

AN INFLUENCE OF THE HELIOGEOPHYSICAL CONDITIONS ON INFLUENZA DISEASES IN AZERBAIJAN DURING 1976–2000

E. S. BABAYEV¹, R. KH. SALMAN-ZADEH¹, F. E. SADYKHOVA², SH. T. SHYKHALIYEVA²

¹*Shamakhy Astrophysical Observatory named after N. Tusi, Azerbaijan National Academy of Sciences
E-mail: elay@lan.ab.az*

²*Azerbaijan State Institute of Advanced Studies of Doctors named after A. Aliyev
Ministry of Health of the Azerbaijan Republic*

Abstract. The possible influence of the solar and geomagnetic activities on the influenza diseases is studied for the 1976–2000 interval. Period, duration as well as tendency beginning within a solar cycle of the influenza epidemic are determined. Influenza epidemic usually begins 2–3 years before or 2–3 years after the sunspot cycle maximum. The intensity of influenza epidemic is also investigated. We suppose that the solar activity affects influenza epidemic mainly through the geomagnetic activity. A forecast method for a prophylactic measure is developed.

Key words: solar activity – influenza – geomagnetic disturbances.

1. INTRODUCTION

The influence of solar activity on all living nature of the Earth, in particular on a human organism, is considered now indisputable. The powerful flows of solar corpuscles, invading the Earth's atmosphere, cause magnetic storms, polar auroras, changes of atmospheric circulation and other phenomena. With incoming of charged particles flows on the Earth, the changes in alive organisms start. In particular, after large solar chromospheric flares, the reaction of the man to a signal is sharply descended; his cardiovascular and digestive systems become more vulnerable and the number of diseases requiring urgent medical intervention is suddenly increased. All these phenomena smoothly change in connection with the 11-year cycle of solar activity. During the periods of increased activity of the Sun, the health condition of diseased patients of hypertension and atherosclerosis is degraded. There also are violations of the functional condition of central nervous system, number of myocardial infarction cases, cardiovascular crisis and connected with them fatal cases are sharply increased (Giordano, 1960; Poumailloux and Viact, 1959; Shul'ts, 1963). The beginning, development and ending of many epidemic diseases, such as a plague, cholera, typhnia, cerebral meningitis, diphtheria, etc., also rhythmically follow the cyclical activity of the Sun (Tchizhevsky, 1973).

Influenza takes a special place among epidemic diseases. Despite of apparent clearness of a problem with an influenza exciter and of influenza vaccines' existence, epidemics and pandemics of influenza periodically whip worldwide. Therefore, it is very important to forecast the most probable time distribution of influenza epidemics in order to have enough time for accepting any preventive measures facilitating flow of this, at the first sight, harmless, however very insidious illness.

In this paper the possible connection of influenza epidemic distribution with solar and geophysical activity is investigated. The empirical data used contain the analysis of influenza infection movement in Baku (the capital of Azerbaijan with millions of habitants) during the interval 1976–2000, including two 11-year cycles of solar activity. The qualitative analysis of the comparison between solar activity data and epidemic rises of the disease number caused by influenza in the marked period is of practical interest.

2. CORRELATION BETWEEN INFLUENZA EPIDEMIC AND HELIOGEOPHYSICAL ACTIVITY

In Fig. 1, the upper curve illustrates the number of diseases caused by influenza in Baku from 1976 to 1997. The total number of patients diseased by influenza for each year (divided by 10000) is marked on the ordinate axis. The lower curve illustrates the yearly averaged sunspot numbers (on the ordinate axis).

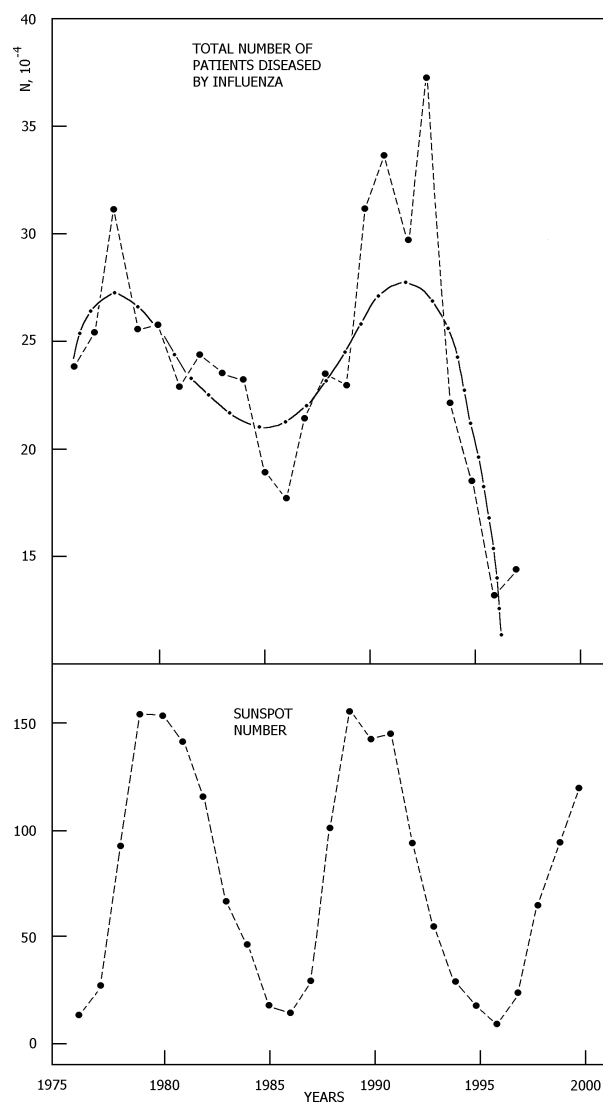


Fig. 1 – The total number of patients diseased by influenza (upper panel) and the sunspot number vs years (bottom panel).

One can see from Fig. 1 that the minimum of the disease number in both considered solar cycles almost precisely coincides with the minimum of sunspot numbers. However, the maximum of influenza epidemic in the first considered cycle (1978 year) appears 1–2 years prior to the proper maximum of solar activity, while in the second considered cycle it happens approximately 3 years (1993 year) after the sunspot activity maximum. For explanation of this fact, we shall address to Fig. 2, where the correlation of geomagnetic disturbances with solar activity is illustrated.

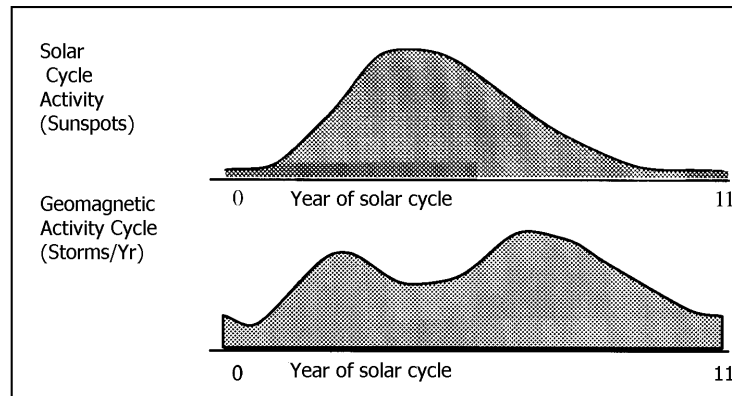


Fig. 2 – Correlation between solar and geomagnetic activity.

The upper curve represents the sunspot number averaged on many solar activity cycles. The lower curve represents the geomagnetic activity (magnetic storms per year) averaged on the same cycles. Storms that are less intense but still rather severe will occur frequently, probably several times per year. From Fig. 2 it is evident that there typically is a double peak in the frequency of these magnetic storms during solar cycles; at the maximum of sunspot numbers, the average number of magnetic storms appears minimum. Maximum epoch of magnetic storms is marked 2–3 years prior to the maximum and, 2–3 years after the maximum of solar activity. This result is obtained from the statistical analysis of the magnetic storms background data (strong, but rather less intense) (Babayev, 2000).

Taking into account the known data of virologic researches about the formation of the "drift - variant" strains of influenza viruses in each 2–4 years and formation of "shift - variant" in each 10–13 years, it is possible to draw the conclusion there is a probable heliogeophysical effect on the new changed strains of influenza viruses.

The table of influenza infections movement is illustrated below.

Hsw1N1	→	H0N1	→	H1N1	→	H2N2	→	H3N2	→	H1N1
1918-1928		1928-1946		1946-1957		1957-1968		1968-1977		1977-1997

The antigenic formulas of influenza viruses described by the structure characters of a virus are given in the upper line: H – haemagglutination, N – neuraminidase. The years of originating of epidemics and pandemics conditioned by the influenza "A" virus are marked in the lower line. The comparative analysis of the solar activity level through marked years and both periods of epidemics and pandemics originating have revealed definite regularity. So, the pandemics of 1918-1919 and 1968 conditioned by the influenza "A" virus with the antigenic formula Hsw1N1 and H3N2, respectively, coincide with the years of solar activity maximum. It should be noted that in 1968 year there were discovered the basic changes ("shift") of the gene of influenza virus with the

antigenic formula H3N2 as compared to the strain H1N1 for the period of 1946–1957 years, i.e., were changed both haemagglutination and neuraminidase. Probably, the same "shift" changes have taken place with the virus Hsw1N1 as well. In 1946 year, the influenza epidemic, conditioned by the circulation of a virus strain of influenza with a new antigenic formula H1N1, as contrasted to 1929, took place. The maximum of solar activity was observed in 1948 year. Thus, the epidemic of 1946 year is also agreed with the supposition about originating of influenza epidemic 2-3 years prior to the maximum of solar activity, that is, in the maximum of magnetic storms.

3. DISCUSSION

As it was mentioned above, according to the Fig. 1, the minimum of the diseases number caused by an influenza, in both considered cycles, almost precisely coincides with the minimum of sunspot numbers. However, the maximum of epidemic (1978) in the first considered cycle happens 1–2 years prior to the maximum of solar activity, while in the second considered cycle, it happens approximately 3 years (1993) after the solar activity maximum. It means that the solar activity does not influence the influenza epidemic directly, but by the means of (through) geomagnetic disturbances (activity). Namely, the maximum distribution of influenza epidemic corresponds to the maximum number of geomagnetic storms within the 11-year cycle of solar activity.

The minimum distribution of influenza epidemic in the minimum of solar activity is apparently connected with the following as well. An organism, after diseases caused by an influenza (it corresponds to the section between maximum and minimum of the first considered cycle), gains a natural immunity to the given type of virus for some years ahead. Past-influenza immunity slowly decays by time, and after the passing of the minimum of solar activity, the gradual growth of new surge of epidemic begins. Apparently, sufficient quantity of UV-radiation, received by an organism during maximum activity of the Sun, in the second considered cycle slows down the tempo of weakening of immune protection of an organism against the given virus of an influenza. Consequently, the maximum of epidemic of the second surge comes in 2–3 years after the maximum activity of the Sun (the section "maximum-minimum" of the second considered cycle). Then, an organism again gains natural immunity and influenza epidemic, with decaying tempo, goes to the minimum. Certainly, these hypotheses are fair only in the permanency case of the antigenic structure for a given type of virus, during the considered periods. In the case of change of antigenic structure of a virus, the new surge can begin after previous one.

Our statistical data on diseases caused by influenza encompass only two 11-year cycles of solar activity. We have not made the separation either between the types of viruses "A" and "B" or between data about adult and children, which have different immunity-protective systems of the organism. However, even on the basis of such preliminary analysis, it is possible to forecast approximate time of probable beginning of the next surge of an epidemic influenza. For this purpose, forecast method for prophylactic measures is developed for Baku with neighbor region and Absheron peninsula.

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