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Psychosomatic Features and Standard of Health of Junior Schoolchildren with Different Temperament Trait Index

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The close relationship of temperament with basic biological processes, peculiarities of the physiology of nervous system, the state of physical health of man is the reason for seeking a deeper connection between bodily and mental functions. This indicates the importance of studies of physiological bases of psychosomatic relations, and hence the mechanisms that explain the features of adaptive responses of healthy people' organisms, especially of junior schoolchildren with different temperament trait index. On this basis, we have carried out an integrative health assessment with measurement of the indices of santiveness and pativeness, studied heart rate variability (HRV) and respiratory function of junior schoolchildren with temperament trait typological differences. It was found out that children in midchildhood with varying index of temperament behaviors have different nature of dominance of autonomic nervous regulatory influences and the standard of individual health. Junior pupils, whose temperament is characterized by a low intensity of behavioral symptoms, have a greater potential of health with predominant parasympathetic influence in the regulation of heart rate, which is accompanied by a higher functional reserve of cardio-respiratory system compared with those children whose temperament is characterized by high behavioral activity. The results of the study demonstrate the relationship of personality temperament traits with the standard and reserve of health, identify the mechanisms underlying psychosomatic relations in midchildhood.

Keywords: temperament, psychosomatic relations, standard of health, junior schoolchildren.

According to statistics and research results, the last decade in the Russian Federation has been remarked by significant adverse changes in the health condition of children (Kuchma V.R., Zvezdina I.V., Zhigareva N.S., 2008; Baranov A.A., Kuchma V.R., Rapoport I.K., 2011). They are characterized by the increasing prevalence of functional disorders and chronic diseases, which are especially pronounced during the period of schooling (Igisheva L.N., 2008; Baranov A.A., Kuchma V.R., Sukhareva L.M., 2009). Health problems of senior pupils are largely determined by the influence of behavioral risk factors: smoking, alcohol consumption,

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low physical activity, etc. (Chekalova S.A., Bogomolova E.S., Leonov A.V., Kuzmichev Yu.G., Chekalova N.G., Nazarov M.M., 2009; Mayorov R.V., 2012; Slobodskaya E.R., Akhmetova O.A., Kuznetsova V.B., Rippinen T.S., 2012; Varshal A.V., Slobodskaya E.R., 2013). At the same time, the high frequency variations in the health of junior school children is currently defining the need to study the psychomedical and sociomedical aspects of its formation during the period of primary school (Savilov E.D., Ilyina S.V., 2012; Kondakova O.E., Gezalova N.V., Shilov S.N., Kozhevnikov V.N., 2013).

The beginning of school is a powerful stress factor that changes the way of life of the child, his order of the day, timetable of lessons and recreation (Chekalova N.G., Silkin Yu.R., Shaposhnikova M.V., Chekalova S.A., Bogomolova E.S., Glushenkova D.A., Scherbaneva M.S., 2009; Dzyatkovskaya E.N., 2011). The change of the dynamic stereotype leads to stress of adaptation mechanisms and reduction of functionality of schoolchildren's organisms, worsened by the influence of unfavorable factors, including lifestyle related. Thus the main factor, causing the disorder of mechanisms of self-regulation of individual functional systems of junior schoolchildren with the subsequent development of chronic diseases, is often a psycho-emotional stress (Slobodskaya H.R., Akhmetova O.A., 2010; Ilyuhina V.A., 2011; Verkhoturova N.Yu., 2012 , Ilyina I.V., 2012).

At present, the ideas of temperament traits are explained by differences in the excitability of the brain systems that integrate the behavior of the individual, his emotions and autonomic functions (Potylitsyna V.Yu., 2008; Petrosyan E.Yu., Savchenkov Yu.I., 2009; Ryasik Yu.V., Tsirkin V.I., Trukhina S.I., 2010; Khabarova I.V., Shilov S.N., 2012). Both cause autonomic mobilization (Savchenkov Yu.I., Soldatova O.G., Shilov S.N., 2013), which largely, in our opinion, explains the adaptive role of temperament.

Circulatory and respiratory systems have a leading role in the adaptive responses of the body when it is exposed to the influence of a variety of factors, ensuring the necessary level of energy and metabolic processes. Cardio-respiratory system is one of the first to get involved in the process of adaptation of the organism to changing environmental conditions and its changing settings may serve as criteria for the effectiveness of adaptive responses (Shlyk N.I., Sapozhnikova E.N., Kirillova T.G., Semenov V.G., 2009; Mikhailov N.A., 2011; Kushnir S.M., Struchkova I.V., Makarova I.I., Antonova L.K., 2012; Ushakov I.B., Orlov O.I., Bayevsky R.M., Bersenev E.Yu., Chernikova A.G., 2013).

Therefore the question about the features of the functional state of breathing, heart rate regulation and the standard of individual health of junior schoolchildren with different index of temperament traits is of an undoubted scientific interest.

The aim of our research is to identify psychosomatic characteristics and to carry out a quantitative evaluation of individual health of junior schoolchildren with different index of temperament traits.

Almost healthy children of 7-10 years old (273 girls and 240 boys) were tested to determine the type of temperament by means of a parental questionnaire DOTS-R (The Revised Of Temperament Survey) adapted for Russia. This technique presents the possibility of accurate quantification of 9 temperament traits of children. The identification of temperament types was conducted by the behavior index (BI), which includes such temperament features as activity, sensitivity (threshold), mood and intensity, and by the behavior stereotype strength index (BSSI), which is the sum of quantitative indices of rhythm and adoptability (Petrosyan E.Yu., Savchenkov

Yu.I., Domracheva M.Ya., Domrachev A.A. Patent of the Russian Federation IPC 7A 61 in 5/16; Petrosyan E.Yu., Savchenkov Yu.I., 2009). All the children were divided into groups on BI; into "intense" (In), "adequate" (Ad) and "quiet" (Q) and on BSSI: into "rigid", "plastic" and "labile", respectively, with high, middle and low index values.

All the children were tested on the following indices: heart rate (HR), systolic and diastolic blood pressure (SBP, DBP), vital capacity (VC), hand power; veloergometry cardiointervalography (by the diagnostic complex "VALENTA"), Stange's test (test of timed inspiratory capacity), Rufe's test (heart rate recovery time after dosed physical load). The obtained data was processed by a computer program "HELMI-test of 7-10 year-old children", developed on the instructions of the Ministry of Education of Russia (Kulikov V.P., Bezmaternykh L.E., Kozlov S.D.) and was presented in the form of opinions on the index of santiveness – health potential that determines its probable quantity and quality (PS) and pativenesses – the probability of the disease, limitation of viability (PP).

Heart rate variability (HRV) and respiratory function were studied by a hardware-programmed complex "VALENTA". The following indices of heart rate were recorded and evaluated: heart rate (HR), tension index of regulatory systems (stress index, TI), Mo – mode, AMo – mode amplitude, the average value of the power of spectrum of a high-frequency component of heart rate variability (BV), the average value of the power of spectrum of a low-frequency component of heart rate variability (SV-2) and of a very low-frequency component of heart rate variability (SV-1), the number of pairs of cardio intervals with a difference of more than 50 ms in % to the total number of cardio intervals in the array (pNN50), and also the centralization index (CI) in rest and in a clinoorthostatic test.

In order to assess a respiratory function such indices as forced vital capacity (FVC), forced expiratory volume (FEV ı), peak volume rate (PVR), forced expiratory rate at 25-75 % of forced vital capacity (VR 25 – 75 %), minute ventilation (MV), respiratory rate (RR), maximum ventilation (MV), Tiffeneau index were recorded.

According to different indices of behavioral responses 51 % of the surveyed children showed the average values. «Intense» and «quiet» children were identified in equal numbers. On the strength of stereotypes formed 50 % of the children were included in the group of «plastic», the other kids in almost equal parts were included in the groups of «labile» (25.7 %) and «rigid» (23.8 %).

The analysis of the integrative index of health established that the tested junior schoolchildren on the average had an index of santiveness that did not exceed 60 %. This indicates a moderate reserve of their health, a rather high probability of disease development. At the same time «quiet» children, both boys and girls, had an index of santiveness higher than «adequate» and «intense» groups, which proves a greater reserve of their health and adaptive capacity in comparison with other groups of the children tested (Soldatova O.G., Shilov S.N., Potylitsyna V.Yu., 2008).

The «quiet» children had a moderate index of reliable negative correlations (correlation coefficient from 0.38 to 0.48) of the index of santiveness with temperament traits characterizing behavioral activity and approach. The index of santiveness of "intense» junior pupils had reliable negative correlations with rhythm, attention and, what is interesting, the behavior index.

Our studies of integrated health indices show that junior schoolchildren have low reserves of health, and therefore a significant probability of disease development. It is important that the reserves of health may be provided not only by the functional capacity of cardio-respiratoty and other systems of the body, but also by the intensity

of the child's personality temperament traits, especially of those that characterize behavioral activity. Health reserve depends on the index of the child's personality temperament traits, especially those that characterize behavioral activity. The children whose temperament is characterized by a low behavior index(«quiet») have a more favorable level of the body's functioning. Their health potential is higher than that of the «intense» children with distinct temperament traits that characterize the activity of conduct.

In this case, the strength index of behavioral stereotypes in the characteristic of temperament traits of the child's personality in the studied age period, are apparently still not fully formed, so they have only a small influence on the adaptive capacity of the organism, as well as on the quantitative parameters of health.

The analysis of the main hemodynamic indices in the groups of children with different temperament trait indices characterizing the activity of the behavior revealed a reliably higher initial autonomic level for boys and girls with high BI compared to «quiet» and «adequate» children. In the groups of children with different plasticity of behavior we did not detect any differences in the basic hemodynamic indices.

In the analysis of heart rate variability at rest we found that there were some differences in the studied indices in the groups of the children that differ in BI. Thus, the «quiet» children had a lower mode amplitude and stress index, reduced power of SV-1, more pairs of cardio intervals with difference of more than 50 ms in % of the total number of cardio intervals in the array and a bigger power of BV and SV-2 compared with the «intense» children.

The findings indicate the prevalence of a parasympathetic component of autonomic regulation in the children with a «quiet» temperament type. As the dominance of a parasympathetic component of the regulation indicates a more efficient and effective level of functioning of the body and adaptation processes (Kulikov V.P., Doronina N.L., Gatalsky K.K., 2008; Khuraskina N.V., Aleksandrova L.A., ChemerovaL.F.,2010;KolpakovV.V,BespalovaT.V., Tomilova E.A., Larkina N.Yu., Mamchits E.V., Chernogrivova M.O., Kopytov A.A., 2011), we can say that children with a low index of behaviors are characterized by a more favorable functional capacity of the cardiovascular system. There were no significant differences in heart rate variability at rest in children with different plasticity of behavior.

It is well known that children and adolescents, regardless of age, sex, place of residence, have individual typological features at the level of maturity of regulatory systems, especially of the cardiovascular system. We identified 4 groups with reliable quantitative and qualitative differences in the indices of heart rate variability, characterizing different degrees of tension and interaction between the sympathetic and parasympathetic parts of the autonomic nervous system, autonomous and central control loops of the heart rhythm. The first group, according to the authors (Sapozhnikova E.N., Shlyk N.I., Shumikhina I.I., Kirillova T.G., 2012) are the children with high activity of a sympathetic part of the autonomic nervous system and the central levels of regulation, the second group consists of the children with high activity of a sympathetic part of the autonomic nervous system and a low degree of tension of the central levels of control, the third group includes the children with high activity of a sympathetic part of the autonomic nervous system, increased activity of the central regulatory systems and low activity of a sympathetic part of the autonomic nervous system, the fourth group are those with high activity of a parasympathetic part and low activity of a sympathetic part and central structures of heart rate regulation. The

most optimal ratio between the autonomous and the central regulation of heart rate is observed in children of the third group; exactly these children have the highest functional reserves of the system of regulation of blood circulation. The first group with predominance of the central mechanisms of control was attributed by the authors to an unfavorable rate.

During the dividing of the examined children into the groups with quantitative and qualitative differences in the indices of heart rate variability we found that the highest percentage of the children of the third, optimal, group of autonomic regulation of heart rate fall into the category of «quiet» boys and girls while the least percentage of the same children are among the «intensive» (Fig. 1). In the groups of the children that differ in the index of strength of developed behavior stereotypes the occurrence of an optimal balance between autonomous and the central regulation of heart rate is almost the same.

In assessing autonomic reactivity it was revealed that the "quiet" children with a low index of behaviors in a reliably greater percentage of the cases have initial vagotony and hypersympathicotonic reaction during functional load (Table 1). The children, who belong to the "intense", have a hypersympathicotonic reaction recorded in a smaller percentage of cases, which indicates a high initial tonus of the sympathetic nervous system, and as a consequence the absence of its additional activation during the transition to a vertical position.

In the groups of children, varying in the strength index of developed behavior stereotypes, the differences in autonomic reactivity were not revealed.

The correlation analysis of the relationship of the indices of heart rate variability and the

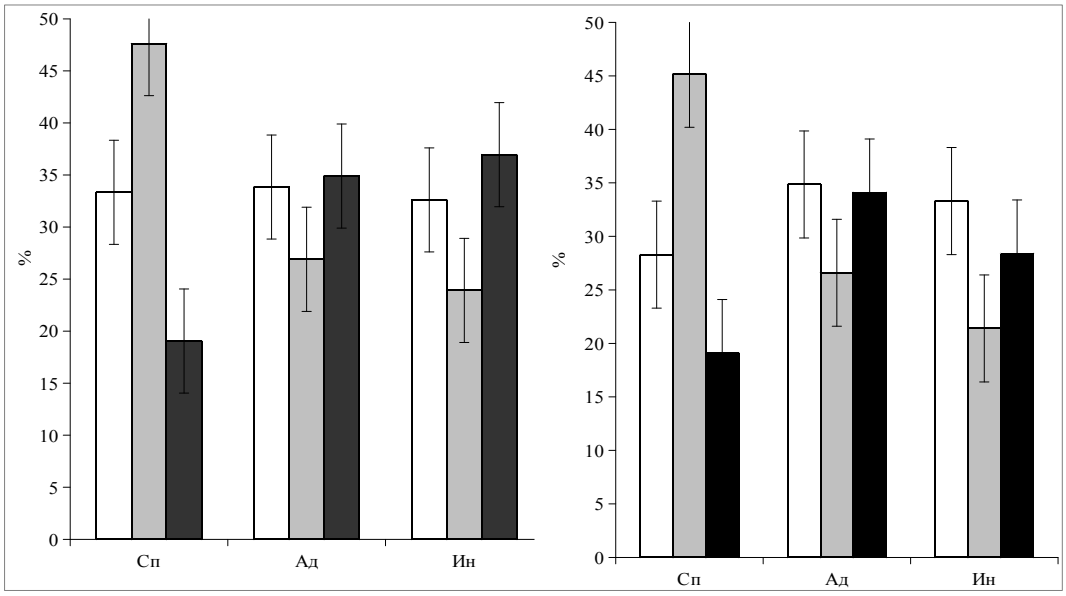

Fig. 1. Occurrence of the groups with the characteristics of regulation of heart rate in the groups of "quiet" (Сп), «adequate» (Ад) and «intensive» (Ин) boys and girls; □ – high activity of a sympathetic part of the autonomic nervous system and a low degree of tension of the central levels of control, ▒ – children with high activity of a parasympathetic part of the autonomic nervous system, increased activity of the central regulatory systems and the low activity of a sympathetic part of the autonomic nervous system ■ – children with high activity of a parasympathetic part and low activity of a sympathetic part and central structures of heart rate regulation

Table 1. Autonomic reactivity of children with different index of behavior manifestations in a clinoorthostatic test

Groups	n	Autonomic reactivity (incidence, %)		
		Asympathicotonic	Normal	Hypersympathicotonic
Boys				
Сп («quiet»)	55	4,1	39,8	56,1
Ад («adequate»)	128	14,5*	36,4	49,1
Ин («intense»)	57	32,1*,#	40,9	27,0*,#
Girls				
Сп («quiet»)	66	4,9	36,8	59,2
Ад («adequate»)	140	11,2*	37,3	51*
Ин («intense»)	67	32,9	32,1	34,9*,#

Note: difference is reliable at p <0,05: * – from the group of «quiet», # – from the group of «adequate» children

Table 2. Correlation coefficients of heart rate variability and index of temperament traits of junior schoolchildren (p <0.05)

Temperament trait	Group on BI	BV	SV-2	SV-1	TI
Activity	Сп				-0,56
	Ин				0,61
Rhythm	Сп				-0,63
	Ин				0,56
Mood	Сп	0,53	0,55	0,46	-0,54
	Ин	-0,62		-0,66	0,64
Attention	Сп	0,64	0,65	0,56	-0,7
	Ин	-0,56		-0,7	0,66

index of temperament traits revealed their lack in «adequate» children, while there are reliable correlations between the indices of heart rate variability and the index of temperament traits in the case of the «intense» and «quiet» junior schoolchildren (Table 2).

The significant (p <0.05) correlations (0,5 <r> 0,7) of the index of temperament traits with the indices of heart rate variability (TI, SV-1, BV, SV-2) in children with different plasticity of behavior were identified only in the group of «labile» children; in the case of the boys in this group, these correlations have such features of temperament as threshold, mood and approach, while the girls' correlations have mood, attention and distractibility (Potylitsyna V.Yu., Bardetskaya Ya.V., 2013).

In the analysis of the indices of respiratory function in groups of junior schoolchildren with different temperament traits indices some differences were also identified. Thus, the respiratory rate of the «quiet» children is less than that of the «intensive», while the minute ventilation and the maximum ventilation rate are reliably higher than that of the children of «intensive» type. In the groups of children with different strength of developed stereotypes the «plastic» children

are characterized by more optimal indices of the respiratory function.

The obtained results show a more optimal functioning of ventilation of junior schoolchildren whose behavior is characterized by a low index of behaviors – the «quiet» children and the «plastic» children, whose temperament is characterized by the average values of the strength index of developed behaviors.

What is the mechanism and physiological significance of the detected patterns of relationship between temperament traits of the child's personality, individual health and functional indices of cardio-respiratory system? The existing concept of «the range of adaptation» comes from evaluation of the ability of functional systems to change their characteristics to provide homeostasis in the implementation of adaptive mechanisms, including the way through the change of behavior regimes. In this regard, our results confirm the recent series of assumptions that temperament refers to individual differences in the excitability of behavioral and physiological systems, as well as in behavioral and neural mechanisms of reactivity modulation (Karavayeva E.N., Soldatova O.G., Pats Yu.S., Savchenkov Yu.I., 2011).

Thus, our study suggests that «quiet» children, whose temperament is characterized by a low behavior index, are marked by the domination of a parasympathetic part of heart rate regulation at rest, the most optimal ratio between autonomic and central heart rate regulation, the higher functional indices of external respiration. This is the factor that contributes to a more economical and effective level of body functioning, adaptive processes and the state of individual health in children of junior school age with a low behavior index.

The results of our study revealed that the physiological mechanisms of psychosomatic relations of children with different temperament traits are also the factors, which along with others determine the quantitative levels and reserves of health of junior schoolchildren.

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Психосоматические особенности и уровень здоровья у детей младшего школьного возраста с разной выраженностью темпераментальных черт

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Тесная связь темперамента с основными биологическими процессами, особенностями физиологии нервной системы, состоянием физического здоровья человека является причиной поисков более глубокой связи между телесными и психическими функциями. Это указывает на важность исследований физиологических основ психосоматических соотношений, а значит, и механизмов, обусловливающих особенности адаптивных реакций организма здоровых людей, в первую очередь детей младшего школьного возраста, с различными темпераментальными свойствами личности.

Исходя из этого нами проведена интегративная оценка здоровья с определением показателей сантивности и пативности, исследованы вариабельность сердечного ритма (ВРС) и функция внешнего дыхания у детей младшего школьного возраста с различными типологическими особенностями темперамента. Установлено, что дети младшего школьного возраста с различной выраженностью поведенческих проявлений темперамента имеют разный характер доминирования вегетативных нервных регуляторных влияний и уровень индивидуального здоровья. У младших школьников, темперамент которых характеризуется низкой выраженностью поведенческих проявлений, больший потенциал здоровья, преобладает парасимпатическое влияние в регуляции сердечного ритма, что сопровождается более высоким функциональным резервом кардиореспираторной системы у этих лиц по сравнению с детьми, чей темперамент характеризуется высокой поведенческой активностью. Результаты исследования доказывают взаимосвязь темпераментальных свойств личности с уровнем и резервом здоровья, выявляют механизмы, обусловливающие психосоматические отношения у детей младшего школьного возраста.

Ключевые слова: темперамент, психосоматические отношения, уровень здоровья, дети младшего школьного возраста.