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# MORTALITY AND DISABILITY OF THE POPULAITON IN YAKUTIA FROM EXPOSURE TO LOW AMBIENT TEMPERATURES

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The official statistics was used to study the consequences of cold temperature exposure for the human organism in the Sakha Republic (Yakutia), a region with the subarctic climate, where the average winter temperature is  $-35-40^{\circ}$ C. The article reviews the mortality rate in the region due to cold temperature exposure in 2011-2019 and the disability level in 2014-2019. It was revealed that cold temperature exposure (cold injury) ranks third among the external causes of death in Yakutia, following suicides and homicides. The mortality rate due to cold injuries exceeds the traffic fatality rate in traffic accidents (TA). In the period 2011-2019, cold injuries killed 1,339 people (mortality rate 15.6 per 100,000 persons), while TA – 1,116 (12.9 per 100,000 persons). The percentages of disability due to severe frostbites were relatively low: in 2017 – 0.06 per 1,000 persons; in 2018 – 0.05; and in 2019 – 0.05.

Keywords. High North, low natural temperature, mortality, disability.

Introduction. The loss of health (disability, premature mortality) due to exposure to cold natural temperatures is one of the poorly understood health problems. The data of scientific publications indicate the global relevance of this issue. For instance, in the period 2003-2013, the USA registered 13,419 hypothermia-related deaths, which makes 0.3-0.5 cases per 100,000 population. Males accounted for 67%; there is also an age-specific feature: for males and females over 65 years of age, the rate was 1.8 and 1.1 cases per 100,000 population, respectively [5]. In Sweden, mortality due to hypothermia, frostbite and cold-water drowning is 3.4, 1.5 and 0.8 cases per 100,000 population, respectively [4]. According to foreign literature, the mortality rate in severe hypothermia ranges from 12 to 80% and depends on age, predisposing factors, causes and how prompt the treatment is [5]. However, the problem is especially acute in the Russian Federation, whose vast territories lie in the northern latitudes. In Amur region, patients with cold injuries account for 12-19% (60-90 people annually) of the patients in the Thermal Injuries Department. In Chita region, the annual regional rate of hospitalization for patients with cold injury is 1.9 cases per 10,000 population [2].

IVANOVA Albina A. - Doctor of Medicine, Professor, Department for Post-graduate Medical Training, Institute of Medicine, Ammosov North-Eastern Federal University. Address: 677000, Sakha Republic (Yakutia), Yakutsk, ul. Oyunskogo, 27. Tel/fax: +7 (4112) 363489, mobile +7-924-762-2916. E-mail: iaa\_60@ mail.ru; POTAPOV Aleksandr F. - Doctor of Medicine, Head, Department of Anesthesiology, Reanimation and Intensive Care, Faculty for Post-graduate Medical Training, Ammosov North-Eastern Federal University. Among the constituent entities of the Russian Federation, Yakutia is the largest with the area of 3,103.2 square kilometers; yet, in terms of the population density, it ranks 83 out of 85 regions (0.3 people per 1 square kilometer); 90% of the area does not have year-round transport access. The cold season in the region lasts for 7 months a year with the average winter temperature of - 35-40°C. In such conditions, the impact of cold natural temperatures on the human body is significant in the structure of deaths from external causes, and is an urgent medical and social problem.

It should be noted that the medical and demographic situation in the Sakha Republic (Yakutia) in 1990-2014 was characterized by a high rate of premature mortality from preventable causes, primarily accidents, injuries, and poisoning. In the structure of the main causes of deaths, external causes consistently ranked second after circulatory system diseases [1]. Since 2015, external causes have moved to third place (circulatory system diseases - neoplasms - external causes). The decrease in mortality from all types of external causes in 2011-2019 amounted to 39.8% (from 181.8 to 109.4 per 100,000 population). As a rule, the official statistics distinguishes the following external causes of mortality: transport accidents, including traffic accidents, violent deaths (homicides, suicides), accidental alcohol poisoning, accidental drowning, accidental falls, etc. Cold injury falls under the category of "Other causes"; therefore, the real situation with the loss of health by the population due to exposure to cold natural temperatures remains hidden.

The aim of the current study was to assess the morality and disability of the population in the Sakha Republic (Yakutia) due to cold temperature exposure in the period 2011-2019.

Material and Methods. The analysis of mortality rates of the population from exposure of cold natural temperatures in the Sakha Republic (Yakutia) was carried out by a selective statistical method basing on the official data from the Regional Office of the Federal State Statistics Service in the Sakha Republic (Yakutia) for the period 2011-2019. On the disability, the data of the Federal State Institution "Main Bureau of Medical and Social Expertise in the Sakha Republic (Yakutia)" for the period 2014-2019 were studied. The selection criteria under ICD-10 were Code 302 (Exposure to excessive natural cold) to study the mortality; Codes T34 (Frostbite with tissue necrosis), T35 (Frostbite involving multiple body regions and unspecified frostbite), and T69.8 (Other specified effects of reduced temperature) - to study the disability.

**Results.** The study period witnessed a positive trend of the decreased mortality rate from external causes in the republic: from all types of external causes – by 39.8% (from 181.8 to 109.4 per 100,000 persons); from suicides – by 42.3 % (from 39.7 to 22.9 per 100,000 persons); from homicides – by 52.0% (from 27.9 to 13.4 per 100,000 persons); from cold injuries – by 53.0%; from all types of transport accidents – by 54% (from 18.9 to 8.7 per 100,000 persons), including traffic-related deaths – by 47.0% (from 16.4 to 8.7 per 100,000 persons) (Tab. 1).

A retrospective analysis of the statistical data revealed that more people die annually of exposure to cold natural temperatures than in traffic accidents in the Sakha Republic (Yakutia). According to Rosstat, traffic accidents killed 1,116 people there in the period 2011-2019, whereas exposure to extremely cold natural temperatures – 1,339, which was



Table 1

Indicators		2011		2015		2017		2018	2019			
	abs.n	per 100,000 persons										
Total deaths of external causes	1740	181.8	1392	2 145.5 1287 133.6		1184	122.6	1061	109.4			
Suicides	380	39.7	333	35.1	267	27.7	231	23.9	222	22.9		
Homicides	267	27.9	198	20.7	175	18.2	138	14.3	130	13.4		
Cold temperature exposure	195	20.4	145	15.1	147	15.3	128	13.3	93	9.6		
Transport accidents	181	18.9	125	13.1	119	12.3	117	12.1	84	8.7		
- including traffic accidents	157	16.4	119	12.4	112	11.6	114	11.8	84	8.7		

### The mortality in the Sakha Republic (Yakutia) from some types of external causes in 2011-2019 (absolute number, rate per 100,000 persons)

Table 2

#### The number of deceased due to traffic accidents and low temperature exposure in 2011-2019

	2011		2012		2013		2014		2015		2016		2017		2018		2019		Всего	
Cause of death	abs.n	per 100,000 persons	abs.n	per 100,000 persons	abs.n	per 100,000 persons														
traffic accidents	157	16.4	134	14.0	156	16.3	140	14.6	119	12.4	100	10.4	112	11.6	114	11.8	84	8.7	1116	12.9
Cold temperature exposure	195	20.4	164	17.6	150	15.7	158	16.5	145	15.1	159	16.5	147	15.3	128	13.3	93	9.6	1339	15.6

Table 3

The number of deceased due to low temperature exposure in 2011-2019 by main age groups \*

Age group	2011		2012		2013		2014		2015		2016		2017		2018		2019			
	male	female	total	share (%)																
under working age	4	1	0	1	2	0	2	0	0	0	3	-	1	-	-	-	2	-	16	1,2
working-age	108	34	113	24	85	28	91	25	80	35	97	20	92	19	79	19	54	9	1012	78,0
over working age	21	14	12	8	17	11	20	12	18	10	20	13	16	19	19	11	16	12	269	20,7
total	133	49	125	33	104	39	113	37	98	45	120	33	109	38	98	30	72	21	1297	-
age unspecified	13	-	5	1	6	1	6	2	2	-	4	2	-	-	-	-	-	-	42	3,1
TOTAL	146	49	130	34	110	40	119	39	100	45	124	35	109	38	98	30	72	21	1339	-

\* under working age -0.15 years, working age - males 16-59 years, females -16-54 years, over working age - males 60 years and older, females -55 years and older.

16.7% more; the mortality rates were 12.9 and 15.6 per 100,000 population, respectively (Tab. 2).

Of all the deceased due to exposure to cold natural temperatures, 75.3% were males (1,008 out of 1,339). In terms of the age structure (in 1,297 cases of reliably established age of the deceased), working-age people accounted for 78.0%, under working age – 1.2%, over working age – 20.7%, with the prevailing share of able-bodied males – 61.6% (799 of 1,297 deceased) (Tab. 3). The presented data

confirm the consistent "supermortality" of the male population, despite the significant positive dynamics in the recent years.

The disability due to frostbites in extremities is another serious medical and social problem. Indeed, the amputation of a limb entails a serious injury, leading to limited physical capabilities and deteriorated quality of life. In one of our previous publications, we pointed at a discrepancy between the number of persons who have undergone limb amputation and the number of persons qualified as disabled for this reason. For instance, in 2014-2016, in a specialized ward for patients with thermal injuries, 40 patients underwent lower leg amputation and 9 patients – forearm and hand amputation (excluding the cases of fingers amputation); yet, only 14 were qualified as disabled. According to the data from the Main Bureau of Medical and Social Expertise in the Sakha Republic (Yakutia), 27 people qualified as disabled due to exposure to extremely cold natural temperatures in the period 2014-2016. The most common cause of disability was amputation of frostbitten limbs (55.6%), including 66.7% arm amputations and 33.3% of leg amputations [3].

According to the official data from the Main Bureau of Medical and Social Expertise in the Sakha Republic (Yakutia), in the period 2017-2019, 154 patients qualified as disabled due to frostbites (hypothermia), including 4 (2.6%) persons under 18 years of age (Tab. 4).

According to experts, official statistics reflects only about a half, at most, of the people with disabilities who actually exist in society, which is due to several reasons. Firstly, it does not include the disabled who have been examined and recognized as disabled by expert commissions, but have not applied for a pension from the social security authorities. Secondly, since the disability accountability is based on the source of pension provision, people with disabilities receiving other types of pensions (by age, loss of breadwinner, etc.) are not included in the general statistics. Thirdly, some of the disabled who receive pensions in other departments (for example, the Ministry of Defense, the Ministry of Internal Affairs, the Federal Security Service, etc.) are also not included in the general statistics.

Conclusion. Thus, the case of the Sakha Republic of (Yakutia) demonstrates how critical is the impact of excessively cold natural temperatures on the human body in the High North due to its significant frequency, disability of patients and high mortality in cases of severe hypothermia. The problem under discussion, as well as other external causes of mortality, is not only medical, but also social in nature, since it goes far beyond the scope of the health care system responsibilities. There are two main negative factors contributing to the problem: the lack of self-preservation (non-compliance with safety rules) and the spread of alcoholism, like in the situation with traffic-related deaths. In other words, "cold

qualified at: qualified at: Total disabled Total Years children under disabled first second first second 18 persons  $\geq 18$ examination examination examination examination 2017 1 0 1 59 28 31 2018 1 0 29 1 47 18

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injury" is indeed a preventable factor of premature mortality and disability in people of predominantly young age groups. An unfavorable background is the vast territory of the region, great remoteness of settlements, impassable roads, lack of infrastructure and stable satellite communications for a timely call for professional medical services. In this regard, the problem is especially acute in the Arctic districts of the republic; it can be solved only by a specific set of measures taken by the state authorities.

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2019

In this situation, medical workers have to work with something that has already happened, that is to say, to deal with the treatment (elimination) of the consequences of the traumatic factor. It is obvious that the clinical course and outcome of the injury will depend on the timely diagnosis, scope and adequacy of first aid and subsequent pathogen-based treatment. At the same time, many issues related to diagnosis and treatment tactics remain insufficiently studied or are controversial. There are no uniform recommendations, or treatment standards for patients with general hypothermia or frostbites; numerous issues in the patient management tactics remain debatable, including the preference for passive or active warming in cases of hypothermia, use of extracorporeal methods, thrombolytic therapy, as well as the timing of surgical treatment [2]. These facts indicate the need for developing clinical guidelines for the diagnosis and principles of treating the consequences of exposure to excessively cold temperatures (cold injury), based on the latest scientific advances and accumulated practical experience.

25

Table 4

19

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44

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# The number of people qualified as disabled due to frostbites (hypothermia) in 2017-2019

