

FEATURES OF NEUROFUNCTIONAL MANIFESTATIONS OF MENTAL TENSION IN CHILDREN CHESS PLAYERS

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Abstract. *Various brain structures, their interaction and, consequently, mental functions reach full development at different ages and in a specific way determine the individual characteristics of the child. When the rates of development of functional systems differ, developmental heterochronies arise. Heterochrony is manifested by the uneven development of functional systems, which must meet the need to comply with the changing forms of interaction of the child with the environment. However, it is argued that heterochronies in the development of functional systems can become the basis for partial delays in motor, speech or mental development. In connection with the above, in this article the authors studied EEG signs that allow us to judge the level and degree of irritation of the brain stem structures under mental stress in primary school students against the background of long-term adaptation to intellectual stress associated with classes in the chess universal education program, which is relevant.*

Keywords: *children; mental development; chess; intelligence; mental stress; brain.*

Introduction: As is known, quite a lot of material has been accumulated in recent years concerning the study of neuromorphological and neurophysiological characteristics of physiological ontogenesis [1, 3, 4]. However, the task of elucidating the mechanisms of development of human brain functions is still far from being resolved [7, 9]. In particular, the neurophysiological mechanisms of various functions of the central nervous system, which can be considered as mechanisms of selective modulation of the activity of brain structures at different levels involved in one or another activity, are of particular interest [5, 12]. The formation of a child's adaptive capabilities is determined by general biological laws, which include: the functional integrity and reliability of the body, the plasticity of physiological systems and processes, functional optimization and heterochronic development of life support systems and their regulators, critical periods of development. The formation of a child's adaptive capabilities is carried out on the basis of psychophysiological mechanisms, both at the hereditarily determined level and at the conditioned reflex level (purposeful forms of behavior) [2, 13, 15].

All over the world, there is a sharp increase in the population of children in a state borderline between normal and pathological, demonstrating pronounced signs of maladaptive behavior and learning difficulties - a kind of "low-normative type of development" [10,11], constituting a risk group for the subsequent development of pathological conditions. At the same time, speaking about the norm in the case of the development of the child's central nervous system, it should be taken into account that it is characterized by uneven development of higher mental functions. In this regard, a number of researchers [3,8,14] propose to consider phenomena associated with the activity of the child's nervous system as optimal or suboptimal.

It is obvious that the manifestation of a deficiency in the development of any function may have a complex multifactorial structure of psychophysiological mechanisms that determine its impairment. Various brain structures, their interaction and, consequently, mental functions reach full development at different ages and in a specific way determine the individual characteristics of

the child [3,4]. When the rates of development of functional systems differ, developmental heterochronies arise [8,9,10,18]. Heterochrony is manifested by the uneven development of functional systems, which must meet the need to comply with the changing forms of interaction of the child with the environment. However, it is argued that heterochronies in the development of functional systems can become the basis for partial delays in motor, speech or mental development [2,8,11,17].

In connection with the above, the study of EEG signs that allow us to judge the level and degree of irritation of the brain stem structures during mental stress in primary school students against the background of long-term adaptation to intellectual stress associated with classes in the chess general education program is relevant.

Purpose of the study: to study EEG signs during mental stress in primary school students during long-term adaptation to intellectual stress associated with classes in the chess education program.

Materials and methods of research: the study is based on survey data from 190 children aged 6 to 11 years old who play professional chess, of which 58 boys (66.7%) and 29 girls (33.3%), average age 10.1 ± 0.2 years. Among the children of chess players, 98 (51.6%) children had at least 2 years of chess experience, 92 children (48.4%) had more than 3 years of experience. The average experience in sports is 3.1 ± 0.01 years. All children chess players undergo a medical examination once a year. These children made up the main group.

The comparison group consisted of 60 children of 2nd and 4th grades of secondary educational schools in Tashkent who were not involved in sports sections. The average age of these children was 9.8 ± 0.3 years, boys made up 60% (36 children), girls made up 40% (24 children).

The EEG was recorded on a 17-channel Nihon Kohden electroencephalograph. The electrodes were placed on the head according to a 10-20 pattern. The recording was carried out in relation to the average potential. Visual assessment determined whether the EEG belonged to one of five types according to the classification of Jirmunskaya E.A. (1991), adapted to childhood (Gorbachevskaya N.L., Yakupova L.P., 1999) [6].

According to this classification, the 1st type included EEGs with a well-formed alpha rhythm, an amplitude of at least 40 μ V, with a medium or high index (over 50%), with clearly expressed zonal differences, a moderate number of slow waves (within the age norm), not exceeding the main activity in amplitude. The same group also included EEGs with a hypersynchronous alpha rhythm (amplitude of alpha oscillations more than 70 μ V). This is the so-called organized type of EEG.

The 2nd type - hypersynchronous - is a hypersynchronous EEG for any rhythm except alpha. The main activity is absent or represented by single oscillations or small groups of alpha waves.

The 3rd - desynchronous - type includes EEGs with a low index and amplitude of the alpha rhythm (less than 30% and less than 40 μ V, respectively). The overall amplitude level of the EEG is also low (the so-called "flat" EEG).

The 4th type - disorganized with a predominance of alpha activity. In this type of EEG, alpha activity dominates, but it is irregular in frequency and amplitude, includes many sharp waves and slow waves.

non-rhythmic oscillations, its index is from 30 to 50%. In general, the level of irregular slow-wave activity in all leads in the EEG is increased.

The 5th type - disorganized with a predominance of slow-wave activity. Alpha activity is practically absent, the index and amplitude of irregular slow oscillations are significantly increased. Oscillations of different frequency ranges do not form rhythmic activity, are mixed with each other, their amplitude is medium or high.

For assessing the reliability of statistical indicators, four main levels were adopted: high – $p < 0.001$, medium – $p < 0.010$, low (marginal) – $p < 0.050$, insignificant (unreliable) – $p > 0.050$.

Results of the study: When visually analyzing the EEG of children in the main group and the comparison group, it was found that the EEG typology differs from that among healthy children (Table 1).

Table No. 1.

Frequency of occurrence of various types of EEG in examined children

EEG type	Main group (n=190)		Comparison group (n=60)	
	Abs.	%	Abs.	%
1 – organized	83	43,7	51	85,0
2 – hypersynchronous	33	17,4	0	0
3 – desynchronous	11	5,8	0	
4 - disorganized with alpha and theta rhythm	56	29,5	9	15,0

As can be seen from the table, in the main group, the 1st type EEG was found in 43.7% (83) of children and was characterized by a well-formed alpha rhythm, amplitude from 48 to 100 μ V, its index over 87.5%. There are clear zonal differences in the distribution of the main EEG rhythms and a moderate number of slow waves that do not exceed the main activity and age norm in amplitude. Whereas in the comparison group this type occurs in 85.30% (51) of cases (Fig. 1).

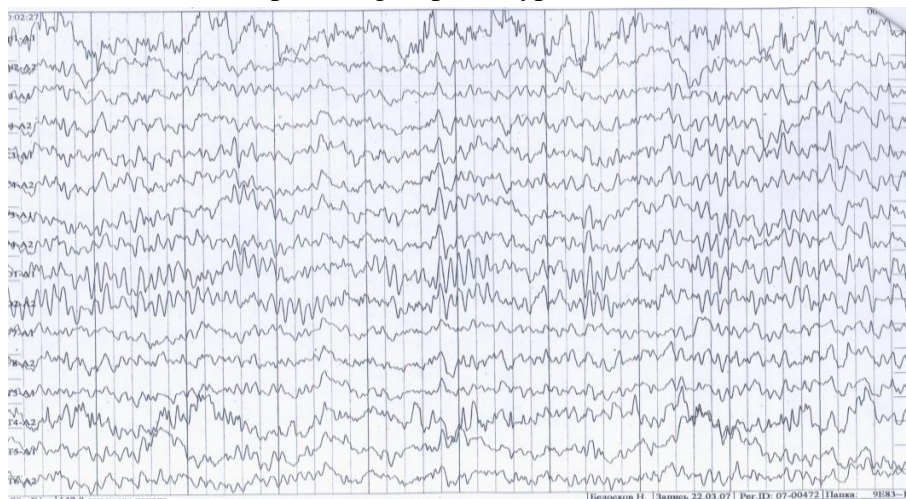


Fig. 1. EEG picture of the age norm. Patient B., 8 years old.

The 2nd type EEG – hypersynchronous – was found in 17.4% (33) of children in the main group, which was characterized by hypersynchronization of the beta rhythm. The main activity was absent and was either represented by single oscillations or small groups of alpha waves. All children with EEG type 2 showed signs of ADHD.

The Desynchronous EEG type (3) in our study occurred in the main group in 5.8% of cases. This type was characterized by a low index (30%) and amplitude of the alpha rhythm (39 μ V), and a low overall amplitude level of the EEG.

The type 4 EEG was recorded in the examined children, both in the main group in 29.5% (56) of children, and in 15.0% (9) of the comparison group. It was characterized by the dominance of theta and alpha activity, irregular in frequency and amplitude (alpha rhythm index below 50%). Moderately pronounced diffuse changes in the bioelectrical activity of the cerebral cortex in both study groups were not statistically significant ($P > 0.01$).

Thus, based on the above, it can be assumed that children of chess players are characterized by a consistently higher level of cortex activation compared to children from the comparison group; for weak and strong relative to excitation, as well as for strong relative to inhibition - the specific functioning of subcortical structures (thalamus and limbic system), which determine the optimal level of activation for the individual; for mobile people – the degree of synchronization of neural activity.

The increased level of mental stress and psycho-emotional stress in primary school students in connection with chess classes and participation in competitions leads to tension in adaptation mechanisms.

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