CROSS EFFECTS OF STUDENTS’ ADAPTATION TO PHYSICAL LOADS

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Annotation: In natural and working environment a person often feels the influence of unusual, excessive and hard factors, which are not adequate to his nature. In this case physical load is the most natural and ancient factor influencing a person. Adaptation to physical load increases the resistance of an organism to a wide range of potentially harmful factors of environment: altitude hypoxia, ionizing radiation, factors which damage blood circulation system and heart. It is known that in case of a harmful influence of the same stress factors, the stress-reaction of the people trained for physical loads is not so intensive, as the reaction of slow-moving, not trained people and their resistance to stress is higher.

The study of the objective laws of adaptation processes of a person to the factors of environment is one of the urgent problems of a modern science. During adaptation the characteristics and qualities which are the most useful for an organism are formed. There can be cross defensive effects of adaptation – the situations when the adaptation to a definite factor influence increases the resistance of an organism to a harmful influence of the other factors.

Research materials. The students with a high and a low level of motion activity took part in the research. The vegetative reactions to the mental workload of the first-year students and students from the fifth course with different level of physical activity were studied.

Research methods: scientific literature analysis and summarizing, the analysis of the State Educational Standards content according to the specialities 033100 “Physical culture” and 032200 “Physics”, testing, the methods of mathematical statistics.

Research results. The research results show that the sensitivity towards stress influences depends on the factors of inner and outer character. The students of physical activity are characterized by more effective and economic work of a cardiovascular system, both at rest and during mental work. Vegetative components of the mental work are also defined by age and gender factors: the female students of the fifth course with a high level of physical activity don’t have reliable changes of a chronotropic reaction to mental workload. Male students with a low level of physical activity have age differences in heart rate level even at rest.

Conclusion. The results of the comparative evaluation of the students’ vegetative reactions to mental workload show that the existing differences are conditioned by the level of physical activity, gender and age. It is proved by the data of a prophylactic meaning of physical exercises in terms of cardiovascular system diseases. However, a real situation in modern Russia is different as physical culture is not so popular among people. In order to achieve results in the sphere of diseases prevention it is necessary to create an infrastructure, to bring up young people on the basis of the principles of healthy behavior.

Introduction. In natural and working environment a person often feels the influence of unusual, excessive and hard factors, which are not adequate to his nature. In this case physical load is the most natural and ancient factor influencing a person. Adaptation to physical load increases the
resistance of an organism to a wide range of potentially harmful factors of environment: altitude hypoxia, ionizing radiation, factors which damage blood circulation system and heart. It is known that in case of a harmful influence of the same stress factors, the stress-reaction of the people trained for physical loads is not so intense, as the reaction of slow-moving, not trained people and their resistance to stress is higher.

A close interconnection of the motor and psychic functions defines a key role of physical activity in life. Considering the questions connected with the influence of physical activity level on a person’s life, it is necessary to define several aspects. One of the most important is a health-improving influence of the movements. Taking into account that hypokinesia, which is the risk factor of some diseases (E.A. Shaposhnikov, 2001; K.E. Powell, 1989; A.V. Rowlands, 1999), is peculiar to most students, a rational physical activity is a condition for general health improvement, physical and mental working capacity (P.O. Astrand, 1992; D. Glenister, 1996; C. Ferron, 1999). Muscular power and endurance positively correlate with the level of health and life quality (D.E. Warburton, 2001). Endurance increase is accompanied by the increase of oxygen use by the tissues and allows to increase the level of a maximum oxygen consumption. According to K. Kuper (1976), G.L. Apanasenko (1985), the level of maximum oxygen consumption (MOC), showing the effectiveness of oxygen transportation and utilization processes in an organism, closely correlates with resistance to diseases and is mainly defined by the degree of motional activity (O.V. Korkushko, Y.T. Yaroshenko, 1996). The volume of an aerobic capacity influences such risk factors of cardiovascular diseases as cholesterol level, the level of blood pressure (R.G. McMurray, 1998). That is why regular physical loads are considered as effective means of many diseases prevention and treatment.

The influence of regular physical exercises on vegetative homeostasis is revealed as the decrease of sympathetic and increase of parasympathetic tone at rest (W.L. Kenney, 1985; K. Shin 1995; M. Huonker,1996). At the same time the influence of a single physical load leads to increase of adrenergic influences on physiological functions, an adaptive reorganization of a cardiovascular system, which provides reactions development of an organism to stress (D. Lucini, 1997). The increase of the level of physical activity is accompanied by the decrease of depression symptoms (C.B. Taylor, 1985; S.A. Paluska, T.L. Schwenk, 2000). The use of a light physical load leads to a moderate increase of mental working capacity (N.I. Sapova, T.A. Pavlova, 1983). Aerobic and power exercises improve brain activity and cognitive processes (K.R. Fox, 1999).

Studying at a higher educational establishment is a difficult and long-term process, which demands inner energy, physical efforts and emotional stability. It is known that physically active students have a higher working capacity (Maaros, Landor, 2001). An intensive intellectual activity not only increases brain activity, but also influences the regulatory systems, heart, tone of the vessels, hemodynamics, metabolism and the state of an organism in general (N.S. Egorov, V.P. Zagryadskiy, 1973; E.V. Belova, 1987; B.M. Fedorov, 1997; Cattaert, 1982; Callister, 1992; Tulen, 1999). According to the data given by B.M. Fedorov (2001), there are several reasons for this. One of them is an emotional accompaniment of an intellectual activity. Another reason of blood circulation change during the intensive mental work is in increase of the oxygen volume needed for a brain in order to provide it to nerve cells and to eliminate metabolites. The energetic supply of the most active structures of a brain during an intensive mental work increases.

The information about the influence of physical activity on vegetative reactions during mental workloads is rarely met. There are a lot of works devoted to the analysis and dynamics of heart rate parameters and lack of information about the adaptive changes of heart rate structures under the influence of educational loads of students, who study according to different educational programs.

The literature analysis shows that an educational activity of the most students is realized together with a constant influence of a complex of risk factors, among which the leading role belongs to hypokinesia, a great volume of informational load in terms of lack of time and nervous
tension. The tension of the adaptive mechanisms is accompanied by sympathetic link of vegetative regulation activation. On the one hand, this provides a successful solution of the educational problems, on the other hand, creates the base for cardiovascular, nervous and endocrine systems dysfunction. In general 15-20% of students have poor health state (V.V. Balashova, 2005).

The spectrum of vegetative reactions in terms of mental workload includes a complex of humoral and nervous mechanisms, which condition cardiovascular system, sympatho-adrenal link of regulation mobilization and emotiogetic structures activation. It is obvious that in case of an intensive mental activity conditions can be created, leading to typical stress changes and donosologic violations development, which are able to transform into pathologic processes.

An intensive mental activity is one of the reasons of diseases level increase of the workers, including students. That is why the study of the mechanisms of adaptation processes and the means, which are able to decrease the risk factors influence on health during an intensive mental activity is very urgent.

As the level of physical activity mainly conditions the ratio of the sympathetic and parasympathetic influences, it is obvious, that it can modulate the vegetative control of students’ mental activity. However, this question is not studied enough in a scientific literature.

Also important aspect of vegetative reactions study should be considered a gender factor. The existing information about gender peculiarities of reactions to mental workload has a contradictory character – from an absolute negation of gender factors (Jones, 1996) to the conclusion that mostly men, involved into mental activity, have the pathology of cardiovascular system than women (Eller, 2007).

The aim of the research work: revelation of vegetative reactions peculiarities in case of mental workload of 17-18 and 21-23 years old students with different levels of physical activity.

Methodology. Hemodynamic indices of the students with different levels of physical activity were studied in terms of background and dosated mental workload.

The female and male students of the first and the fifth courses of Perm Sate Pedagogical University took part in the research (186 people). The age range of the first-year students was 17-18 years, the fifth course students were 21-23 years old. The students were divided into two groups. The first group included the students with a high level of motional activity, who studied at physical culture department. The second group included the students with a low level of motional activity, who studied at physics department. The evaluation of the level of regulated physical activity was held by means of the State Educational Standards content analysis, according to the specialties 033100 “Physical culture” (group 1) and 032200 “Physics” (group 2), taking into account additional lessons on health-improving physical culture and sport. An average week volume of physical load was calculated according to the curriculum for the students of the 1st and the 5th courses of the both faculties. According to this, an average week volume of physical load on the speciality 033100 at the 1st and the 5th courses was 16 and 10 hours, on speciality 032200 – 4 hours at the 1st course, at the 5th course physical culture lessons are not included into the curriculum.

As a mental workload the students were offered to fulfill multiplication of two-digit numbers mentally.

Research results. Evaluating the influence of vegetative reactions on mental workload of students with different levels of physical activity a range of peculiarities was revealed.

In conditions of background the volume of heart rate of female students with a high level of motional activity is at the same level at the beginning of education and to the moment of graduation. But the reaction of an organism to mental workload of the female students of the 1st and the 5th course differs. 17-18 years old female students had heart rate increase because of mental workload. At the 5th course there are revealed no reliable changes of chronotropic reactions. It can be considered as a specific result of a long-term adaptation to educational activity. The female students with a low level of physical activity don’t have age differences of chronotropic reaction to mental
workload. In spite of a constant influence of mental load during education at physics faculty there were no features of a long-term adaptation in cardiovascular system among the female students.

Table 1
Heart rate indices (beats per minute) of the female students with different level of physical activity in terms of relational rest and mental workload

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Background</td>
<td>Mental workload</td>
</tr>
<tr>
<td>17-18</td>
<td>78,00 ± 2,51</td>
<td>87,94 ± 2,77 ***</td>
</tr>
<tr>
<td>21-23</td>
<td>78,23 ± 2,21</td>
<td>81,50 ± 3,46</td>
</tr>
</tbody>
</table>

Note: 1. *- p<0,05; ** - p<0,01; *** - p<0,001 to the magnitude of the index in background (t-test for connected sampling); **1 - p<0,05; ***1 - p<0,01 to the magnitude of the index in group 1.

It is obvious that a mental activity of female students with a low level of physical activity is realized in terms of high energy costs in comparison with the female students form group 1, who have economization of physiological functions, peculiar to the trained people (A.G. Dembo, E.V. Zemtsovkiy, 1989).

The character and the volume of vegetative shifts, as the reaction to mental workload, of 17-18 year old male students, as well as the female students, depends on the level of physical activity. The analysis of chronotropic reaction shows that the male students with a high level of physical activity have the increase of heart rate in response to mental workload 6 beats per minute (8,1 %), in group 2 - 16,4 beats per minute (21,5 %). Such a difference can have in its base the change of a vegetative balance in response to mental workload.

Table 2
Heart rate indices (beats per minute) of the male students with different level of physical activity in terms of relational rest and mental workload

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Background</td>
<td>Mental workload</td>
</tr>
<tr>
<td>17-18</td>
<td>74,35 ± 1,58</td>
<td>80,40 ± 1,43 ***</td>
</tr>
<tr>
<td>21-23</td>
<td>71,59 ± 2,37</td>
<td>81,34 ± 2,52 ***</td>
</tr>
</tbody>
</table>

Note: 1. ** - p<0,01; *** - p<0,001 to the magnitude of the index in background (t-test for connected sampling); **1 - p<0,01; 111 - p<0,001 to the magnitude of the index in group 1.

Between age categories of students with a high level of physical activity significant differences, both in case of background and in case of mental workload are absent. Thus the process of long-term adaptation to mental workload doesn’t affect heart chronotropic reaction of male students from group 1. Age differences of heart rate level of the students with a low level of physical activity are revealed already at rest (table 2).

21-23 years old male students have a higher heart rate than 17-18 years old students. It can be supposed that growing older people with a low level of physical activity have the increase of the role of a sympathetic regulation in heart rate organization.

The results of the comparative evaluation of the students’ vegetative reactions in response to mental workload show that the existing differences are conditioned by the level of physical activity, gender and age. Among the students with a high level of physical activity female students are characterized by a better resistance to mental irritants than male students.

The analysis of a chronotropic function of a heart and the indices of hemodynamics proves the importance of physical activity for a vegetative supply of a mental work. People with a high
level of physical activity react to mental workload by less defined vegetative shifts. It also proves the data about a preventive meaning of physical exercises in terms of cardiovascular system diseases. In case of all sport trainings, anticipating periodical appearance of competitive situations, we speak about a complex adaptation to physical load and stress situations.

The processes of adaptation to physical load improve the mechanisms of aerobic energy supply, hemodynamics and condition vegetative balance shift to predominance of parasympathetic mechanisms.

However, it is necessary to remember that a positive cross effect of adaptation is revealed only in case of a rational dosing of physical load, which is directed at a healthy organism. If the organization of the training process is not correct, even a steady, high level adaptation to physical load can have its biological or structural cost: a direct damage of a functional system, which experiences the main volume of load or the phenomena of a negative cross adaptation, damage of the other functional systems not connected with physical load.

**Conclusion.** The influence of physical activity level on vegetative supply of mental activity of 17-18 and 21-23 years old students is defined by means of adaptive changes of a vegetative balance and aerobic activity mechanisms. The students with a low level of regulated physical activity in terms of mental activity have a considerable increase of heart rate.

The level of physical activity also defines the specificity of gender differences of vegetative reactions to mental workload. At 21-23 the female students with a high level of physical activity have a lower level of the complex of vegetative reactions to mental workload than the male students.

The students’ adaptation to physical loads provides more effective and economic work of a cardiovascular system in terms of mental workload.

The results of our research work prove that vegetative phenomena of mental activity, mainly depends on the level of students’ physical activity. It is proved by the data of a prophylactic meaning of physical exercises in terms of cardiovascular system diseases. However, a real situation in modern Russia is different as physical culture is not so popular among people. In order to achieve results in the sphere of diseases prevention it is necessary to create an infrastructure, to bring up young people on the basis of the principles of healthy behavior.

**Bibliography**


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