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*The dynamics of psychophysiological functions
in the female teenagers and youngsters in the process
of their adaptation to educational and sport activity*

**Dynamika funkcji psychofizjologicznych u młodszych i starszych dziewcząt
w procesie ich przystosowania do działalności edukacyjnej i sportowej**

INTRODUCTION

All organs and systems undergo quantitative and qualitative changes in the process of biological maturation of human organism to adapt to the life conditions. The central nervous system connects all system and organs into one unity, ensures contact of the organism with environment, and provides psychological and cognitive functions as well as behavioural reactions. The importance of the presented problems is proved by the great interest of scientists investigating actively the questions of formation and development of individual-typological peculiarities of higher nervous activity in ontogenesis, age aspects of memory and attention in correlation with success of education, effectiveness of work and sport activity [2, 4, 5]. At the same time one should note that the problems of adaptation to education activity of children and students in various age categories are explored insufficiently. The problems with the use of psychophysiological indexes complex for primary selection and other stages in sport generally and in women's handball specifically remain actual.

MATERIAL AND METHODS

The research was held on the base of Cherkasy B. Khmelnytskyi National University, Cherkasy Chernobyl Heroes Fire Safety Institute, Cherkasy General Education Schools № 7, 10 and Cherkasy Children-Youngsters Sport School № 1. 180 girl-students, 34 girls aged 17-21 of stated institutes, and 459 girls aged 9-16 took part in the complex examination. All examined girls were practically healthy at the moment of the investigation. Psychophysiological function state was determined with automated "Intest" method worked out by L.M. Kosak, and V.O. Yelisarov [3]. "Intest" gives a possibility to determine indexes of simple sense – motor reactions; the functions of perception, attention, and memory were evaluated with the use of methods by G. Izenk [1], M.V. Makarenko [5], G.M. Chaychenko [6], F. Halberg [7], D. Wechsler [8].

RESULTS

In the investigation process a number of psychophysiological indexes were determined:

- The latent period of visual-motor and audio-motor reactions.
- The functions of space and time perception.
- Short-term memory volume.

- The coefficient of abstract, associative, logical, operative and spatial thinking.

The above indexes characterize the central nervous system activity, but on one hand they present certain regularities in the process of human organism biological maturation, on the other though they become perfected in the process of education and sport activity and may be regarded as adaptation factors.

When analyzing the latent periods of the visual-motor and audio-motor reaction of the investigated age groups, we can mostly note gradual perfection of the given indexes with the growing age except for the age period from 16 till 17, when the latent period of the visual-motor reaction shortens essentially ($p < 0.05$) – from 0.43 sec. till 0.27 sec. The same period of essential decreasing is observed a year earlier in the formation of audio-motor reaction latent period. That is to say that for girls at the age of 15-16 and 16-17 is sensitive in forming latent period of visual-motor and audio-motor reactions, which can signify the perfection of the nervous impulse conduction. However, the education and sport activity of the subjects has no influence on the mentioned processes (Table 1).

Table 1. Dynamics of the Changes in the Psychophysiological Function of Investigated Age Groups of Girls in the Process of Biological Maturation and Education-Sport Activity ($M \pm m$)

№	Age		Psychophysiological Indexes								
	(years old)	Time Perception Error (s)	Space Perception Error (sm)	Visual-Motor Reaction Latent Period (s)	Audio-Motor Reaction Latent Period (c)	Short-Term Memory Volume (%)	Abstract Thinking Coefficient (%)	Associative Thinking Coefficient (%)	Logical Thinking Coefficient (%)	Operative Thinking Coefficient (%)	Spatial Thinking Coefficient (%)
1.	9	9.29±1.54	0.19±0.03	0.45±0.02	0.37±0.02	36.0±4.30	48.0±1.93	24.7±3.11	90.7±1.76	69.33±2.90	17.8±5.32
2.	10	9.00±1.54	0.17±0.03	0.47±0.01	0.35±0.01	36.0±4.40	54.7±2.96	24.8±3.38	90.0±2.98	65.3±5.32	44.4±6.79
3.	11	8.47±1.33	0.20±0.04	0.46±0.01	0.35±0.02	38.7±3.76	54.7±3.51	29.3±3.83	88.7±7.69	67.3±7.02	45.5±3.81
4.	12	3.40±1.21	0.20±0.02	0.45±0.03	0.37±0.04	42.7±4.42	56.2±2.95	36.0±8.79	66.0±8.79	65.0±9.80	49.9±6.31
5.	13	2.73±0.67	0.19±0.03	0.46±0.01	0.30±0.01	47.3±4.27	66.0±2.09	35.7±3.64	90.0±2.35	82.0±4.54	48.9±6.93
6.	14	2.13±0.36	0.08±0.01	0.45±0.01	0.28±0.01	49.3±3.20	63.3±3.85	38.7±3.51	88.0±6.27	80.0±4.99	47.8±8.82
7.	15	1.60±0.16	0.10±0.02	0.45±0.01	0.27±0.01	62.6±4.20	61.3±3.11	40.0±2.95	88.6±6.32	81.0±5.32	49.5±8.70
8.	16	1.59±0.14	0.10±0.06	0.43±0.01	0.21±0.01	60.0±3.94	61.0±2.33	40.8±2.77	87.0±1.53	80.0±7.92	48.3±4.77
9.	17.	0.18±0.10	0.17±0.01	0.27±0.04	0.19±0.03	60.0±2.63	64.0±3.50	38.0±4.23	88.0±6.19	89.0±7.38	49.9±8.92
10.	18	0.19±0.06	0.23±0.06	0.24±0.03	0.20±0.03	70.9±2.56	70.9±3.44	39.1±5.78	90.9±9.44	88.9±5.04	48.4±2.49
11.	19	0.14±0.02	0.26±0.01	0.23±0.03	0.19±0.03	76.3±3.02	67.5±3.65	41.3±4.58	97.5±7.07	89.5±2.53	55.2±3.56
12.	20	0.27±0.02	0.29±0.01	0.23±0.03	0.19±0.03	74.0±3.47	67.0±3.37	42.0±4.89	96.0±6.99	90.0±6.19	55.3±7.25
13.	21	0.25±0.05	0.55±0.08	0.25±0.04	0.20±0.02	61.4±2.74	70.0±3.69	48.0±5.32	98.6±3.78	90.0±5.54	57.2±6.27

Some different tendencies are observed among the girls aged 9-21 in forming such coordinative skills as time perception (in testing for determination of 60 sec. term) and space perception (determined with the error in drawing 10 cm line) during their study at primary and higher schools. Thus, the coordinative skills in time orientation had the tendency to improve among investigated girls at the age of 9-19 with three periods of essential decrease ($p < 0.05$) of time perception error – at the age of 11-12, 14-15, 16-17. Given indexes were in fact stable in other age periods. The time perception function decreased essentially ($p < 0.05$) among the third-fourth year students aged 19-20 and remained at the same level to the end of the fifth year.

The space perception function presents some different patterns of adaptative changes during the study among the girls of investigated age categories (aged 9-21). In the period of girls' active pubescence (aged 9-13) their space perception error remains in fact invariable being at the level of 0.17 cm – 0.20 cm. In girls aged 13-14 the given index improves essentially ($p < 0.05$) to 0.80 cm and remains at the same level for a rather long time (till the age of 20) with the tendency to gradual decrease. The last-year students show the lowest indexes of space perception function. Besides, its essential decrease is observed from the fourth till fifth year of the higher school – from 0.29 cm till 0.55 cm ($p < 0.05$).

Changes of such functions of the higher nervous system as memory and thinking are best stimulated in the process of education and sport activities. Thus, short-term memory volume among the girls aged 9-20 increases gradually – from 36% till 74%. Two periods of essential increase may be noted – at the age of 14-15 (13.3%) and 17-18 (10.9%) ($p < 0.05$). However, the memory function decreases considerably among the examined group – almost by 13% - and remains on the level of 61.4% among the girls aged 21 ($p < 0.05$).

The process of thinking in the girls aged 9-21 reveals the same tendencies in the process of age perfection and adaptation to the education-sport activity. Thus, their abstractive thinking indexes

increase gradually from 48% to 70% with a period of rapid increase at the age of 12-13 of almost 10% ($p < 0.05$).

The girls' associative thinking possibilities increased gradually from 24% to 48% for investigated period.

Their operative thinking increased by 20.67%. The age period of 12-13 should be noted especially as the girls' operative thinking rose by 17% in this period of time.

Logical thinking of the girls aged 9-21 remains practically invariable for investigated period, ranging 90%-98%. Only periodical increasing or decreasing of its coefficients should be mentioned.

The greatest changes took place in girls' spatial thinking. The index of this function increased almost by 40% during 12 years. The age period of 9-10 should be mentioned especially because the spatial thinking coefficient increased by 26.6%.

So, memory function and thinking varieties are considered to change the most in the process of education-sport activity adaptation among the girls aged 9-21.

CONCLUSIONS

1. Perfecting speed of nervous impulse conduction that was determined with latent periods of visual-motor and audio-motor reactions takes place gradually among the girls aged 9-21 but with two sensitive periods at the age of 16-17 and 15-16. The factors of education and sport activity do not essentially affect formation of these functions.
2. Coordinative skills of the investigated girls' group develop irrespectively of their education-sport activity. The time perception function unevenly with the periods of considerable increase and stability. The space perception function remains in general stable during investigated period.
3. Such functions as memory and thinking give way to changes more in the education-sport process of the girls aged 9-21. Their short-term memory increased on 38% with two periods of essential increase being motivated with transition to the senior form and the first years at higher school and definitely decreased during the last years at higher school. The same tendencies are noted in formation of abstract, associative, operative thinking with the greatest changes in increase of spatial thinking – 40% and especially at the age of 9-10. Logic thinking remains stable being at high level – 90%-98%. Obviously, the responsible functional systems are formed somewhat earlier.

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SUMMARY

The investigation of psychophysiological function dynamics among the girls aged 9-21 was carried out in the process of their adaptation to educational and sport activity. The authors found that this activity does not affect the speed of nervous impulse conduction and coordinative skills. Short-term memory function and thinking are more affected by teaching influence, especially spatial thinking among girls aged 9-10, just during the period of primary selection to handball groups.

STRESZCZENIE

Autorzy badali dynamikę zmian czynności psychofizjologicznych u dziewcząt w wieku 9 – 21 lat w trakcie ich adaptacji do działalności edukacyjnej i sportowej. Stwierdzono, że tego typu aktywność nie wpływa na szybkość przewodnictwa nerwowego i zdolności koordynacyjne. Pamięć krótka i myślenie są bardziej podatne na wpływy zewnętrzne, szczególnie w zakresie myślenia przestrzennego u dziewczynek w wieku 9 – 10 lat.