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Somatic component of risk of the development of vegetative-vascular dysfunction at children of the average and advanced school age

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Purpose: *to estimate quantitatively factors of somatic component of risk of the development of vegetative-vascular dysfunction at children of the average and advanced school age.*

Material & Methods: *569 children of 14–17 years old are examined in order to the existence of somatopathies, violation of posture, level and harmony of physical development, extent of development of adipopexis, functional indicators of health. Influence of somatic factors on risk of developing of vegetative-vascular dysfunction was revealed by means of the correlation analysis.*

Results: *the system of assessment and the integrated indicator of action of somatic factors on risk of the development of vegetative-vascular dysfunction are offered. 6,57% of pupils with the low level of probability of risk of developing of vegetative-vascular dysfunction, 24,25% of pupils with the level below the average, 38,36% of children of 14–17 years old with the average level of probability of risk of developing of vegetative-vascular dysfunction, 24,25% of teenagers with the average level of probability, 6,57% of pupils with the high level of probability of risk of developing of vegetative-vascular dysfunction are revealed. The reliable communications between the low level of functionality on the test of Ruffier and the disharmonious physical development ($p<0,001$), low indicators of power and respiratory indexes ($p<0,05$) are established statistically.*

Conclusions: *the children of the group of risk, who need the individual approach at lessons of physical culture, are defined.*

Keywords: *children, vegetative-vascular dysfunction, physical development, somatic factors.*

Introduction

According to the main theses of the Law of Ukraine "About the approval of the Nation-wide program "Zdorovya-2020: the Ukrainian measurement" the urgent world problem is the considerable prevalence of chronic noninfectious diseases on which, according to WOHP, suffer 20% of the children's population in XXI century. Chronic somatopathies of organism belong to powerful etiological factors which lead to the development of the vegetative-vascular dysfunction (VVD) at children (N. A. Belokon and M. Kuberger, 1987, V. G. Maydannik, 1998, 2013, O. M. Vein, 2000).

The formation of psychological frustration (including vegetative dystonias) against the background of the available not only expressed, but also compensated and subcompensated violations of internals was shown in the researches of N. K. Bogolepov (1949-1978) and his pupils and followers (Yu. S. Martynov, 1964–1978; E. V. Malkova, 1969; L. S. Yegorova, 1970; L. G. Yerokhina, 1974; L. O. Badalyan, 1975; I. A. Suchkova, 1977; Yu. I. Koshelyev, 1976 and others).

According to A. M. Vein, somatic diseases are one of the important etiological components of the development of VVD which contains in classification of vegetative dystonias of the author [2]. The role of somatopathies in the development of VVD is displayed in the working scheme of pathogenesis of vegetative dysfunctions at children that includes among the acquired factors: chronic diseases and centers of infection, hormonal dysfunction, diseases of the central nervous system, and so forth (N. A. Belokon and M. Kuberger, 1987, V. G. Maydannik, 1998).

The scientific research of the last years found the reliable connection quantities of chronic somatopathies with severity of vegetative violations (A. Yu. Shutkova, 2008), the interconnections between the development of vegetative-vascular dysfunction and the level of physical development (L. N. Volkova, 2005), the features of vegetative dystonia at teenagers with disharmonious physical development are investigated (V. A. Pavlova, 2009).

Influence of somatic factors on the development of VVD is described the most widely in the works of V. G. Maydannik. So, they carry to the main factors which cause the development of vegetative dystonia: 1) hereditarily-constitutional features of activity of the autonomic nervous system (ANS) (autosomno-dominant mode of inheritance); 2) adverse course of pregnancy and childbirth that leads to violation of ripening of cellular structures of the super-segmentary apparatus, natal trauma of CNS and cervical department of backbone (hypertensive-hydrocephalic syndrome, vertebral-basilar insufficiency); 3) disease of endocrine glands (thyroid gland, adrenal and sexual glands); 4) endocrine reorganization of organism (often vegetative dysfunction is most brightly shown during active hormonal reorganizations, for example, during sexual ripening); 5) organic damages of brain (trauma, tumor, violation of brain blood circulation, – strokes); 6) defeat of CNS infections, intoxications, operative measures; 7) sharp and chronic infectious and somatopathies, infection centers (tonsillitis, caries of teeth, sinusitis, and so forth); 8) other

reasons of development of vegetative dysfunction (scoliosis, cervical osteochondrosis, violation of mineral exchange in organism (especially Ca and Mg); operative measures and anesthesia; excess body weight) [4].

Thus, total influence of somatic factors on the child's organism in certain period forms somatic component of risk of development of VSD. In literature remains to VSD which are insufficiently opened question of quantitative assessment of negative impact of somatic factors on the child's organism in the context of risk of development.

Communication of the research with scientific programs, plans, subjects

The research is executed according to subject of the RW of the chair of medico-biological fundamentals of physical culture educational of Educational-scientific institute of physical culture of A. S. Makarenko Sumy state pedagogical university "Physiologo-hygienic maintenance of healthcare activity of institutions of education" (number of the state registration – 0113U004662).

The purpose of the research:

to estimate quantitatively factors of somatic component of risk of the development of vegetative-vascular dysfunction at children of the average and advanced school age.

Research tasks:

1) to define the structure of somatic component of risk of the development of VVD at teenagers of 14–17 years old;
2) to offer the system of estimation and integrated indicator of action of somatic factors on risk of emergence of VVD;
3) to make the analysis of results of the research by means of quantitative assessment of factors of somatic component of risk of the development of vegetative-vascular dysfunction.

Material and Methods of the research

The somatic indicators which can influence the development of VVD at children of 14–17 years old were selected on the basis of the analysis of scientifically-methodical sources. Indicators of incidence of 569 pupils of 14–17 years old of Sumy were received by the method of copying of the data from medical documentation. The tendency to VVD was defined by the questionnaire of O. M. Vein [2]. The health of children was estimated by means of specially developed questionnaire. The existence of violation of posture in the sagital and frontal planes was defined by the humeral index:

$$HI = \frac{WSh}{HA} \cdot 100\%$$

and by the index of vertical rachiocampsis:

$$VR = \frac{LS}{RS} \cdot 100\%$$

The regional tables of physical development of children were used for the assessment of level and harmony of physical development [6]. Thickness of hypodermic fatty fold on stomach was determined by kaliperometry. The respiratory index was counted by the formula:

$$I_R = \frac{Vital\ capacity\ of\ lungs\ (VCL)}{BW}$$

VCL was measured by means of spirometer.

The power index was defined by the formula:

$$I_P = \frac{Force\ of\ the\ right\ (left)\ hand}{BW}\ .$$

Force of hand was measured by means of hand dynamometer, and the greatest indicator for the right or left hand was undertook in calculations. Levels of respiratory and power indexes were defined by the technique of G. L. Apanasenko. The adaptation potential of the child was counted by the index of functional changes (IFC) [3]. The scored system of estimation of action of somatic factors was used for the quantitative assessment of somatic component of risk of the development of VVD. The statistical data processing, which was received during the research, was carried out by means of the application program "STATISTIKA".

Results of the research and their discussion

The structure of somatic component of risk of the development of VVD, which is based on the etiological approach, is defined on the basis of the analysis of scientific literature (pic. 1).

We developed the system of numerical score of somatic risk factors of the development of VVD for the quantitative assessment of somatic component of risk of the development of vegetative-vascular dysfunction at children of the average and advanced school age (tab. 1). The assessment of somatic risk factors was carried out by the 5-pointed scale depending on the existence and degree of negative impact of factor: 1 – the negative impact of factor is least expressed or is absent, 2 – the negative impact of factor, 3 – the influence of negative factor of average intensity, 4 – the expressed influence of negative factor is poorly expressed, 5 – the negative impact of factor is most expressed.

By means of the mathematical procedure of rationing of physical quantity [1] we will carry out rationing of indicators so that the condition was satisfied:
$0 < P_i^N \le 1$, then the normalized value will decide on the help of the following expression:

$$P_i^N = \frac{1}{P_i}\ ,$$

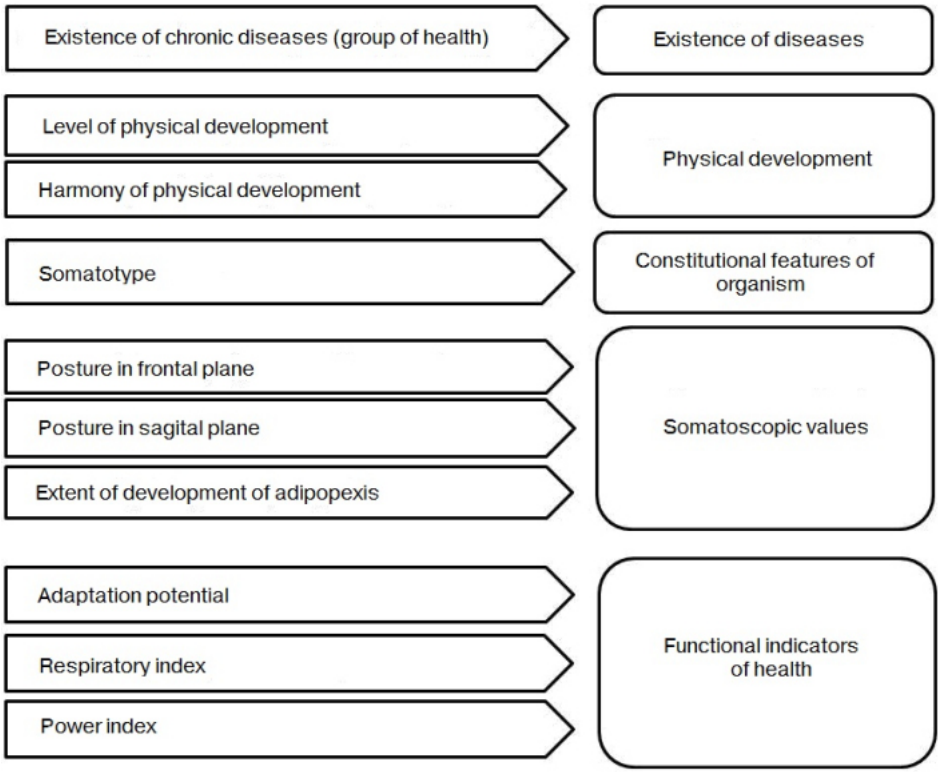
where P_i^N – the normalized indicator of somatic factor of risk of the emergence of VVD at teenagers of 14–17 years old;
P_i –the point of somatic factor of risk of the emergence of VVD at teenagers of 14–17 years old is got on the system of numerical score.

We suggest counting the integrated indicator of somatic component of risk of the emergence of VVD by the following formula:

$$II_{sr} = \frac{\Sigma P_i^N}{\Sigma P_{i\ opt}} = \frac{\Sigma P_i^N}{n}\ ,$$

where II_{sr} – integrated indicator of somatic risk of the emergence of VVD;
P_i^N – the normalized indicator of somatic factor of risk of the emergence of VVD at teenagers of 14–17 years old;
$P_{i\ opt}$ – the optimum value of somatic factor by the system of numerical score, ($P_{i\ opt}$=1);
n – quantity of somatic factors.

We suggest carrying out the assessment of level of probability



Pic. 1. Structure of somatic component of risk of the development of VVD

Table 1

System of numerical score of somatic risk factors of development of VSD

Somatic component of risk	Point				
	1	2	3	4	5
Group of health	1	2	3	4	5
Humeral index	90–100%	86–89,9%	83–85,9%	80–82,9%	≤79,9%
Index of vertical rachiocampsis	90–110%	89,0–89,9% or 110,1–111,0%	88,0–88,9% or 111,1–112,0%	87,0–87,9% or 112,1–113,0%	≤86,9% or ≥113,1%
Thickness of hypodermic fatty fold on stomach	2–3см	3,1–3,5 sm or 1,7–1,9 sm	3,6–4,0 sm or 1,4–1,6 sm	4,1–4,5 sm or 1,1–1,3 sm	≥4,6 sm or ≤1 sm
Level of physical development	Average		Below the average Above the average		Low High Very high
Harmony of physical development	Harmonious physical development				Disharmonious physical development of excess body weight or deficient body weight
Somatotype	Normosthenic				Adynamic Hyperstenic
Adaptation potential	Satisfactory adaptation		Voltage adjustment mechanisms	Poor adaptation	Disruption adaptation
Power index	Average Above the average High		Below the average		Low
Respiratory index	Average Above the average High		Below the average		Low

of risk of emergence of VVD on the scale which is developed according to the law of normal distribution (tab. 2).

Using II_{sr} during the research, children with such levels of probability of risk of the emergence of VVD are found: 6,57% of pupils – low, 24,25% of pupils – below the average, 38,36% of children – average, 24,25% of teenagers – above the average, 6,57% of pupils – the high level of probability. The age distribution of children of 14–17 years old by the level of probability of risk of the emergence of VVD demonstrates that the largest specific weight of the from above average and high by levels of probability of risk of the emergence of VVD under the influence of somatic factors is observed teenagers at the age of 14 years old (pic. 2).

Studying of the state of health of pupils of 14–17 years old found 39,19% of children who were carried to the 1st group of health, 52,37% – to the 2nd group of health, 8,26% – to the 3rd group of health and 0,18% – to the 4th group of health.

The correlation analysis of groups of health of children of 14–17 years old demonstrates that the more chronic diseases children had, the more often they felt bad mood (r=0,13, p<0,01) and irritability (r=0,10, p<0,05), had the lowest self-assessment of health (r=0,19, p<0,001), had the highest points by the questionnaire of O. M. Vein (r=0,13, p<0,01).

Indicators of the existence of vegetative dystonia by the questionnaire of O. M. Vein was correlated with the existence of diseases of the cardiovascular system (CVS) (r=0,12, p<0,05), gastrointestinal tract diseases (r=0,12, p<0,05), diseases of the nervous system (r=0,15, p<0,01).

Studying of the structure of incidence according to the medical documentation found a big percent (19,86%) of children with orthopedic diseases which are consequence of inactive lifestyle of children. The analysis of indicators of the humeral index (HI) demonstrates that 78,01% of teenagers of 14–17 years old have a correct posture in the frontal plane, 15,98% of children have kiphotic posture with % HI=86-89,9 indicators, kiphonic changes with HI=83–85,9 value of % are in 3,95% of pupils, in 1,88% of teenagers of HI=80–82,9 of % and in 0,19% of children of HI makes less than 79,9%.

The correlation analysis didn't find the direct correlation link between indicators of index of vertical rachiocampsis (VR) and humeral index and indicators of the existence of vegetative dystonia by the questionnaire of O. M. Vein. However, the statistically reliable connections between indicators of the existence of scoliotic posture by the VR index and the low level of physical development (r=–0,13, p<0,05), and also the adynamic constitution are found (r=–0,13, p<0,05). The analysis of data found the direct correlation connection between indicators of scoliotic posture by the HI index and the presence of cardiovascular diseases at children (p<0,01).

In recent years even more often scientists state the growing number of children with excess weight [6; 9; 10]. We revealed 67,50% of teenagers with harmonious physical development, 8,80% of children with disharmonious physical development with deficiency of body weight, 23,70% of pupils – with disharmonious physical development with a lot of body weight during the research of harmony of physical development. The direct correlation link with the low level of functionality of the cardiovascular system (CVS) by the test of Ruffier had the disharmonious physical development (r=0,18, p<0,001). The aberration of indicators of systolic (r=0,17, p<0,001) and diastolic arterial pressure (r=0,15, p<0,05), adaptation potential (r=0,19, p<0,001) were more often observed at teenagers with the disharmonious physical development.

As a result of kaliperometry it is established that than the more the size of fatty fold on stomach exceeds norm, especially the kiphonic posture at the child is expressed (r=0,11, p<0,05) and the more the physical development of the child is disharmonious (r=0,44, p<0,001). Thus, excess fatty tissue testifies to weakness of muscles of stomach which can lead to the development of kiphonic posture. The more developed fatty fold had the direct correlation connection from hypersthenic somatotype. The deviation of fatty fold from norm correlates with imbalance of nice and parasympathetic departments of VVD by the index of Kerdo (r=0,19, p<0,001).

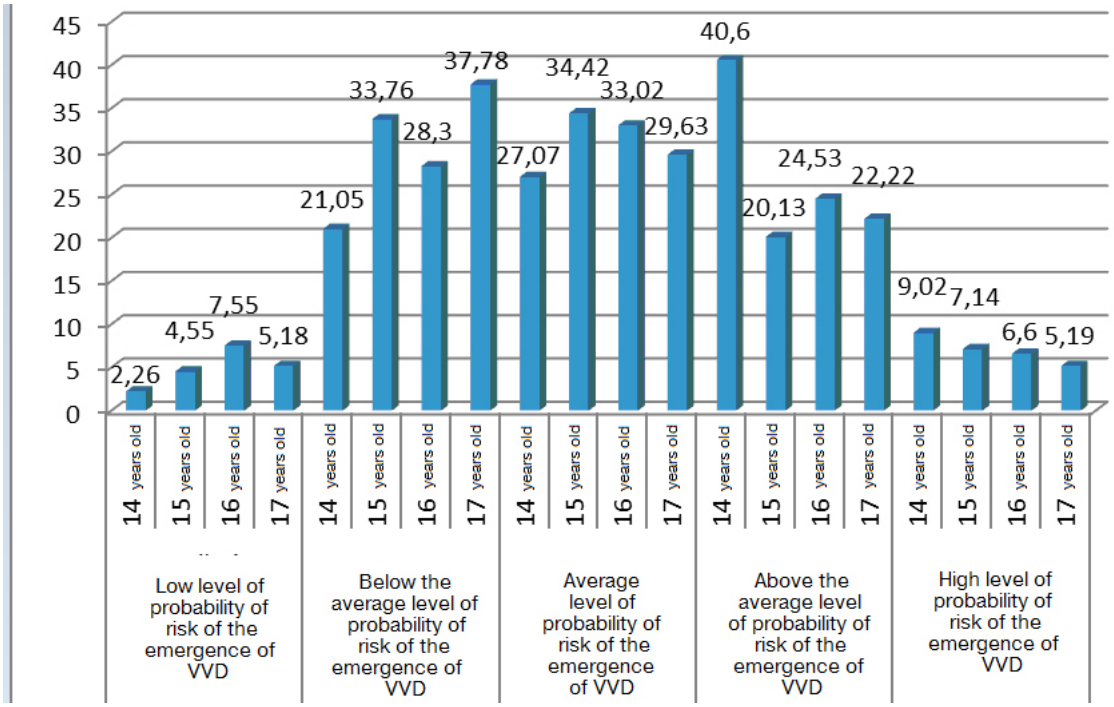
It is scientifically proved what somatotype defines features of the development of organism. These researches demonstrate that adynamic and hypersthenic somatotypes had the direct correlation connection with low and high levels of physical development according to (r=0,10, p<0,05), with the disharmonious physical development with deficiency and surplus of body weight according to (r=0,46, p<0,001), with the worst indicators of adaptation potential (r=0,16, p<0,01), with the aberration of indicators of systolic arterial pressure (r=0,13, p<0,01), with the lowest indicators of functionality of CVS by the test of Ruffier (r=0,19, p<0,001).

The analysis of indicators of physical development found the main specific weight of children (66,19%) with the average level of physical development, 22,66% of pupils with the level of physical development above the average, 5,04% of pupils with the high level of physical development, 5,04% of teenagers with the level of physical development below the average, 1,07% of children with the low level of physical development. The correlation analysis testifies, the level of physical development of the child is lower, the more scoliotic posture is expressed by the VR index (r=–0,12, p<0,05), the group of health is worse (r=–0,16, p<0,01), the more often

Table 2

Scale of probability of risk of emergence of VVD

Points	Characteristics of the level of probability
0,859–1	Low
0,734–0,858	Below the average
0,608–0,733	Average
0,483–0,607	Above the average
0–0,482	High



Pic. 2. Distribution of children of 14–17 years old by the level of probability of somatic risk of the emergence of VVD (%)

such orthopedic diseases children had (r=–0,13, p<0,05). Low or high rates of physical development correlated with aberrations of indicators of diastolic arterial pressure (r=0,15, p<0,01).

The available and informative express method of assessment of the state of health of children is calculation of size of index of functional changes (IFC) which gives the chance to determine the level of adaptation opportunities of organism [3]. Using IFC formula, 12,29% of teenagers of 14–17 years old which had satisfactory adaptation, 63,31% of children with tension of adaptable mechanisms, 21,05% of pupils with unsatisfactory adaptation, and also 3,35% of pupils with adaptation failure are revealed during the research. Children who had satisfactory adaptation for IFC, had the highest indicators respiratory (r=0,18, p<0,001) and power indexes (r=0,10, p<0,05), functionality of CVS, by the test of Ruffier (r=0,26, p<0,001).

One of the mechanisms of development of vegetative (cardiovascular) frustration, according to O. M. Vein, is respiratory dysfunction [2]. According to the research, 14,42% of children with the high level of respiratory index are revealed, 23,03% of pupils with the level of respiratory index above the average, 17,60% of pupils with the average level, 14,05% of teenagers with level below the average, and also 30,90% of children with the low level of respiratory index. Low indicators of respiratory index had the direct correlation connection with the low level of functionality CVS by the index of Ruffier (r=0,13, p<0,05).

It is well-known that the sufficient level of development of power qualities of muscles promotes the best blood circulation after vessels. 17,80% of children with the high level of power index, 17,60% of pupils with the level of power index above the average, 14,42% of pupils with the average level, 24,34% of teenagers with the level of power index below the average, 25,84% of children with the low level of power index are revealed during the research. The correlation analysis demonstrates that the indicators of power index were higher, the less the hypodermic fatty fold on stomach was (r=–0,21, p<0,001), the less often such orthopedic diseases children had (r=–0,12, p<0,05). The low indicators of power index correlated with the low level of functionality CVS by the index of Ruffier (r=0,12, p<0,05).

Conclusions

The analysis of references confirms the need of improvement of monitoring of children with somatic pathology. The quantitative assessment of somatic indicators of risk of the development of VVD and the integrated indicator of somatic risk of the emergence of VVD were developed for this purpose. 6,57% of pupils with the low level of probability of risk of the emergence of VVD, 24,25% of pupils – with the level below the average, 38,36% of persons of 14–17 years old – with the average level of probability of risk of the emergence of VVD, 24,25% of teenagers – with the level of probability above the average, 6,57% of pupils – with the high level of probability of risk of the emergence of VVD are revealed. It is established during the research that the largest specific weight of children with the level above the average and high level of probability of somatic risk of the emergence of VVD is observed at the age of 14 years old.

The data, which were received during the research, demonstrate what children with the low and high levels of physical development, with the existence of scoliotic posture, chronic diseases, diseases of the cardiovascular system and gastrointestinal tract, low indicators of respiratory and power indexes, disharmonious physical development,

with unsatisfactory adaptation potential, adynamic and hypersthenic somatotype are in risk group of the development of vegetative-vascular dysfunction and need individual approach at lessons of physical culture.

Prospect of the subsequent researches in this direction is the development of individual approach to children of risk group of the development of vegetative-vascular dysfunction at lessons of physical education.

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