Level of Schoolboys’ Psychophysiological Adaptation Process in Metropolis Megapolis

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Abstract

The paper presents the results of research on school children who live and study in different ecological conditions of the Moscow city districts. It analyses the level of psychophysiological adaptation based on a selection of 276 pupils from Moscow schools. The study reveals that the adaptation processes of school pupils in different age groups is significantly impacted by a whole complex of environment factors. It shows that school pupils living in ecologically adverse areas are the hardest hit by dysadaption. This has been confirmed by the data obtained in the psychological and psychophysiological tests.

Keywords: psychophysiological adaptation; dysadaption; health; school pupils; environment; heart rate variability; megapolis

Introduction

One of the key environments for a child’s personal growth and socialization during its school education is an adequate level of its psycho-physical health which has a direct bearing on the successful learning of subjects in the school curriculum. A systemic approach in the assessment of the child’s health includes such important indicators as its physical and mental development, the degree of functionality of its organism in various age periods, level of its potential adaptation, etc [1].

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The analysis of scientific publications in the field of children’s health safety in the past decade has shown a significant deterioration in children’s health for all age groups [1,2]. More than 80% of children have been found to have impaired physical and mental health [3]. In the course of their school education, the number of children with chronic diseases has doubled [4]. There has been a significant increase in violations of health conditions among these schoolboys (grades 1-4) [3-5]. New forms of school pathology have been identified that arise under the influence of school environmental factors. They include pathology of school posture disorders, myopia, hyperactivity dysfunction of various functional systems such as cardiovascular, nervous, musculoskeletal, respiratory, digestive, etc. [6].

The social environment has a huge impact on the health and activity of children and adolescents indeed [8]. However, in the context of a large industrial city anthropogenic factors tend to have a vast impact on psychosomatic development and learning processes, too [9-11]. The aim of our study is to identify the impact of complex factors that exist in a megacity on the level of adaptation processes in the child population.

Organization and Research Methods

The preliminary stage should involve the monitoring of physical and mental health and human adaptation processes. We conducted such monitoring at several schools which are located in different parts of Moscow: South-East Administrative District (SEAD) and South-West Administrative District (SWAD) in different environmental conditions. The research was conducted in 2008-2012.

The sample was made up of pupils from schools No. 126 (SWAD) and the Educational Center No 1989 (SEAD). The sample included pupils of primary (forms 1-3), junior (forms 5-7) and high school (forms 9-10). Moreover, we conducted a study of adaptation in a group of preschool children who received their initial playgroup education (zero forms) at the selected schools. The total number of the children studied was 276. Out of which 43 were nursery kids (24 girls and 19 boys aged 5.9-6.4), 72 were primary school pupils (40 girls and 32 boys aged 7.2-9.9), 84 were junior school pupils (40 girls and 44 boys aged 11.5-13.3) and 77 were high school pupils (39 girls and 38 boys aged 15.2-16.4) respectively.

We used a battery of psychological and psycho physiological tests.

Psychological

The emotional situation of playgroup children and schoolboys is estimated by using the Orekhovoy test "lodge" (a projective test of personal relations, emotions and valuable orientations). The personal level and situational nervousness of school pupils are examined by using the Spilberger–Khanin test. Children’s speech development is defined by using a neuropsychological test, according to Luriya A.R., [7].

Psychophysiological

Heart rate variability (HRV) and simple motor reaction times (SMRT) are used to diagnose the functional condition of the systems (cardiovascular and nervous) in playgroup and school children. The potential adaptation assessment of school pupils is carried out by employing the Bayevsky and Apanasenko method [12].

Result and Discussion

The analysis of Moscow official sources on population development [13,14] shows the following picture. The South-East Administrative District is one of the most industrially developed districts in Moscow. It has 1/3 of the city’s industrial facilities with more than 400 industrial enterprises, over 100 motor transportation...
enterprises, two aeration plants located in this district and accounting for a large volume of harmful pollution to the city’s ecology [13,14].

Ecologically the South-West Administrative District is considered to be one of Moscow’s safest and cleanest areas. But geographically it borders on the city’s Southern Administrative District which has a pollution impact on the the SWAD’s eastern section [13,14].

According to the theory of adaptogenic adaptation, the human body’s capabilities depend on the intensity and duration of its exposure to, and the time of influence of, ecological factors. If the pressure is insignificant and the time duration short the biosystem is able to function successfully. Long-term and significant impacts on the strength of environmental factors result in overstress and malfunction of physiological systems which eventually leads to human diseases [1].

The results obtained by using this research method illustrate that the number of children with an adequate adaptation level was much lower than expected. Thus, analysis of such data of psychophysical development as height, weight, vital capacity, blood pressure, levels of functional state of the cardiovascular system, the degree of CNS activation indicators in the playgroup and primary school age sample can be conditionally divided into three groups depending on their health state: Group 1 includes healthy children, Group 2 covers children ‘at risk’, Group 3 lists those with significant deviations in their health. Their age group distribution is as follows:

Playgroup children: Group 1 is 26.9%, Group 2 is 45.0% and Group 3 is 28.1%.
Schoolboys: Group 1 is 14.6%, Group 2 is 47.5% and Group 3 is 37.9%.

It reveals that the level of psychosomatic health indicators in both girls and boys is low. It also highlights the fact that first-graders who attend introductory school lessons, adapt themselves to the study loads better than their classmates who have not taken these classes.

But on the other hand, playgroup children are found to have experienced heavy stresses on their adaptable mechanisms during their attendance of the playgroup classes which is reflected on higher disease incidence among them.

The results obtained show that both boys and girls have a low level of physical development that affects the functioning of their cardiovascular and nervous activation systems. It also affects the adaptation processes of school pupils (Table 1) and children’s harmonious psychophysical development. The research results prove that the boys’ and girls’ physical development tends to be disharmonious. It is an established fact that children and teenagers with harmonious and physical development in accordance with their age enjoy better health. Such children have optimal adaptation capabilities, greater resistance to various stresses both physically and mentally. Conversely, delayed or accelerated maturing is considered to be a risk factor fraught with emergence of various diseases — cases of extreme development have been found to have significant deviations at a number of clinics [1].

Table 1. Average group values of psycho physiological condition of children at different age depending on the ecological situation in the different areas of Moscow (n=115, %)

| Tests | Levels | School No. 126 | Educational Center No. 1989 |
|-------|--------|----------------|---------------------------|
|       |        | Children of preschool age (n=20) | Schoolpupils (n=35) | Children of preschool age (n=23) | Schoolpupils (n=37) |
|       |        | Form 1 (n=18) | Form 3 (n=17) | Form 1 (n=20) | Form 3 (n=17) |
| Male (%) | Female (%) | Male (%) | Female (%) | Male (%) | Female (%) | Male (%) | Female (%) | Male (%) | Female (%) |
According to L.G. Apanasenko [12], Rapid Assessment of the physical health level shows that the majority of children among both boys (84.9%) and girls (78.6%) have a low level of physical health.

The assessment of the extent of first graders’ adaptation to new learning and educational conditions, according to R. M. Bayevsky, is based on the parameters of their cardiovascular functioning systems revealing that most boys (70.7%) and girls (68.9%) have a satisfactory assessment of adaptation processes. At the same time, a failing degree of adaptation is found in every 4 boys (29.3%) and in every 5 girls (31.1%).

At the beginning of the school year, all first-graders were examined according to the extent of their speech violations (Luriya’s test) which is closely related to such formation processes as thinking, generalization, logical constructions, etc. It has turned out that among all those children selected 29.4% have violations in the speech sphere. Out of them 19.9% are first graders who have phonetically underdeveloped speech habits with unformed articulation, 66.4% have phonetic and phonemic speech disorders which violate the formation system of pronunciation of their native language and 13.7% have generally underdeveloped speech in which all the components of the speech system are broken. The research shows that children with speech violations tend to be less adaptable. At the beginning of the school year, the percentage of children with speech disorders is 12.3% higher than that among children with stress adaptation mechanisms.

In the middle of the school year, the number of children increases by 34.1%, whereas in the control group (children with normal speech activity) stress adaptation mechanism is registered only in 8.8%. By the beginning of the fourth term the number of children with violations in their adaptation mechanisms decreases by 10.4% and by the end of academic year by 9.7%. In the control group there are only 8.3% of such children. Thus, the first half of the school year is the hardest for children with speech impairments.

The procedure for rating graders’ emotional state [4] shows that 29.4% of the children with speech disorders are dominated by negative emotions. Such children have unpleasant experiences, they are predominately moody. In 62.7% of the cases, they have a negative attitude toward their school. Our data confirms the study results, obtained by Gratcheva I.A., 2009 [15]. She observes that many schoolchildren (74%) with speech pathology are constantly experiencing a psycho-emotional stress. Considering the conditions of the emotional sphere of the preschool and primary school children age (tab. 2), it is possible to note that the emotional sphere corresponds to age development among preschool and elementary schoolchildren.

Table 2. Results of psycho-emotional sphere condition of preschool and schoolchildren depending on the ecological situation in different parts of Moscow (n=115%)
Comparing the results according to the schools, it is possible to note that the best psychosomatic condition of the children is observed at school No. 126. So cases of underdevelopment among preschool children from school No. 126 are fewer (26.5%) than those among preschool children at the Educational Center (33.2%). The same trend is observed in school and school-age children.

Nervousness has a significant effect on human life. High levels of anxiety tend to increase mental stress. Levels of personal anxiety reflect the body's ability to adapt to new living conditions. V.V. Gafarov and others (2005) found that there exists a close interrelation between high personal anxiety and the coronary heart disease [6]. The study shows a significant prevalence of high trait anxiety among young men, which is often associated with sleep disturbances, depression, etc.

Table 3 gives group results of average nervousness levels among pupils in junior and senior forms at the two schools. It is evident that the levels of anxiety in the middle and high school results are different. These indicators (personal and situational nervousness) tend to be better among the selection of pupils from School No. 126.

Table 3. Average group values of nervousness levels among pupils of junior and senior forms in relation to the ecological conditions in the Moscow districts (n=161. %)
middle school (Form 5) and to high school (Forms 9-10) shows growing levels of both personal and situational nervousness (Table 3). It indicates the existence of stressful growth and tensions and stronger dysadaptation processes which have much to do with the environmental factor (increased study loads, heavier psycho-emotional stress and further deterioration of the ecological situation in the city).

The results show that the majority of adolescents (66.3%) in all the age groups are characterized by adequate adaptation at the beginning of the school year. However, there are markedly greater tensions in the adaptation processes at the end of the academic year, especially during examinations, practically among all those studied (94.8%). This tension adaptation trend is more significant and frequent among schoolboys at the Educational Center No. 1989 (SEAD) where the ecological condition of the area is characterized as unsatisfactory.

During the study of adaptation of adolescents at Moscow schools with different ecological status the experiments revealed that the end of the academic year, mostly the examination period tend to overtax the children’s functional systems by increasing their pulse rate and blood pressure. The number of adolescents with increased sympathotony has been found to increase among all the pupils at the end of the academic year, especially during the examination period. It is important to note that the values of tension in the central regulatory mechanisms of cardiac activity (psychophysiology test HRV) [16,17] and activation of the central nervous system (prevalence of the sympathetic nervous system) among SEAD pupils are 36.4 % higher than those among SWAD high school pupils.

Conclusions

Thus, the results indicate that the functionality of the school pupils of all the age groups is ensured through the mobilization of the organism’s inner reserves that can't but have a negative effect on their health. Undoubtedly, various complex factors of their environment impact the adaptation processes in child and adolescent populations in large cities both socially and ecologically. More or less analogous conditions of the social environment (similarities in the school curricula, their scope and complexity, families’ socio-economic status) have been observed in the studied sample of Moscow schoolchildren while the environmental conditions of the areas under study differ significantly. The ecological stress in the South-Eastern Administrative District where Educational Center No.1989 is located can be seen in the number of psycho-functional systems in different age groups and its adverse effect on the adaptation processes.

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