New Approaches to Identifying Children of Psychosomatic Disorders Risk Group
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Abstract

Stressful school situations are similar for all students. However, risk of developing psychosomatic disorders is different for different students. Multifactorial causes of psychosomatic disorders impede reliable prediction of risk of their development. The paper provides the results of nearly 30 years of studies of pathogenetic mechanisms of the development of psychosomatic disorders in children of school age. Biochemical, physiological, neuropsychological and psychological methods were used. The role of conflict between social control of the school student's studies and its biological regulation has been proven as well as the role of immaturities of vegetative and cognitive regulation of learning activity in a stress situation.

Keywords: psychosomatic disorders; conflict management; self-regulation

1. Introduction

Problems of general interest which manifest themselves in different regions in their own specific way, is the situation with school mental health (Taras, Duncan, Luckenbill, Robinson, Wheeler & Wooley, 2011). Number of Russian children with certain problems of perinatal nature, which result in immaturity of neural and psychic regulation by the time of the beginning of learning process, amounts to 60-80%, based on various sources. Most of these children attend regular schools. This is why the number of children having difficulty in mastering school curriculum is growing. The number of psychosomatic disorders increases as well. Increasingly more children require aid of neuropsychologists, corrective psychology and adaptive pedagogy. Mass school oriented at hygiene-
based approach to health and authoritarian management of the schoolchild's academic work remains the source of psychotraumatic impact, which exacerbates the situation further yet (Bejs & Kuchma, 2009). Social resources are necessary for compensation of such problems (Green & Kreuter, 1991) but they are modest today. Numerous families fail to provide children with necessary psychosocial conditions of development.

According to WHO expert committee statement in 1993, growth of psychosomatic disorders in children indicates at the impact of the combination of undesirable biological and social factors onto children. Psychosomatic disorders belong to chronic non-infectious processes. Primary pathological changes occur in the neural regulation system causing subsequent disturbance of adaptation and compensation activity of the vegetative nervous system, humoral systems, dysfunction of various organs (Kolesnikova, Dolgikh, Polyakov & Rychkova, 2005). These disorders begin to manifest themselves in the conditions of school stress. Psychosomatic disorders may be triggered by excess learning load, hypodynamia, family problems, authoritarian teaching style and other emotional and information stresses.

Specialists of our clinic, who conducted medical check-ups of schoolchildren for many years, observe that incidence of psychosomatic pathologies in children's population grows from 20% in pre-school age to 60-80% by the time of graduation. These pathologies become the cause of over 80% of diseases in adults. Children with non-infectious diseases attended by doctors include 50-75% of patients with angioneurosis. More than a quarter of children have progressing course of arterial hypertension with early development of essential arterial hypertension in the course of ontogeny. Number of children with heart rhythm disorders increases significantly from grades 1 to 4. One out of three students leaving primary school suffers from food or drug allergy, and one out of two has functional disorders of gastrointestinal tract.

As psychosomatic disorders are determined by many factors, the issue of building the unified pathogenetic model of their development remains unresolved. It is yet to be answered which features of central regulatory systems are responsible for resistance to school stress, while others result in instability.

For instance, it was stated that if one variable were to be isolated as the dominant source of stress, it would be uncertainty (i.e., psychological characteristic). Hygiene researchers adhere to the opinion on the leading role of the information environment's hygiene (Isaev, 1996). Bodrov (2000) believes that personal factors play the dominant role rather than features of learning information. Of high interest are the studies of the effect of individual cognitive features of the child onto school health (Bruner, 1964; Globerson, 1983; Grossman & Kaestner, 1997; Hunt, 1983; Sternberg, 1996), their role in regulation of human activity, including during critical periods of ontogeny (Lazarus, 1966; Thurstone, 1924).

2. Objectives, methodology and research design

We departed from the assumption that substantiality of environment risks to human health is largely determined by the status of his/her regulatory systems, their compensation capacities and adaptation resources. Regulation resources of neural and psychic domain are manifested in stress-condition activity. For children aged 7-18 years, this would be learning and cognitive activity (Vygotskij, 1996). We supposed that quality of neural and psychic regulation of learning activity is determined by preceding biosocial development of the child, its functional status, as well as conditions of the current activity: methods of teaching, quality of textbooks and relations with the teacher.

We supposed that the mandatory component of the complex task of prevention, correction and rehabilitation of children with psychosomatic disorders is optimization of neural and psychic regulations of the dominant learning activity. This will enhance their stability against the risk of dysfunction of psychoneurosomatic regulation in conditions of school stress.

The object of the study is the psychoneurosomatic regulations of child's learning activity.

The subject of the study – mechanisms of development of psychosomatic diseases of school students from 7 to 17 years which had different perinatal stories and psychosocial conditions of the childhood and studied by different technologies. Such children differed in a maturity of neural and psychic regulations (condition of deep diencephalic mediobasal structures, sympathomedular and hypothalamic-pituitary system, lateral organization of brain, neuropsychological syndromes, profiles of various levels of learning activity regulation). Conditions of training differed in training techniques. They are characterized by different ways of presenting information, its processing, transformation, organization activities.
**Purpose** of the study was to determine features of neural and psychic regulations in children of psychosomatic disorders risk group.

The study was conducted at the Institute of Pediatrics and Human Reproduction of East-Siberian Research Center of the Siberian Branch of the Russian Academy of Medical Science (ESRC SB RAMS), on the basis of its clinic and experimental platforms of the Medical Ecology Research Center ESRC SB RAMS (later renamed into Research Center of Family Problems and Human Reproduction), since 2005 – in partnership with Institute of Teaching Content and Methods of the Russian Academy of Education, researchers, university teachers and school teachers of Moscow, Irkutsk region, Buryatia Republic, Chita region, Ust-Orda and Aginsky Buryat Autonomous Districts. The study covered total of more than 200 schools, more than 10 thousand students. Number of girls vs. boys in groups was 53% and 49%, accordingly. No special selection of children into experimental classes was performed, either based on medical or psychological-pedagogical parameters. The study was conducted both in conditions of a natural experiment and clinic.

**Stages of the study**

The first stage (since early 1990) comprised determination of pathogenetic development model of psychosomatic disorders, inclusive of features of the different levels of neural and psychic regulation of school studies and their management on school's behalf; determination of risk group criteria.

The second stage (since 2000) was dedicated to development of school studies management model, based on principle of homeostat - a natural counterpart, based on the previously developed pathogenetic model of psychosomatic disorders.

The third stage (since 2005) was related to the development of the school activity program for implementation of the developed control model, including education content "Ecology and Human Health". Purpose of the Program is frontal prevention, and, based on medical and psychological indications, individual correction of immaturities of neural and psychic regulations of learning (Bodienkova, Kolesnikova & Timofeeva, 2006; Kolesnikova, Dolgih, Leont'eva & Bugun, 2008; Protopopova, Kolesnikova & Il'in, 2008; Savchenkov & Savilov, 2006).

In this article, we present the results of the first stage of the study.

**Methods** used included method of natural experiment with physiological, biochemical and psychological methods of research, as well as clinical and laboratory methods.

Profiles of child's learning activity regulation were studied at its cognitive (memory, attention; perception, processing, coding, transformation of information, activity organization; scheme of actions orientation basis) and non-cognitive (vegetative support, motivation, emotions, will, social-communicative links) levels (Dzjatkovskaja, Nodel'man, & Vostrotina, 1998). The typology of regulation profiles according to Morosanova (2008) was used to describe the quality of regulation: harmonic, accentuated, trapped (immature).

The following indicators were studied.

**Physiological**: blood pressure, heart rate, estimated values - pulse pressure, cardiac output per minute, double product, Kerdo vegetative index; orientation, amplitude and asymmetry of galvanic skin reaction; their values in conditions of rest / learning activity / completion of learning assignments during modeling of information stress by Hananashvili (1978) method; during the school day from class 1 to 6, academic year (autumn – spring).

**Biochemical**: condition of antioxidant protection system, content of bioelements, aminoacides, vitamins, hormones in blood serum (Dzjatkovskaja, Kolesnikova & Dolgih, 2002).

**Neuropsychological**: neuropsychological symptoms and syndroms of deep, mediabasal and cortical structures, lateral brain organization profile, level of development of interhemispheric transfer of visual, auditory and tactile information.

**Psychophysiological**: baseline vegetative status, vegetative reactivity; dynamic features of psychomotorics, physiological and psychological resistance to information stress (Simernitskaja, 1991; Tsvetkova, 1998).

**Psychological indicators**: regulatory profiles of modal information perception, processing, coding and transformation; emotional reaction; style of learning activity regulation, style of communications (Dzjatkovskaja, Nodel'man & Vostrotina, 1998).
Clinical examination included collection of data on prenosological psychosomatic manifestations: somatic, vegetative, emotional, neurotic and psychic phenomena, life and case history of the object, epidemiological history, genetic survey, analysis of social living conditions, clinical examination proper.

3. Discussion of the research outcomes

The studies have shown that system of school activity regulation undergoes considerable change over years of school. General trend is the increase of the number of freedoms in the correlation system of vegetative, emotional, cognitive, volitional and communicative regulations of learning activity, reduction of the sum of internal links from 23.1 to 20.2 and reconfiguration of the leading regulation levels (Fig.1)

Profiles: correlation constellation of cognitive (3), vegetative (1), emotional (2), volitional (4), communicative (5) regulation profiles. A – children aged 7 years. B – children aged 11 years. Relation confidence: double solid line – p< 0.01; single solid line – p< 0.05; dotted line – p< 0.1. CB – sum of internal relations.

Fig.1. Correlation constellation of cognitive, vegetative, emotional, volitional and communicative regulation profiles in children aged 7 to 11 in comparison

A group of students was identified, where "coupling" of different regulation levels remained high through the entire duration of education, thus preserving high level of stress of psychosomatic relations also in adolescent age. These children were typical of trapped or accentuated profiles of learning work regulation, especially in conditions of information stress (high volume of information, insufficient amount of time, high responsibility). They constituted the main group of children with psychosomatic disorders (Fig.2).
Profiles: 1 – vegetative, 2 – emotional, 3 – cognitive, 4 – volitional, 5 – communicative regulation. A – harmonic regulation profile. B – trapped regulation profile. Relation confidence: double solid line – $p<0.01$; single solid line – $p<0.05$; dotted line – $p<0.1$. CB – sum of internal relations.

Fig.2. Correlation constellation of cognitive, vegetative, emotional, volitional and communicative regulation for harmonic (A) and trapped (B) profiles in children aged 11.

Growth of psychosomatic disorders was observed in children with immaturities of vegetative and cognitive regulations of learning activity (Fig.3).

![Graph showing correlation between cognitive, vegetative, emotional, volitional, and communicative regulation for harmonic and trapped profiles in children aged 11.]

Profiles:

Percentage of children trapped at information recoding
- [Diagram indicating percentage]

Trapped at analysis-synthesis
- [Diagram indicating percentage]

With manifested sympathetic or parasympathetic symptoms
- [Diagram indicating percentage]

1 – number of students with trapped cognitive and vegetative regulations (%) among schoolchildren, who developed psychosomatic disorders in the process of school learning,
2 – same among total schoolchildren population.

Differences confidence (1) and (2): $p < 0.01$

Fig. 3. Psychosomatic disorder frequency vs. cognitive and vegetative regulations immaturity

81% of children in elementary school, who developed psychosomatic disorders, possessed "trapped" means of information coding, 83% - immature information processing profiles, 61% - immature cross-analyzer links. 92% of children with difficulties in recoding information demonstrated organic neurological symptoms, and, in that case, 64% – disorder of interhemispheric transfer. It is important to highlight that the group of schoolchildren with psychosomatic disorders included only 6% of children with polymodal structure of perception, 9% – capable of easy information recoding, 11% – without problems in transition from information synthesis to analysis and vice versa.

Children of risk group reliably included more students, whose individual features in information processing and coding (creative, holistic thinking) failed to meet the requirements of teaching methods (to analytical thinking).

The "depriving" role of school curricula in forming risk groups of psychosomatic disorders is apparent in schools with advanced studies of foreign languages. In such schools, 85% of children with disorders of phonemic hearing had psychosomatic disorders, whereas in a regular school, this indicator amounted to 43%.

The results of study of homeostatic indicators in blood serum produced a biochemical confirmation of the high psychophysiological "price" of teaching children with non-harmonious profiles of learning regulation. They are typical of changes in antioxidant status, concentrations of hormones, vitamins, aminoacids, bioelements and their ratio (Cu/Zn, K/Fe, Zn/Ca), which indicate at strain of adaptation mechanisms (Fig.4).
Profiles:
1 – $\alpha$-tocopherol/diethenoid conjugates x 10, molar ratio
2 – $\alpha$-tocopherol x 10 / Cu, molar ratio
3 – diethenoid conjugates x 100 / Cu, molar ratio

Fig. 4. Biochemical indicators of antioxidant activity in blood serum of children aged 9 years with harmonic and trapped cognitive regulation profiles

Results of biochemical tests were confirmed by neuropsychological studies. In particular, children in arterial hypertension group demonstrated expressed left lateral and ambidextrous features, which (by comparison to control group) indicate at particular immaturity and delayed developed of functional hemispheric brain asymmetry.

As psychosomatic disorders continue to develop, the child demonstrates changes in intellectual, speech, and personality development; effectiveness of his/her learning activity declines and learning motivation drops. By teenage years, the child develops the stereotype of psychosomatic reaction to any stressful situations. This takes its toll on adolescent health. For example, a group of 14-18 years old schoolchildren was identified, whose psychosomatic reaction stereotype was characterized by sympaticotonic reactivity to stress and stayer adaptation type. This group carries high risk for development of arterial hypertension.

High psychophysiological price of teaching children with immature regulations of learning activity is confirmed by cardiovascular indicators in the conditions of learning load, both in lab setting and in natural experiment (completion of a test in class).

Overall, the number of students with non-harmonic regulation profiles ranges from 30 to 70%. This broad spread in data is related to different combinations of perinatal, family and school risks.

We have included the following into these risks:
mother's attitude to pregnancy as negative or alarming,
low level of emotions in communication with the child, while ethnocultural traditions (lullabies, rocking, folklore) are not used,
mother's knowledge nothing about childcare, which can compensate his/her perinatal problems (e.g. prevention of tactile disgnosia is required after caesarean section),
early attendance of daycare centers (nursery),
mother's occupation at study or work,
unsatisfactory social and living conditions,
single-parent family, parents' alcoholism, low mother's education,
over or insufficient parental care, family violence (physical, psychological),
distorted internal image of the disease in adults significant for the child.

School risk factors include:
authoritarian teaching style,
reproductive nature of learning,
psychotraumatic character of knowledge evaluation,
restriction of children's movement activity in class,
taboo on show of emotions,
lack of alternatives in information handling strategies offered to schoolchildren (the child is refused the right to adjust the rate, scope and intensity of his/her work, alternate work and leisure, redistribute the load, receive external help and support),
forced development rate of schoolchildren,
lack of quality correction aid to student.

Such pedagogic control of the child's learning blocks his/her biological, psychological and sociocultural sanological mechanisms and delays natural maturing processes of integral systems of neural and psychic regulations (Dzjatkovskaja, Kolesnikova & Dolgih, 2002).

Most of children, who acquire psychosomatic disorders in schools, are schoolchildren with immature cognitive and vegetative regulations of the dominant activity. This indicates at profound integration of such regulations into the holistic system of psychosomatic regulations, which determine the child's health resource. It is not the academic "load", or the emotional stress, but rather the conflict between the character of external control of the child's dominant activity and character of its self-regulation by internal mechanisms that becomes the key mechanism in development of psychosomatic disorders. We have defined this conflict as "control conflict". It is associated with opposition of natural regulation mechanisms and social control.

Structural and functional complex of human activity regulation is formed before birth. However, it does not remain unchanged, but continues to build and functionally develop in the course of growing, especially during the first years of life. A complicated congenital-acquired stereotype is developed for regulation of the individual's life and social activity. The biggest changes in the regulations system occur at the age of 1,3,7,12-14 years (during critical periods of development). School education plays the key role here.

Indicators of premorbid changes in regulatory systems include changes in homeostatic blood indicators, functional tests in stress conditions, interhemispherical asymmetry, as well as "trapped" profiles of vegetative and cognitive regulations of learning activity in stress conditions.

Harmonic profiles of cognitive and vegetative regulations are typical of multioption combination of reaction methods. For non-harmonic profiles – number of reaction liberties declines, adaptation range becomes narrower, developmental maturing trend of psychoneurosomatic regulations decelerates, and the process of the child's medical rehabilitation becomes more complicated. Chronic adaptation strain becomes the background for a particular stable pattern of neuro and psychophysiological reactions to particular stress factors critical for the individual, and the stereotype of pathological psychosomatic reaction is developed. It is supported by the primary pathodeterminant – rigidity center – the "trapped" regulation profile. It gradually brings to pathological options of regulation also in other elements of the system due to reduced range of "permitted" reaction options. In the course of further development of deadaptation, psychic, psychomotor or psychosomatic disorders, or their combinations are observed in structure of neuroses, anomalies of personality development, psychosomatic disorders. On the other hand, organic neurological pathology, despite being the factor of "predisposition" for development of psychosomatic disorders and reducing the resources of the child's mental capability, by far not always brings to development of learning-induced psychosomatic disorders.

Study of schoolchildren having psychosomatic disorders without non-harmonic profiles of learning activity regulation has indicated that unfavorable family circumstances (divorce, death of a close person), injuries, surgeries or severe infections played role in development of the disorder.

4. Conclusion

Connection has been proven to exist among the conflict between biologic regulation and social control of schoolchildren's learning and risk of them developing psychosomatic disorders. The role of immaturities of vegetative and cognitive regulations of the dominant activity in appearance of such conflict has been identified. Causes of immaturity of vegetative and cognitive regulations are related to problems of perinatal nature and their unsatisfactory compensation in the process of postnatal development.

The study has revealed that approximately 80% of risk group schoolchildren have immaturities of vegetative and/or cognitive regulations. Their root causes are related to problems of perinatal nature and their insufficient compensation in the process of postnatal development. Approximately 20% of schoolchildren have borderline individual features of regulation, which fail to comply with requirements of the learning process. A pedagogic
design of education environment, where method of control complements the laws of neural and psychic self-regulation, is required to prevent risks of psychosomatic disorders development.

The obtained results have established the basis for pathogenetically justified modeling of the learning process. It has been proven that orientation of the learning process at prevention of control stress allows reducing the development of psychosomatic disorders by more than 2 times using only pedagogical means, without medications and in the course of learning. We propose to supplement the international health monitoring project Fresh with indicators reflecting the trend of immaturities in cognitive regulations and manifested sympathicotonia and vagotonia, as a reflection of implementation of health-preserving capacities of the learning process.

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