

Discussion. Lack of treatment and disinfection of wastewater and frequent flooding of local settlements lead to the ingress of helminth eggs into water bodies. According to the Ministry of Ecology, Nature Management and Forestry of the Sakha Republic, in 2018, the republic had 28 treatment facilities (of which 20 were biological, 7 were mechanical, and 1 was physico-chemical). Some districts do not have wastewater treatment facilities, and in many areas, the technical condition of the facilities and outdated technologies do not provide regulatory wastewater treatment. According to Tonoeva N.C. et al. [4], treatment methods at the sewage facilities in Yakutsk (biological treatment) also do not ensure epidemiological safety of the water. When analysing samples of water and sediment from the n-filter after mechanical cleaning, we found ascaris and diphyllobotriid eggs in 100% and 80% of cases, respectively. After repeated mechanical and biological treatment of water with activated sludge, the number of positive samples was 33% and 17%, after exposure to ultraviolet radiation – 18% and 9%, respectively.

The prevalence of diphyllobothriasis among the population of Yakutia is caused by the characteristics of the traditional nutrition of the population, insufficient awareness of the risks of infection, and socio-economic factors. A low standard of living contributes to the search for other food sources, including independent fishing, the acquisition of fish from sellers without permits, and the use of home-made fish products. The tradition of eating raw fish, the ambiguous, non-specific symptoms during infection, low diagnostic efficiency, lack of control after deworming all lead to helminth prevalence. In addition, the widespread popularity of Southeast Asian cuisine using raw fish may become an additional risk factor for diphyllobothriasis, which can change the spectrum of diphyllobotriids circulating in Yakutia.

Conclusion. In the Sakha Republic, diphyllobothriasis is an endemic helminthiosis, the spread and preservation of which is facilitated by socioeconomic and behavioural factors. These include a low standard of living, low sanitary and hygienic culture, violation of sanitary and hygienic standards, food traditions of the peoples of the North, and insufficient public awareness.

At the moment, to change the situ-



Awareness of the Sakha Republic's Population on Diphyllobothriasis Preventive Measures

ation with the prevalence of diphyllobothriasis in the Sakha Republic, we require the organisation of local water treatment devices in rural areas, the widespread introduction of modern technologies for wastewater disinfection (use of purification, ultraviolet radiation, and track-etched membranes), and the strengthening of fish product quality control measures. We also require qualitative helminthological examination of the population, monitoring the effectiveness of deworming and informing the population about methods of preventing infection with fish parasites. Conducting molecular genetic studies to confirm the fact that there are no errors in identifying *D. latum* as the sole or main causative agent of human diphyllobothriosis in Yakutia holds scientific and practical importance. If other species of tapeworms of the Diphyllobothrium family are found in the Yakutian population, we may require additional changes to the preventative programs.

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