

**ІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ ТА ІМІТАЦІЙНЕ
МОДЕЛЮВАННЯ В НАУКОВИХ ДОСЛІДЖЕННЯХ**

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**MATHEMATICAL ANALYSIS OF BIBLIOMETRICAL
INDICES OF INVESTIGATIONS OF INFLUENCE OF
NON-IONIZED RADIATION OF DIFFERENT KINDS
UPON THE CORTEX (MEDLINE-INTERNET)**

Biological effects of non-ionized radiation of different kinds - electromagnetic (EMF), magnetic (MF), and electrical (EF) fields - interest people for many centuries [1]. In the middle XX-th century in consequence of appearance of new technological approaches investigations of this trend were facilitated. Towards middle of the seventies years of XX-th century more 3 thousand publications on biological effects of EMF and about 2 thousand publications on biological effects of MF were accumulated [1]. 20 years later the number of publications concerned electromagnetic biology is believed to reach 10 thousand [2].

Russian researches (including the author of the present work [2-5]) made essential contribution to development of this problem. Just our pioneering investigations established a key role of influence these penetrating factors on the brain in the rearrangements functional systems of animals and humans to them.

Bibliometrical investigation of published material on biological effects of non-ionized radiation including neurophysiological aspects was not carried out up to now, what was reason of our researches. Information accumulated in world on these trends during 35-year period in the later half of the XX century (1966-2000) was considered. Quantitative characteristics of publications on biological effects of EMF, MF and EF were found. Moreover especially biological effects of microwaves (MW) were selected because this factor was in the center of attention of researchers in the middle of the XX-th century.

Materials on of bibliometrical investigations partly were presented in our recent papers [6-11] and monograph [12]. In one of these papers information concerning works on action of non-ionized radiation of different kinds upon the whole brain was considered specially [11].

The present work is devoted to examination of bibliometrical characteristics of published works on action of non-ionized radiation of different kinds (EMF, MW, MF and EF) on the cortex.

Materials and methods. Bibliometrical investigation of published works was carried out by means of the database «Medline» accessible in

Internet. Published works concerning effects of EMF, MW, MF, and EF on condition and functions of the cortex were examined. Quantitative characteristics of values of published works during 35-year period in the later half of the XX century (1966-2000) were considered.

At statistical analysis of the material the coefficient of correlation, usual Student *t*-test for comparison of mean values, another Student *t*-test and Wilcoxon test for conjugate pairs were used. Besides the comparison of the parts of the numbers of works carried out with different physical factors in general totality were performed by *t*-criterion for selective fractions of variants.

Results and discursion. The number of published works on neurophysiological effects of non-ionized radiation during 35-years period from 1966 till 2000 reached 5935. From them 3188 ones were carried out on the whole brain (53.72%), 1032 - on the cortex (17.39%), 770 - on neurons (12.97%), and 945 - on nerves (15.92%).

General quantitative characteristics of values of published works carried out on the cortex with application of non-ionized radiation of different kinds (EMF, MW, MF and EF) are demonstrated in table 1. Mathematical comparison of the numbers of published works of indicated trends is presented in table 2. Dynamics of the numbers of published works performed on the cortex with EMF, MW, MF, and EF during 35-year period and dynamics of their sampling fractions (%) from the total number of works on the cortex with all factors during 35-year period are displayed accordingly in fig. 1 and 2.

Table 1.

General data on the number of published works carried out with different kinds of non-ionized radiation in the cortex during 35-year period

Factors	Characteristics of totalities					
	Total number for 35 years	Mean over 1 year	Variance	Sigma	Standard deviation	Fraction (%) in general totality
1	409	11.69	201.93	14.21	2.40	39.63
2	225	6.43	22.66	4.76	0.80	21.80
3	328	9.37	216.83	14.73	2.49	31.78
4	70	2.00	20.94	4.58	0.77	6.78
5	1032	29.49	924.43	30.40	5.14	100.00

Application: 1 - electromagnetic fields, 2 - microwaves, 3 - magnetic fields, 4 - electrical fields, 5 - sum.

The table 1 presents general quantitative characteristics of published works about action of EMF, MW, MF, and EF upon the cortex. This table shows significant predominance published works with application of EMF, that takes place at investigation of effects of radiation upon the brain [11].

The second place belongs to works with MF as well at study on the brain. The number of works on effects of MW approaches to the latter but locates on the third place.

Table 2.

Comparison of quantitative indices of published works carried out with different kinds non-ionized radiation in the cortex during 35-year period

Factors	Comparison of totalities				
	Coefficient of correlation	Student <i>t</i> -test	Student <i>t</i> -test for conjugate pairs	Wilcoxon test for conjugate pairs (<i>U</i>)	Comparison of fractions in general totality(<i>U</i>)
1 c 2	<u>0.44</u>	2.08	2.42	1.97	<u>10.79</u>
1 c 3	<u>0.54</u>	0.67	0.98	1.90	<u>17.00</u>
1 c 4	<u>0.41</u>	<u>3.80</u>	<u>4.40</u>	<u>4.06</u>	<u>23.16</u>
2 c 3	0.03	1.13	1.13	0.23	<u>6.25</u>
2 c 4	0.06	<u>3.97</u>	<u>3.85</u>	<u>4.11</u>	<u>12.36</u>
3 c 4	<u>0.91</u>	<u>2.83</u>	<u>4.06</u>	<u>4.31</u>	<u>18.61</u>

Application: 1 - electromagnetic fields, 2 - microwaves, 3 - magnetic fields, 4 - electrical fields. Significant values of coefficients of correlation and statistically significant distinctions between distributions and between sampling fractions are underlined ($r > 0.435$ corresponds to $p < 0.01$, $r > 0.332$ - to $p < 0.05$; t and $U > 2.58$ corresponds to $p < 0.01$).

The table 2 shows positive correlation between the numbers of works made with different penetrating factor in parts of cases. Positive correlation is absent at observation of such pairs as MW-MF and MW-EF, which may connects with different characteristics of dynamics the numbers of these works as it will show below in fig. 1 and 2. By means of different statistic methods it reveals than significant distinctions between data concerning EF and another analyzed assemblages exist. Results of comparison of sampling fractions (%) from the total number of works confirm them quantitative difference presented in table 1. Moreover date of application of *t*-test for conjugate pairs and Wilcoxon test for conjugate pairs show probability of different dynamics of events, which presents in fig. 1 and 2.

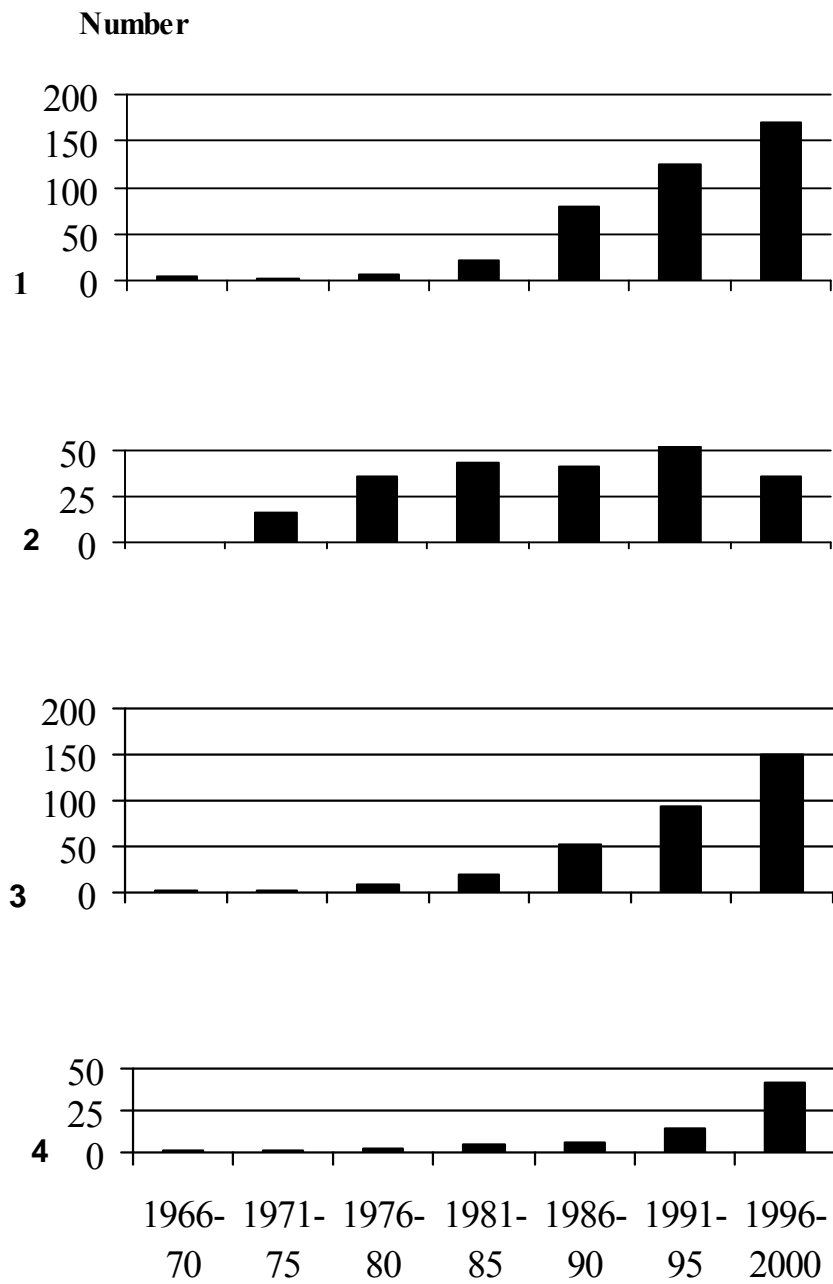


Fig.1. Dynamics of the number of published works carried out on the cortex with EMF (1), MW (2), MF (3), and EF (4) during 35-year period

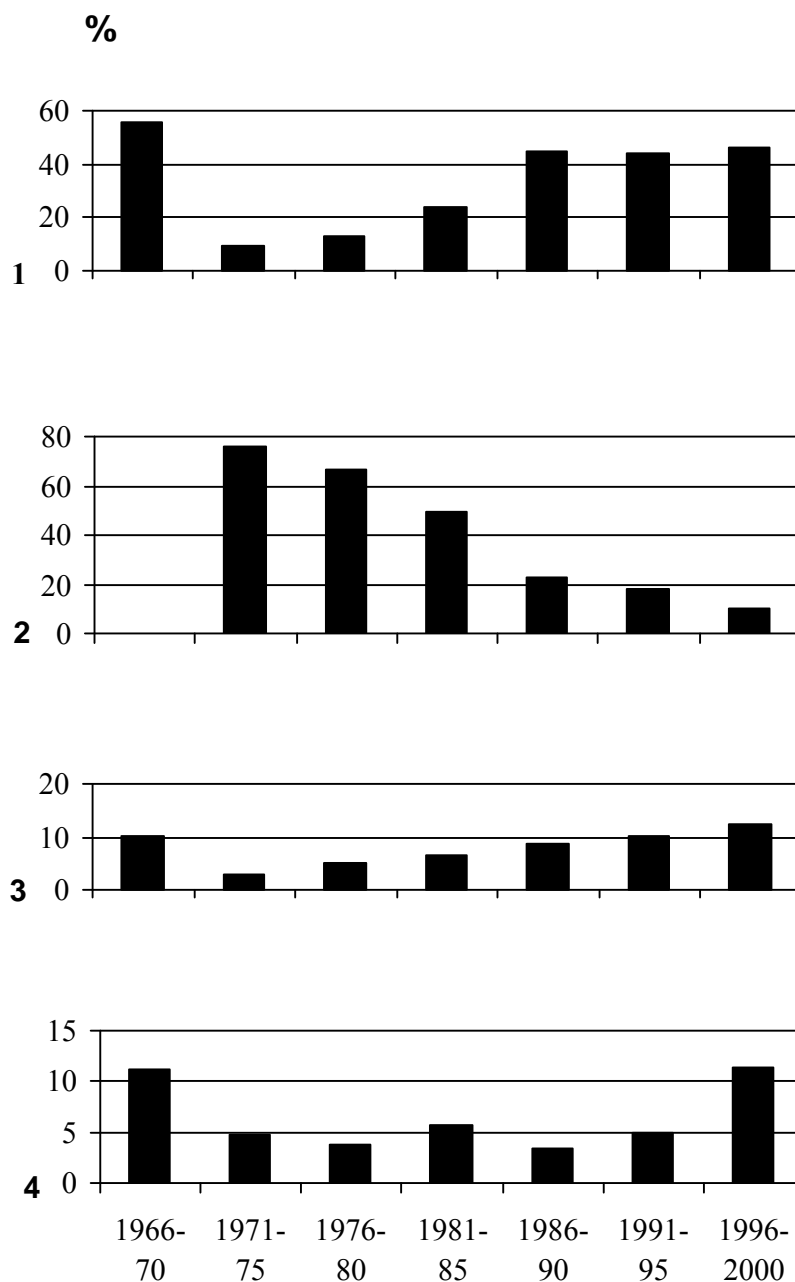


Fig.2. Dynamics of sampling fractions (%) of published works carried out on the cortex with EMF (1), MW (2), MF (3), and EF (4) from their total number during 35- year period

Dynamics of the number of published works performed on the cortex with application of EMF, MW, MF, and EF are demonstrated on fig. 1. The steady essential increase of the numbers of works of all considered kinds during 35-year time interval takes place. The clear effect is found at works with EMF, MF and EF. The pattern of this increase in case MW differs from

the same with another kinds of non-ionized radiation, that takes place at published works performed on the brain [11].

Dynamics of sampling fractions of published works carried out on the cortex with application of EMF, MW, MF, and EF (%) from the total number of these neurophysiological works with non-ionized radiation during 35-year period are presented in fig. 2. Essential distinctions between of patterns of dynamics of these events are observed. The most increase of sampling fractions exists at works with MF and EF. Similar pattern of dynamics is noted at works with EMF from 70 years. Dynamics of sampling fractions of published works on action of MW differs from such events. Prevailing increase of these sampling fractions is in 70-80 years.

Obtained data show that among published works carried out on the cortex with application of non-ionized radiation the works on action of EMF prevail. Moreover numbers of published works with EMF, MW, MF, and EF steadily increased during analyzed period. However dynamics of the sampling fractions (%) of works about considered factors are not identical. Dynamics of works with application of MW possesses specific character and demonstrates them in middle of observed period. It may be presumed that intensity of investigation of any trend is determined by technical equipment of society and special features of use of different kinds of non-ionized radiation in different time periods.

In whole results of bibliometrical analysis of published works carried out on the cortex with application of non-ionized radiation are similar with the same on the brain [11]. The nervous system plays a key role in the all reactions of organism to non-ionized radiation of different kinds. Besides our pioneering investigations revealed predomination of direct influence of these penetrating factors on brain structures, personally on the cortex, in origin of reactions [2-5].

Now researches of applied aspects of biological effects of non-ionized radiation (dosimetrical, hygienic, therapeutic) are in the lead. However, fundament investigations of neurophysiological effects of non-ionized radiation are necessary for understanding of formation and organization of reaction upon radiation [12].

Conclusion. At paper bibliometrical analysis of published works carried out on the cortex with application of non-ionized radiation of different kinds (EMF, MW, MF, and EF) is present. The special features of quantitative characteristics of published works on action of EMF, MW, MF, and EF upon the cortex are considered. Mathematical comparison of the numbers of published works of indicated trends is performed. Complex dynamics of number of these works is found. Representative data are priority.

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Чиженкова Р. О. Математичний аналіз бібліометричних показників досліджень впливу неіонізуючої радіації різних видів на кору великих півкуль (Medline-Internet)

Представлені бібліометричні дані з дослідження дій неіонізуючої радіації різних видів (електромагнітних, магнітних і електричних полів) на кору великих півкуль. Розглянуто кількісні характеристики публікацій і динаміка показників з 1966 по 2000 р. на основі «Medline».

Ключові слова: бібліометрія, неіонізуюча радіація, кора великих півкуль, Інтернет.

Чиженкова Р. А. Математический анализ библиометрических показателей исследований влияния неионизирующей радиации разных видов на кору больших полушарий (Medline-Internet)

Представлены библиометрические данные по исследованию действия неионизирующей радиации разных видов (электромагнитных, магнитных и электрических полей) на кору больших полушарий. Рассмотрены количественные характеристики публикаций и динамика показателей с 1966 по 2000 г. на основе «Medline».

Ключевые слова: библиометрия, неионизирующая радиация, кора больших полушарий, интернет.

Chizhenkova R. A. Mathematical Analysis of Bibliometrical Indices of Investigations of Influence of Non-ionized Radiation of Different Kinds Upon the Cortex (Medline-Internet)

Bibliometrical data of investigations on action of non-ionized radiation (electromagnetic, magnetic, and electrical fields) on the cortex are presented. Quantitative characteristics of published works and dynamics of indices from 1966 to 2000 year were considered by means of the database «Medline».

Key words: bibliometria, non-ionized radiation, the cortex, internet.

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