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Mini Review

Space weather and COVID-19 Pandemic Genogeography

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Space weather and the dynamics of Solar Activity (SA) have a significant impact on biota and society. So, all influenza epidemics of the 19–21 centuries developed only at the extremes of solar activity (Table 1)

The difference in the number of infectious diseases in Russia in the minimum and maximum of the 11-year cycle of SA is more than 25 million people (Figure 1).

As a result of long-term multi-latitude online monitoring of 2003–2015 from Yakutsk to Simferopol and Baku, simultaneous statistically significant changes in the biomedical parameters were revealed, associated with variations in solar dynamics, geomagnetic field and cosmic rays (total number of measurements is more than 500,000). 1–2 days after flare-ups on the Sun, even in healthy people, a transition of heart

Table 1: Influenza pandemics of the 19-21 centuries and the corresponding extremes of solar activity. Designations: maximum cycle number 23 - Max 23; minimum between 23 and 24 SA cycles - min 24.

Years	Disease	Phase Cycle SA
1889-1890	Flu	min13
1918-1920	Spanish Flu, H1N1	Max15
1957-1958	Asian Flu, H2N2	Max19
1968-1970	Hong Kong Flu	Max20
1995-1996	Influenza	min23
2002-2003	SARS, SARS-CoV	Max23
2004-2005	Flu	Max23
since 2004	Avian influenza, H5N1	Max23
2009-2010	Sw	
ine Flu, H1N1	min24	
2019-2020	COVID-19, SARS-CoV-2	min25

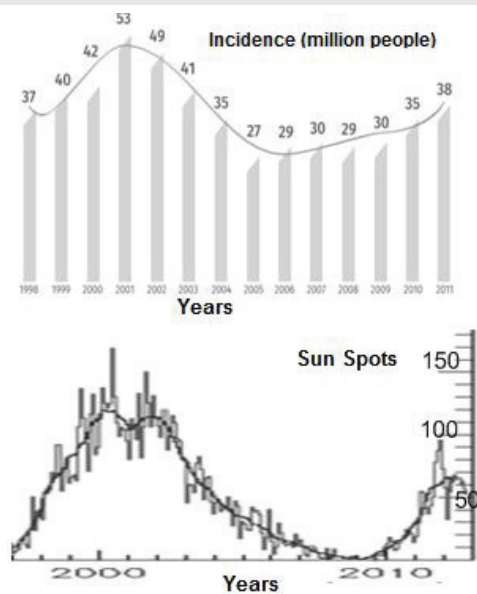


Figure 1: The number of infectious diseases in Russia for 1998-2011 (million people) according to the Federal State Statistics Service; and the dynamics of solar activity 23-24 cycles (the number of daily and smoothed sunspots).

dynamics to a more chaotic mode of functioning was observed [1,2]. A more detailed study of the heart dynamics in the phase space showed the division of the types of phase cardio-portfolio of the subjects into the “South Russian” (S) and “North Russian” (N) version with different adaptive dynamics to variations in space weather. Further research showed the affiliation of these cardiodynamics to various haplogroups. One of the significant genetic differences between haplogroups is the difference in the production of complexes of human leukocyte antibodies. It is associated with the strength of the immune response of representatives of a particular haplogroup to the

virus. Additional environmental factors and the characteristics of the genetics of the population in each particular country can accelerate the development of a local epidemic, increase its severity and mortality rate. SARS-CoV-2 virus pandemic is unexpectedly difficult in prosperous European countries with a high level of medical development. Mortality by country varies by more than 15 times. To explain this fact, one must look not in the field of the laws of epidemiology. Apparently, in the development of current local epidemics, the main modulating factor is the genogeographic characteristics of the population. Genetic variations explain the differences in the strength of the immune responses of leukocyte antigens. The largest number of victims per 1 million inhabitants is recorded in the territories of Northern Italy, Spain, France, Belgium, Great Britain, and the USA. All these countries have populations with a dominant haplogroup R1b.

In the European territory of Russia, the dominant haplogroup is R1a. This haplogroup was characterized by a rapid development of the epidemic with low mortality and a large number of asymptomatic patients (Russia, Germany, Iran). We compared the dynamics of the coronavirus epidemic in Moscow and St. Petersburg. The density and age composition of the population in both cities is comparable. The quarantine measures taken by the city government were more stringent in Moscow. However, the local epidemic in St. Petersburg is developing 10 times slower. The proportion of haplogroup R1a is halved in the northern regions of Russia and St. Petersburg. Haplogroup R1a gives way to haplogroup Nc1. Differences in the genetic composition of the population can explain the significant difference in the development of the epidemic in Moscow and St. Petersburg, and its milder course in the St. Petersburg Figure 2.

Understanding the genetic and geographical features of the development of a pandemic COVID-19 contributes to the correct distribution of medical resources, assessing the severity of the

disease and optimal therapy. This is important because in the conditions of a solar activity global minimum, pandemics of the 21st century will occur 2 times more often than in the 20th century.

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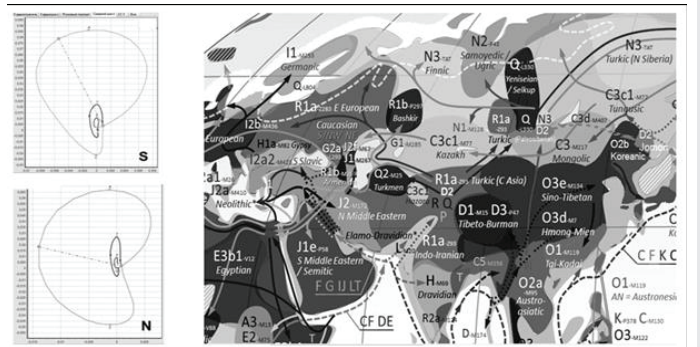


Figure 2: On the left are phase portraits of the “South Russian” cardiocycle (S) and “North Russian” cardiocycle (N). On the right is the genetic map of Eurasia. The dominant haplogroup R1b is northern Italy, France, Spain, and Great Britain; R1a - Germany, Russia, Iran; N - Finland, North-West Russia and Siberia.

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