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STUDY OF THE MORPHOFUNCTIONAL INDICATORS OF SENIOR SCHOOLCHILDREN IN ISHIM DISTRICT

ABSTRACT. The assessment of morphofunctional indicators of senior pupils living in the Ishim district was carried out by means of traditional methods. The examined pupils are characterized by an average level of physical development. In the course of the study no pupils with a high level of physical development were detected, except in the group of 16-years-old pupils (3%). The group of 12- and 13-year-old children included boys and girls with a low level of physical development (4%). Depending on their age, distribution of the schoolchildren according to the level of their physical development changed in wavelike patterns.

The levels of systolic and diastolic blood pressure rise with older children. The boys were found to have higher levels of blood pressure. The level of blood pressure is above the norm for all the groups under study.

Lung capacity increases with age. The increase in lung capacity is more typical for boys, than for girls. In all the groups the living capacity of lungs is higher for boys than girls.

The data obtained are accepted and used for objective assessment of the functional status of the children studying in the rural educational institutions of the south of the Tyumen Region as well as for planning a health care program for the children in comprehensive educational institutions. The data obtained during the experiment are used to optimize the functional status of pupils.

KEY WORDS. Morphological, functional indicators, schoolchildren, health.

According to a number of scientists [1-4], not only genetic but also a mixture of ecological factors from the place of residence influence on the person's morphofunctional parameters. Physiological problems of the influence of internal and external factors on the morphofunctional condition of modern schoolchildren are in the center of attention of scientists [5-7]. The issues of prevention and early diagnostics of psychosomatic diseases of schoolchildren are becoming a growing problem as health condition of contemporary schoolchildren is characterized by a number of negative trends: slowing down of physical and psychic development, general health deterioration, change of the disease structure etc. [8]. Functional capabilities of a young man have decreased: muscular strength dropped down by 18%, vital lung capacity by 15%, one third of young males and females experience delayed puberty [9-10].

Special attention was paid to the analysis of the populations of children and adolescents of sensitive age periods – preschoolers aged 6 and schoolchildren aged 15. In the sensitive periods a child's body finds itself in an "unstable" condition as the range of its adaptation reactions is limited and sensitivity towards exogenous factors is high and the body is subject to a higher risk of development of borderline and pathological conditions [1], [10].

An even closer attention to children's and adolescents' development should be paid in the critical life periods, such as puberty, during which development of functional and morphological transformations is much faster than during stable age periods. Acute exposures during this time can lead to severe disorders in the process of maturity. 11-16-year olds belong to the risk group. It is the most active period regarding evolution of chronic pathologies [9].

Among the factors influencing on the health state of schoolchildren 21-27% are those from the school environment [6-7]. Recently the educational system has undergone complication of the school curriculum, emergence of specialized classes, classes with varied degrees of school load which does not always promote normal adaptation and health preservation of students. The problem of adaptation of the schoolchildren involved in enhanced studying of a number subjects in the schools of a new type has not been duly tackled neither by foreign nor Russian authors. There are only some literary data on the influence of the peculiarities of the school loads in classes of different specializations on the morphofunctional and psychophysiological indices of senior schoolchildren.

The abovementioned encouraged us to conduct the following experimental research and defined its goal: to study the morphological and functional parameters of the schoolchildren of Ishim district in regards to their gender, age and school specialization.

We carried out our research in Larikhinskaya and Novoloktinskaya secondary comprehensive schools of Ishim district in 2010-2011 and 2011-2012 academic years.

11-16-year old teenagers took part in the study. The test groups were divided depending on the age and gender. The anthropometric survey was done with the use of the widely-accepted methods; the results of it are presented in table 1.

Table 1

Morphological parameters of 11-16 year old boys and girls of Ishim district (M±m)

| Parameter | Height, cm | Weight, kg | Chest circumference, cm |
|---------------------|-------------------------|-----------------------|-------------------------|
| Girls, 11 years old | 140,61 ± 2,22 | 38,62 ± 2,33 | 69,67 ± 4,63 |
| Boys, 11 years old | 138,12 ± 2,37 | 35,20 ± 1,54 | 71,62 ± 2,42 |
| Girls, 12 years old | 148,46 ± 1,12 * (11,12) | 36,3 ± 2,11 | 73,46 ± 1,02 |
| Boys, 12 years old | 144,92 ± 1,16 | 35,38 ± 2,09 | 76,7 ± 2,3 |
| Girls, 13 years old | 154,04 ± 2,54 | 43,22 ± 2,31 | 77,33 ± 2,21 |
| Boys, 13 years old | 152,23 ± 2,10* (12,13) | 42,28 ± 3,39 | 75,09 ± 2,33 |
| Girls, 14 years old | 155,61 ± 1,79 | 47,24 ± 2,44 | 81,04 ± 1,78 |
| Boys, 14 years old | 159,32 ± 2,72* (13,14) | 51,74 ± 3,28* (13,14) | 80,59 ± 1,30* (13,14) |
| Girls, 15 years old | 167,8 ± 3,55 | 56,4 ± 3,04 | 86,55 ± 3,12 |
| Boys, 15 years old | 168,6 ± 2,23 | 61,66 ± 2,95 | 81,59 ± 1,3 |
| Girls, 16 years old | 167,1 ± 2,1+ (m, d) | 65,9 ± 2,5 + (m, d) | 87,9 ± 2,1 |
| Boys, 16 years old | 176,3 ± 2,4* (15,16) | 68,2 ± 2,3* (15,16) | 85,12 ± 2,3* (15,16) |

Note: n – sample size; significance of differences regarding age * - P<0.05; significance of differences regarding gender: ± P<0.05.

Morphofunctional properties were defined by the correlation of the three main body dimensions: height, weight and chest circumference.

In our research the girls of the 6, 7, and 8 grades exceeded the boys of the same ages in height. These differences were not statistically significant. With age the height curves crisscross. In the 8, 9, and 10 grades the males are taller than the girls of the same age.

In the 10 grade 16-year old boys were taller than the girls of the same age by 8.9 ± 3.1 cm. These gender differences are statistically significant. The average height of the 16-year old boys is 176.3 ± 2.4 cm. The average height of the 16-year old girls is 167.1 ± 2.1 cm.

With age height of the teenagers and senior schoolchildren of different age groups increased. Height depends on the stage of biologic maturity, health state, and level of physical activity, ecological conditions, social-economical and hygienic factors.

The 11, 12 and 13-year old girls weigh more than the boys of the same age; these differences are not statistically significant. With age (8, 9, and 10 grades) the weight of males increases and boys outweigh girls. Comparing the weight indices we have concluded that this parameter grows with age.

The next total dimension is chest circumference. It was measured in three positions according to the methodology. The 11 and 12-year old boys exceeded the girls of the same age in this parameter. In table 1 one can see that the males from 8, 9 and 10 grades do not measure up to the girls of the same age, though insignificantly. In the 10 grade the average chest circumference of the 16-year old males is 85.12 ± 2.3 cm; as for the girls of the same age it is 87.9 ± 2.1 cm. According to our study with age chest circumference increases.

At the next stage of our research we carried out individual estimation of the physical development of the schoolchildren in question.

There are almost no children with a high level of physical development. Only 3% of young males aged 16 qualified for that level. Low percentage of the children have a low level of physical development: 12-year old girls – 4%; boys – 6%; 13-year old girls – 5%; boys – 3%. The levels of physical development above and below average constantly vary regardless the gender and age. Thus, the majority of the children regardless their gender and age have average physical development. With age this percentage only increased.

Study of the cardiovascular system holds a central position in medicine as its functional condition is one of the most important indicators of the organism's functional capabilities.

Arterial pressure both systolic and diastolic increases insignificantly with age both for the boys and girls. Statistical difference as regards to age is relevant only for the 13-14-year old boys; as for the rest of the children it was not statistically significant. Having measured arterial pressure we initially compared the children of different genders and the same age. As a result statistical difference regarding the gender was detected only for the 11-year old children.

Moreover, estimation of the arterial pressure indices has revealed that the measured systolic arterial blood pressure differed from the estimated pressure only for 12-year

old girls and 12-13-year old boys. As for the other children the differences are not statistically valid. Comparing the values of the diastolic arterial blood pressure the measured pressure is significantly higher than the estimated one for exactly the half of the test groups of the children from Ishim district. The increase in the factual values of diastolic pressure as compared to the estimated pressure is a sign of a stressed cardiovascular system and especially of its vascular component. The data in table 2 demonstrate higher diastolic pressure values for the boys.

Table 2

Hemodynamic parameters of the schoolchildren aged 11-16 in Ishim district (M±m)

| Parameter | Systolic blood pressure, mm of mercury | | Diastolic blood pressure, mm of mercury | |
|---------------------|----------------------------------------|---------------|-----------------------------------------|--------------|
| | Factual | Estimated | Factual | Estimated |
| Girls, 11 years old | | | | |
| Boys, 11 years old | 98,89 ± 5,59 | 110,08 ± 1,21 | 64,72 ± 4,16 | 61,99 ± 0,35 |
| Girls, 12 years old | 112,22 ± 3,33 +(M,Д) | 109,96 ± 1,12 | 65,14 ± 2,77 | 59,81 ± 0,51 |
| Boys, 12 years old | 101,98 ± 2,60 | 111,21 ± 0,4 | 65,41 ± 2,62 | 61,61 ± 0,21 |
| Girls, 13 years old | 103,96 ± 2,88 | 111,91 ± 0,21 | 68,49 ± 3,05 | 60,09 ± 0,22 |
| Boys, 13 years old | 106,59 ± 4,53 | 112,33 ± 0,36 | 64,79 ± 3,20 | 62,23 ± 0,32 |
| Girls, 14 years old | 102,20 ± 3,08 | 113,86 ± 0,22 | 63,47 ± 1,80 | 60,37 ± 0,61 |
| Boys, 14 years old | 105,31 ± 4,93 | 113,46 ± 1,61 | 66,28 ± 3,06 | 62,84 ± 0,32 |
| Girls, 15 years old | 114,79 ± 3,82 *(13,14) | 115,82 ± 2,15 | 69,09 ± 2,93 | 60,64 ± 0,5 |
| Boys, 15 years old | 113,09 ± 2,36 | 114,59 ± 4,12 | 72,77 ± 2,14 | 63,46 ± 0,33 |
| Girls, 16 years old | 115,51 ± 2,60 | 117,77 ± 2,18 | 73,42 ± 4,45 | 60,02 ± 0,64 |
| Boys, 16 years old | 113,11 ± 2,65 | 115,71 ± 1,61 | 69,61 ± 1,64 | 64,07 ± 0,53 |

Note: significance of differences between the factual and estimated values: - $P < 0.05$; significance of differences regarding age*: - $P < 0.05$; significance of differences regarding gender: ± $P < 0.05$.

Vital lung capacity (VLC) is an indicator of lungs and chest expansion. It depends on many factors: body constitution, age, gender, and fitness degree.

VLC allows indirectly estimating the total area of the breathing surface of the lungs on which gas exchange between the alveolar air and blood of the pulmonary capillaries occurs.

Study of the Ishim schoolchildren's VLC has shown increase in this value with age for the girls and boys of all the age groups (table 3).

Significance of the differences regarding age exists for the 11, 12, 15 and 16-year old girls. This parameter equals 2.04 ± 0.11 for the 11-year old girls; 2.44 ± 0.11 for the 12-year old girls; 3.08 ± 0.18 for the 15-year old girls and 2.90 ± 0.14 for the 16-year old girls. Significant VLC differences regarding the gender are registered for the ages 14, 15 and 16. Other differences are not statistically valid. Since VLC differences depend on weight, height and age, its actual value can be correctly estimated only when compared with the reference value. When we compared the actual VLC with the reference value, we have found that 12-year old girls had VLC equal to 2.44 ± 0.11 , which is higher than RVLC — this is statistically significant. 14-year old boys also

have the actual VLC higher than the reference values, which is statistically significant. All the other test groups demonstrated the actual VLC lower than the reference value. Thus, with age there is an increase in the VLC value. VLC growth is higher for the boys than for the girls. In all the test groups VLC is higher for the boys than for the girls.

Table 3

Functional parameters of the respiratory system of the 11-16-year old boys and girls in Ishim district (M+m)

| Parameter | VLC (l) | | Reference VLC (l) | |
|---------------------|-----------------------|-------------|-------------------|-----------------------|
| | Girls, 11 years old | 2,04 ± 0,11 | 2,17 ± 0,16 | 109,09 |
| Boys, 11 years old | 2,17 ± 0,65 | 2,48 ± 0,18 | 87,50 | 2,17 ± 0,65 |
| Girls, 12 years old | 2,44 ± 0,11 * (11,12) | 2,15 ± 0,15 | 113,49 | 2,44 ± 0,11 * (11,12) |
| Boys, 12 years old | 2,34 ± 0,14 | 2,74 ± 0,39 | 85,40 | 2,34 ± 0,14 |
| Girls, 13 years old | 2,03 ± 0,23 | 2,35 ± 0,14 | 86,38 | 2,03 ± 0,23 |
| Boys, 13 years old | 2,52 ± 0,27 | 3,28 ± 0,20 | 76,83 | 2,52 ± 0,27 |
| Girls, 14 years old | 2,18 ± 0,15 | 2,55 ± 0,15 | 85,49 | 2,18 ± 0,15 |
| Boys, 14 years old | 2,84 ± 0,26 + (M,Д) | 2,29 ± 0,18 | 124,02 | 2,84 ± 0,26 + (M,Д) |
| Girls, 15 years old | 2,39 ± 0,17 | 2,72 ± 0,21 | 87,87 | 2,39 ± 0,17 |
| Boys, 15 years old | 3,08 ± 0,18 + (M,Д) | 4,10 ± 0,37 | 75,12 | 3,08 ± 0,18 + (M,Д) |
| Girls, 16 years old | 2,90 ± 0,14 + (15,16) | 3,18 ± 0,16 | 96,44 | 2,90 ± 0,14 + (15,16) |
| Boys, 16 years old | 3,29 ± 0,11 + (M,Д) | 4,57 ± 0,62 | 71,99 | 3,29 ± 0,11 + (M,Д) |

Note: significance of differences regarding gender: $\pm P < 0.05$; significance of differences regarding age: * - $P < 0.05$.

Conclusions.

With age there is a logical increase in the schoolchildren's morphological parameters which corresponds to the general biological regularities of a child's body development. At the age of 14 there is a crossing of the growth curves for the boys and girls.

Most of the tested schoolchildren have an average level of physical development. We have revealed no adolescents with a high level of physical development except for the group of young males aged 16 (3%). In the age group of 12-13-year old boys and girls there are schoolchildren with a low level of physical development (4%). With age distribution of the schoolchildren into the levels of physical development changes in a wavelike fashion. The ages of 11 and 15 provide the highest numbers of the schoolchildren with the level of physical development above average. 12-year old girls and 12, 15 and 16-year old boys demonstrated the level below average more often.

The values of systolic and diastolic arterial blood pressure increase with age. The highest values of diastolic blood pressure are registered for the boys. The actually measured blood pressure is higher than the reference value in all the test groups.

With age an increase in VLC value is observed. The amount of VLC growth is higher for the boys than the girls. In all the studied test groups of schoolchildren VLC of the boys is higher than that of the girls.

REFERENCES

1. Baranov, A.A., Kuchma, V.R., Suhareva, L.M. *Ocenka sostojanija zdorov'ja detej. Novye podhody k profilakticheskoj i ozdorovitel'noj rabote v obrazovatel'nyh uchrezhdenijah* [Evaluation of Children's Health. New Approaches to Preventive and Rehabilitation Activity in Educational Institutions]. Geotar Medicina, 2008. 432 p. (in Russian).
2. Bogomolova, E.S., Kuzmichev, Ju.G., Chekalova, S.A. Evaluation of the Physical development of Children and Adolescents with the help of Standards of Different Territorial Levels [Ocenka fizicheskogo razvitiya detej i podrostkov s ispol'zovaniem standartov raznogo territorial'nogo urovnja]. *Materialy X Vserossijskogo s'ezda gigienistov i sanitarnyh vrachej* (Materials of X All-Russian Assembly of Hygienists and Sanitarians). Moscow, 2007. Pp. 474-478 (in Russian).
3. Katashinskaja, L.I., Gubanova, L.V. Health Condition of Modern Schoolchildren. *Izvestija Samarskogo nauchnogo centra RAN — Bulletin of Samara Scientific Center of the Russian Academy of Sciences*. 2009 Vol. 11. №1. Pp. 869-871 (in Russian).
4. Kozin, V.V., Koshheeva, G.S. Contamination of the Waters of Tyumen Priishimye: A Problem to be Solved. *Vestnik Tjumenskogo gosudarstvennogo universiteta — Herald of Tyumen State University*. 2010. № 7. Pp. 167-174 (in Russian).
5. Suppes, N.E. Ecological Evaluation of the Dead Waters of Ishim by the Method of Bioindication. *Izvestija Samarskogo nauchnogo centra RAN — Bulletin of Samara Scientific Center of the Russian Academy of Sciences*. 2009. Vol. 11. № 1. Pp. 1157-1160 (in Russian).
6. *Fiziologija razvitiya rebenka: teoreticheskie i prikladnye aspekty* [Physiology of Child Development: Theoretical and Applied Aspects]. Moscow, 2000. 319 p. (in Russian).
7. Shhepljagina, L.A., Rimarchuk, G.V., L.I. Vasechkina. *Fizicheskoe razvitie detej v uslovijah jekologicheskogo neblagopoluchija: Posobie dlja vrachej* [Physical Development of Children in Ecologically Unsafe Environment: Textbook for Doctors]. Moscow, 2005. 28 p. (in Russian).
8. Korzan, E.S., Solov'ev, V.S. Physical development of Khanty and Russian Schoolchildren in Non-Industrial Environment. *Vestnik Tjumenskogo gosudarstvennogo universiteta — Herald of Tyumen State University*. 2011. № 6. Pp. 112-115 (in Russian).
9. Agadzhanjan, N.A., Baevsij, R.M., Berseneva, A.P. *Uchenie o zdorov'e i problemy adaptacii* [Study on Health and Adaptation Problems]. Stavropol, 2000. Pp. 168-170 (in Russian).
10. Kuvichkina, M.V. Morphofunctional Indicators of Physical Development of Schoolchildren of Different Age Groups from Contaminated Industrial Regions. *Vestnik Orenburgskogo gosudarstvennogo universiteta — Herald of Orenburg State University*. 2008. № 88. Pp. 107-111 (in Russian).