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LEVEL OF SOLAR ACTIVITY AS FACTOR INFLUENCING ON LIFESPAN

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Introduction

It is now recognized that the solar activity (SA) affects a variety of processes in the biosphere, including the state of the human body [1-9]. Variations of the geomagnetic field (GMF), whose amplitude may increase by several orders of magnitude in high latitudes during the "solar disturbance" are the main "mediator", between solar flare and the state of living systems. It is shown, that the increase of the GMF activity are the one of the cause for the worsening health in the certain group of people and the increasing of the risk of death [10-13].

Because variations GMP modulate the functional state of the organism [14], the question naturally arises, does the solar activity and associated with it GMP variations affect on the human prenatal period? Moreover, does whether the life expectancy during prenatal and early postnatal stages depend on the phase of the SA?

The literature on this subject is contradictory. In particular, one was shown that a high SA in during prenatal development and in the year of birth shortens lifespan and increases the risk of death from cardiovascular disease [3, 5, 8, 15]. On the other side, studies of Siberian scientists have shown that a high level of solar and geophysical activity during prenatal development in some extent contributes to a higher adaptive reserves of the human body and determines its suitability for living and working in regions with extreme climatic and geophysical conditions of existence [4,7]. The purpose of this study was to determine the relationship between lifespan and level of SA in the year of birth of patients Mental hospitals, as well as to make a comparative evaluation of lifespan for men and women.

Materials and Methods

In the material for the study is included medical and statistical data on the dates of births, deaths and causes of death in patients with psycho-neurological boarding (Regional psychoneurological boarding Apatity, Murmansk region.) To considering were selected data for the period from April 1984 to December 2009 (total of 967 cases). This set of data is unique in that all patients are identical living conditions and nutrition, which eliminates the influence of the environment and lifestyle. Years of birth people covered the period from 1895 po1984 years. The study examined the relationship between life expectancy and level of SA in year of birth. The Wolf numbers were indicators of the SA. Statistical analysis was performed using Statistika 6.0 at a significance level of $p < 0,05$.

Figure 1 shows the contribution of diverse causes (%) that led to the death of patients Mental hospitals. One can see that the overwhelming number of deaths occur due to diverse type of cardiovascular disorders (87%). Other deaths were due to various causes, such as cachexia, cancer, epilepsy, etc. (13%).

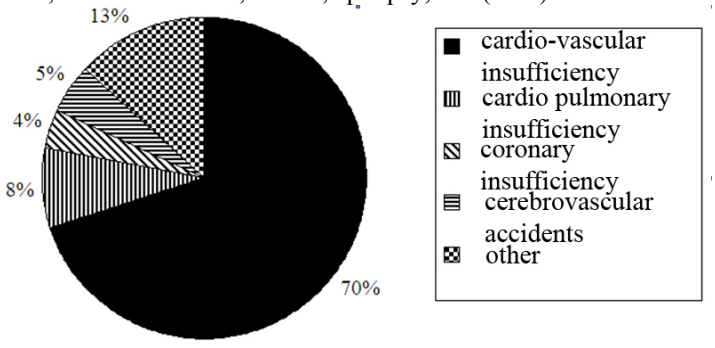

Fig. 1. The contribution of diverse causes (%) to prevalence of death cases at the boarding

The average values of the Wolf numbers for the entire study period (W mean), the average values of the Wolf numbers at low (W low) and high (W high) SA have calculated by descriptive statistics are presented in Table 1. As can be seen from Table 1, the average life expectancy of people in the mental boarding is 59,5 ± 0,63 years, lifespan at birth under low SA is 63,1 ± 0,79 years, and under high CA is 54,6 ± 0,96 year. This mean, that people in group

have born in the years of low SA have lifespan on the 8.4 years more than in the group where people have born in the years of high SA.

Table 1. Summary statistics of distribution of Wolf numbers (W), life expectancy (age) for the entire study period (mean), at low (age group 1) and high (Age column 2).

indicators	N	mean	median	Mode	Freq. mode	min	max	St. Dev.	st. error
W	967	55,4	45,9	9,6	29	1,4	190,2	43,70	1,40
Age mean	967	59,5	64	80	34	18	94	19,51	0,63
Age (gr 1)	557	63,1	68	74	26	18	94	18,74	0,79
Age (gr 2)	410	54,6	59	70	17	18	93	19,47	0,96

Over the entire study period, the dead in the first group (at low values of the Wolf numbers) were more on 36% than in the second one, mainly due to the contribution to the overall mortality rate of people with age over 60 years. At the same time, in the second group, the younger people aged 20-30 years have introduced the main contribution to the overall mortality (Figure 2). That is, in the first group the mortality dominates in old age, and the young people who died at the age of 20-30 years make a significant contribution to mortality in the second group.

To confirm the null hypothesis, which consists in assuming that high SA in the period of conceiving and prenatal development has a negative impact on life expectancy, the significance of the differences between the distribution of ages on groups was assessed. To do this, were applied the criteria nonparametric statistics (Mann-Whitney and Wald-Wolfowitz criterion), allowing to compare the distribution of the parameters in two independent groups.

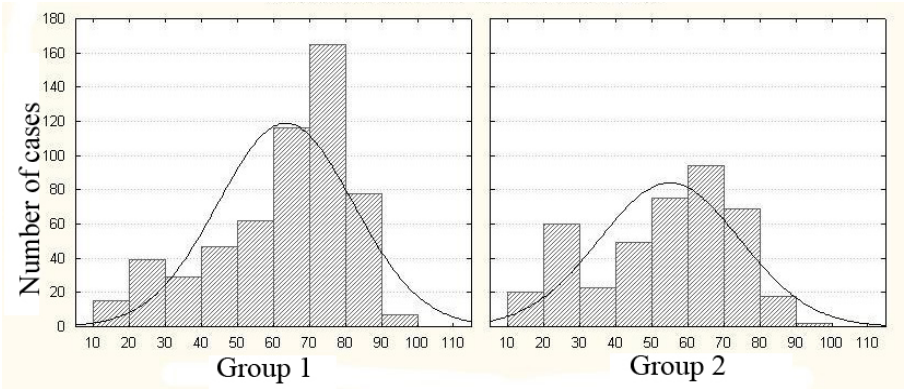

Fig. 2. Frequency distribution of life in 1 (low SA) and 2 (high SA) groups

Mann-Whitney test is a nonparametric alternative to the t-test for independent samples with abnormal distribution. In the analysis using the Mann-Whitney test, the indicators (age) in the two groups are combined, arranged based on ascending point value and ranked. Rank values are summed for each group and use them to calculate the values of the criterion U (for each sample), used to assess the significance of differences between the two samples. U value of the criterion reflects how large area of agreement between the two samples and the smaller the value of U, so the differences are more significant. The results of analysis of the differences between the two groups are shown in Table 2.

Table 2. Evaluation of the significance of differences between the two groups, corresponding to the birth in years with low (gr. 1) and high (gr 2) of solar activity using the Mann-Whitney-U test

Mann–Whitney U p <0,05					
number of observations		sum of the ranks		U	***p***
gr. 1	gr. 2	gr.1	gr. 2		
557	410	301007,0	167989,0	83734,00	<0,001

The data in Table 2 show that there are significant ($p < 0.001$) differences between distributions in age of dead patients of two groups.

According to the second criterion (Criterion series of Wald-Wolfowitz) indicators (age) in the two groups are combined, line up by degree of their ascending and then count the number of cases with adjacent values of age, belonging to the same group (with low or high SA in the year of birth). If there are no differences between the

groups, the number of repetitions and length of occurrence group numbers (1st or 2nd) will be random. If there are differences between the groups, the alternating groups and the frequency of their occurrence will be uneven. The results of this comparison are presented in Table 3.

Table 3. Evaluation of the significance of differences between the two groups, corresponding to the birth in years with low (gr. 1) and high (column 2) of solar activity using Wald-Wolfowitz test

Wald-Wolfowitz test p <,05				
number of observations		The number of alternations of groups	The number of matches in groups	***p***
gr 1	gr 2			
557	410	399	370	<0,001

Assessment of the significance of differences between the two groups by using different algorithms show that the differences between the them are significant at p <0.001.

To analyze the differences in the distribution of lifespan y between men and women in the 1 st and 2 nd group maximum life span was divided into 10-year periods, in the repartitions of which was estimated the incidence of death in men and women who were born with low and high CA. Frequency distribution of deaths within these groups are presented in Table 4.

Table 4. Frequency distribution of deaths (frequency) in different age groups for men and women in the cohorts born in years with low (group 1) and high (group 2) of solar activity

Age group	Male $_1$		Male $_2$		Female $_1$		Female $_2$	
	frequency	% observ.	frequency	% observ.	frequency	% observ.	frequency	% observ.
11-20	10	3,984	12	5,357	5	1,629	8	4,324
21-30	17	6,773	43	19,196	22	7,166	17	9,189
31-40	20	7,968	12	5,357	9	2,932	10	5,405
41-50	33	13,147	36	16,071	14	4,560	13	7,027
51-60	34	13,546	47	20,982	28	9,121	28	15,135
61-70	58	23,108	53	23,661	58	18,893	41	22,162
71-80	58	23,108	18	8,036	107	34,853	51	27,568
81-90	19	7,570	3	1,339	59	19,218	15	8,108
91-100	2	0,797	0	0,000	5	1,629	2	1,081

Study showed that the mortality in both men and women in group 2 occured under the age of 60 years, and a significant contribution (19%) to mortality are contributed by men aged 21-30 years. In the 1st group, on contrary, death rate increased after 60 years and in this group there are a high percentage of centenarians. In order to identify the significance of the differences between the life expectancy of men and women born in the years with different levels of CA, was used the Mann-Whitney test, as described above. Results of the assessment of differences using this test are shown in Table 5.

Table 5. Evaluation of the significance of differences in lifespan for men and women in the 1 st and 2 nd groups using the Mann-Whitney

Gender	number of observations		sum of the ranks		U	***p***
	gr 1	gr 2	gr 1	gr 2		
male	251	224	67225,50	45824,50	20624,50	<0,001
female	268	224	67213,00	54065,00	28865,00	0,464

The data in Table 5 show that between the life expectancy of men born in the years of low and high SA are significant differences, whereas between the life expectancy of women belonging to different groups, no significant differences were found.

Thus, we have shown that the SA in the year of birth determines the life span. The average life expectancy of people born in years with low SA of 8.4 years higher than in those born in the year with a high SA.

Since most of the deaths occurred in the boarding due to cardiovascular disease, it can be assumed that a high SA during prenatal and postnatal development predetermines the vulnerability of the cardiovascular system [10,11,13-16]. Inasmuch as high CA, usually accompanied by magnetic storms, the geomagnetic disturbances could lead to the same violations in the heart of the child, as in experimental animals during magnetic disturbances. It was shown in experiments, the ventricular contractile force of the heart, the fall of the absolute values contractile force of the heart and arterial pressure, changes in the ultrastructure of cardiac cells are disordered under GMF disturbances [17]. These changes are likely to "remember" (heliogeophysical imprinting, [4]), and create the preconditions for the high sensitivity of the cardiovascular system, not only to heliogeophysical influences, but also to other traumatic agents, that ultimately, could lead to a decrease in the duration of life as a result of premature "wear" the cardiovascular system. It can be assumed that men are more sensitive to the effects of CA in utero, because only men born in the years of low and high SA, identified significant differences in life expectancy.

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