

UDC 376 37
BBC Ч457.091+P733.614.52
GSNTI 14.29.29
Code VAK 13.00.03

I. V. Kalashnikova
Apatity, Russia

CHANGES IN VARIABILITY OF HEART RATE OF PRESCHOOL CHILDREN IN THE COURSE OF REALIZATION OF THE PROGRAM “ECOTHERAPY FOR CHILDREN OF 6 – 7 YEARS OF AGE WITH SPEECH DISORDERS” IN POLAR REGIONS

Abstract. The article describes an authored educational rehabilitation program for children with general underdevelopment of speech of the 2nd – 3rd levels and dysarthria and argues its effectiveness in the conditions of Polar regions. Recent years have seen an increase in the number of preschoolers with speech disorders. In Polar regions these children refer to the “group at risk” because it is in the winter-spring period that they demonstrate growth of chronic somatic pathology exacerbation, reduced immunological reactivity and adaptive potential, metabolism changes, general weakness, atonia and increased fatigability. A combination of educational, rehabilitative and communicative constituents in education and upbringing of such children using non-traditional methods may ensure their emotional well-being and adequate psychic development.

An educational rehabilitation program “Ecological Therapy” with special education elements for children of 6—7 years of age suffering from speech disorders has been worked out and tested at the Polar-Alpine Botanical Gardens-Institute named after N.A. Avrorin. Classes were held during the period of transition from the Polar night in the natural conditions of the Kolskiy North. Dynamic registration of cardiorythmographic parameters of children was done during the whole period of realization of the program.

Children who have undergone ecological therapy show higher index of heart tension after ten treatments in comparison with the control group; naturally, by the end of the program their concentration of attention reached its maximum. In addition, the study reveals increase of organism resilience and tolerability of heliogeophysical agents actively influencing people in the conditions of high latitudes.

Keywords: general underdevelopment of speech; gardening-assisted therapy; animal-assisted therapy, ecotherapy; heart tension index; heliogeophysical agents.

About the author: Kalashnikova Irina Vladimirovna, Junior Researcher.

Place of employment: Laboratory of Ecotherapy and Educational Programs of Polar-Alpine Botanical Gardens-Institute named after N. A. Avrorin, Kolskiy Scientific Center of the Russian Academy of Sciences.

Analysis of the modern situation in the system of education and upbringing of preschool children shows that the number of children with underdevelopment of speech is constantly growing.

Underdevelopment of speech

may be manifested in mispronunciation, violation of grammatical structures and poor vocabulary. Severe speech disorders are characterized by general underdevelopment of speech, which is expressed in impairments of both phonetical and lexico-

© Kalashnikova I. V., 2016

grammatical aspects. As a result of this many children with underdevelopment of speech demonstrate limitations in thinking and oral communication and have problems in reading and writing [14]. Apart from this, the given category of schoolchildren exhibit disorders of attention, poor cognitive activity, reticence and inadequate formation of play activity [13].

According to psychological literature on the problem under study, a combination of developmental and individual approaches to education and upbringing of such children may guarantee their emotional wellbeing and full psychological development. Realization of the potential of different stages of psychic development takes place due to the children's participation in age-defined activities – playing, speech communication, drawing, designing, music, etc. [7].

An additional education rehabilitation program with special education elements “Ecological Therapy for children of 6 - 7 years of age with speech disorders” (further referred to as *Program*) has been worked out and tested at the Polar-Alpine Botanical Gardens-Institute named after N.A. Avrorin [2]. The Program includes several parts: educational (acquaintance with the world of plants and animals); rehabilitative (elements of art-, work-, animal- and gardening-assisted therapy); communicative (stimulation of speech activity and social adaptation); and special education (development of minor motor activity, use of tongue twisters, logopedic games and psycho-emotional relaxation).

Collections of plants and a pets’

corner belonging to the Polar-Alpine Botanical Gardens-Institute were used for the realization of the Program.

The given Program for children with speech disorders has no analogues as it uses a complex approach accompanied by non-traditional methods. The Program is based on reinforcement of the child's motivation to getting new knowledge through research activity in the field of ecology and biology with visualization of the final goal and implementation of results in practice.

According to literature, initial stages of design of developmental programs focus on the principle of interconnection of sensory, intellectual and speech development of children; this principle is based on the interpretation of speech as a kind of verbal thinking, the development of which is connected with cognition of the surrounding world [3; 7]. The Program worked out at the Polar-Alpine Botanical Gardens-Institute is aimed at enhancing the rehabilitative effect by means of co-use of elements of gardening-assisted and animal-assisted therapy.

Distinction of stages of implementation is an important characteristic feature of the Program. This peculiarity lets children gradually learn the flora and fauna, starting with the simpler forms of activity and then passing over to more complex ones.

At each lesson, special emphasis is placed on observation and tactile contacts with living nature (touching grass, smelling flowers, patting an animal, listening to birds singing).

The Program includes blocks of

gardening-assisted and animal-assisted therapies, and each block consists of 15 lessons with the schedule of one lesson a week. According to SanPiN Sanitary Norms and Regulations (2.4.1201-03) lessons for this category of pupils should last 30 minutes (10 minutes may be allotted to new material acquisition in the form of computer presentations or narration with visual support and 20 minutes – to practical activity). Various forms of lessons are used in the course; they are worked out for each topic and include both traditional and unique (authored) methods. The realization of the Program takes 3.5 months [2].

Classes were held during the period of transition from the Polar night. It is a most unfavorable period for the children of at-risk group, to which children with general underdevelopment of speech belong. The child's functional state in the severe conditions of the North is subject to a complex of unfavorable natural factors. They include extreme climatic and heliogeophysical factors, violations of photoperiodicity, etc. [4]. At this time of year children demonstrate metabolism changes, general weakness, atonia and increased fatigability. It is traditionally believed that it is a period of astheno-vegetative and neurotic disorders, growth of chronic somatic pathology exacerbation, reduced immunological reactivity and adaptive potential [11; 15].

Two groups of children of the age of 6 – 7 attending a special nursery school of Apatity, Murmansk Region, took part in the experiment: the experimental group (12 children) took part in the lessons of the Program, and

the control group (also 12 children) were subject to dynamic measurements only. Children of both groups had general underdevelopment of speech of levels 2 and 3 and dysarthria. The children's parents and guardians (in cases of absence of parents) were given the text of "Agreement with child's participation in a scientific experiment" which explained the purpose and tasks of the investigation. Only those children whose parents or guardians signed the agreement took part in the experiment [5].

We registered electrocardiograms objectively reflecting the frequency of heart rate for measurement and calculation of heart rate variability parameters [16]. The functional state of children was evaluated with the help of the digital cardiorythm analyzer Omega M produced by LLC Dynamic Technologies, St. Petersburg [12; 16].

Electrocardiograms were taken after afternoon nap in the sitting position. This position was chosen as a most physiological and suitable one for the children of this age. Hemodynamic parameters in the sitting position slightly differ from the ones in the horizontal position but their interference with the parameters of heart rate variability is insignificant. For each parameter of heart rate variability we assessed the importance of differences caused by gender distinctions of children. All parameters of significant deviations (with the level of significance $p < 0,05$) did not depend on gender distinctions [8; 9].

Adaptation of the child's organism to the changing conditions of environment was evaluated through

analysis of heart rate variability allowing us to give quantitative characteristics of activity of various parts of the autonomic nervous system through their influence upon the function of the sinoatrial node. Investigation of autonomic regulation of heart rate proves that fluctuations of statistical parameters of heart rate variability signal about excessive overload quicker than other functional parameters: thus, nervous and humoral regulation of blood circulation change before energetic, metabolic or hemodynamic disturbance are revealed [10].

Heart tension-time index, or Baevskiy index, is one of the cardiorythmic parameters measured with the help of cardiorythm analyzer Omega M. This parameter was chosen as the most adequate indicator matching the purpose of our investigation. It shows the degree of centralization of heart rate regulation and serves as an integral marker of centralization of adaptive processes. According to data from special literature, in healthy 6 – 7 year old children it is estimated at $87,4 \pm 10,6$ conventional units [8]. We carried out an analysis of changes of the heart tension-time index in

children with speech disorders attending lessons of ecotherapy in comparison with the control group. The data were statistically processed and diagrams of changes of the heart tension-time index were built (Fig. 1).

The diagrams demonstrate a value increase of the given parameter by the tenth lesson (210 conventional units). Consequently, by the end of realization of the Program the concentration of children's attention reaches its maximum value [6].

According to current research, periods of concentrated and hard work demonstrate growing tension of regulatory systems of the organism, activation of the *central regulatory contour and domination of the sympathetic division of the autonomous nervous system* [1].

As the Ecotherapy Program was carried out in high latitudes (in Polar Regions) and overcoming negative impact of natural phenomena characteristic of these latitudes (polar night and excessive influence of solar activity) was one of its goals, we studied the influence of heliogeophysical factors on variable physiological parameters.

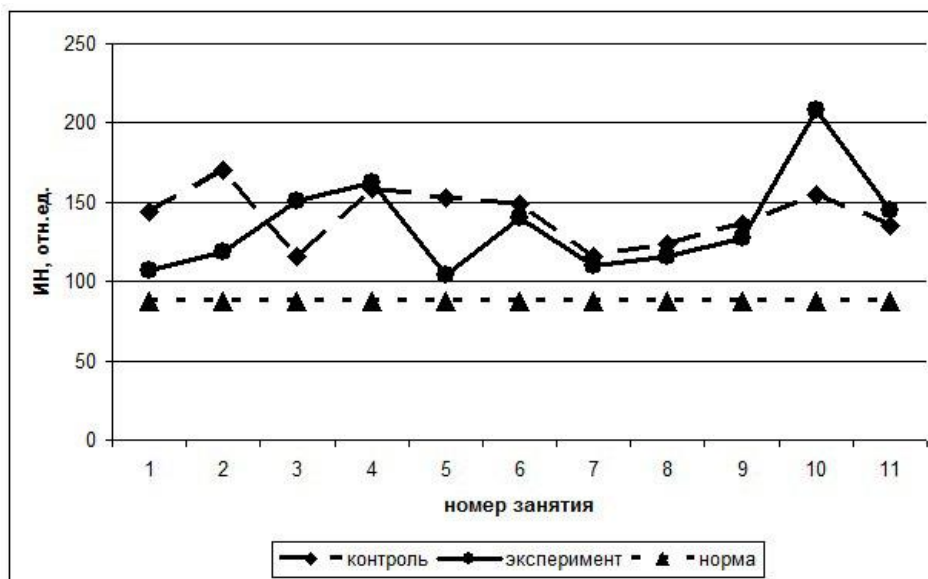


Figure 1. Dynamics of the heart tension-time index in the control and experimental groups in the course of the Ecotherapy Program.

We considered three such factors: the solar flux, the average planetary A-index and the average planetary K-index (according to the data provided by the project “Tesis” of the Lebedev Physical Institute of the Russian Academy of Sciences).

Low heart rate frequencies of the control group demonstrated high level of correlation with the solar flux, whereas the values of correlation of the same parameter in preschool children of the experimental group were lower.

The obtained data testify to the fact that the preschoolers of the experimental group showed better results than the children of the control group.

The diagram in Fig. 2, showing the dynamics of the low frequencies of heart rate in children and the solar flux demonstrates that the two waves of fluctuation in the beginning of the Program are approximately in the reversed phase to each other (the same as in the control group) (Fig. 3), but from about the middle of the course they change in the same phase or independently.

A possible conclusion based on these data may be that the participation of children with speech disorders in the Program facilitated better resilience of the organism to external influence and its more stable functioning in the conditions of the Polar Regions.

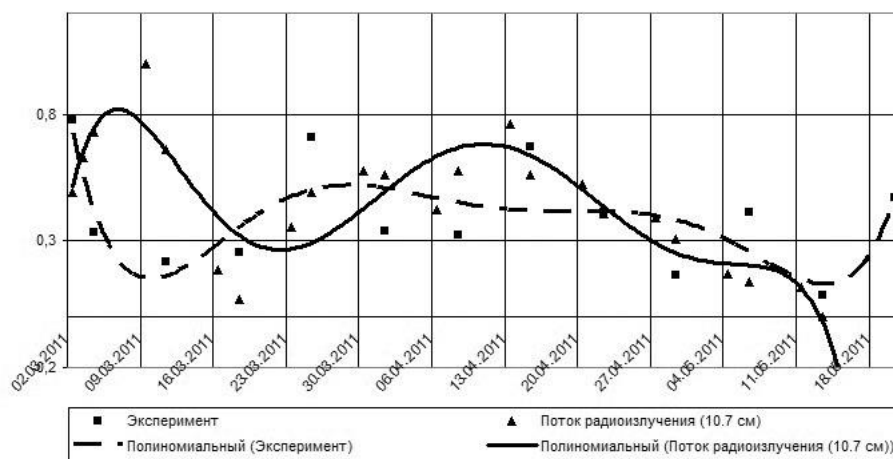


Figure 2. Dynamics of changes in the solar flux and the power of the low frequency component spectrum in the experimental group

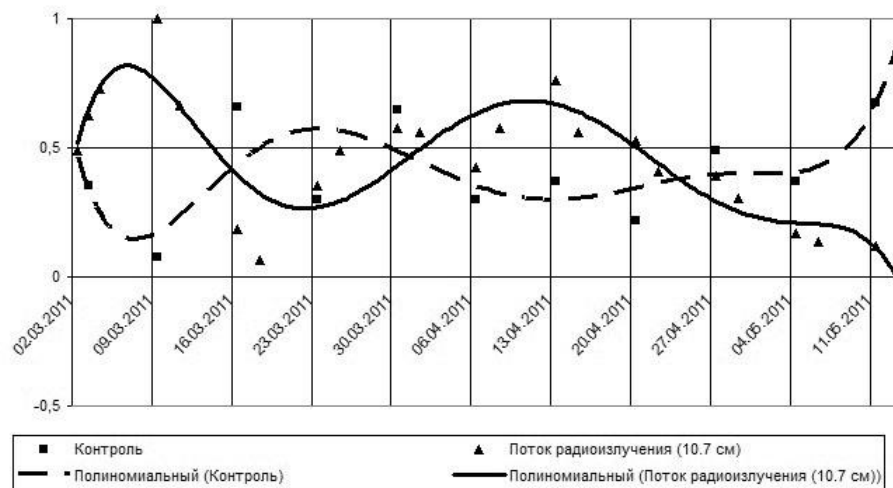


Figure 3. Dynamics of changes in the solar flux and the power of the low frequency component spectrum in the control group

It is well known that adaptive compensatory mechanisms of vegetative regulation are characterized by high adaptive tension (expressed sympathetic activity) mostly due to central stimulation through the neurogenic regulatory channel. We believe that it is this

level of vegetative regulation that guarantees the “stationary character” of the functional systems of the child’s organism and the “rigid nature” of the basic parameters.

The analysis of cardiorythmographic parameters of the cardiovascular system of children with general underdevelopment of

speech during lessons of the program “Ecological Therapy for children of 6 - 7 years of age with speech disorders” revealed increase of organism resilience and tolerability of heliogeophysical agents actively influencing people in the conditions of high latitudes.

Analysis of variability of heart rate in the course of the experiment makes it possible to register the dynamics of the state of children taking part in the Program and to make corrections in order to prevent excessive tension caused by nervous processes.

The results of the study corroborate the previously obtained facts and allow diagnosing the functional state of the children of preschool age and correcting presentation of material according to their individual abilities and adaptive potential [1].

References

1. Golubeva, I. Yu. Dinamika serdechnogo ritma u detey doshkol'nogo vozrasta pri popytke vypolneniya nereshaemogo zadaniya / I. Yu. Golubeva, T. G. Kuznetsova, E. A. Sokolova, K. N. Fomkina // Vestn. SamGU. Estestvennonauchnaya ser. — 2007. — № 8 (58).
2. Gontar', O. B. Programma dopolnitel'nogo obrazovaniya «Ekoterapiya dlya detey 6—7 let s rechevymi narusheniyami» : metod. posobie / O. B. Gontar', E. A. Svyatkovskaya, N. N. Trostenyuk, I. V. Kalashnikova, O. Yu. Nosatenko, E. P. Shlapak, I. N. Mazurenko, T. V. Kazak. — Apatity : GILTs, 2013.
3. Grigor'eva, L. P. Deti s problemami v razvitii (kompleksnaya diagnostika i korrektsiya) / L. P. Grigor'eva, L. I. Fil'chikova, Z. S. Alieva, M. E. Ver-nadskaya, V. A. Tolstova, M. N. Fishman, L. A. Rozhkova, N. K. Blagosklonova, N. K. Kostina. — M. : Akademkniga, 2002.
4. Enikeev, A. V. Sezonnye izmeneniya funktsional'nogo sostoyaniya organizma detey Kol'skogo Zapolyar'ya / A. V. Enikeev, O. I. Shumilov, E. A. Kasatkina, A. O. Karelin, A. N. Nikanov // Ekologiya cheloveka. — 2007. — № 5.
5. Zakon RF «O poryadke provedeniya biomeditsinskikh issledovaniy u cheloveka» // Byulleten' VAK Minobrazovaniya Rossii. — 2002. — № 3.
6. Kalashnikova, I. V. Osobennosti serdechnogo ritma u detey v khode provedeniya obrazovatel'no-reabilitatsionnoy programmy s korrektsionnymi elementami «Ekoterapiya dlya detey v vozraste 6—7 let s rechevymi narusheniyami» / I. V. Kalashnikova, O. B. Gontar', V. K. Zhiron // Fiziologiya i meditsina. Vysokie tekhnologii, teoriya, praktika / Politekhnichestkiy unt. — SPb, 2013.
7. Kir'yanova, R. A. Kompleksnaya diagnostika i ee ispol'zovanie uchitelem-logopedom v korrektsionnoy rabote s det'mi 5—6 let, imeyushchimi tyazhelye narusheniya rechi / R. A. Kir'yanova. — SPb., 2002.
8. Kushnir, S. M. Sostoyanie vegetativnoy regulyatsii serdechnogo ritma u zdorovykh detey v razlichnye periody detstva / I. V. Struchkova, I. I. Makarova, L. K. Antonova // Nauchnye vedomosti BelGU. — Seriya: Estestvennye nauki. — 2012. — № 3 (122).
9. Lollini, S. V. Serdechnyy ritm kak kriteriy otsenki napryazhennosti «shkol'nogo stressa» u detey mladshego shkol'nogo vozrasta [Elektronnyy resurs] / S. V. Lollini. — Rezhim dostupa: http://www.rusnauka.com/36_NIO_2008/Biologia/38843.doc.htm.
10. Mikhaylov, V. M. Variabel'nost' ritma serdtsa: opyt prakticheskogo prime-

neniya / V. M. Mikhaylov. — Ivanovo : Ivanov. gos. med. akad., 2002.

11. Rapoport, Zh. Zh. Adaptatsiya rebenka na Severe / Zh. Zh. Rapoport. — L. : Meditsina, 1979.

12. Sistema kompleksnogo komp'yuternogo issledovaniya funktsional'nogo sostoyaniya organizma cheloveka «OMEGA-M» : dokumentatsiya pol'zovatelya / nauch.-proizvodstvennaya firma «Dinamika». — SPb, 2007.

13. Filicheva, T. B. Vospitanie i obuchenie detey doshkol'nogo vozrasta s fonetiko-fonematcheskim nedorazvitiem : programma i metodicheskie rekomendatsii dlya doshkol'nogo obrazovatel'nogo uchrezhdeniya kompensiruyushchego vida (starshaya grupa) / T. B. Filicheva, G. V. Chirkina — M. : Shkol'naya Pressa, 2002.

14. Fomicheva, M. F. Osnovy logopedii s praktikumom po zvukoproduktsionnoy / M. F. Fomicheva, T. V. Volosovets, E. N. Kutepova. — M. : Akademiya, 2002.

15. Shumilov, O. I. O sezonnykh aspektakh vozdeystviya prirodnykh faktorov na funktsional'noe sostoyanie detey v Zapolyar'e / O. I. Shumilov, E. A. Kasatkina, A. V. Enikeev, A. V. Khramov // Sever 2003: problemy i resheniya : sb. nauch. trudov. — Apatity : Izd. KNTs RAN, 2004.

16. Yarilov, S. V. Fiziologicheskie aspekty novoy informatsionnoy tekhnologii analiza biofizicheskikh signalov i printsipy tekhnicheskoy realizatsii / S. V. Yarilov. — SPb : Ros. voenno-meditsinskaya akad : Nauchno-issledovatel'skaya laboratoriya «Dinamika», 2001.