

## BIBLIOMETRICAL ANALYSIS OF SAMPLING FRACTIONS OF THE NUMBER OF PUBLISHED WORKS WITH APPLICATION OF MAGNETIC FIELDS, CARRIED OUT ON NEUROPHYSIOLOGICAL OBJECTS OF DIFFERENT KINDS

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Bibliometrical data on neurophysiological published works with application of magnetic fields are presented. Quantitative characteristics of published works carried out on different neurophysiological objects (the brain, the cortex, neurons, nerves) during 35-year time interval (1966-2000) are considered. Among neurophysiological published works with application of this factor predominance of published works, carried out in the brain, was established. Positive dynamics of number of neurophysiological published works of these trends was observed. Conclusion about prospects of investigations of neurophysiological effects of magnetic fields is done.

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**Keywords:** bibliometry, magnetic fields, neurophysiological effects, the brain, the cortex, neurons, nerves

It is known what, non-ionizing radiation exerts essential action on functional condition of nervous system, that reflected on electrical activity of the brain and also on fermentative activity in the brain structures [4-6, 8].

Influence of non-ionizing radiation interested humanity for many centuries. Towards the seventies years of XXth century more 3 thousand publications on biological effects of electromagnetic fields and about 2 thousand publications on biological effects of magnetic fields were accumulated. 20 years later the total number of publications concerned action of these factors of different kinds is believed to be 10 thousand. In 2000 year their number reached 21606 what was considered in our monograph [1].

Now on the strength of our researches of the sixties years it was established, what leading role in reactions of organism on non-ionizing radiation of different kinds belongs to the nervous system [1, 4]. Nevertheless before our investigations bibliometrical analysis of neurophysiological aspects of action of non-ionizing radiation was not realized. Namely therefore we began to set working at this problem for the present unexplored.

Series of our recent works were devoted precisely to scientific trend of examination of quantitative characteristics of published works on neurophysiological effects of action of non-ionizing radiation of different kinds. General quantitative characteristics of published works of above-mentioned trend were examined in our recent works [1]. Quantitative characteristics of published works on neurophysiological effects of electromagnetic fields and microwaves radiation were considered in our previous paper [2, 3].

The present work is devoted to examination of quantitative characteristics of pub-

lished works on neurophysiological effects of magnetic fields. Bibliometrical data were obtained according to chosen key words and concerned investigations performed in different neurophysiological objects (the brain, the cortex, neurons, nerves) with application of magnetic fields.

### Materials and methods of research

Quantitative characteristics of published works on neurophysiological effects of non-ionizing radiation in world during 35-year intervals in second half of the XX century (1966-2000) were considered. Investigations were carried out by means of mainly the database "Medline", accessible through Internet. Bibliometrical data concerned published works performed in different neurophysiological objects were studied: the whole brain, the cortex, neurons, nerves. Besides in addition published works with application of magnetic fields were selected. The numbers of published works of observed trends were determined for every analyzed year with the aid of corresponding keywords. Details of analysis of quantitative characteristics of neurophysiological published works were described in our monograph [1]. There also it brought another our published works devoted bibliometrical investigations.

The comparison of the parts of the numbers of published works, carried out on different neurophysiological objects, in general totality and the comparison of the numbers of published works in different time periods were performed as the comparison of two selective sampling fractions of variants.

### Results of research and their discussion

The number of published works carried out in different neurophysiological objects reached

1401300 in 35-year period. The numbers of investigations performed in the brain, the cortex, neurons, nerves were 705259, 180602, 237160 and 278279 correspondingly. The total number of works with application of magnetic fields was 5316. From them only 1649 published works were carried out in neurophysiological objects. Materials concerned investigations in different neurophysiological objects under action of magnetic fields were considered for every year during 35-year period. Obtained data and results of them mathematical analysis are demonstrated in tables 1, 2 and 3.

General characteristics of received totalities are presented in Table 1. Sampling fractions of received data from the total number of works with application of magnetic fields and from the total number of works carried out in corresponding neurophysiological objects are shown in Table 2. Dynamics of the considered sampling fractions are demonstrated in Table 3.

Table 1 shows that investigations made on the whole brain with employment of magnetic fields predominate. Sampling fractions from total data (1649) of neurophysiological works with magnetic fields microwaves were for the brain – 57,31%; for the cortex – 19,89%; for neurons – 9,22%; for nerves – 13,58%.

This phenomenon is the result of increased interest of specialists of applied sciences to investigation of effects of physical factors in the whole brain [1]. The point is that knowledge of special feature of influence of non-ionized radiation is necessary for medicine, psychology and ecology. Besides such scientific trend allows to receive the larger information on condition of organism.

Table 2 demonstrates that among sampling fractions of neurophysiological works with magnetic fields from total number data with magnetic fields (5316) those, carried out in the

whole brain, prevail. These facts conform to above-mentioned supposition.

Moreover similar effect is at the total number of all works of different kinds performed in neurophysiological objects (in the brain – 705259, the cortex – 180602, neurons – 237160, nerves – 278279). Marked increased sampling fraction from all works in neurophysiological objects was observed in investigations on the cortex too.

However it is necessary to note, that relatively small part of the number of investigation on the cortex in general totality of neurophysiological works (12,89% for the cortex comparative with 50,33% for the whole brain), which can be reflect in obtained information. The numbers of published works on investigations, carried out neuronal level and nerves were enough low. In particularly that effect was expressed at quantitative indices of published works, related with neurons.

The least quantitative was at number of published works, carried out on neuronal level. It represents interest, that by both version of analysis similar results were received.

The increase of the numbers of published works carried out in different neurophysiological objects with application of magnetic fields developed during 35-year period. Dynamics of the sampling fractions (%) of published works carried out in different neurophysiological objects during 35-year period from the total number of works with application of magnetic fields displayed non-linear fluctuations (Table 3). The greatest values for works in the whole brain were in year periods 1981-2000. The sampling fractions of the works on the cortex showed essential increase in 1986-2000 years.

On the whole dynamics of investigated indices was extremely uneven. In particular this concerned materials on neuronal level and nerves.

**Table 1**

General data on the number of published works carried out in different neurophysiological objects with application magnetic fields during 35-year period

Objects	Characteristics of totalities			
	Total number of papers in 35 years	Sampling variance	Average number of papers in 1 year	Standard deviation
1	945	996,35	27,00	5,33
2	328	216,83	9,37	2,49
3	152	23,35	4,35	0,82
4	224	61,78	6,4	1,33
5	1649	3321,16	47,11	9,74

Note: 1 – the brain, 2 – the cortex, 3 – neurons, 4 – nerves, 5 – sum.

**Table 2**

Comparison of sampling fractions of the number of published works carried on different neurophysiological objects with application of magnetic fields and from the total number of these works during 35-year period

Factors	Parts from the total number of published works with magnetic fields (5316)		Parts from the total number of published these neurophysiological works (705259, 180602, 237160, 278279)	
	Sampling fraction from these data (%)	Comparison with average quantity (U)	Sampling fraction from these data (%)	Comparison with average quantity (U)
1	17,78	15,78	0,134	2,42
2	6,17	3,20	0,182	5,87
3	2,86	11,60	0,064	6,39
4	4,21	7,73	0,080	4,33
5	7,75		0,118	

Note: 1 – the brain, 2 – the cortex, 3 – neurons, 4 – nerves, 5 – average quantity; statistically significant distinctions are underlined ( $U > 2,58$  corresponds to  $p < 0,01$ ).

**Table 3**

Dynamics of sampling fractions of the number of published works carried on different neurophysiological objects out with application of magnetic fields during 35-year period (% from the total number of works with application of this factor)

Factors	Indices for different five-year periods						
	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-2000
1	8,93	8,03	8,97	15,09	19,18	18,74	19,36
2	5,36	1,46	3,10	3,59	5,48	6,99	7,42
3	3,57	2,92	1,03	2,26	3,06	3,27	2,89
4	0,00	3,65	4,14	2,64	5,16	4,91	3,88
5	17,86	16,06	17,24	23,58	32,88	33,90	33,55
Comparison with the number of works in “average” five-year period (U)							
1	1,91	3,18	3,78	1,27	0,76	0,55	0,96
2	0,25	2,80	2,14	2,14	1,35	0,75	1,15
3	0,30	0,04	1,93	0,67	0,25	0,53	0,05
4	2,29	0,31	0,06	1,54	0,90	0,70	0,40
5	2,23	3,85	4,72	2,97	0,82	1,34	1,24

Note: the numbers of works in “average” five-year period were: 1 – 17,78%; 2 – 6,17%; 3 – 2,86%; 4 – 4,21%; 5 – 31,02%. ( $U > 2,58$  corresponds to  $p < 0,01$ ). Another applications as in Table 1.

### Conclusion

The results of the present bibliometrical investigations makes it possible to analyse quantitative characteristics of published works performed with application of magnetic fields in different neurophysiological objects during 35-year period of later half of XX-th century. The whole brain, the cortex, neurons and nerves were selected for examination on this trend. The total number of publications was considered for every year during period 1966-2000. Dynamics of the number of published works carried out in different neurophysiologi-

cal objects and dynamics of the corresponding sampling fractions were studied.

It was established, that predominance of investigations of effects of magnetic fields on the whole brain existed. Such investigations are suitable for specialists of applied sciences. Second place belonged to works carried out in the cortex. Works on neuronal level have the slight number. The reason of this fact is their methodical complexities. Such results show necessity of neurophysiological investigations of action of magnetic fields for applied science [4, 7]. Moreover information, obtained in these investigations, is able to know functions

on nervous system, in particularly organization of cognitive function [4-6, 8].

Non-ionizing radiation is not only harmful factor. It discovered, that non-ionizing radiation is useful at disturbance of health. It is known, that application of certain kinds of non-ionized radiation is successful in physiotherapy. Hopeful results take place at investigations treatment and prophylaxis of oncological diseases [4, 9, 10].

It was found, that significant increase of the number investigations with application of magnetic fields during 35-year period and moreover the sampling fractions (%) of published neurophysiological works from the total number of works performed with this factor and those carried out in corresponding neurophysiological objects existed.

Obtained results on published works with magnetic fields is differ from data on works with electromagnetic fields and microwave radiation, considered in our previous paper [2, 3]. First, the number of works on magnetic fields was less than the number of works on electromagnetic fields in 1,3 time (2151) and was above than on microwave radiation in 1,2 time (1435). Besides dynamics of quantitative characteristics of publications of above-mentioned trends is different. The most pronounced dynamics took place at published works with microwave radiation. Increase of number of published works performed with application of magnetic fields during investigated period reached 1,3 time, with application of electromagnetic fields – in 1,14 time and microwave radiation – in 2,48 time.

Fundamental investigations of neurophysiological effects of non-ionizing radiation are played no enough attention to. However, in the future they will hold a leading position in solution of the problem of biological action of these factors, what connects with development of applied and fundamental sciences.

Undoubtedly neurophysiological researches of effects of magnetic fields have further development in XXI century [1]. Besides investigations on neuronal level will enough successful.

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