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Autonomic nervous regulation in preschool children with neurotic symptoms

The article evaluates the results of autonomic nervous regulation in preschool children with different psychological status through the analysis of heart rate variability. We examined 127 children aged 3,8–5,5 years. The average statistical indices describing the regulation of the heart rhythm in preschool children with neuroses, predoneuroses, anxiety and normally developing have been determined. Preschoolers with neurosis were characterized by significantly higher temporal HRV values: heart rate, heart rate, activity index of regulatory systems, SI. The changes in the regulation of the heart rhythm have been established, which testify to the strengthening of the sympathetic contour of regulation in children with neurosis, the immaturity of the parasympathetic department of the central nervous system, reflect the stress of the regulatory systems, and also indicate a decrease in the reserve capacities of the organism.

Keywords: heart rate variability, preschool children, neurosis, anxiety, cardiovascular system, autonomic balance, functional reserves, sympathetic department, parasympathetic department.

Every year there is a tendency to increase the number of appeals to specialists of a narrow profile (neuropathologists, psychiatrists) of families whose children are suffering from diseases of the nervous system. In Kazakhstan according to statistical data of the Ministry of Health of the Republic of Kazakhstan, 297 thousand patients with mental and behavioral disorders were registered in 2009 [1], which is 1,15% [2] of the population of Kazakhstan. Bakhyt Tumenova, the president of the Amansaulyk Public Foundation, cites about 10%, according to unofficial data [3]. The above figures, referring to the incidence and prevalence of mental disorders in Kazakhstan, are somewhat contradictory. This is due to the fact that registration of incidences of mental and behavioral disorders takes into account only one source - psychiatric institutions in Kazakhstan [4]. According to the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan, the number of residents of the republic as of January 1 2015 was 17 417 673 people (of which children from 0-17 to 5 298 488) [5]. The Ministry of Health and Social Development of the RK cites the following statistics: among children registered with a psychiatrist, 12. 678 adolescents aged 15 to 17 years, and children under 14 years old — 37. 836. It is worth noting that the increase in the incidence of children under 14 in three times is a weighty argument and an urgent issue of our time. It is also striking that the fact that mental illnesses are increasingly manifested in childhood and young age. Of course, this is far from all cases considered, since patients with a borderline level of disorders (psychopathies, neuroses, reactive states), as a rule, consider themselves completely healthy, do not consider it necessary to seek qualified help in a psychoneurological dispensary. The results of special epidemiological studies that characterize the level and state of mental health of the population, for one reason or another not in the field of view of specialists, the so-called contingent «The characteristics of the incidence of mental and behavioral disorders can be judged from a retrospective analysis of the development of psychiatry in Kazakhstan, which demonstrates the prevalence of acute delusional disorders, delirious disorders of consciousness, symptomatic mental disorders as a result of infectious diseases at the beginning of the 20th century [6]. The research of B.B. Dzharbusynova for the period of 1992–2002 made it possible to establish the dynamics of primary and general morbidity indicators along the profile of general psychoses, including affective psychoses and schizophrenia [7]. In addition, at the same time there was a steady increase in the prevalence of organic mental disorders, the growth of mental retardation, as well as a clear dynamics of growth in the profile of mental and behavioral disorders that begin in childhood and adolescence. Comparatively recent studies by B.N. Aitbembet, N.I. Raspopova, and A.A. Merkulova [8] allowed establishing an increase in the incidence of organic mental disorders in Zhambyl region in 2002 compared to 1997, which amounted to 372.1%. Similar indicators, but less intensive, were typical for the Southern region of the Republic of Kazakhstan as a whole [9].

B.S. Vladimirov established the proportion of organic mental disorders increasing in ecologically unfavorable areas adjacent to the Semipalatinsk nuclear test site [10]. M.A. Asimov, investigating the prevalence of neurotic disorders, came to the conclusion that somatoform disorders are more common in women with an

overall incidence of 1–2%, and generalized anxiety disorder is more common in men, and among patients of ordinary polyclinics such disorders occur in 3–14 % of cases [11]. Neurotic disorders, in the context of ethnicity K.T.Sarsembayev investigated [12]. In particular, the high prevalence of this pathology in the Slavic group (2.04 per 100,000 population) and other ethnic groups (1.6 per 100,000 population) was determined in comparison with the indigenous nationality (0.82 per 100,000 population).

In the world statistics today, there are 10 percent of people with mental or borderline diseases: according to the American National Association of Mental Health [13], every tenth child in the United States has a violation, denoted by the term «Serious Emotional Disorders» (a serious emotional disorder) that is interpreted, as «a group of mental disorders, including violations of behavior and (or) thinking and (or) emotions». By this term all violations of the neurotic register are understood.

Statistics of the Ministry of Health of the Russian Federation indicate that over the past decade among nonpsychotic mental disorders in children, the incidence rate has increased in almost all positions: the incidence of neuroses increased by 9,7 %, psychopathy by 37,5 %, specific symptoms and syndromes — by 38,9% reactive state — 45,6 % [14]. In earlier studies, V.I. Kagan pointed out that of the children who are registered with any neuropsychological pathology, every third child has a neurosis [15]. However, data from selected epidemiological studies show that the true prevalence of neurotic disorders in childhood exceeds the indicators of dispensary registration by 5–7 times [16] and influence the complex of social, sex-age, somatic and personality-psychological factors.

Development of children in the preschool years is pretty intense and relatively evenly. Given the morphological and functional maturation of the cardiovascular system, this period is very favorable for the exercise of those physical exertions that are mandatory for children of this age. However, the transition to other social conditions (admission to kindergarten), the beginning of systematic training in the garden, the transition to new social conditions (a great burden on the emotional and intellectual sphere of preschool children lies in building relationships with peers, educators, parents and the environment) requires from children of high adaptive abilities and attention to the state of health of the child in this age range. It is obvious that an imperfect organization in preschool children affects the health not for the better. One of the reasons for not wanting to be in the garden is chronic increased anxiety of preschool children. Under the influence of anxiety, the volume of visual-shaped memory decreases, the speed of perception and information processing. As a result, frequent colds ARD, due to the weakening of the protective functions of the immune system. Psychological discomfort is manifested at the behavioral level in the form of apathy, inhibition, excessive shyness, depression, which ultimately leads to abnormalities in higher nervous activity, the development of neurotic states, and in the long term to psychosomatic diseases [17].

In the literature there is no detailed analysis of the state of the cardiovascular system in preschool children with neuroses. Meanwhile, the determination of cardiac rhythm variability is recognized as the most informative noninvasive method of quantitative assessment of vegetative regulation of heart rhythm. WCC indicators reflect the vital parameters of controlling the body's physiological functions — the vegetative balance and the functional reserves of its management mechanisms. Analyzing WCC, we can not only evaluate the functional state of the organism, but also monitor its dynamics, up to pathological states [18]. In connection with this, we were tasked with a detailed assessment of heart rate variability in preschool children with neuroses in Karaganda city. The aim of the study was to identify group features of heart rate variability in children with different neurotic conditions.

Materials and methods

We conducted a study in the preschool center of the nursery school No. 15 «Akku», kindergarten «Tolagai» in Karaganda city. The psychological state of children was established with the help of psychological tests taking into account the medical conclusion. Based on the results of primary research, a group of 127 children was selected, which were further studied in in-depth studies. The entire sample was divided into four groups. 22 children with established diagnosis have neurosis, 18 children with pre-neurological status, 40 — with a high degree of anxiety, 48 children — normally developing. On the basis of gender, the study involved 55 girls and 72 boys. The number of children in the main groups was as follows: in the neurosis group — 18 girls, 13 boys; In the group of predneurosis — 8 girls, 10 boys; In the group of anxious children — 17 girls, 23 boys; In the group of normally developing children — 24 girls, 24 boys. The age of the children ranged from 3 years 8 months till 5 years 5 months. The indicators of the physical development of children were within the limits of the age norm. The body weight of children 4 to 5 years old was 15,2 ± 1,3;

from 5 to 5,5 years -21,4 ± 1,1. The average height of children from 4 to 5 years is 103 ± 0,9; from 5 to 5,5 years — 108,4 ± 2,1.

The study was carried out using the method of cardiointervalography according to R.M. Bayevsky by complex «Varikard», registered ECG and performed automatic analysis of WCC [19] and the program «ISKIM-6», spectral analysis of WCC. The use of spectral analysis makes it possible to quantify the various frequency components of the heart rhythm oscillations and graphically represent the relationships of different components of SR reflecting the activity of certain parts of the regulatory mechanism of the child's organism.

The examination was conducted in the morning hours from 9–12 in a quiet room. Parameters of heart rate variability were recorded in the second lead. The duration of recording is 5 minutes lying, 2 minutes standing. During the WCC study, children were encouraged to breathe without making deep breaths. Among the WCC parameters studied, the following were studied: heart rate (HR), sympathetic and parasympathetic division of LF / HF, activity index of regulatory systems (AIRS), stress index (SI).

To interpret our research, one-way analysis of variance for independent groups will be most appropriate. When calculating these statistical criteria, as for all previous ones (psychological tests), the program Statistica V.6.1 was used.

Based on the results of single-factor analysis of variance analysis for the data expressed in interval scales and relationship scales, the following results were obtained below.

Results and its discussion

In the study, the average statistical indicators characterizing the regulation of the heart rhythm in children of different groups (neuroses, predneurosis, anxiety states, and norm) were determined. Analysis of WCC in preschool children showed significant differences in heart rate, AIRS, SI index.

In the body of a healthy child, the influence of the parasympathetic and sympathetic divisions is in a state of optimal balance. There is a probability of a slight predominance of one of them, which is due to the immaturity of one of the departments, or uneven maturation, which is also a variant of the norm. In our case, attention is drawn to the absence of significant differences in the values of LF / HF — 0,329 at 0,805.

It is well known that if the LF / HF ratio is less than one, the parasympathetic department of the central nervous system predominates, if more than one is sympathetic. But there is a fairly wide range, within which it is unacceptable to talk about the predominance of one or another department of the ANS. It should be remembered that the «norm» range of the LF / HF relationship depends on age, living conditions, adaptation to the environment, and daily level of physical activity. In our case, it is appropriate to interpret the obtained data as the imperfection of regulatory mechanisms — «incomplete adaptation», more precisely «the search phase of adaptation» [20].

The increase in sympathetic regulation in the Neurosis group is indicated by heart rate, which demonstrates statistically significant differences. In the course of the analysis, the obtained data were F = 4,87 at p = 0,003. Graphical analysis, as well as descriptive statistics on heart rate, indicates the following characteristics of these differences below (Fig. 1).

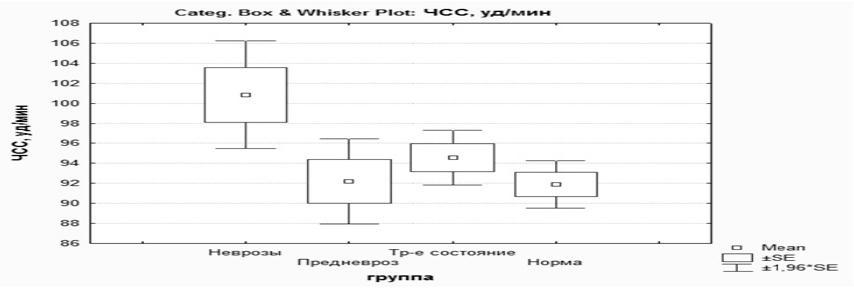

Figure 1. Comparative dynamics of HR parameter in preschool children

Taking into account the arithmetic mean for the heart rate, it can be seen that the differences are determined by a significant separation in the group «Neuroses» — 13,701 ± 2,740. In this group, there is clearly an increased heart rate than in the remaining groups, while at the same time, in the group of children with a high level of anxiety (9,709 ± 2,171), the heart rate is clearly higher than in the group «Predneurosis» — 8,980 ± 1,386. This is because children with a high level of anxiety are daily in a state of psycho emotional

stress and in the future, with age, it will increase, which may be a predictor of neuropsychic disorders. There is a tendency to decrease the heart rate from the group «Neurosis» to the group «Norm» — 8,766 ± 1,216.

Rates in SI parameter (stress index of regulatory systems) also showed statistical significance at F = 6.04 and p = 0.001. Graphic analysis of the differences shows that the stress index in different groups behaves as follows (see Fig. 2): if the parameters of the first three groups («Norm», «Alarming state» and «Predneurosis») are practically not different, then on going to the group «Neurosis» rates go up sharply. The parameter SI depends on the tone of the sympathetic nervous system and on the state of the central contour of regulation. High values of this indicator in the group «Neurosis» allow classifying these children as super-sympathetic type. In children of this group, SI increased to 305–950 rounds, which exceeds the normal values by several times and reflects the stress of regulatory systems and the activation of sympathetic effects on the heart, and also indicates a decrease in the reserve capacity of the body.

In addition, it can be noted that this group has a higher range of values than the remaining three groups. All this makes it possible to assume that the differences are due to the indices in the Neurosis group 402,024 ± 80,405, while there is no significant difference in the stress index of the regulatory systems between the remaining groups. The value of the studied indicator did not exceed the standard values in the group «Predneurosis» — 115,328 ± 25,788, «Alarming state» — 112,764 ± 17,400, «Norm» 127,516 ± 17,683, although it tended to decrease.

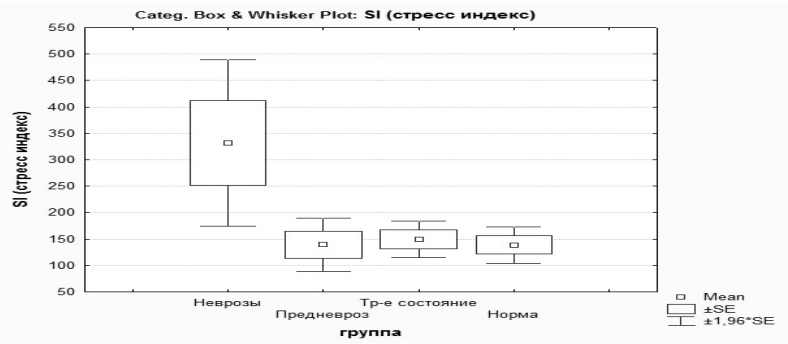

Figure 2. Comparative dynamics of the parameter «SI»

The obtained data serve as the basis for the assumption of overstrain of vegetative centers in children in the «Neurosis» group, apparently due to high psycho emotional loads.

The next significant difference was given by the indicators on the AIRS scale (activity indicator of regulatory systems). The value of the F-test turned out to be 6.39 at p = 0.001. Graphical analysis based on the arithmetic mean shows below the following picture (Fig. 3).

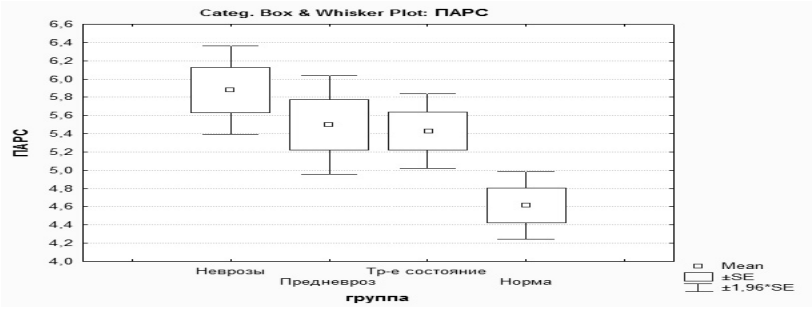

Figure 3. Comparative dynamics of the parameter «AIRS»

The graph in Figure 3 shows that the regulatory system activity indicators rather smoothly rising from the group «Norm» (AIRS — 3–4), which indicates the state of a moderate tension of regulatory systems; «Anxious state» — (AIRS — 4–6) — a pronounced tension of regulatory systems, caused by active mobilization of protective mechanisms, including an increase in activity of the sympathetic-adrenal system; «Predneurosis» — (AIRS — 6–8) — overstress of regulatory systems, which is characterized by the inadequacy of protective adaptive mechanisms, their inability to provide an adequate response of the body to the

effects of environmental factors; In the group of children with neurosis (AIRS — 6–8), with the last group achieving maximum results on this scale, which indicates a condition close to disruption of adaptation.

Thus, the obtained results indicate that in children of preschool age with neuroses, predoneuroses, anxiety, a change in the state of vegetative regulation of the heart rhythm is observed. The established variations of the basic parameters of HRV indicate a greater influence of the sympathetic link, a decrease in parasympathetic influences on the heart rhythm, a pronounced tension of the regulatory mechanisms in the group «Neurosis», «Predneurosis», «Anxiety».

Preschool children with a predominant sympathicotonic type of autonomic dysfunction need of immediate corrective measures in this segment of ontogenesis, especially if they have the following manifestations: high sensitivity to stress — children react to desperate stress or aggression, excessive tearfulness, excessive vulnerability, high anxiety, preoccupation with traumatic situations, fatigue, sensitivity to loud or harsh sounds, bright light, temperature changes, sleep disorders, autonomic disorders.

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А.Е. Конкабаева, Р.Т. Бөдеева, З.Я. Олексюк, М. Даниленко

Невротикалық белгілері бар мектеп жасына дейінгі балалардағы вегетативтік жүйкесін реттеу

Мақалада түрлі психологиялық дәрежедегі невротикалық белгілері бар мектеп жасына дейінгі балалардағы вегетативтік нервтік реттеудің нәтижелері жүрек ритмінің вариабельділігінің талдануы арқылы бағаланды. 3,8–5,5 жастағы 127 бала зерттелді. Невроздары, неврозалды, аландаушылық жағдайдағы және дамуы қалыпты мектепке дейінгі жастағы балалардың жүрек ритмінің реттелуін сипаттайтын орташа статистикалық көрсеткіштері анықталды. Неврозы бар мектеп жасына дейінгі балалар ЖРВ: ЖЖЖ, ЖБРК, SI уақытша көрсеткіштерінің жоғары мәндерімен сипатталды. Невроздары, ОЖЖ парасимпатикалық бөлімінің жетілмеуі байқалынатын балалардың реттеудің симпатикалық күшеюін білдіретін жүрек ритмінің реттелуінің өзгерістері анықталған, реттеу жүйелерінің күшеюін бейнелейді, сонымен қоса ағзаның күш мүмкіншіліктерінің төмендеуін көрсетті.

Кілт сөздер: жүрек ритмінің вариабельділігі, мектеп жасына дейінгі балалар, невроз, аландаушылық, жүрек-тамырлы жүйе, вегетативтік баланс, функционалды резервтер, симпатикалық бөлім, парасимпатикалық бөлім.

А.Е. Конкабаева, Р.Т. Бодеева, З.Я. Олексюк, М. Даниленко

Вегетативная нервная регуляция у детей дошкольного возраста с невротическими проявлениями

В статье исследованы результаты вегетативной нервной регуляции у детей дошкольного возраста с различным психологическим статусом посредством анализа вариабельности сердечного ритма. Обследованы 127 детей в возрасте 3,8–5, 5 года. Были определены среднестатистические показатели, характеризующие регуляцию сердечного ритма у детей дошкольного возраста с неврозами, предневрозами, тревожным состоянием и нормально развивающихся. Дошкольники с неврозом характеризовались достоверно более высокими значениями временных показателей ВРС: частота сердечных сокращений, показателя активности регуляторных систем, SI. Установлены изменения регуляции ритма сердца, которые свидетельствуют об усилении симпатического контура регуляции у детей с неврозом, незрелости парасимпатического отдела ЦНС, отражают напряжение регуляторных систем, а также указывают на снижение резервных возможностей организма.

Ключевые слова: вариабельность сердечного ритма, дошкольники, невроз, тревожность, сердечно-сосудистая система, вегетативный баланс, функциональные резервы, симпатический отдел, парасимпатический отдел.

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