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АДАПТАЦІЙНІ МОЖЛИВОСТІ ДІТЕЙ ТА МОЛОДІ

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XIV МІЖНАРОДНОЇ НАУКОВО-ПРАКТИЧНОЇ КОНФЕРЕНЦІЇ,
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Адаптаційні можливості дітей та молоді: збірник наукових праць XIV міжнародної науково-практичної конференції, присвяченої 205-річчю з дня заснування Державного закладу «Південноукраїнський національний педагогічний університет імені К. Д. Ушинського» (Одеса, 15–16 вересня 2022 року, Ч. 2) / голов. ред. А. І. Босенко. Одеса: Видавець Сімекс-прінт, 2022. 195 с.

У збірнику наукових праць представлені роботи широкого кола фахівців з сучасних проблем фізичного виховання і спорту. В статтях розкриваються медико-біологічні, фізіолого-гігієнічні, психолого-педагогічні та валеологічні основи розширення адаптаційних можливостей дітей та молоді, зміцнення їх здоров'я.

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DYNAMICS OF ULTRA-SLOW BIOELECTRIC PROCESSES OF THE BRAIN IN PRIMARY SCHOOL-AGED CHILDREN UNDER THE INFLUENCE OF DIFFERENT LOADS

The goal of our paper was to study the functional capabilities of the central nervous system in primary school-aged children when performing mental work and physical exertion. It is shown that in children aged 9–10 years mental work load causes greater tension in the mechanisms of brain regulation, characterized by an increase in the level of ultra-slow bioelectric processes. Physical exertion in the form of a game lesson of physical training optimizes the state of the brain of primary school-aged children.

Key words*: omegametry, schoolchildren, Landolt's test, physical activity.*

One of the main issues covered by the World Health Organization is the health of children and adolescents. Unfortunately, in our country, there has recently been a tendency to reduce the health status of schoolchildren. Every year, the number of students who are completely exempt from physical training lessons increases, and there are cases of child mortality in physical training lessons [2, 3].

This is due to various factors, the key one of which is physical health, which places high demands on the level of physical development and functional capabilities of the body. Today, unfortunately, sufficiently comprehensive examination of children is not conducted. Based on the results of one Ruffier test, a conclusion is made about the student’s state of health. It does not take into account either a sedentary lifestyle, an increase in mental stress at school, or the fact that it is physical

training and sports that increase the reserves of adaptation. Their limits in the child's body, reaction ranges and level of performance are determined by the value of physiological and biochemical reserves. The main tasks of Physical Training at school are the development of motor abilities of children, the formation of the foundations of a healthy lifestyle, especially in the lower grades [4]. However, these age opportunities are neither used enough, nor little studied.

In connection with the above, the goal of our paper was to study the functional capabilities of the central nervous system (CNS) in primary school-aged children when performing mental work and physical exertion.

The study was conducted in Odesa Secondary School No. 107. 30 students aged 9-10 years (3rd grade) were examined. At the time of examination, there were no complaints about the state of health.

To determine the functional capabilities of the central nervous system, the method of recording ultra-slow bioelectric processes (BEP) of the human brain (omegametry) was used according to the method of O. H. Sychev et al. (1980). The method of recording the omega potential involves the discrete measurement of indicators in a sitting position at rest and directly under the influence of test and training loads. One of the electrodes is installed in the fontanel area on the surface of the head, and the second is in contact with the tenor of the right or left hand.

This methodology enables to quickly assess the state of adaptive and regulatory systems of the body and the degree of their damage based on the values of omega potential at different time intervals, after functional load [5].

Measurements were taken in a state of relative muscle passive tone, after mental work load, and after physical exertion. We used the Landolt test as mental work load, and physical exertion was given during a physical training lesson (different parts of the game lesson are a game of football).

Empirically, we have identified the three gradations of the limits of omega potential fluctuations (OP), which characterize differences in the functional state of the brain: low level (determined by the OP fluctuation in the range from 1 to 20 mV),

medium (from 21 to 40 mV), high (41-60 mV).

Children with low OP values are diligent, master the material well during training, but are not always able to successfully implement it. With inadequate physical exertion and mental work load, they are characterized by a decrease in reserve capabilities, tension of adaptive mechanisms, which requires an individual approach, more attention and encouragement.

Students with average values of omega potential, as a rule, cope well with the training load, easily learn the techniques, clearly implement the scheduled program, and are able to consciously manage their actions.

Children with high omega potential values learn mainly by the demonstration method, they are persistent and determined to succeed. However, they need more time to work out precise technical actions (relative to years of training sessions) and achieve high technical results.

The analysis of the results of the study of ultra-slow brain processes has shown that in the initial state, the value of omega potential in children aged 9-10 years ranges from 13 to 55 mV, which, according to V. A. Iliukhina and O. H. Sychev, is an optimal indicator for future activity. The obtained data indicate that in the majority of the examined students (56.25%), the OP is in the range from 40 to 60 mV, that is, corresponds to a high level, which, according to the established canons, can reflect the tension in the mechanisms of neuroreflective regulation of the background state [5].

The dynamics of OP under the influence of mental load was characterized by a further decrease in the number of students with low and medium levels of OP, but the main type of changes in ultra-slow bioelectric activity was its increase both in quantitative and qualitative terms. The analysis of individual data showed that 18.75% of students experienced a decrease in the OP values and their increase in 75% of cases (Fig. 1).

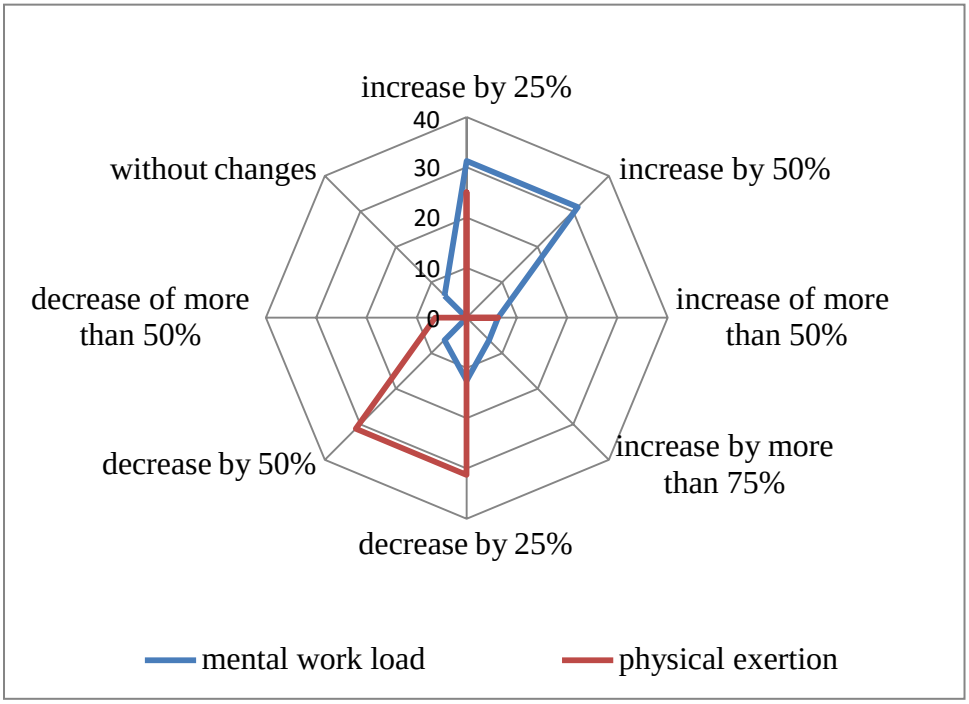

Fig. 1. Changes in ultra-slow bioelectric processes of the brain in children aged 9-10 years under the influence of different loads.

An increase in omegametry indicators within 25 %, according to the literature data, is a physiologically optimal brain response. An increase in the constant potential from 25 to 50% indicates a state of voltage level of relatively stable operation. A reduction in OP to 50%, according to O. H. Sychev et al., characterizes a high degree of tension in the regulatory mechanisms of the brain.

It is interesting to note that in 6.25% of students, the mental load has caused changes in OP of more than 75%. A similar range of response is given in the studies by A. I. Bosenko [1], in which omega potential in children has decreased in some cases by 75% or more from the initial level during work to failure. Most researchers who have studied the dynamics of ultra-slow bioelectric processes under the influence of factors of different modality and strength have come to the conclusion that a positive or negative shift in the level of OP within these limits should be considered as a sign of overexertion of the body.

In relative passive muscle tone before exercise, the omegametry data ranged from 14 to 64 mV. At the same time, a low level of OP values was observed in 6.25%

of cases, which indicated low brain activity, an average level was registered in 12.5%, and a high level was registered in 62.5% of students. There were also students with the registered level higher than high, which was 18.75% of those examined.

Muscle loads have a positive effect on the body, in particular, on the central nervous system. Thus, there were no students with a low level of OP after a physical training lesson. There were also no children with higher levels of omegametry. In addition, the number of respondents with an average level of indicators increased (Table 1).

The analysis of individual brain responses to physical exertion enabled students to be divided into two groups according to the type of reaction: an increase and a decrease in omegametry values. It was found that an increase in constant potential was observed among subjects with the low OP values, and a decrease – with high ones. It can be concluded that physical exertion causes convergent changes in the omega potential, which are due to the initial values of the constant potential.

The issue of gender characteristics of the omega potential dynamics is interesting. Our study has found a significant difference between the data of girls and boys. Thus, in a state of relative rest to mental load, among girls there was the same number of students with medium and high levels (37.5% each). Low levels of OP were registered in 25% of girls. No low-level individuals were found among boys. Most of the boys were characterized by a high level of permanent potential (75 %), and 25% – by an average level.

Mental work load had different effects on the super-slow BEP of boys and girls. In boys, the percentage of cases of the average level decreased (12.5%), the high level remained at the same figure, but there were cases of registration of the level above the average.

In girls, on the contrary: after the Landolt test, the number of female students with the high-level OP decreased and increased with the low-level OP (50%, 12.5%, respectively). The percentage of respondents with an average BEP level did not

change. That is, mental performance in boys caused tension in the mechanisms of brain regulation.

In relative passive muscle tone before exercise, 12.5% of girls were in the low – to-medium range, 50% had a high level, and 25% had an above-average level. After the physical training lesson, the majority of girls (62.5 %) had an average level. At the same time, a significant number of girls (37.5%) had a high level of OP.

Three levels of potential were found in boys before physical activity: average – in 12.5 %, high – in 75 %, above average – in 12.5% of cases. After playing football, their omegametry values were in the range of high OP levels.

Thus, it is shown that in children aged 9-10 years, students of the 3rd grade of a general education school, mental work load causes greater tension in the mechanisms of brain regulation, characterized by an increase in the level of ultra-slow BEP. Physical exertion in the form of a game lesson of physical training optimizes the state of the brain of primary school-aged children.

References

1. Blakemore S, Choudhury S. Development of the adolescent brain: implications for executive function and social cognition. Journal of Child Psychology and Psychiatry. 2006; 47(3-4): 296–312.

2. Bosenco A. I., Topchii M. S. General functional state of the central nervous system of the first and second year students of the physical education faculty. Science Rise: Biological Science. 2017; 4(7): 31–36.

3. Wolf S., Brölz E., Keune P. M., Wesa B., Hautzinger M., Birbaumer N. et al. Motor skill failure or flow-experience? Functional brain asymmetry and brain connectivity in elite and amateur table tennis players. Biological Psychology. 2015; 105: 95–105.

4. Даниленко Г. Н., Попов Н. Н., Пашкевич С. А., Яблучанский А. Н. Особенности состояния здоровья и функционирования регуляторных систем организма младших школьников в зависимости от социально-психилогической

адаптации к обучению в школе. *Вестник Харьковского национального университета имени В. Н. Каразина*. № 7 (614). 2004. С. 88–91.

5. Коренєв М. М., Даниленко Г. Н. Здоров'я школярів, сьогодення та проблеми на перспективу. *Науково-практичний журнал «Охорона здоров'я України»*. № 1 (8). 2003. С. 49–54.

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ДИНАМІКА НАДПОВІЛЬНИХ БІОЕЛЕКТРИЧНИХ ПРОЦЕСІВ МОЗКУ У ДІТЕЙ МОЛОДШОГО ШКІЛЬНОГО ВІКУ ПІД ВПЛИВОМ НАВАНТАЖЕНЬ РІЗНОЇ СПРЯМОВАНОСТІ

Проведено дослідження реакції центральної нервової системи у дітей 9–10 років на навантаження різної спрямованості. Встановлено більше напруження механізмів регуляції головного мозку у дітей під час розумових навантажень, що характеризується зростанням рівня надповільних біоелектричних процесів мозку. Фізичні навантаження під час уроку з фізичної культури оптимізують стан головного мозку дітей молодшого шкільного віку.

Ключові слова: омегаметрія, школяри, тест Ландольта, фізичні навантаження.