UDK 577.359

R.A. Chizhenkova

MATHEMATICAL ASPECTS OF BIBLIOMETRICAL ANALYSIS OF INVESTIGATIONS CARRIED OUT ON NEUROPHYSIOLOGICAL OBJECTS OF DIFFERENT KINDS (MEDLINE-INTERNET)

Introduction

Abstract. Bibliometrical data on neurophysiological published works carried out on different objects (the brain, the cortex, neurons, nerves) are presented. Quantitative characteristics of published works of choose subdivisions during 35-year time interval (1966-2000) be considered. Dynamics of number of published works of these trends is analyzed. Conclusion about prospects of neurophysiological investigations, in particularly on neuronal levels done.

Keywords. Published work, non-ionized radiation, neurophysiological, bibliometrical indices, nervous system.

Neurophysiology is one of the most intensively developing parts of biology. Its achievements can enable to understand organization and control of functions of organism and even mentality [1, 2, 5, 15]. Neurophysiological investigations are extremely in touch with electrophysiological approaches [1].

Purposeful investigation of electrical processes in the brain arose in the late XIX-th century. Formation of Russian neurophysiology and electrophysiology is undoubtedly relates to M.N. Livanov who created whole school of excellent specialists of mentioned trend - I.N. Kondratyeva, T.A. Korolkova, G.I. Shulgina and etc. [10]. The author of the present work began to work in laboratory by M.N. Livanov.

Bibliometrical investigation of published material on neurophysiology and electrophysiology was not carried out up to now. The present work is devoted just to this material. Some results of our bibliometrical investigations on this problem partly were presented in our published works [3, 4, 6].

Materials and methods

Quantitative characteristics of published works in trend of neurophysiology in world during 35-year interval 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 brain, the cortex, neurons, nerves. The numbers of published works of observed trends were determined for every analyzed years with the aid of corresponding key words.

At statistical analysis of the received bibliometrical data 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 publications carried out on different neurophysiological objects in general totality and the comparison of the numbers of publications in different time periods were performed as the comparison of two selective sampling fractions of variants.

Results

In considered 35-yaer interval the total number of published works carried out in different neurophysiological objects reached almost 1.5 millionth.

General characteristics of received totalities are presented in table 1. Sampling fractions of obtained data on different neurophysiological objects from their total sum are shown in table 2. Statistical comparison of mean quantities, conjugate pairs of corresponding values, and indicated sampling fractions is reflected in table 3. Dynamics of the numbers of published neurophysiological works of different kinds is show in table 4. Dynamics of the considered sampling fractions (%) are demonstrated in tables 5 and 6. All kinds of dynamics are in base of indices for different five-year intervals.

Table 1 shows that among published neurophysiological works carried out in different neurophysiological objects the predominance of works carried out in the whole brain took place in investigated time interval

Table 2 demonstrates that sampling fraction (%) from total data in published neurophysiological works completely prevailed in works carried out in the whole brain. The least sampling fraction (%) is observed at works on the cortex.

Data of statistical analysis represented in table 3 proved significance of distinctions between mean quantities of the numbers of indicated of published works, conjugate pairs of corresponding values, and indicated sampling fractions. The letter is most pronounced.

 ISSN 1562-9945

Table 1

General data on the number of published neurophysiological works carried out upon different objects during 35-year interval

Objects	Characteristics of totalities			
	Total number of papers in 35 years	Sampling variance	Average number of papers in 1 year	Standard deviation
1	705259	58408316.37	20150.26	1291.82
2	180602	3266247.76	5160.06	305.49
3	237160	19665941.47	6776.00	749.59
4	278279	10921755.50	7950.83	558.61
5	1401300	293697907.7	40037.14	2896.79

Application: 1 - the brain, 2 - the cortex, 3 - neurons, 4 - nerves, 5- sum.

Table 2

Sampling fractions (%) of published neurophysiological works carried out upon different objects from their sum during 35-year interval

Objects	Sampling fractions from total number of neurophysiological works (%)
1	50.33
2	12.89
3	16.92
4	19.86
5	100.00

Application: as in table 1.

Dynamics of the observed bibliometrical indices during 35-year period is presented in tables 4-6.

Table 4 gave dynamics of the concrete numbers of published neurophysiological works carried out carried out in different neurophysiological objects during 35-year interval. In this table one can see the gradually development of the considerable increase of the numbers of published neurophysiological works of all kinds during 35-year interval.

Table 5 reflects dynamics of the sampling fractions (%) of published neurophysiological works of different kinds from them number during 35-year interval. Essential increase of these values is observed. The most distinct progressive increase was observed at work on neuronal

level. Comparison of indices with average quantity of sampling fractions shows its statistical significance in all cases.

Table 3

Comparison of quantitative indices of published neurophysiological works of different kinds

Objects	Comparison of received data			
	Student test for comparison of mean quantities (*t*)	Student *t*-test for conjugate pairs	Wilcoxon test for conjugate pairs (*U*)	Comparison of sampling fractions of totality (*U*)
1 - 2	**11.29**	**15.16**	**5.15**	**705.63**
1 - 3	**8.95**	**23.74**	**5.15**	**611.05**
1 - 4	**8.67**	**16.61**	**5.15**	**546.59**
2 - 3	**2.00**	**3.57**	**2.78**	**94.59**
2 - 4	**4.38**	**10.82**	**5.15**	**159.04**
3 - 4	**1.26**	**5.42**	**3.93**	**64.45**

Application: statistically significant distinctions between distributions are underlined (U>2.58 corresponds to p<0.01); the other designations as in table 1.

Table 4

Dynamics of the number of published neurophysiological works carried out upon different objects during 35-year interval

Objects	Indices for different five-year intervals						
	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-2000
1	47198	66047	79531	95671	119201	143246	154365
2	13629	17837	21071	23911	28873	35417	39864
3	7436	13723	19356	28933	41574	58503	67635
4	16895	24918	29804	37964	47548	58285	62865
5	85158	122525	149762	186479	237196	295451	324729

Application: as in table 1.

Table 6 demonstrates dynamics of the sampling fractions (%) of neurophysiological published works of different kinds in single five-year periods from their total number. Predominance of the sampling fractions (%) of works on the whole brain takes place. Therefor gradual increase of sampling fractions (%) of works on neurons is observed. Found arrangements (except works on nerves and the cortex in some periods) are statistical significance.

 ISSN 1562-9945

Table 5

Dynamics of the sampling fractions (%) of published neurophysiological works carried out upon different objects from them number during 35-year interval

Objects	Indices for different five-years periods						
	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-2000
Sampling fractions from total number of these works (%)							
1	6.69	9.36	11.28	13.57	16.90	20.31	21.89
2	7.54	9.88	11.67	13.24	15.99	19.61	22.07
3	3.14	5.79	8.16	12.20	17.53	24.67	28.52
4	6.07	8.95	10.71	13.64	17.09	20.94	22.59
5	6.08	8.74	10.69	13.31	16.93	21.08	23.17
Comparison of indices with average quantity of sampling fractions (U)							
1	149.64	91.45	54.04	13.06	42.16	94.42	117.58
2	66.41	40.87	23.74	9.32	14.12	42.37	60.70
3	144.63	100.21	67.84	21.35	30.30	90.57	97.45
4	103.70	62.67	41.03	7.46	28.72	65.28	80.20
5	232.70	147.32	92.08	24.27	80.27	148.99	190.85

Application: average quantity of sampling fractions of published works for five-year interval was 14.29% (100%:7); the other designations as in table 3.

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) during 35-year interval of second half of XX century (1966-2000 years). The numbers of these published works were found for every observed year. Dynamics of the numbers of published works was studied.

It was established that the total number of published works on neurophysiological objects was almost 1.5 millionth. The predominance of works performed in the whole brain took place in investigated period, which is conditioned by relatively simplicity of research approaches.

Positive dynamics of the number of neurophysiological published works of all indicated kinds during 35-year interval was observed. But dynamics of the sampling fractions (%) of neurophysiological published works carried out in different objects were complex and unequal. The most considerable increase was observed at work on neuronal level.

Table 6

Dynamics of the sampling fractions (%) of published neurophysiological works carried out upon different objects in single five-year periods from their total number

Objects	Indices for different five-year intervals						
	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-2000
Sampling fractions from total number of these works (%)							
1	55.42	53.91	53.10	51.30	50.25	48.48	47.54
2	16.00	14.56	14.07	12.82	12.17	11.99	12.28
3	8.73	11.20	12.92	15.51	17.53	19.80	20.82
4	19.84	20.34	19.90	20.36	20.05	19.73	19.36
Comparison of indices with average quantity of sampling fractions (U)							
1	24.69	19.57	16.10	5.90	0.66	12.73	19.71
2	21.51	12.96	9.95	0.93	7.25	9.67	6.69
3	60.62	45.77	32.78	12.12	4.94	25.56	35.19
4	0.24	3.31	0.29	3.73	1.32	1.38	4.57

Application: average quantities of sampling fractions of published works in five-year interval were 1 - 50.33%; 2 - 12.89%; 3 - 16.92%; 4 - 19.86%; the other designations as in table 3.

Unfortunately neurophysiological researches will have further development in XXI century that is necessary for understanding of function of nervous system. The most development is expected at investigations on neurons level.

At present it is recognized that fundamental science is need for our civilization itself and humanity even [2, 7, 8, 11, 13, 14]. Only on the base of fundamental science applied investigation in part technology and medicine [9, 15]. Consequently society (and government) must support fundamental science [12].

REFERENCES

1. Chizhenkova R.A. Structural-functional organization of the sensorimotor cortex (morphological, electrophysiological, and neurotransmitter aspects) - M.: Nauka, 1986. - 242 p. (in Russian).
2. Chizhenkova R.A. Science in modern society // Actual problems in social philosophy // Ed. E.V. Girusov. - M., Int. philosophy of RAN, 1998. - P. 111-112 (in Russian).
3. Chizhenkova R.A. Bibliometrical review of neurophysioligical investigation of action of non-ionized radiation in second half of the

XXth century // Biophysics. - 2005. - V. 50. - Supplement. - No. 1. - P. 163-172.

4. 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).
5. Chizhenkova R.A., Chernukhin V.Yu. Nonlinear relations between some parameters of the pattern of pulse flows of cortical neurons // J. biological Physics. - 2000.- V. 26 - No. 1.- P. 65-73.
6. Chizhenkova R.A., Safroshkina A.A., Slashcheva N.A., Chernukhin V.Yu. Bibliometrical analysis of neurophysiological aspects of action of non-ionized radiation // Uspekhi sovremennoy biologii. - 2004. - V. 124. - No.5. - P. 472-479 (in Russian).
7. Efremov Yu. N. Why is necessary science for society? // Bulletin of RFFI. 2000. - No. 1(19). - P. 40-43 (in Russian).
8. Gaydenko P.P. For problem of formation of European science // Questions of philosophy. - 2009. - No.5. - P. - 80-87 (in Russian).
9. Gorohkov V. G., Sidorenko A.P. Role of fundamental investigations if development of modern technologies // Questions of philosophy. - 2009. - No.3. - P. - 80-87 (in Russian).
10. Mikhail Nikolaevich Livanov. Materials to biobibliograhphic of scientists of USSR. Series of biological sciences. Issue 12. M.; Nauka, 1983. - 62 p. (in Russian).
11. Nikiforov B.B/ Fundamental science in the XXIth century. Did fundamental science died? // Questions of philosophy. - 2008. - No.3. - P. - 59-61 (in Russian).
12. Obama B. Science is necessary // Remark be president at the National Academy of Sciences/ Annual Meting/. April 27, 2009. - www.whitehose.gov/the_presss_office.
13. Pruzhinin B.I. I hope, it will live // Questions of philosophy. - 2008. - No.5. - P. - 66-67 (in Russian).
14. Seitz F. China and natural science: a conundrum. In remembrance of professor Ta You Wu (1907-2000) // PAPhS. - 2002. - V. 146. - No. 1.- P. 1-17.
15. Stearns S.C., Nesse R.M., Govindaraju D.R., and Ellison P.T. Evolutionary perspectives on heals and medicine // PNAS. - 2010. - V. 107. - Suppl. - No. 1. - P. 1691.