



CODEN [USA]: IAJPBB

ISSN: 2349-7750

**INDO AMERICAN JOURNAL OF  
PHARMACEUTICAL SCIENCES**<http://doi.org/10.5281/zenodo.1304357>Available online at: <http://www.iajps.com>

Research Article

**FRACTAL MODEL TO STUDY BIOLOGICAL RHYTHMS OF  
MAN PSYCHIC ACTIVITY****Viktoria B.Tarabaeva\*, Valentina V. Grebneva, Svetlana A. Korneeva, Oksana S.  
Miroshnikova, Tatyana V. Sulima**

Belgorod State University, Russia, 308015, Belgorod, 85, Pobedy street

**Abstract:**

*The article considers the possibility of applying the fractal self-similarity principle to reveal the influence of the individual annual rhythm on the processes of human vital activity. An interdisciplinary approach to the study of the states of mental activity as a property of the psyche to the reproduction of the same structures at different levels of its integrity is proposed. A unique model of cyclicity of vital activity from the position of psychological science is presented. A brief review of the results of the authors' studies, pointing to the fractal nature of human states and proving the existence of the relationship between the individual annual cycles of the subjects, the activity and the effectiveness of their vital activity is made. The problem of developing research methods is discussed. Empirical data obtained by the authors on different samples of the subjects is presented and testifying to the existence of a connection between the three life cycles of a person: the daily, individual, and full life cycles. On the basis of the obtained results, conclusions are drawn on the example of the fractal nature of the individual life cycle regarding the advisability of applying the principle of self-similarity in studying various phenomena of the human psyche as a nonlinear dynamic system.*

**Keywords:** *biorhythms, individual year cycle, self-similarity principle, mental activity, fractal, trimester***Corresponding author:****Viktoria B.Tarabaeva,**  
Belgorod State University,  
Russia, 308015, Belgorod, 85, Pobedy street  
Email id: [tarabaeva@bsu.edu.ru](mailto:tarabaeva@bsu.edu.ru)

QR code



Please cite this article in press Viktoria B.Tarabaeva et al., *Fractal Model to Study Biological Rhythms of Man  
Psychic Activity, Indo Am. J. P. Sci, 2018; 05(06).*

**INTRODUCTION:**

The discoveries in the field of fractal geometry, made by Benoit Mandelbrot in 1977, the revealing of the fractal structure of the structure of a man's body, suggests the existence of certain regularities in human activity [1]. Thus, the basic principle of a fractal organization is the self-similarity of forms and phenomena. In this regard, the following issue arises: does the fractal principle of self-similarity work in different cycles of human life? Can we find patterns and relationships between the cycles of life activity and their influence on a person's mental activity?

Living organisms and a man in particular, are designed in an amazing way. All systems of a body are designed so that they can work rhythmically. And it is provided by a fractal design. Therefore, the most suitable complex processes for understanding and operating are fractal geometry with its possibilities of multidimensional phenomenon consideration and, in particular, multifractal analysis. There are many fractal-like formations in a man's body: in the structure of blood vessels and various ducts, in the nervous system, in the structure of respiratory tract, through which air enters the lungs. Many other organ systems are also fractal ones [3].

Studying various areas of human life, the researchers came to the conclusion that fractality is present in almost all spheres of human life from economics and finance, to social sphere, medicine and arts. Moreover, when we consider this or that area of objective reality in a more generalized way, the more it will seem to us more stable and ideal by form, but the closer we consider its individual details, the more diverse it will be to us, and in will represent a growing chaos at a micro level already [1].

**MATERIALS AND METHODS:****Experimental research base**

In this article, we attempted to fill this gap by combining the information about the effect of biological rhythms on mental activity from different areas of scientific knowledge and empirical data under the idea of a person fractal organization. The theoretical and methodological basis was made by the synergetic approach in psychology (Poddubny N.V.), the fractal principle of self-similarity (B. Mandelbrot, S.V. Bozhokin), the study of the fractal nature of biorhythms from various systems (L. Glass, M. Mackie, T. Buzen and others), as well as the works of Russian scientists studying the features of biological rhythm influence on human activity (A.M. Vayserman, A.P. Dubrov, Yu.A. Karetin, etc.). The analysis of theoretical sources gives us the possibility

to assume that the temporal cycles of human life have a fractal structure.

**RESEARCH METHODS**

If we assume that daily, individual annual rhythms with a fractal structure are self-similar, then we can put forward the hypothesis that the life cycle of a particular person is built on the same fractal design, that is, the state of an organism life activity during the day, the IAC and all life have a similarity in general. Having deciphered this principle of self-similarity, it can be assumed that a person experiences the same fluctuations of health within a day which he feels during an individual year cycle and all life in general.

Considering the fact that the fractal self-similarity principle extends to a human body structure and design, it can be assumed that the cycles of mental activity and vital activity are also subject to this principle.

Human life passes certain periods after birth: development, the assimilation of life experience, productive activity and the extinction of life activity. In philosophy and psychology, a person's life is divided into four periods: childhood, youth, maturity and late maturity. For example, the ancient philosopher Pythagoras applied the term "quaternary" to the age periods and compared them with the eternal, unchanging phenomena of nature (elements). In addition, the age periodization of Pythagoras corresponds to four 20-year periods. An individual annual cycle (IAC) starts from the birthday and can also be conditionally divided into four terms. By analogy with the astronomical year, let's call them spring (1st trimester), summer (2nd trimester), autumn (3rd trimester) and winter (4th trimester). A specific day you live can be broken down into similar periods: the awakening after sleep, the entering into the meaning of upcoming affairs, productive activity, the rest after work and sleep again (the awakening, morning, work time, evening time). Therefore, most likely, a person's well-being during a day is to some extent a reflection of the state of health in the process of an individual year and an entire life cycle as a whole.

Thus, the expediency of our research is seen by us in the establishment of the relationship between vital, annual and daily rhythms of a man in accordance with the fractal principle of self-similarity.

**RESULTS:**

The conditionality of state stability, including human health, his adaptation to the endogenous environment

conditions by the nature of an individual year cycle, was pointed by many domestic and foreign biologists, physiologists, physicians, and psychologists. For the first time this was announced in 1969 by D. Bitout and I. Assenmaher, indicating that an individual annual cycle is fractal in nature and includes four trimester (fractals) from one birthday to another and does not depend on a calendar year [4].

Our analysis of the statistical data on the birth and death of 1193 people over the past 100 years in the Belgorod region showed that about 70% of the death date is close to the date of birth. A high level of such coincidences allowed us to make the assumption that the beginning and the end of an individual year cycle is to a certain extent the zone of risk for physical and mental health [5]. Thus, one can speak about the stress factor of a birthday. In some studies, it is suggested that the "birthday effect" is associated with the imprinting of "birth stress" in the structure of the biological rhythms of a body, which in its turn can lead to the periodic changes in viability throughout an individual year cycle. For example, the studies of a group of Ukrainian scientists (A.M. Vaiserman, P.E. Grigoriev, I.I. Bely, V.P. Voitenko and others),

based on the example of the inhabitants of the city of Kiev revealed the data indicating the number of death increase in the period before and after a birthday [6].

The studies conducted on a sample of university students showed a statistically significant relationship between physiological states and the functioning of the cardiovascular system among students at different periods of an individual year cycle. It was proved that in the third and the fourth trimester there was the decrease of functionality, as well as intellectual performance. At the same time, the level of personal anxiety increased significantly [7]. During the research, we also observed the interdependence of the IAC, the state of health, the activity and the mood of the tested subjects, which we confirmed during the comparison of its results with the results obtained in the groups of subjects (students) differentiated by the date of birth according to SAN method developed by V.A. Doskin. The study involved 80 people (20 subjects in each group, four trimesters of an individual year and 40 people concerning the resources of a patient's mental activity. At the time of examination, the individual rhythm of the subjects was determined by the date of their birth.

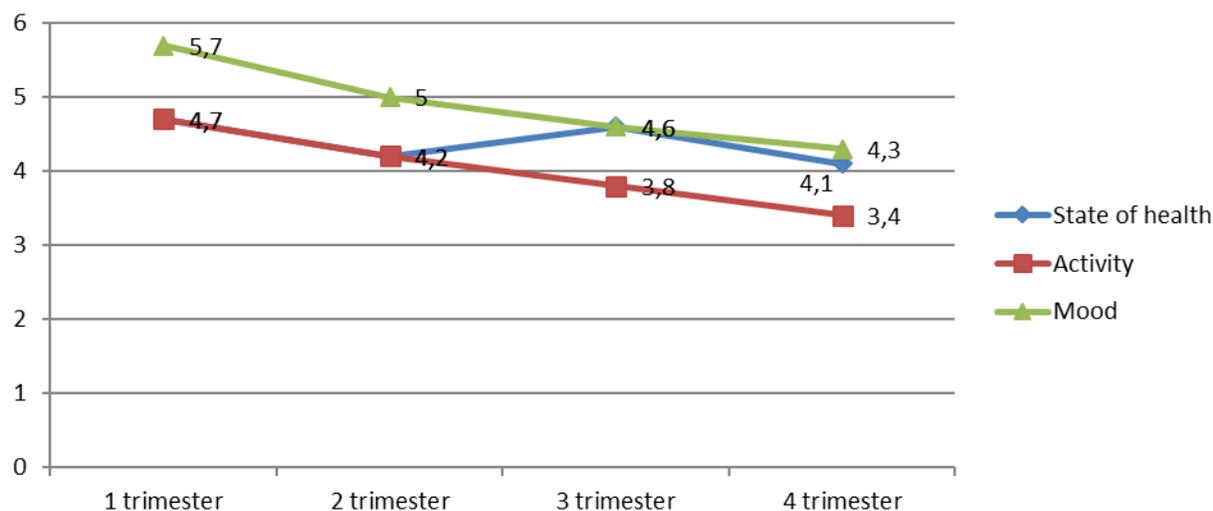


Figure 1. Indicators of the SAN in the groups of subjects, differentiated by season of birth (in points)

The activity index of the subjects born during the 1st and the 2nd period corresponds to the norm determined by SAN method, and lies within the limits of 4.2 - 4.7 points, while activity corresponded to 3.8 - 3.4 points in the groups of subjects born during the 3rd and the 4th trimester, which indicates a low rate. A similar pattern was observed, also according to the criterion of "mood": 5.0 - 5.7 points in the 1st and the 2nd trimester, and 4.3 - 4.6 points in the 3rd and the 4th trimester. The smallest

discrepancies were revealed only in terms of "well-being". In accordance with the Student's t-criterion, the obtained empirical value of the differences between two samples is found in the significance zone ( $t = 2.51$   $p \leq 0.01$ ).

In order to compare the indices of mental activity dynamics in this sample of subjects conditioned by the dynamics of the seasonal and individual rhythm and to check the statistical significance of change

vector and the degree of their severity, we used the Wilcoxon T-test. Using it, we determined the significance of changes in mental activity indices within the samples of the subjects in half a year after the first measurement. We assumed that the individual rhythms of the subjects at this time will be opposite to the rhythms of the primary measurement time, which means that we will be able to detect the features of mental activity index shift in the groups of subjects. Statistical testing was carried out on 48 subjects selected by us in accordance with the capabilities of this statistical method (the maximum number of samples should not exceed 50). The results of T-Wilcoxon test indicate that the obtained

empirical value is in the significance zone (at  $n = 48$   $T = 362$  ( $p \leq 0.01$ )).

The hypothesis about the fractal nature of human psychic activity was confirmed by us also in relation to such indicators of subject life quality as physical and psycho-emotional well-being, working capacity, revealed by us in accordance with the methodology by Mezzich J.E., Cohen N., Liu J. et al. (1999. - pp. 427-428) [14]. Three age groups of subjects took part in the study, young people at the age of 18-22 years, the sample of middle and older age was made of the subjects at the age of 40-45 years and of 50-55 years, correspondingly.

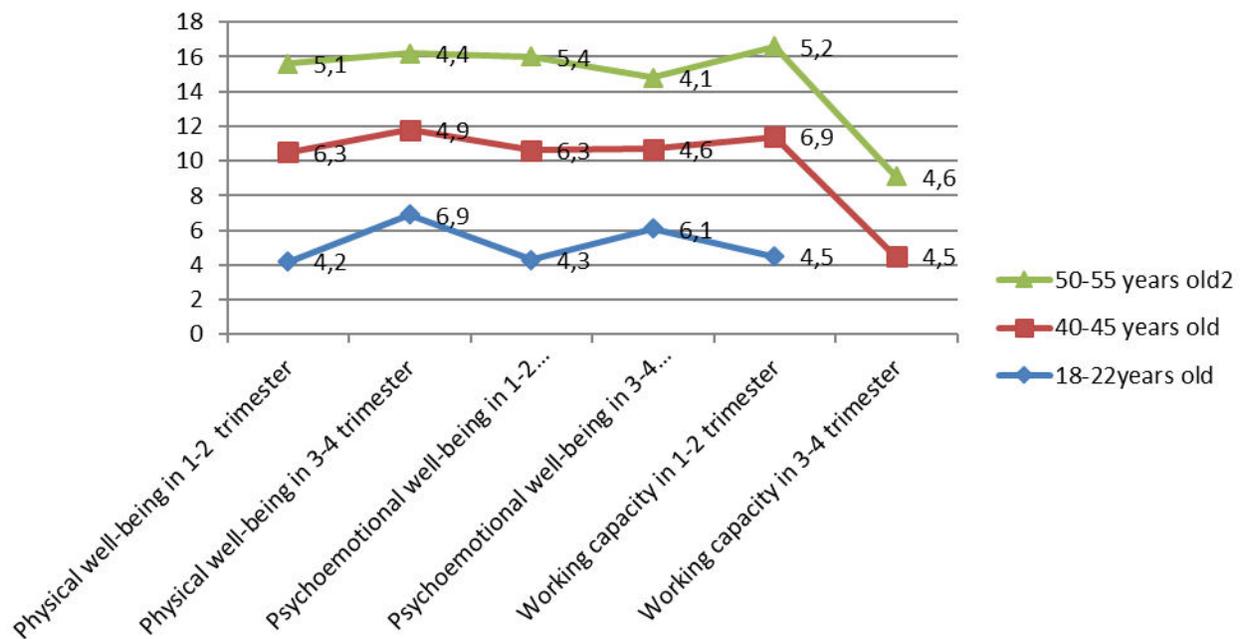


Figure 2. Fractal distribution of indicators of quality of life of subjects in different periods of life and in accordance with the periods

Statistically significant differences were obtained at the level of  $p \leq 0,05$ , and make up the difference ( $2.5 \pm 1.7$ ) in all groups of subjects during the diagnosis in the 1st and the 2nd, and in the 3rd and the 4th trimester.

The study of the stated topic in psychology is faced with the problem of effective diagnostic method development aimed at the revealing the IAC influence on the processes of vital activity and the state of mental activity of subjects.

In order to identify various aspects of human states, we have developed a number of questionnaires, the content of which is set out below. Based on four questionnaires developed by us, the respondents of different ages were interviewed in respect of their

well-being during a day, an astronomical year, and also in different age periods. In order to assess the state of well-being during a day, the participants of the experiment were asked to recall and answer the question: what is the state of health (calm, irritated) that usually occurs during certain periods of a day cycle (in the morning, during work hours, in the evening)?

It was necessary to indicate the date of birth and the months of the year in the questionnaire, in which they usually feel best and those months during which they most often get sick or feel depressed. The comparison of the data of 326 respondents showed that about 68% of people feel physical and psychological discomfort during the months close to the date of birth. This indicates that the date of birth in IAC is a

risk area. The second questionnaire should specify the date of birth and assess one's physical and mental state in different trimesters of IAC, answering the following question: what are the months during which you experience poor health or mental stress most often? In the third questionnaire the subjects answered the question concerning the state of health in different periods of life. Since the interviewed people were of different ages, then their life cycle is different, of course. We conducted the survey of 150 people. 42 of them were under the age of 22, 30 of them were middle-aged people - up to 40 years, 32 people were under 60, and 46 were elderly people at the age of 60 years and more.

The answers we received from respondents were reduced to a single data table in which we tried to compare the state of health during a day, in different IAC trimesters, and by the presence or the absence of disease states at certain periods of life.

The interview of 150 different age groups showed that 108 people had some similarity in the course of day, IAC and life cycles, i.e. in 72% of cases. The

questionnaires of the remaining 42 people (28%) showed a discrepancy between data.

It should also be taken into account that the self-esteem of states is highly subjective by each person, it is influenced by the mood of a person during an interview, his physical and mental state. Besides, the division of a day, IAC and life cycles into four parts is very conditional. Nevertheless, this survey shows that the principle of self-similarity of day, IAC and life cycles is likely to exist. Our assumption is confirmed by the empirical data obtained by us through the correlation of data among the questionnaires of 326 interviewed respondents, 50 employees of "Ecolog Project" company and the life-cycle data of 1193 metric records of Belgorod Region residents over the previous 100 years, according to the trimester of an individual annual rhythm. In order to compare the graphs with a large difference in the number of people, we took the maximum value in each questionnaire and equated it to the maximum value on a 10-point scale. This allowed us to derive the comparative data from all questionnaires.

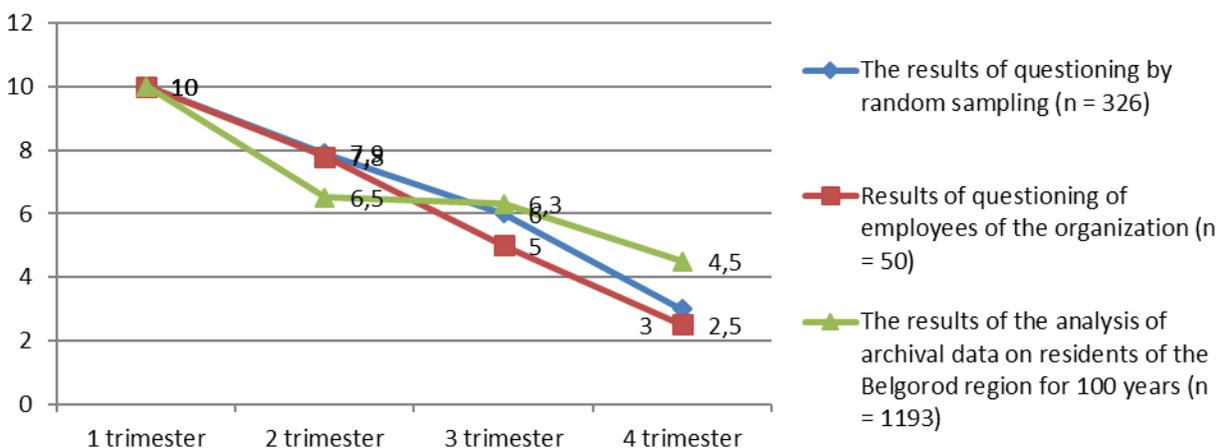


Figure 3. Fractal model of a biorhythmic peculiarities of mental activity of the subjects

As can be seen from the graph, the data obtained by us as the result of the questionnaire indicate the decrease in the mental activity of the subjects within IAC dynamics. Its highest rates are observed in the first trimester of an individual year, whereas in the last fourth trimester the indices of mental activity decreased significantly.

### CONCLUSION:

Thus, our study, based on a comparison of daily, individual, yearly and life cycle among the people of different ages, shows the presence of a certain regular connection, which can be explained by the fractal principle of self-similarity. Our local study has shown that the assumption about the relationship of a day, IAC and a full life cycle is sufficiently substantiated.

We believe that a number of more in-depth studies should be conducted in this direction with the involvement of more respondents from different social and age groups.

### REFERENCES:

1. Mandelbrot, B., 2006. (Un)obedient markets: a fractal revolution in finance - Transl. from

- English. Publishing house "Williams", p.400. (In Russian)
2. Peitzer-Karrpf, A., 2012. The dynamic matching of neural and cognitive growth cycles. *Non Linear Dynamics, Psychology, and Life Sciences*, 16 (1): 61-78.
  3. Kirilenko, N.Ya, 2017. Fractals and health - URL: <http://kirilenko-nya.ru/fraktali.html> (appeal date: 10.4. 2017). (In Russian)
  4. Grebneva, V.V., 2010. Influence of the phenomenon of desynchronization of seasonal and individual rhythms on human life processes - *Complex rehabilitation: science and practice*, p. 35 - 44. (In Russian)
  5. Grebneva, V.V., 2016. The use of the chronobiological method in the study of psychophysical states of a person in the process of vital activity. *Scientific journal "Discourse"*, 1 (1) Ser.Psychological Sciences, 1(1): 90-93. (In Russian)
  6. Vayserman, A.M., 2003. Relationship between the dates of birth and death in the population of Kiev - URL: <http://polit.ru/article/2003/05/30/618748/> (date of the appeal: 15.10.2017). (In Russian)
  7. Grebneva, V., Kovtunencko, A., Tarabaeva, V., 2015. The influence of an individual year cycle on psychophysiological conditions of the person. - July-August, -*RJPBCS* 6 (4), p. 191 <http://www.rjpbcs.com/> (date of the application: 15.01.2018). (In Russian)
  8. Bozhokin, S.V., Parshin, D.A., 2001. Fractals and multifractals. - Izhevsk: "RHD", p. 128 (In Russian)
  9. Byuzan, T., 2004. Teach yourself to think! - Transl. from English; 2nd ed. - Minsk: Open Company "Popurri", p. 192. (In Russian)
  10. Dubrov, A.P., 1990. Lunar rhythms in humans (Brief essay on selenomedicine). - Moscow: Medicine, p.160. (In Russian)
  11. Karetin, Yu.A., 2016. Fractal organization of the primary structure of DNA. - *Bulletin of SPbSU. Part 3. Biology*: 155-157. (In Russian)
  12. Lombroso, C., 2006. The genius and insanity / Cesare Lombroso. Trans. From Italian by K. Tetyushinova. - Moscow: RIPOL classic, p. 400.
  13. Poddubny, N.V., 2003. Psychology and synergetics: a methodological aspect - Belgorod: "Politerra", p. 152. (In Russian)
  14. Mezzich, J.E., Cohen, N., Liu J., Ruiperez, M., Yoon, G., Igbal, S., Perez, C., 1999. Validation an efficient quality life index. Abstracts XI World Psychiatry Congress «Psychiatry on new Thresholds». – Hamburg: 427-428.