

# BIBLIOMETRICAL ANALYSIS OF SAMPLING FRACTIONS OF THE NUMBER OF PUBLISHED WORKS WITH APPLICATION OF EMF, 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 electromagnetic fields (EMF) 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 these neurophysiological published works with application of EMF 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 EMF is done.

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

Neurophysiological effects of electromagnetic fields (EMF) were interested humanity for many centuries [6]. In the middle XX-th century heightened attention of researchers on influence of EMF arisen. Undoubtedly the nervous system plays an important part in reactions of organism to EMF. Neurophysiological rearrangements for different kinds of non-ionizing radiation were considered to our works in detail [1–3, 7]. The present work is devoted just to examination of quantitative characteristics of published works with application of EMF, carried on different neurophysiological objects. Bibliometrical analysis of published works on influence on EMF was not carried out before our investigation. Some results of our bibliometrical investigations of such trend partly were presented in our works [4–6].

## Materials and methods of research

Quantitative characteristics of published works in the field of neurophysiology 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 “Med-line” 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 EMF 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.

**Table 1**

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

Factors	Parts from the total number of published works with EMF (6001)		Parts from the total number of published these neurophysiological works (705259, 180602, 237160, 278279)	
	Sampling fraction from these data (%)	Comparison with average quantity ( <i>U</i> )	Sampling fraction from these data (%)	Comparison with average quantity ( <i>U</i> )
1	18,53	<u>15,45</u>	0,158	0,48
2	6,82	<u>4,33</u>	0,226	<u>5,87</u>
3	4,62	<u>9,59</u>	0,117	<u>3,76</u>
4	5,90	<u>6,41</u>	0,127	<u>2,76</u>
5	8,97		0,154	

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

### Results of research and their discussion

On the whole the number of published works carried out in different neurophysiological objects reached 1401300 in 35-years period. The numbers of investigations carried out in the brain, the cortex, neurons, nerves were 705259, 180602, 237160, 278279 correspondingly. The total number of works with application of EMF was 6001. Materials concerned investigations in different neurophysiological objects under action of EMF were considered. Such published works were 2152. From them 1112 works were carried out in the brain, 409 – in the cortex, 277 – in neurons and 354 – in nerves.

Comparison the number of published works with application of EMF, carried out in different neurophysiological objects: in the brain, the cortex, neurons, nerves are presented in Table 1. The sampling fractions of obtained data from the total number of works with application of EMF and from neurophysiological works of corresponding kinds and their statistical distinctions are shown.

Table 1 shows that among published neurophysiologic works on research of action of EMF the predominance of works, carried out in the brain, took place in investigated period. The least number observed in works on analy-

sis influence of EMF on neuronal level (level part of Table 1). However among published works with EMF, carried out in different neurophysiologic objects, the same in the cortex were in the lead (right part of Table 1).

Dynamics of sampling fractions of the number of published works performed with application of EMF on different kinds of neurophysiological objects (the brain, the cortex, neurons, nerves) in five-year intervals during 35-years period and their statistical distinctions are demonstrated in Table 2.

Table 2 demonstrates compound dynamics of sampling fractions of the number of published works performed with application of EMF in different neurophysiological objects (the brain, the cortex, neurons, nerves) in five-year intervals during 35-years period. Essential increase of these values during analyzed period was found. Distinctions of values between results of 1996–192000 years in regard to 1966–191970 years reached in published works, carried out in the brain, the cortex, neurons accordingly in 14,9; 11,5; 2,7 times. Published works with EMF in nerves in interval 1966–191970 years were absent. But distinction of its values of 1996–192000 years and 1971–191975 was 11,7 times. For total number of published neurophysiological works on investigation of action EMF that distinction was 12,1 times.

**Table 2**

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

Factors	Indices for different five-year periods						
	1966–1970	1971–1975	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000
1	16,98	13,82	9,34	11,78	18,64	21,01	20,59
2	9,34	1,63	1,77	3,26	8,15	7,46	7,95
3	7,55	6,50	3,03	2,33	5,70	4,96	4,65
4	0,00	3,25	3,28	3,72	6,93	7,58	5,55
5	33,96	25,20	17,42	21,09	39,41	41,01	38,74
Comparison with the number of works in “average” five-year period (U)							
1	0,28	1,33	4,43	3,65	0,06	1,48	1,29
2	0,67	2,83	4,31	3,18	1,07	0,57	1,06
3	0,88	0,86	1,37	2,44	1,05	0,38	0,05
4	3,47	1,33	2,09	1,98	0,90	1,60	0,40
5	0,28	2,41	6,96	6,32	1,56	2,52	1,48

Note. the numbers of works in “average” five-year period were: 1 – 18,53%; 2 – 6,82%; 3 – 4,62%; 4 – 5,90%; 5 – 35,86% ( $U > 2,58$  corresponds to  $p < 0,01$ ). Another applications as in Table 1.

### Conclusion

The results of the present bibliometrical investigations makes it possible to analyze quantitative characteristics of neurophysiological published works carried out in different objects (the brain, the cortex, neurons, nerves) with application EMF during 35-year interval of second half of XX century (1966–192000 years). The number of published works with application EMF carried out the brain predominated. Second place belonged to works carried out in the cortex.

Sampling fractions (%) of received data from the total number of works with of EMF and from the total number of works, carried out on certain neurophysiological objects, were considered.

Positive dynamics of the number of neurophysiological published works, carried out on different objects with application EMF during 35-year interval was observed.

Unfortunately neurophysiological researches of effects of EMF 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. – Vol. 63. – № 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. – Vol. 50. – Supplement. – № 1. – P. 163–172.
3. Chizhenkova R.A. Flows of populations of cortical neurons under microwave irradiation: burst activity // *Biophysics*. – 2010. – Vol. 55. – № 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. – № 13. – Vol. 1. – P. 98–104.
5. Chizhenkova R.A. Mathematical aspects of bibliometrical analysis of investigations carried out on neurophysiological objects of different kinds (Medline-Internet) // *System technology*. – 2013. – № 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.
7. Chizhenkova R.A. Pulse flows of populations of cortical neurons under microwave radiation: the number of burst activity // *Radiation biology. Radioecology*. – 2014. – Vol. 54. – № 4. – P. 393–404.