

BIBLIOMETRICAL ANALYSIS OF SAMPLING FRACTIONS OF THE NUMBER OF PUBLISHED WORKS WITH APPLICATION OF MICROWAVE RADIATION, CARRIED OUT ON NEUROPHYSIOLOGICAL OBJECTS OF DIFFERENT KINDS

Chizhenkova R.A.

Institute of Cell Biophysics, RAS, Pushchino, e-mail: chizhenkova@mail.ru

Bibliometrical data on neurophysiological published works with application of microwave radiation 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 microwave radiation is done.

Keywords: bibliometry, microwave radiation, neurophysiological effects, the brain, the cortex, neurons, nerves

It is known, that biological effects of non-ionizing radiation of different kinds interested humanity for many centuries [6]. In the middle XX-th century heightened attention of researchers on influence of these factors arisen.

The nervous system undoubtedly is of great significance in reactions of organism to non-ionizing radiation [1, 3, 7]. Nevertheless bibliometrical investigation of published material on neurophysiological aspects of action of such physical factors was not carried out up to now. Therefore we began bibliometrical analysis on this problem.

General quantitative characteristics of publications of above-mentioned trends were examined in our recent works. Information accumulated in world on neurophysiological effects of non-ionizing radiation during 35-year period in the later half of the XX-th century (1966-2000) was considered. The state of investigations of these trends was analyzed on the base of the database "Medline" and "Current Content System Search", accessible through Internet. Information on general results was presented in our another published works [2, 4-6, 8]. Quantitative characteristics of publications on neurophysiological effects of electromagnetic fields (EMF) were considered in our previous paper [8].

The present work is devoted to examination of quantitative characteristics of published works on neurophysiological effects of microwave radiation. 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 microwaves.

Materials and methods of research

Quantitative characteristics of published works in the field of neurophysiology in world during 35-year inter-

vals 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 microwave radiation were selected. The numbers of published works of observed trends were determined for every analyzed year with the aid of corresponding keywords.

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

It was found that 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 microwave radiation was 6920. Materials concerned investigations in different neurophysiological objects under action of microwave radiation were considered for every year during 35-year period.

General characteristics of received totalities are presented in Table 1. Sampling fractions of received data from the total number of works with application of microwaves 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 microwave radiation predominate. Sampling fractions from total data (1435) of neurophysiological works with microwaves were for the

brain – 62,65%; for the cortex – 15,68%; for neurons – 11,50%; for nerves – 10,17%. This phenomenon is the result of increased interest of specialists of applied sciences to investigation of effects of physical factors in the whole brain [6].

Table 2 demonstrates that among sampling fractions of neurophysiological works with microwaves from total number data with microwave radiation (6920) those, carried out in the whole brain, prevail. These facts conform to above-mentioned supposition.

Table 1

General data on the number of published works carried out in different neurophysiological objects with application microwave radiation 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	899	234,22	25,69	2,59
2	225	22,66	6,43	0,81
3	165	17,09	4,71	0,70
4	146	11,26	4,17	0,58
5	1435	640,53	41,00	4,28

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 microwave radiation and from the total number of these works during 35-year period

Factors	Parts from the total number of published works with microwave (6920)		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	12,99	16,41	0,127	3,39
2	3,25	5,65	0,125	2,07
3	2,38	8,82	0,070	4,14
4	2,11	9,82	0,052	7,09
5	5,18		0,102	

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 microwave radiation 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	5,58	12,79	18,28	15,67	14,88	10,85	10,32
2	0,00	3,41	4,42	4,18	3,43	3,24	2,32
3	0,00	1,92	1,47	2,56	2,59	2,93	2,52
4	1,29	2,56	1,96	1,33	2,68	2,50	1,87
5	6,87	20,68	26,14	23,74	23,58	10,53	17,02
Comparison with the number of works in "average" five-year period (U)							
1	3,58	0,11	3,06	1,72	1,26	1,63	2,06
2	4,99	0,05	1,29	1,11	0,23	0,03	1,43
3	4,24	0,55	1,37	0,27	0,35	0,87	0,27
4	0,88	0,75	0,25	1,36	0,84	0,64	0,42
5	5,70	0,04	2,68	1,63	1,58	0,74	2,33

Note: the numbers of works in "average" five-year period were: 1 – 12,99%; 2 – 3,25%; 3 – 2,38%; 4 – 2,11%; 5 – 20,74%. ($U > 2,58$ corresponds to $p < 0,01$). Another applications as in Table 1.

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 increase of the numbers of published works carried out in different neurophysiological objects with application microwaves 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 microwaves displayed non-linear fluctuations (Table 3). The greatest values for works in the whole brain were in year periods 1976-1980, 1981-1985, and 1986-1990. It is interesting that the sampling fractions of the works on the cortex and neuronal level showed steady essential increase.

Conclusion

The results of the present bibliometrical investigations makes it possible to analyse quantitative characteristics of published works performed with application of microwave radiation 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 neurophysiological objects and dynamics of the corresponding sampling fractions were studied.

It was established, that predominance of investigations of effects of microwaves 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.

It was found that significant increase of the number investigations with application of microwaves during 35-year period and moreover the sampling fractions (%) of published neu-

rophysiological 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 microwaves is differ from data on works with electromagnetic fields considered in our previous paper [8]. First, the number of publications on microwave radiation was less than the number of publications on EMF: 1435 for microwave and 2151 for EMF, distinction in 1.5 time [6]. Secondly, dynamics of quantitative characteristics of publications of above-mentioned trends is different. The number of works with EMF had steady increase during 35-year period [8]. However the number of works on microwaves had the greatest values in middle of considered time period, which is conditioned by their extensive employment in this part of period.

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.

Unfortunately neurophysiological researches of effects of microwave radiation will have further development in XXI century [6].

References

1. Chizhenkova R.A. Pulse activity of populations of cortical neurons under microwave exposures of different intensity // *Bioelectrochemistry*. – 2004. – V. 63. – No. 1-2. – P. 343-346.
2. Chizhenkova R.A. Bibliometrical review of neurophysiological investigation of action of non-ionized radiation in second half of the XXth century // *Biophysics*. – 2005. – V. 50. – Supplement. – No. 1. – P. 163-172.
3. Chizhenkova R.A. Flows of populations of cortical neurons under microwave irradiation: burst activity // *Biophysics*. – 2010. – V. 55. – No. 6. – P.1085-1093.
4. Chizhenkova R.A. Mathematical analysis of published works upon neurophysiological effects of non-ionized radiation // *Open system evolution problem*. – 2011. – No. 13. – V. 1. – P. 98-104 (in Russian).
5. Chizhenkova R.A. Mathematical aspects of bibliometrical analysis of investigations carried out on neurophysiological objects of different kinds (Medline-Internet) // *System technology*. – 2013. – No. 6(89). – P. 21-27.
6. Chizhenkova R.A. Dynamics of neurophysiological investigations of action of non-ionized radiation in second half of the XXth century. M.: Publ. House of Acad. of Natural Sciences, 2012. – 88 p. (in Russian).
7. Chizhenkova R.A. Pulse flows of populations of cortical neurons under microwave radiation: the number of burst activity // *Radiation biology. Radioecology*. – 2014. – V. 54. – No. 4. – P. 393-404 (in Russian).
8. Chizhenkova R.A. Bibliometrical analysis of sampling fractions of the number of published works with application of EMF, carried out on neurophysiological objects of different kinds // *European journal of natural history*. – 2016. – No. 4. – P. 30-32.