

About the role of environmental factors in carcinogenesis

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Abstract. There were found out the connections of the activity of the Sun and smoke of forest fires with the incidence of various forms of benign and malignant neoplasms in the population of young children 0-4 years old, in Khabarovsk Region, Russia. Thus, it was determined that so-called "sporadic" fluctuations in the incidence of neoplasms in the child population are not random. They are caused by long multi-year cycles of changes in the complex of environmental factors. The authors identified this phenomenon as "Alternative oncogenesis", meaning by it the predominant occurrence of various forms of neoplasms in a certain period of time due to a change in the parameters of the complex of environmental factors. A proposed hypothesis is: ecologically linked oxidative stress as a cause of the epigenomic modulation leading to an imbalance between semaphorins and integrins that brings to oncogenesis.

1 Introduction

Investigation of the links between environmental factors and malignant neoplasms is important both for understanding the causes of cancer and developing measures for its prevention. Our approach consists in the simultaneous study of the association of environmental factors with the incidence of benign tumors and malignant neoplasms in cohorts of young children 0-4 years, since this allows a broader out look at oncogenesis. Tumors in this period have predominantly the prenatal origin, and it makes possible to obtain information in a fairly short time. As environmental factors we have chosen solar radiation and the smoke of forest fires.

2 Materials and methods:

The incidence of benign tumors in the cohorts of young children born in Khabarovsk city in 1976-1986 years (693 causes) have been studied (per 10⁵). It was studied the incidence of malignant neoplasms (per 10⁶) in the cohorts of young children born in Khabarovsk Region in 1972-1988 years (572 cases of the disease).

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For the system analysis, we used the interval characteristics within the calendar year: the average of annual number of sunspots, the number of forest fires in the Khabarovsk Region, and the incidence of neoplasms. The time series were subjected to multivariate correlation and regression analysis using the IBM SPSS Statistics 23 software package in seven iterations with a 1 year lag to the year of birth of children in the cohorts (-3, -2, -1.0, + 1, + 2, + 3).

3 Results and discussion

When studying the influence of the Sun, it was established a link between the Sun activity 3 years before the birth of children and the incidence of benign tumors ($r = 0.785$; $p = 0.004$). Among the specific forms of benign neoplasms, tumors of soft tissues [1] as well as papillomas of the skin and mucous ($r = 0.720$; $p = 0.012$) showed a connection with the activity of the Sun 3 years before the birth of children. Among malignant neoplasms, a connection between solar activity 1 year before the birth of children was found for non-Hodgkin's lymphomas (Fig.1) [2].

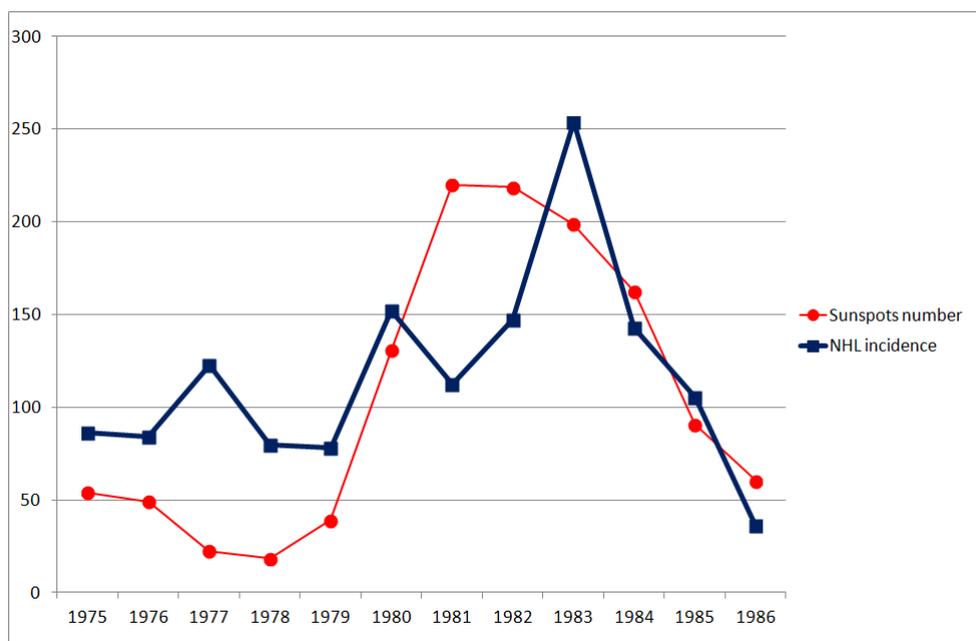


Fig. 1. Incidence of non-Hodgkin's lymphoma (NHL; per 10^6) in cohorts of children 0-4 years old (born 1975-1986), and sunspots number in 1 year before their birth (Khabarovsk Region, Russia)

The smoke of forest fires 2 years before the birth of the children turned out to be associated with the incidence of lymphangiomas ($r = 0.695$; $p = 0.009$), and for teratomas a connection with smoke was established 1 year before birth ($r = 0.656$; $p = 0.014$). The study of the connection of smoke with the occurrence of malignant neoplasms revealed a link between the number of fires 2 years before the birth of children and the incidence of Hodgkin's disease [3]. The number of fires 1 year after the birth of the children turned out to be associated with incidence of tumors of the central nervous system (Fig.2) [4].

For hemangiomas and leukemia, which are the most frequent forms of benign tumors and malignant neoplasms, respectively, a significant relationship was found with both the activity of the Sun and the smoke of forest fires. Multivariate analysis showed a strong

multiple correlation between the activity of the Sun 3 years before the birth of children, the number of fires 3 years after their birth, and the incidence of hemangiomas ($R = 0.870$; $F(2.8) = 12.424$; $p < 0.004$) [1]. According to the graph (Fig. 3), the incidence of hemangiomas predominantly reflects the long-term slow change in solar activity that had an

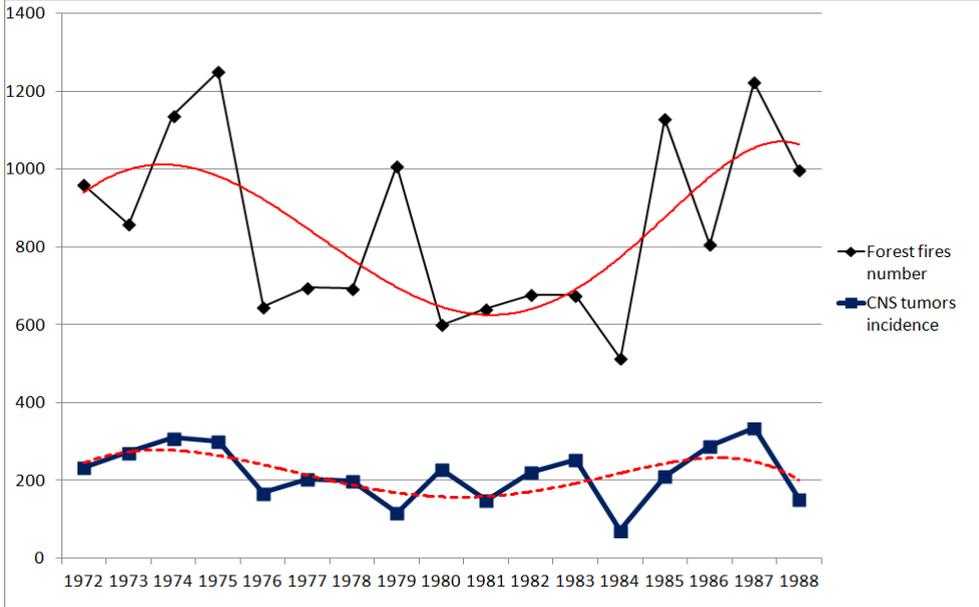


Fig. 2. Incidence of the central nervous system (CNS) tumors (per 10^6) in cohorts of children 0-4 years old (born 1972-1988) and the number of forest fires 1 year after the birth of the children (Khabarovsk Region, Russia).

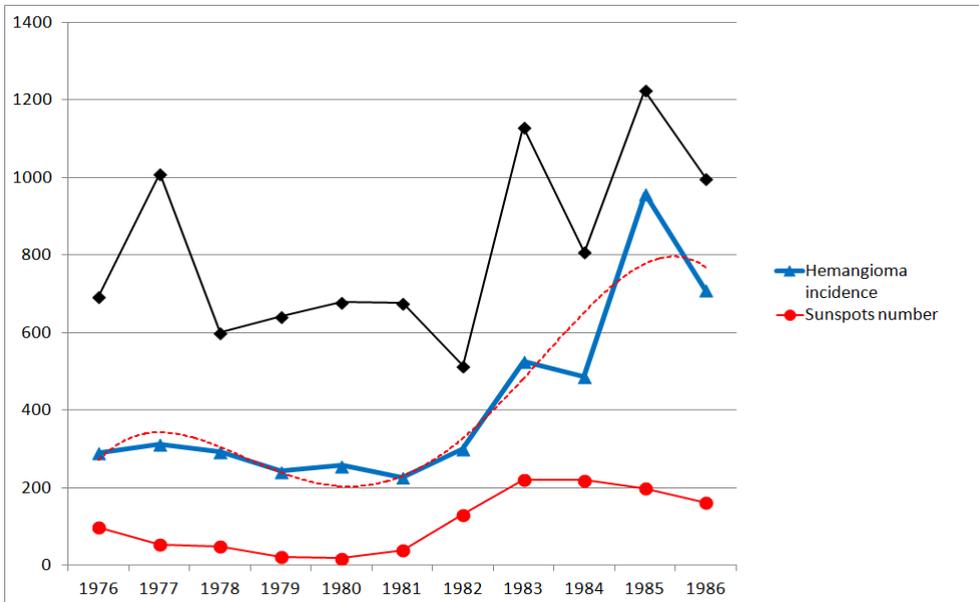


Fig. 3. Hemangioma incidence (per 10^5) in cohorts of children 0-4 years old (born 1976-1986), sunspots number 3 years before their birth, and the number of fires in a season 3 years after their birth (Khabarovsk Region, Russia).

effect on the gametes of the parents, and to a much less extent was a consequence of the postnatal effect of smoke.

For leukemia, multivariate analysis established the presence of a multiple correlation between the number of fires 2 years before the birth of children, the activity of the Sun 3 years after their birth and the incidence of this pathology [5]. As it can be seen (Fig. 4), the leukemia incidence curve reflects annual fluctuations in the number of fires, and the polynomial trend of this incidence has a high degree of similarity to long-term changes in solar activity. It can be assumed that a significant part of cases of leukemia in children occurs due to air pollution by the smoke of forest fires that had affected parental gonads 1-2 years before conception. A change in the activity of the Sun during the period of continued rapid development of the body of a child at the age of about 3 years contributes to the appearance of additional cases of the disease.

4 Conclusions

Thus, “sporadic” fluctuations in the incidence of neoplasms in the child population are not random. They are caused by long multi-year cycles of changes in the complex of environmental factors. We identified this phenomenon as “Alternative oncogenesis”, meaning by it the predominant occurrence of various forms of neoplasia in a certain period of time due to a change in the parameters of the complex of environmental factors.

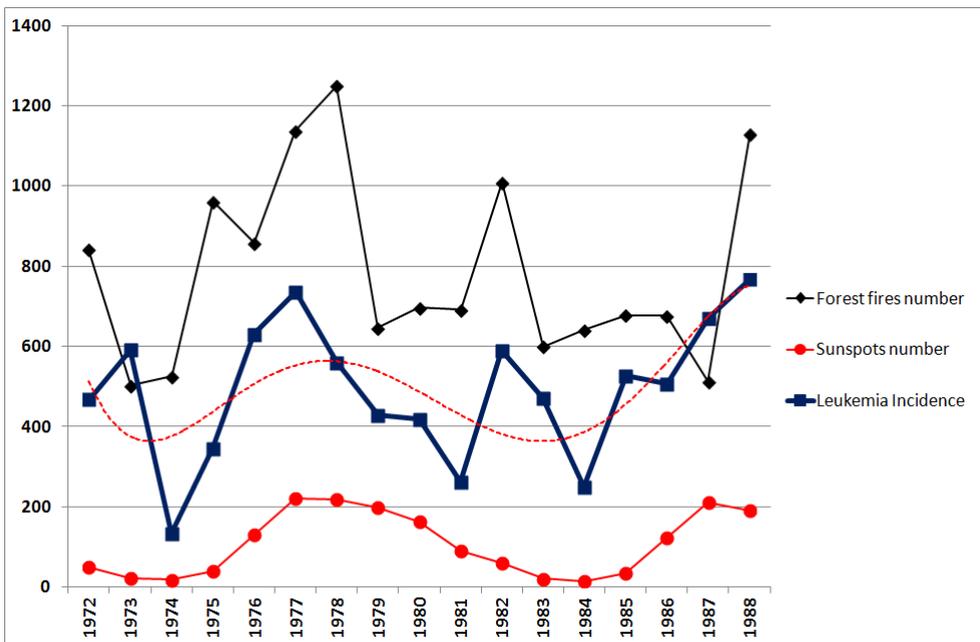


Fig.4. Leukemia incidence (per 10⁶) in cohorts of children 0-4 years old (born 1972-1988), the number of fires in a season 2 years before their birth, and sunspots number 3 years after their birth (Khabarovsk Region, Russia)

The connection of neoplasms incidence with the smoke of forest fires confirms the carcinogenic effect of smoke in general. The link of solar activity with the incidence of leukemia and lymphomas may be due to changes in the Earth's magnetic field under the influence of the Sun, leading to failure of physiological rhythms. Our hypothesis is

confirmed by the fact that professional exposure to low-frequency electromagnetic fields increases the risk of non-Hodgkin's lymphomas by 3 times [6], and the birth at the period of a calm Sun increases the average life expectancy by 5.2 years [7].

The oxidative stress and the epigenomic modulation caused by it, leading to an imbalance between semaphorins and integrins, with an outcome in tumor transformation can be the vector uniting environmental influences on a living organism.

In order to reduce the risk of neoplasia in children, it is recommended to the future parents, starting from the period 1-2 years before the planned conception, mothers during pregnancy and lactation, and young children to use sufficient vitamins, protect their respiratory organs with effective respirators, clean the indoor air, and make an immune rehabilitation using Transfer factor.

References

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