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ENVIRONMENT SITUATION AND MALIGNANT NEOPLASM MORBIDITY IN ARCTIC REGIONS OF YAKUTIA

ABSTRACT

Effect of anthropogenic and technogenic environment influence and social-economic factors on malignant neoplasm among the population living in the severe arctic conditions has been analyzed.

Keywords: the Arctic, neoplasm, environment factors, morbidity.

PREFACE

Medical-demographic data of the population are indicators of life – quality and health not only of a man but also of the whole society defined by social-economic and sanitary-hygienic factors and a way of life. Intensive exploitation of the arctic territories and river basins at the end of 20th c. influenced environment pollution because of mining enterprise activities and consequences of which are observed today.

The arctic zone is a vast coastal and tundra zone including Anabar, Allaekha, Bulun, Nizhnekolym, Olenek, Ust-Yana regions, where average annual winter temperature is 12.6-14.5 degrees below zero, average January temperature is 32-40 degrees below zero, average July is 4-14 degrees above zero. Precipitation is 187.6-256.0 mm., total a daily average temperature is 5 degrees of 557.3 in Bulun to 256.0 mm. in Olenek. Permafrost is more than 500 m. Climatic conditions in Anabar, Bulun, Ust-Yana, Allaekha and Nizhnekolyma regions are absolutely extreme but in Olenek it's the most extreme ones. Severe climatic conditions determine economic activities and have influence on environment situation and population health of the zone.

In the arctic zone traditional economic branches: hunting, reindeer-breeding, fishery are developed. In Anabar, Bulun, Olenek diamond extraction industry, in Ust-Yana gold- and tin-industry are developed.

Research aim. Estimation of anthropogenic and technogenic facts and social-economic life factors influence on the data of malignant neoplasm morbidity of the population living in the severe arctic conditions.

MATERIALS AND METHODS

Reports of YaROD of 1989-2010 and statistic data of TO FSGS of the Republic Sakha (Yakutia) [2] are analyzed. Research results aimed at anthropogenic, technogenic and economic influence in the arctic territories were the basis to estimate influence of regional factors on environment situation. Estimation was carried out according to the method made up by E.I.Burtseva [1]. Statistic data are worked up according to generally accepted method using programme "Statistical".

RESULTS AND DISCUSSION

Anthropogenic effect. In the arctic regions the population increased 3.1 times in comparison with 1950 especially in Ust-Yana 6.8 times which influenced greatly environment situation. By 2012 in connection with mining industry disorganization the population reduced to 7.8 thousands. Now the anthropogenic effect is on the lowest level in all arctic regions (Table 1).

Population and medical-demographic data. In Anabar region the population increased in connection with diamond industry development and new arrival contingent. In 2010 it made up 49.2% [2,11].

In Olenek native people occupy 76.5% of the population, in Bulun-39.0%, the Yakut people occupy in these regions accordingly -21.0 and 23.4%. In connection with mining industry development the population number in Ust-Yana reached its maximum (49.9 thousands) in 1990. About 90.9% were the Russians and other ethnic groups. By 2010 after disorganization of the industry and disintegration of the Soviet Union most of them migrated and the number of living people in the region was 7.8 thousands. In Allaekha and Nizhnekolyma regions, where fishery is developed, proportion of the Russians and other nationalities is 50%. But since 2010 a quick population increase has been observed owing to migrants from other Russia regions.

The best birthrate was noticed in Olenek region, where the most part of the population is the Yakut people and northern native people, though in the years of perestroika the above mentioned rates had a tendency to come down till a minimum level (Table 2). The birthrate and population increase were the lowest ones in Ust-Yana, Allaekha, Nizhnekolyma regions where the most of the population were the Russian people and other nationalities especially in the years of perestroika.

It's necessary to point out a presence of a strong correlation tie (r=-0.91) between the number of new comers living in different regions of the arctic zone and coefficients of birth-rate. Between coefficient of birth-rate and a number of northern native not numerous people a strong direct tie is singled out (r=0.91). Analogous situation is observed in correlation analysis of population increase and a portion of new-comers and a native population (accordingly: r=-0.76, r=+0.76).

The given data might be a consequence of negative influence on the results of medical-demographic situations, environment factors, a way of life, nutrition. Analysis pointed out that a birthrate has an influence on a morbidity level of MN of reproducting woman organs. It can be seen in Table 3 where a birthrate is low, but woman morbidity with MN of reproductive organs is higher in Allaekha, Bulun, Nizhnekolyma, Ust-Yana regions (r=-0.71 and -0.68). This fact has been proved by researches [9,10].

Economic and technogenic effect on environment. Agricultural influence on

Table 1

Anthropogenic effect in the arctic regions

Index	Regions					
	Anabar	Allaekha	Bulun	Nizhnekolym	Olenek	Ust-Yana
Territory, 1000 км^2	55,6	107,3	223,6	97,1	18,1	127,3
Population (n - 1000)						
1959	1,4	2,4	10,0	4,2	3,4	6,0
1990	4,0	5,4	16,9	13,7	4,1	40,9
2012	3,4	2,9	9,4	4,5	4,1	7,8
population density (1prs per 1 км^2)						
1959.	0,025	0,022	0,045	0,048	0,011	0,050
1990	0,072	0,050	0,076	0,157	0,013	0,340
2012	0,061	0,027	0,041	0,057	0,013	0,071
environment effect:						
1959	L	L	L	L	L	L
1990	L	L	L	Rd	L	A
2012	L	L	L	L	L	L

Note: environment effect: L – low, Rd – reduced, A– average

Table 2

Medical demographic data of arctic regions (per1000 people)

Index	Regions						
	years	Anabar	Allaekha	Bulun	Nizhnekolym	Olenek	Ust-Yana
Child birt hrate	1990	29,0	18,7	16,0	15,2	28,1	14,3
	2000	18,7	17,8	14,6	13,3	17,8	10,3
	2005	20,7	17,2	11,0	12,5	13,7	10,2
	2011	19,4	18,0	17,0	14,6	24,8	19,3
Population mortality	1990	9,5	6,1	16,2	3,7	9,0	3,5
	2000	11,3	12,2	14,6	11,9	8,3	10,8
	2005	11,7	13,1	11,9	14,9	12,9	11,3
	2011	10,9	15,7	12,4	15,4	13,2	15,3
Population growth	1990	19,5	12,6	11,4	11,4	19,0	10,9
	2000	7,4	6,8	4,7	1,3	9,5	-0,5
	2005	8,5	4,1	1,8	-2,4	0,7	-1,1

environment is insignificant because only reindeer-breeding is developed in these regions. Reindeer-breeding has a lower influence on environment in Anabar, Ust-Yana, Nizhnekolyma regions, in Olenek and Allaekha it is low (Table 4).

In Table 5 estimations of economic and technogenic influence on environment are given in those regions where there is a different level of technogenic influence: Ust-Yana region has a high influence because of polluting mining mass , polluting substances thrown into the air and sewage. Anabar, Bulun, Allaekha regions have a lower influence on environment, Olenek and Nizhnekolyma regions – a low one.

It's set up that transbordering pollutions from mining enterprises of upper reaches of Yana, Indigirca, Kolyma influence water pollution of lower reaches. If some drastic measures are not taken in Anabar, Olenek, Bulun regions to protect their territories we won't escape the common lot of Ust-Yana.

Estimation of regional influence factors on environment in the arctic regions is based on research results finding out anthropogenic, economic and technogenic effects and the data of E.I Burtseva [1] estimating timber industry influence and vulnerability of nature complex to technogenic factors (Table 6).

Table 3

Correlation analysis of birthrate and woman MN morbidity of reproductive organs in the arctic regions

Regions	Period	Child birth ($^0/_{00}$)	Period	MN of WRO*/ ($^0/_{0000}$)	including:			
					Breast	Cervix	Uterus body	Ovule
Anabar	1980-1990	26,8	1989-1998	26,0	10,4	5,2	0,0	10,4
	2000-2010	19,3	2001-2010	25,0	10,0	5,0	5,0	5,0
Allaekha	1980-1990	21,4	1989-1998	30,2	15,1	11,3	0,0	3,8
	2000-2010	14,7	2001-2010	75,0	46,1	17,3	5,8	5,8
Bulun	1980-1990	16,7	1989-1998	49,1	25,7	11,7	4,7	7,0
	2000-2010	14,4	2001-2010	78,8	29,8	27,7	6,4	14,9
Nizhnekolym	1980-1990	16,2	1989-1998	42,4	26,3	8,8	1,5	5,8
	2000-2010	15,3	2001-2010	50,2	33,5	10,0	6,7	0,0
Olenek	1980-1990	28,5	1989-1998	24,5	14,7	4,9	0,0	4,9
	2000-2010	18,4	2001-2010	29,4	24,5	0,0	4,9	0,0
Ust-Yana	1980-1990	14,6	1989-1998	30,6	20,4	6,1	1,0	3,1
	2000-2010	11,2	2001-2010	56,1	29,1	14,5	0,0	12,5
The correlation between the birth rates of the 1980-1990 biennium. and MN of WRO for 1989-1998				-0,71	-0,83	-0,51	-0,59	0,41
The correlation between the birth rates of the 1980-1990 biennium. and MN of WRO for 2001-2010,				-0,68	-0,47	-0,70	0,24	-0,55

*/ MN of WRO – malignant neoplasms of women reproductive organs

Table 4

Reindeer –breeding influence on environment in arctic regions

Regions	Period	The deer population	environment effect
Anabar	1995	21262	H
	2008	15485	Rd
	(± head)	-5777	
Allaekha	1995	11961	Hght
	2008	2207	L
	(±head)	-9754	
Bulun	1995	19257	H
	2008	15770	Rd
	(±head)	-3487	
Nizhnekolym	1995	20320	H
	2008	16773	Rd
	(±head)	-3547	
Olenek	1995	9410	L
	2008	4694	L
	(±head)	-4716	
Ust-Yana	1995	17252	H
	2008	12852	Rd
	(±head)	-4400	

Note: ± head – in 2008 in comparison with 1995. Environment effect: L – low, Rd – reduced, Hght – heightened, H – high.

Table 5

Estimation of economic and technogenic effect on environment in arctic regions

Index	Regions					
	Anabar	Allaekha	Bulun	Nizhnekolym	Olenek	Ust-Yana
Agricultural effect on E. (2008.)	Lr	L	Lr	Lr	L	Lr
Transport influence on E.	L	L	L	L	L	Lr
Extraction of mining mass from entrails of the Earth till 2002, mln. m^3	13,9	-	0,3	-	-	482,8
effect on E.	L	-	L	-	-	Hght
Average annual polluting substances thrown into the air (1995-2005) (thous. ton)	0,81	0,4	2,1	2,2	0,3	5,9
effect on E.	Lr	L	Lr	Lr	L	-
Sewage throwing (mln. m^3)	2,10	0,30	1,60	1,11	No register	0,90
effect on E. (ha)	A	-	Lr	Lr		L
Injured lands 1990-2001 (ha)	354,0	362,0	383,0	7,0	31,0	4256,0
effect on E.	Lr	Lr	Lr	L	L	Hght

Notes: L- low, Lr.- lower, A- average, Hght- heightened

The given data show that environment situation in the arctic regions under the influence of different factors of stages 1 and 2 can be estimated as follows: Ust-Yana territory is tensed because of the mining industry; Olenek region is relatively good; Bulun region is relatively good; Anabar region is satisfactory; Allaekha region is relatively satisfactory because polluting substances thrown into the air, sewage, water pollution from Ust-Yana mining industry and the river Indigirka; Nizhnekolyma region is relatively satisfactory. Environment is polluted from transbordering sources of Srednekolyma and Verkhnekolyma regions and Magadan region.

Annual MN morbidity of the coastal population in Allaekha region came down to 39.2 men during the analysis period where the population is 100 thousand men with average annual rate of 1.40%. While in other regions of the arctic zone data are higher. (In Anabar-15.4 0\0000, in Bulun-39.5, in Nizhnekolyma-76.00, in Olenek-1.1, Ust-Yana-81 0\0000). Annual average rate is 1.30%, 3.96, 4.85, 0.05, and 8.4%.

Data increase might be the result of environment pollution, some changes of a way of life and nutrition of the population in the severe arctic conditions. Some differences in the MN morbidity can be explained by peculiarities of each region depending on the regional environment situation.

- In Anabar region morbidity increased in; cancer of liver (annual average rate-8.30%), breathing organs (5.60), lymphatic and blood tissues (19.55). Reduction of data was observed in digestion organs (-o.15), woman reproducting organs (-0.40).

- In Olenek region MN morbidity was observed in dynamics of head, neck, stomach, bowels, breathing organs, reproducting organs of women and men, lymphatic and blood tissues morbidities. Reduction was explained by carcinoma of gullet, bones, soft tissues and urination organs.

- In Bulun region general cancer increase (1.5) was observed in gullet (1.1), stomach (more than 2), liver (1.8), pancreas (9.6), bowels (2.7), breathing organs etc. It's necessary to note a revealed tendency to reducing MN of man reproducting organs, bones and soft tissues, lymphatic and blood tissues was not so important.

- In Nizhnekolma region cancer morbidity rose(1.6) in digestion organs (2.1 in annual increase of 7.95%); stomach (7.25%). Liver(6.20), pancreas(25.35), bowels (12.20 and 4.65% of colon and rectum). Average annual rise of MN of breathing organs is 0.30%, reproducting man organs (21.95), woman (1.75), urination organs (25.45), lymphatic and blood tissues (5.35). Reduction of MN was observed in bones and soft tissues (10.0%).

- Among the arctic regions Ust-Yana region is singled out for its highest rise of morbidity (8.45% annually). Thus, general morbidity coefficient of

Table 6

Population morbidity of the arctic regions in the Republic Sakha (Yakutia) and its annual average rate (1989-1998, 2001-2010) per 100 thousand population [4-6]

Localization	Period	Regions					
		Ana-bar	Allae-kha	Bu-lun	Ni-zhne-kolym	Ole-nek	Ust-Yana
1	2	3	4	5	6	7	8
Malignant neoplasm total	1989-1998	111,3	293,5	105,0	126,3	177,3	65,3
	2001-2010	126,7	254,3	154,50	202,3	178,4	146,9
	Growth rate	1,30	-1,40	3,96	4,85	0,05	8,45
Head and neck	1989-1998	0,0	3,6	1,4	2,4	0,0	0,8
	2001-2010	1,4	2,0	2,0	6,8	15,5	8,5
	Growth rate	0,0	-5,70	3,30	10,95	0,0	26,65
digestive organs – total	1989-1998	47,9	98,6	42,3	44,0	82,6	20,8
	2001-2010	47,3	119,7	62,5	94,4	70,8	54,0
	Growth rate	-0,15	1,95	4,45	7,95	-1,55	10,00
Esophagus	1989-1998	20,1	27,9	11,9	10,7	32,5	2,9
	2001-2010	2,5	17,5	7,2	11,8	14,7	9,0
	Growth rate	0,05	-4,55	-4,90	1,00	7,65	12,00
Stomach	1989-1998	17,7	35,2	9,4	15,6	20,0	9,7
	2001-2010	9,9	40,9	13,3	33,7	24,4	17,0
	Growth rate	-5,15	1,60	3,45	7,25	2,00	5,80
colon	1989-1998	0,0	3,8	4,6	7,8	5,0	2,2
	2001-2010	7,5	17,5	5,1	27,0	12,2	14,0
	Growth rate	0,0	16,50	1,05	12,20	16,50	20,35
rectum	1989-1998	0,0	7,5	2,9	6,4	5,1	3,2
	2001-2010	0,0	11,7	8,2	10,1	0,0	7,0
	Growth rate	0,0	4,55	10,96	4,65	0,0	8,15
liver	1989-1998	10,1	24,2	9,6	2,8	17,5	1,3
	2001-2010	22,4	29,2	20,5	5,1	17,1	4,0
	Growth rate	8,30	1,90	7,90	6,20	-0,25	11,90
pancreas	1989-1998	0,0	0,0	3,9	0,7	2,5	1,5
	2001-2010	5,0	2,9	8,2	6,7	2,4	3,0
	Growth rate	0,0	0,0	7,75	25,35	-0,40	7,20
Respiratory organs - total	1989-1998	22,5	40,7	20,4	35,4	45,0	13,7
	2001-2010	32,3	70,1	32,7	38,8	46,5	28,0
	Growth rate	5,60	4,85	1,05	0,30	6,70	0,0
larynx	1989-1998	2,5	5,5	1,7	4,2	2,5	1,7
	2001-2010	2,5	2,9	0,0	3,4	4,9	1,0
	Growth rate	0,05	-0,70	0,0	-0,2	1,08	-0,6
Trachea, bronchi, lungs	1989-1998	20,0	33,4	18,1	31,2	40,0	11,1
	2001-2010	29,8	67,2	32,7	35,4	41,6	27,0
	Growth rate	4,05	7,25	6,10	1,3	0,4	9,3
Bone and soft tissue	1989-1998	25,0	41,8	19,8	38,8	47,4	13,8
	2001-2010	0,0	11,7	3,0	3,4	2,4	3,0
	Growth rate	0,00	-10,0	-10,0	-10,0	-10,0	-10,0
Bone	1989-1998	7,5	3,7	1,7	0,7	7,5	0,2
	2001-2010	0,0	2,9	1,0	1,7	0,0	2,0
	Growth rate	0,0	-2,40	-5,20	9,25	0,0	29,15

all MN kinds rose 2.3 times. (of 65.3 to 146.9 0\0000) the reasons of which were a positive rate of head and neck MN (26.65%, gullet (12.00), liver (11.90), pancreas (7.20), bowels (20.35 and 8.15), breathing organs (7.20), reproducting man organs (11.35) and woman (6.25), thyroid gland (9.60), urination organs (19.95). Reduction was observed in lymphatic and blood tissues (-9.30%) .

- In the arctic coastal zone Allaekha region having a leading position in a general level of cancer morbidity, is the only region where at the same time a reduction is observed (of 293.5 0\0000 in 1989-1998 to 254 0\0000 in 2001-2010, annually -1.40%. Meanwhile total data of MN of stomach cancer (1.60), liver (8.30), colon (16.50), rectum (4.55), breathing organs (4.85), reproducting woman organs (9.55) are increasing in dynamic. MN of bones and soft tissues (-10.0%), urination organs (-10.0) , gullet (-4.55) and others reduced showing a general tendency of dynamic.

Among the coastal arctic zone Allaekha region (293.5) is in the first place, Olenek region (177.3)- second, Nizhnekolyma region (126.3)- third according to the cancer morbidity level. Including gullet morbidity Allaekha (119.7), Nizhnekolymsk (94.4), Olenek (70.8); breathing organs: Allaekha (70.1), Olenek(46.5), Nizhnekolymsk(38.8); reproducting woman organs:Bulun(78.8), Allaekha (75.0), Nizhnekolymsk(50.2); urination organs: Nizhnekolymsk(13.5), Ust-Yana (8.0), Bulun (5.1); Anabar, Nizhnekolymsk, Olenek in cancer morbidity of thyroid gland and haemoblastosis occupy the first three places accordingly.

Results of the research prove that MN is higher in those regions located in the lower reaches of great northern rivers because the upper reaches are influenced by environment pollution of mining industry.

Some researchers [3, 9-12] explain MN morbidity rate as follows: a way of nourishment, especially non-qualitative imported products, lack of vegetable products leading to macro-and-micro -nutrient in a ration, birth-rate reduction, a short period of nurse, environment pollution, smoking, alcoholism, a changed way of life.

CONCLUSION

Thus, the main factor of MN morbidity in Ust-Yana, Allaekha regions is the functioning mining enterprises in the upper reaches. Water territory

Continued table 6

1	2	3	4	5	6	7	8
Soft tissue	1989-1998	1,1	0,0	1,5	2,1	0,0	1,1
	2001-2010	0,0	8,8	2,0	1,7	2,4	1,0
	Growth rate	0,0	0,0	2,90	-2,20	0,0	-0,95
Skin (including melanoma)	1989-1998	2,6	1,8	1,8	2,1	5,1	1,9
	2001-2010	2,5	0,0	3,1	3,4	4,9	10,0
	Growth rate	-0,40	0,0	5,60	4,95	-0,40	18,05
Female reproductive organ in total	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6	1989-1998 26.0 30.2 49.1 42.4 24.5 30.6
	2001-2010	25,0	75,0	78,8	50,2	29,4	56,1
	Growth rate	-0,40	9,55	5,40	1,75	6,35	6,25
Breast	1989-1998	10,4	15,1	25,7	26,3	14,7	20,4
	2001-2010	10,0	46,1	29,8	33,5	24,5	29,1
	Growth rate	-0,40	11,85	5,75	2,30	5,20	3,65
Cervix	1989-1998	5,2	11,3	11,7	8,8	4,9	6,1
	2001-2010	5,0	17,3	27,7	10,0	0,0	14,5
	Growth rate	-0,40	3,95	9,00	1,30	0,0	9,10
Uterus body	1989-1998	0,0	0,0	4,7	1,5	0,0	1,0
	2001-2010	5,0	5,8	6,4	6,7	4,9	0,0-
	Growth rate	0,0	0,0	3,15	16,15	0,0	0,0
Ovule	1989-1998	10,4	3,8	7,0	5,8	4,9	3,1
	2001-2010	5,0	5,8	14,9	0,0	0,0	12,5
	Growth rate	-7,05	4,30	7,85	0,0	0,0	14,95
Male genitals-total	1989-1998	0,0	11,1	1,1	1,4	5,1	1,3
	2001-2010	5,0	0,0	0,0	10,2	4,9	3,8
	Growth rate	0,0	0,0	0,0	21,95	-0,40	11,35
Prostate	1989-1998	0,0	11,1	1,1	1,4	5,1	0,4
	2001-2010	0,0	0,0	0,0	10,2	4,9	1,9
	Growth rate	0,0	0,0	0,0	21,95	-0,35	16,85
testicle	1989-1998	0,0	0,0	0,0	0,0	0,0	0,9
	2001-2010	5,0	0,0	0,0	0,0	0,0	1,9
	Growth rate	0,0	0,0	0,0	0,0	0,0	7,80
urinary	1989-1998	0,0	11,1	1,1	1,4	5,1	1,3
	2001-2010	5,0	2,9	5,1	13,5	2,4	8,0
	Growth rate	0,0	-10,0	16,55	25,45	-7,25	19,95
kidney	1989-1998	5,2	-	2,8	3,5	5,0	1,1
	2001-2010	5,0	2,9	5,1	8,4	2,4	7,0
	Growth rate	-0,40	0,0	6,20	9,15	-7,15	20,35
bladder	1989-1998	2,5	0,0	0,6	2,1	0,0	1,5
	2001-2010	0,0	0,0	0,0-	5,1	0,0	1,0
	Growth rate	0,0	0,0	0,0	9,25	0,0	-3,95
CNS	1989-1998	5,1	1,9	2,2	0,7	0,0	1,2
	2001-2010	0,0	0,0	1,0	0,0	2,4	2,0
	Growth rate	0,0	0,0	-7,60	0,0	0,0	5,25
Thyroid	1989-1998	0,0	1,9	0,5	0,0	4,9	1,2
	2001-2010	7,5	2,9	4,1	5,1	4,9	3,0
	Growth rate	0,0	4,30	23,40	0,0	0,00	9,60
hemoblastosis	1989-1998	2,5	5,6	2,3	5,0	5,0	2,8
	2001-2010	14,9	5,8	1,0	8,4	7,3	1,0
	Growth rate	19,55	0,35	-8,00	5,35	3,85	-9,80

of the lower reaches and the rivers Yana, Indigirka, Anabar are polluted by transbodering mining enterprises. Nizhnekolyma region is polluted by mining enterprises of Srednekolyma, Verkhnekolyma and Magadan regions. At the same time a changed way of life, nutrition, lack of vegetable products leading to deficit of important nourishing substances play a great role in cancer morbidity rate data.

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RELATIONSHIP OF THE GEOMAGNETIC DISTURBANCE TO THE STATE OF THE CARDIOVASCULAR SYSTEM AT HIGH LATITUDES ON THE GROWTH PHASE OF THE 11-YEAR SOLAR ACTIVITY CYCLE

ABSTRACT

Aim. To determine the dependence of the cardiovascular system's changes on specific physical parameters of space weather.

Materials and methods. The research covered 47 volunteers of different age, gender, and health conditions. The research was conducted at two observing stations: in the city of Yakutsk and the settlement of Tiksi in the Far North. For two months in March and April of 2011, on weekdays, we did ECG of the volunteers with Phasagraph system.

Results. It was revealed that the test people organisms react with changes in the T-wave symmetry on each change in the geomagnetic storminess.

Conclusion. The existence of coincident peaks of ECG data changes with geomagnetic parameters at the two observing stations proves the impact of the changes in geomagnetic storminess on the human cardiovascular system. The contrasting of the research results to the 2009 experiment results assumes that the different reactions of the human cardiovascular system may be related to the different phases of the 11-year Solar cycle.

Keywords: cardiovascular system, electrocardiogram, degree of symmetry, Solar activity, geomagnetic storminess.

The term 'space weather' describes the state of the near-Earth space. The Sun has the main impact on the near-Earth space. Therefore, identifying the link mechanisms between the solar activity and the functioning of various objects of the biosphere, including humans, is one of the fundamental issues of modern science.

The human organism is an open system; thus, changing conditions in the external environment have an impact on human well-being. The cardiovascular system is one of the first to participate in the process of adapting to changing environmental conditions. This is manifested in changes in the circulatory system, in particular, in the vascular tonus and blood rheological properties, as well as a disturbed balance between the coagulation and anticoagulation systems [4]. Cardiovascular diseases rank first in the morbidity and mortality of people; therefore, these diseases are socially significant and require more attention [5].

Living organisms on Earth are under the constant influence of environmental factors [1]. They include both widely known meteorological factors (temperature, pressure, wind, and humidity) and less known factors of electromagnetic nature, whose influence is not felt until their intensity reaches a certain level. The factors of electromagnetic nature change primarily under the influence of the Sun on the magnetic field, gaseous mantle and solid crust of the Earth [6]. To date, a large body of scientific information on the matter is accumulated. However, the conclusions of individual authors are contradictory. For example, Yu. I. Gurfinkel et al. [2] claim that the impact of geomagnetic storminess on the cardiovascular system of a patient with coronary artery disease is most pronounced during the first three days after the storm beginning. Meanwhile, E. I. Nesmeyanovich and A. V. Bukalov [3] conclude that the heart attacks dynamics is not correlated with the dynamics of storminess of the Earth magnetic field; they note that the highest number of heart attacks occur 9-10 days prior a geomagnetic storm.

Thus, the results of individual authors on the reaction of the human body to heliogeophysical disturbances do not always agree with each other.

The aim of the present research was to determine the dependence of the cardiovascular system's changes on specific physical parameters of space weather.

MATERIALS AND METHODS

To address this aim, in the period March-April 2011, we carried out a biomedical monitoring experiment to check the cardiovascular system state of volunteers with Phasagraph express-cardiograph.

At two stations: in the city of Yakutsk – Shafer Institute of Cosmophysical Re-