Neurophysiological Disorders at Chronic Stresses in Cadets and Their Prevention

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Abstract: The aim of this study was to investigate the features and development of functional neurotic responses among adolescents, to elaborate practical recommendations for preventing neurophysiological disorders and neutralizing their effects. Based on the statistically representative data obtained from healthy adolescents, a positive correlation between the formation of adaptive responses and perinatal & family situation, interpersonal, and living conditions (e.g., birth pathology, poor living conditions, parental divorce, incomplete family, family relationship problems), as well as a number of extremal factors (e.g., emotional stress, studying conditions, interpersonal relationship) that disclose the ethiological factors inducing borderline neuropsychic disorders was detected. The use of biological feedback based on electroencephalography allows one to perform the correction of neurotic responses, resulting in a decrease in vegetative disorders and improvement of the general psychophysiological condition of adolescents. In adolescents with somatic disorders, more pronounced shifts from the vegetative nervous system are observed at the disadaptation stage, which presumably is one of the factors contributing to the emergence of a disease or its exacerbation under stress.
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1. Introduction

Functional disorders in higher nervous activity (HNA) are caused by chronic stress, genetic defects, functional disorganization of the neuronal microsystems, excitatory and inhibitory elements of the human cerebral cortex 1–7.

Human activity is always associated with social interactions, and its target orientation can differ dramatically from that of biological protective responses. This not only enhances the role of physic factors in the formation of the stability mechanisms but also results in the fact that there can be some contradictions between an individual as a biological unit and a member of a society. The problem of behavioral deviations under modern conditions has become so urgent that it can be referred to as the problem of first priority in post-Soviet countries.

The tense political and socioeconomic situation characterizing the critical points in the development of social relations directly contributes to the increase in the number of various deviations of personal development and behavior of individuals. It can be specifically observed in adolescents, in whom the features of psychic and physical development increase the activity level of functional systems that enhance the adrenergic effect and, in particular, enhance the cardiovascular responses. This dynamics of physiological functions corresponds to the intensive mobilization of energy resources of the organism and is considered by a number of researchers to be unfavorable 8–14.

The mobilization frequently results in overstrain and exhaustion of the regulatory mechanisms, in the emergence of borderline pre-pathological and pathological conditions. With allowance for a variety of etiological factors and the features of their manifestation and course, different forms and variants of neurotic responses, reactive conditions, neurosis- and psychopathology-like disorders, neurotic and behavioral syndromes associated with the effect of physical factors are classified as borderline disorders. Hence, this problem cannot be confined to physiology or neurology only; its resolution is tightly connected with a number of other disciplines: social, mathematical, and other sciences. Physiology of the human brain is currently becoming tighter connected with psychology; one of its branches, neurophysiology, allows one to get a deeper insight into the mechanism of brain function. Being a border discipline, it contributes to an equal extent to both psychology and physiology.

It is important to detect the cause-and-effect relationships that are responsible for the strategy of

adaptive responses, which determine the contents and structure of these responses, their target orientation and intensity. During the late adolescent age, when the development of certain systems of the organisms (primarily, of their psychics) has not been completed yet, the conditions for changes in normal response of the nervous system to the external and internal factors are formed. In other words, there emerges a certain degree of disadaptation. The concept of disadaptation frequently includes not the deterioration of protective responses, but a condition of the organism under which it cannot cope with the social tasks set.

The published data indicate that the clinical presentation of this condition has been mostly investigated, while its neurophysiological and psychological mechanisms have been hardly studied. Neither has their intensity been compared to the external and internal factors. In this context, the combined use of the neurophysiological, clinicostatistical, psychological, and mathematical methods to study the regular tendencies in the formation and distribution of neurophysiological disorders will allow one to outline the range of adolescents who will demonstrate poor adaptation to various factors and conditions due to their individual characteristics, familial, household, and social factors. In turn, this will allow one to substantiate and systematize the measures for primary prevention of the borderline disorders and to elaborate the recommendations to improve interpersonal relationships and to eliminate the exposure to chronic extreme conditions so that a harmonically developed personality could be formed.

This work is aimed at studying the features and development of functional neurotic responses among adolescents, elaborating practical recommendations to prevent neurophysiological disorders and to neutralize their effects.

2. Material and Methods

Conditions for conducting the study and methods of studying neurotic responses. The study was conducted in educational institutions of the Republic of Kazakhstan. A total of 3,000 individuals of late adolescent age (16–21 years), who studied in the higher education institutions, were examined. Moreover, patient medical records of the adolescents, who had been diagnosed with various somatic disorders, were subjected to dynamic analysis; the total number of patient medical records was 110.

Electroencephalography (EEG) was used to assess the functional state of the brain. Monopolar EEG was recorded using the international 10/20 system15 in individuals at rest. The results of studying biopotentials of the brain were analyzed with allowance for the classification of EEG types.

The state of vegetative tonus was determined using the integrated indices (ECG, AP, Kerdo index, and Hildebrandt index).

The vegetative reactivity characterizing the response to external and internal stimuli was studied using the Dagnini–Aschner (eyeball-heart) reflex and the sino-carotid reflex. Functional status of the vegetative nervous system was studied using the orthoclinostatic test 16. The Kerdo vegetative index (VI) was calculated using the following relationship: VI = (1 – D/HCF) x 100, where D is the diastolic pressure; HCF is the heart contraction frequency per min.

At the point of complete vegetative equilibrium (eutonia) in the cardiovascular system, VI = 0. If the Kerdo index value has a positive sign, sympathetic effects are predominating; the negative sign means an increase in the parasympathetic tone.

The Hildebrandt index (i.e., the ratio between the heart beat rate and the breathing rate) is calculated as follows: Q = HCF/NB, where HCF is the heart contraction frequency per min; NB is the number of breaths per min. If the index is equal to 2.8–4.9, it attests to the fact that the intersystemic relationship is normal. The divergence of these indices indicates that there is a disagreement in the activity of individual visceral systems.

The evaluation of the vegetative reactivity based on the Dagnini–Aschner eyeball-heart reflex was carried out as follows: an ECG was recorded for 1 min in individuals who had preliminarily lied at rest for 15 min. The HCF value per min (initial background) is calculated. Next, both eyeballs are pressed through closed lids until an individual feels a mild pain. Deceleration of the HCF by 6–12 beats per min is assumed to be the normal vegetative reactivity; a stronger deceleration (parasympathetic, vagal reaction) is interpreted to be the increased vegetative reactivity; insufficient deceleration – reduced vegetative reactivity; no deceleration at all – perverted vegetative reactivity (sympathetic reaction).

The procedure of inducing the sino-carotid reflex is as follows: the HCF value per min (initial background) is calculated in individuals after the 15-min stage of adaptation (at rest). Then the upper third of *m. sternoclaidomastoideus* somewhat lower the mandibular angle is alternatively pressed (after 1.5–2 s) with fingers (forefinger and thumb) until pulsations of the carotid artery are felt. It is recommended to start pressing on the right side, since the stimulation effect is known to be stronger in the right side. Pressure is to be imposed for 15–20 s; it is to be very slight and cause no painful feelings. Starting on the 15th s, HCF is recorded for 10–15 s. Deceleration in

the HCF to 12 beats per min after 10 s is considered to be the norm. The higher values attest to an increased vegetative reactivity; i.e., to an increase in the parasympathetic or insufficiency of the sympathetic activity. The lower values indicate that the vegetative reactivity is reduced.

The vegetative homeostasis is studied as follows. The CHF and AP values were measured in an individual at rest in a horizontal position. Then, the patient slowly stood up without making additional movements and stood next to the bed in a comfortable position. The pulse rate and arterial pressure (AP) were immediately measured in the individual in a vertical position, followed by measurements during 10 min with a 1-min interval. The individual tested could stay in a vertical position for 3–10 min. If pathological changes are observed by the end of the test, measurements should be continued. Then the patient is made to lie down; AP and HCF values are measured immediately after he/she takes a horizontal potion (1-min intervals) until these indices reach the initial values. In the normal condition, when an individual stands up, a short-term increase in systolic pressure to 20 mm Hg, a less significant increase in diastolic pressure, and a transient increase in HCF to 30 contractions per min are observed. If AP decreased by more than 10–15 mm Hg, vegetative homeostasis was considered to be insufficient. Vegetative homeostasis was considered to be excessive if systolic AP increased by more than 20 mm Hg, HCF increased by more than 30 contractions per min, the patients experience blackouts and congestion in the area of the head at the instant of standing up.

Certain other anatomic and physiological indices were also measured in the adolescents (body weight, height, chest circumference, vital capacity of the lungs, etc).

The functional state of the cardiovascular system in adolescents was examined using the indices of systolic (SAP), diastolic (DAP), and pulse (PD) arterial pressure, heart contraction frequency (HCR) per minute, stroke volume (SV), and minute volume of blood circulation (MVBC).

The minute volume of blood circulation was examined indirectly using the following calculations:

AP amplitude = APsyst – APdiast;

APav. = (APsyst – APdiast)/2;

APred. = AP amplitude / APav. x 100;

MVBC = APred x HCF,

where MVBC is the minute volume of blood circulation; APav is the average AP; APred is the reduced AP.

When evaluating the data obtained by examination of healthy adolescents we were guided by the main provisions of the probability theory, the law of large numbers and specialized calculation tables 17. The procedure included the elaboration of a specialized questionnaire about the neuropsychic state of the adolescent cohort under study, a logical program to establish the correlation between the items, which was required to process the data using specialized software “Anketa”.

The basis of the study, “Questionnaire for Evaluation of the Neuropsychic State” contained the sections that included 54 large items to question cadets 3. Most sections were subdivided into a number of additional features. In order to make computer-aided statistical processing of the resulting data simpler, each item and each feature was attributed to an individual reference number. In addition to personal details (last name, first name, patronymic name, examination date, nationality, sex, place of residence), the questionnaire included the professional detail section and other sections that appeared to be significant for the study.

Special attention was paid to systematization of familial & household and social & professional factors and to the content of neurotic (non-adaptive) responses, which were the basic ones to solve the tasks of this study.

The group of familial & household factors comprised the following items: birth, living conditions, characteristics of the family before an individual reached the age of 18, relationship between the parents before an individual reached the age of 18, marital status, relationship in the individual’s own family.

The group of social & professional factors included such positions as education, occupation, occupational hazards, characterization of physical efficiency, degree of nervous strain at the workplace, frequency of conflicts at the workplace, work capacity, etc.

The neurotic responses in the adolescents were systematized using the previously designed software “Anketa”, which was based on the procedure proposed. As a result, the main groups of neurotic responses were distinguished: asthenic, obsessive, and hysterical, which in turn were classified as “all”, “pronounced”, and “mildly pronounced” with respect to the intensity of their manifestation. It is these groups and types of responses, which were revealed in almost healthy adolescents, that were used as a base for the in-depth clinicostatical and social-physiological examination and discussion of the conditions under which early indicators of functional disorders of the higher nervous activity are formed in healthy adolescents. However, these manifestations cannot be assessed as pathological conditions and turn out to be responses that may be transformed into more severe borderline

neuropsychic disorders only under certain negative effects of the environment.

The aforementioned adolescent groups were analyzed in connection to the age, familial & household and social & professional factors, which made it possible to determine the regular tendencies in their interrelationship and interdependence (which have not been studied earlier in the mass experiment).

The logical program "Anketa" to establish the correlation between the items included the necessity of processing the data in such a manner that the dependence between the emergence and variation of the adaptive reactions on a combination of familial & household, social & professional, and other factors and living conditions of the adolescents.

The program for statistical processing of the data included mathematical justification of the experimental design; the use of procedures to assess the reliability of an indicator and the difference between the indicators; and the determination of the confidence coefficient. When necessary, it was supplemented with correlation procedures, including the variance analysis. The statistical indicators of the results were processed on a PC using the standard software based on parametric and non-parametric statistics for Windows: Excel 97, Statistics for Windows v. 4.01. The correlation and regression analysis was used to reveal the existence and character of dependence between the indicators.

3. Results

Efficient social performance upon possible insignificant deviation of the average mental health indicators with possible self-correction under varying environmental factors is not considered to be pathological. These conditions are known as psychophysiological responses, with which an individual is supposed to cope (it is one of the main aspects of psychoadaptation of individuals).

Insignificant duration, broad variability and instability, detection polymorphism and maximal formation during adolescence, episodicity with respect to reduction, dependence upon personality and premorbid properties are the characteristic features of these responses. They can be formed as independent features or as a component of psychopathology of borderline neuropsychic disorders 3, 4.

The study performed using neurophysiological, clinicostatistical, social-hygienic and mathematical methods allowed us to obtain statistically reliable data concerning the distribution of neurotic responses among the examined cohort of adolescents, the features of their emergence, the dynamics among adolescents, and the effect of a number of familial & household and other environmental factors on their formation.

When evaluating the resulting data, we were guided by the main provisions of the probability theory, the law of large numbers, variance analysis, and specialized calculation tables compiled by A.Ya. Boyarsky 17, which ensured the statistical representativeness of the observations during the analysis.

In order to implement this task, virtually healthy adolescents were interviewed over the period of 1980–2002; the data required for the study were recorded into the specialized questionnaire.

The individuals were ensured not to be the patients with neuropsychic disorders (medical records in out-patients clinics of Karaganda were inspected).

A total of 3,000 individuals have been examined. After the logical and mathematical software had been designed and the data had been subjected to computer-aided processing, it was ascertained that 63.92% of these individuals had no abnormal responses; while 36.08% of individuals observed these responses. Among them, 21.45, 11.31, and 3.32% of the individuals experienced asthenic, obsessive, and hysterical responses, respectively.

After using the main provisions of the sample procedure, which was widely used to provide a complex study of the adolescent health 18, 19, we acquired an opportunity to establish the regularities in distribution of neurotic reactions among healthy adolescents. This approach (provided that the mathematical laws are obeyed) allows one to extrapolate the revealed regularities of distribution of disadaptive responses among the examined cohort of healthy adolescents onto all adolescents of this age (the total population), which is associated with the fundamental novelty.

Neurotic responses were revealed in 1263 (12.63%) of all adolescent students. In accordance with specialized calculation tables 17, the 2% error threshold was used to plan a sufficiently representative number of observations (the allowable threshold being 1–10%). With allowance for statistical reliability of 2t, for the indicator = 12.63% and the error threshold of 2%, the number of observations is to be equal to 900. A total of 1263 individuals who exhibited neurotic responses have been examined (i.e., the degree of confidence was higher than 3t (99.7%)).

The examination of the entire cohort of adolescents revealed 751 individuals (7.51%) with asthenic responses, 396 individuals (3.96 %) with obsessive responses, and 116 individuals (1.16) with hysterical responses. With allowance for the starting data of the same calculation tables and the specified error threshold (2%), under condition that the statistical reliability is at least 2t, we are supposed to have 650, 300, and 100 observations with asthenic, obsessive, and hysterical responses, respectively. It

can be easily seen that the data obtained exceeds the values required to ensure a fairly good representativeness.

Guided by the main provisions of the probability theory, the law of large numbers, and the calculation tables to determine the reliability of the number of observations and statistical indicators, we used the data that are reliable both for revealing all the neurotic responses in general and their individual forms.

The following regular tendencies of the development of neurotic responses among healthy adolescents were observed:

a) asthenic responses were developed in the first instance: their frequency predominated over that of the obsessive and hysterical responses by 1.2 and 22 times, respectively.

b) obsessive responses were developed in the second instance: their frequency was higher than that of hysterical responses;

c) the frequency of hysterical responses was insignificant.

Adolescence is one of the most important variables characterizing the fluctuations in the frequency of development of neurotic responses – the favorable soil for the development of borderline neuropsychic disorders.

As a psychological trauma interacts with the characterological properties of a personality, there emerges neurotic conflict, the major link of the neurotic mechanism. There are three types of conflicts:

1) exaggerated personal ambitions that combine with underestimating or totally ignoring the real conditions or claims of surrounding people (is typical of hysteria);

2) a person's own inner tendencies and demands are inconsistent; struggle between the aspiration and the obligation, between the moral principles and personal affections (is typical of obsessive–psychoasthenic disorders);

3) contradiction between a person's capabilities and its aspiration, self- exactingness (is typical of neurasthenia).

The development of neurotic responses can be schematically represented to comprise two stages. The abnormal responses to external and internal stimuli (stress situations) of the environment were initially expressed as instable, fragmentary, inadequate responses (i.e., weakly pronounced neurotic responses). The properties of an active response – a specific feature of an abnormal response (inadequate response) – were subsequently acquired and anchored, which manifested itself as a strictly outlined complex of pronounced neurotic reactions (e.g., irritability, exhaustibility, phobic and sensomotoric responses).

When discussing the factors causing neurotic disorders, preference is typically given to the familial & household and social & professional factors 20.

Meanwhile, no studies that would be focused on the effect of familial & household and extremal factors on the development of abnormal responses in adolescents have been published thus far. In order to fill this gap, we have studied the correlations between the perinatal hazards, living conditions, integrity and breakdown of their families, marital status, the character of interrelations between their parents, emotional overstrain, work capacity, degree of typical nervous strain, frequency of conflicts, physical activity, and state of the mental health in persons who exhibited the neurotic responses.

An analysis of these interrelations conducted using the statistically representative data is based on revealing the frequency of emergence of neurotic responses. It has demonstrated that unfavorable familial & household and extremal factors had a substantial effect on the psychics of the examined adolescents, which was confirmed by high repetition factor of the responses, degree of statistical reliability being $t = 4$, $P = 99.99\%$ for asthenic responses; 99.7% for obsessive responses; and 95.5% for hysterical responses.

In order to deepen the correlation analysis, the neurotic responses were classified in a number of subgroups according to the clinical principle. The asthenic responses included irritability, exhaustibility, dyssomnic and vegetovascular responses. The obsessive group included the phobic, abstract, and contrastive obsessive reactions. A variety of hysterical responses were classified into three groups: vegetosomatic and sensomotoric responses, attacks.

The features of emergence and development of neurotic responses exhibited a number of statistically reliable correlations: the perinatal conditions promoted the formation of asthenic responses (irritability, exhaustibility, dyssomnic and vegetovascular), obsessive-phobic (phobic), and hysterical (vegetosomatic and sensomotoric) responses. The unfavorable living conditions facilitated the formation of asthenic and obsessive-phobic responses. A single-parent family (either mother- or father-headed) caused the formation of asthenic (irritability, exhaustibility) and hysterical responses. An incomplete family (father and stepmother) caused the formation of obsessive-phobic responses. Bringing up by grandparents resulted in formation of asthenic reactions. Living in families where either mother or father or both parents had died before a child reached the age of 18 more

frequently resulted in the formation of asthenic reactions (irritability; exhaustivity; vegetovascular and dyssomnic responses, respectively). The obsessive-phobic reactions emerged because of the living conditions in families where either mother or both parents died before a child turned 18 (phobic responses). Living in conditions when father left the family before a child turned 18 resulted in the development of hysterical responses (vegetosomatic and sensomotoric responses). A divorce was a reason for the formation of asthenic, obsessive-phobic (phobic and abstract obsessive), and hysterical (vegetosomatic and sensomotoric) responses. The formation of asthenic responses was promoted either by regular conflicts in one's own family (irritability, vegetovascular responses) or by instable relations in one's own family (irritability). The development of obsessive-phobic responses was promoted by episodically conflict relationships that disturbed the integrity of the family (phobic responses), cool (formal) relationships (abstract obsessive responses). The formation of hysterical responses was caused by conflict relationships disturbing the integrity of the family (vegetosomatic and sensomotoric responses), cool and instable relationships in one's own family (sensomotoric responses). Emotional overstrain due to dissatisfaction with studying and living conditions were the reasons for the formation of asthenic responses (irritability, exhaustivity, vegetovascular and dyssomnic responses). The obsessive-phobic responses emerged because of the dissatisfaction with service conditions (phobic and abstract obsessive responses). The asthenic, obsessive and hysterical responses formed because of the development of overstrain in adolescents.

Neurotic (abnormal) responses were exhibited almost identically under all the extremal conditions mentioned above. The high Spearman correlation coefficient attested to strong relationship between the familial & household, extremal factors and the frequency of emergence of abnormal responses.

Thus, the perinatal hazards (birth asphyxia, prolonged dry labor, the use of mechanical methods of obstetric aid, etc.); unfavorable living conditions; deterioration of familial conditions and changes in upbringing because of an incomplete (disintegrated) family before and after the age of 18, divorce, unfavorable interrelations between the parents and in one's own family, emotional overstrain, work capacity, degree of typical nervous strain, frequency of conflicts, and physical activity are the reasons that disturb harmonous psychic functioning.

The revealed tendencies of formation of neurotic responses support the role of familial & household and social & professional factors 14.

We used the same scheme of the analysis of neuropsychic condition to study the role of familial & household and extremal factors in the formation of abnormal (neurotic) responses in 500 adolescents graduating from higher education institutions.

The living conditions of adolescents give rise to a number of factors that substantially affect their organisms and, in particular, their central nervous activity. This fact requires the elaboration and specification of the measures to carry out psychic adaptation among adolescents, improvement of the psycho-emotional "climate" and the corresponding conditions for psychic development starting from the earliest period of one's life. Thus, the knowledge of the transient conditions from well-being to a pathology and their significance for the emergence of familial & household and extremal factors offers broad opportunities for the adequate adaptation of the organism to the conditions of student environment in order to retain one's psychic health and prevent the emergence of borderline neuropsychic disorders.

Severe psychic traumas may result in the development of somatogenic diseases even in individuals with a balanced nervous system.

In our case, the process of development of somatic disorders associated with asthenization of the nervous system among virtually healthy adolescents has been studied. A total of 110 individuals with somatic morbidity have been detected. Among those, 70 individuals underwent regular medical check-up with: chronic gastritis – 74.28%; chronic cholecystitis – 5.72; duodenitis – 11.43%; vegetovascular dystonia – 7.15%; biliary dyskinesia – 1.42%. The symptomatology was more pronounced in the remaining 40 patients: gastric ulcer – 30%; gastritis (various disturbances of the secretory function) – 50%; vegetovascular dystonia of the hypertonic type – 10%; vegetovascular dystonia of the cardiac type – 5%; essential hypertension – 2.5%; and toxic goiter – 2.5%.

An intensive formation of neurosis-like responses during the adolescence can be explained by the fact that a person undergoes growth and maturation stages, which determine the organism development in ontogenesis and, of course, the level of personal transformation.

The formation of neurotic responses during adolescence demonstrates that certain systems of the organisms have been insufficiently developed (in particular, psychics or its involutions). It is not a mere chance that it is during these periods that the corresponding morphofunctional brain systems are most sensitive to unfavorable conditions of the external and internal environment. The changes in the normal type of responding of the nervous system to the factors of the internal and external environment primarily manifest themselves as the development of

asthenization. The major contribution to it is made by psychogenic effects of the external environment.

Based on these findings, the conceptual model of variation of the adaptive responses to the conditions of external and internal environment in adolescents has been proposed.

The conditions of specialized educational institutions, changes in the environment, familial & household factors, and biological constitutional factors facilitate the development of stress for a young organism and subsequent disturbance of the integrative brain function. It results in the dysfunction of the limbico-reticular complex, which manifests itself as a disturbance of the relationship between the activating and deactivating or ergo- and trophotropic systems.

Hence, the insufficient integrity of brain function and vegetative shifts result in the disturbance of homeostasis (including brain homeostasis), which results in variation of the adaptive responses of the entire organism.

The features of the adaptation processes in humans with respect to acute and chronic stress factors manifest in a regular manner. The mechanisms have been developed during the evolution, which are the most stable with respect to the acute factors and less stable with respect to the chronic extremal situations. There are three possible variants of the adaptation process in humans as a biosystem:

a) acute adaptation process and recovery of the response;

b) transition of an acute process into the chronic one and changes in the responses of a biosystem to adequate and inadequate chronic extremal conditions of the environment;

c) death of a biosystem (an organism).

The variation of adaptive responses during adolescence attests to the insufficient development and instability of certain systems of the organism (in particular, of the vegetative nervous system, psychics, and cortico-subcortical relations). It is not a mere chance that the corresponding morphofunctional brain systems exhibit the highest sensitivity to unfavorable conditions of the external and internal environment during this period.

The adaptation to external stimuli can be represented as continuous processing of the data at the highest level of evolution of living beings in the nervous system of humans and animals, as "processing of a continuum of effects having no jump-wise discontinuities in space and time" 21.

Thus, the conditions of living in higher education institutions result in the emergence of a number of factors that have a rather significant effect on the organism of adolescents and, in particular, on their nervous system. This fact requires specialized measured for psychic adaptation of adolescents, improvement of the psycho-emotional "climate" and the corresponding conditions for psychic development starting from the early age to be elaborated and concretized. Thus, the knowledge of the transient conditions from well-being to a pathology and their significance for the emergence of familial & household and extremal factors offers broad opportunities for the adequate adaptation of the organism to the conditions of increased psychic and physical strain in order to retain one's psychic health and prevent the emergence of borderline neuropsychic disorders.

4. Discussions

The aforementioned data can be used to draw the following remarks: investigation of the adaptive reactions in connection with the causal factors among almost healthy cadets using neurophysiological, clinicostatistical, and mathematical methods enabled revealing the character of changes in them and to make it possible to conduct primary prevention of borderline neuropsychic disorders with allowance for the peculiarities of the adaptation of adolescents to the environment.

The use of neurophysiological and clinicostatistical studies allows one to identify the most significant etiological factors for the emergence of borderline forms of neuropsychic disorders.

First-year cadets (month 1.5–2 after the beginning of study) exhibit neurotic responses of asthenic, obsessive, and hysterical types, which are pronounced to a higher degree in adolescents who entered the institute after they had graduated from school as compared to the adolescents who had already had some work experience.

In first-year adolescent students of higher education institutions, one of the mechanisms of the emergence of the disadaptation state of asthenic form is related to the emergence of vegetative dystonia syndrome (the sympathetic form predominating). Upon the obsessive-phobic reaction, the role of the parasympathetic nervous system increases in addition to a considerably high contribution of the sympathetic nervous system.

Neurotic responses in adolescents to stress are induced by intrasystemic disintegration in the cortico-limbico-reticular complex and are characterized by a decrease in amplitude of the alpha rhythm and an increase in slow-wave activity in EEG.

The formation of adaptive responses among healthy adolescents occurs as follows: in the first instance, asthenic responses emerge (their frequency is higher than that of the obsessive and hysterical responses by 1.2 and 22 times). In terms of their

intensity, the adaptive responses can be subdivided into the pronounced (79.76%) and mildly pronounced (20.24%) ones. Asthenic and obsessive responses are mostly pronounced; while mildly pronounced responses are predominant among the hysterical-type responses.

The educational process involves not only training of highly skilled specialists but also improvement of their health: at months 1.5–2 of the study process, the number of absolutely healthy individuals was 57.9%; after 1 year, 72.0%; after 4 years of study, 98.6%.

A smaller number of individuals exhibiting the neurotic reactions was observed among the adolescents who were born in the mountainous regions; they also demonstrated faster recovery of the adaptation potential during the educational process.

A positive correlation between the formation of adaptive responses and perinatal, family & situational, interpersonal, living-and-household conditions (birth pathology, poor living conditions, parental divorce, incomplete family, family relationship problems), as well as a number of extremal factors (e.g., emotional stress, studying conditions, interpersonal relationship), which disclose the etiological factors inducing borderline neuropsychic disorders, has been detected among healthy adolescents using statistically representative data.

The use of biological feedback based on EEG allows one to correct neurotic responses in order to reduce vegetative disorders and improve the general psychophysiological state of adolescents.

In adolescents with somatic disorders, more pronounced shifts from the vegetative nervous system are observed in the disadaptation state, which presumably is one of the factors facilitating the emergence of the disease or its exacerbation under stress conditions

These findings can be used to give the following practical recommendations:

1. Ordering interpersonal relations, providing compatibility (both physiological and psychological) in the family and educational groups, reducing emotional stress, eliminating overstrain, systematic individual education. Psychological preparation providing stress neutralization significantly contributes to prevention of neurotic responses.

2. In order to eliminate the negative effect of the conditions of higher education institutions on the psychic condition of adolescents and to prevent the emergence of neurotic responses, the following prevention measures should be taken: correct psychophysiological professional selection; efficient psychophysiological professional orientation that corresponds to the capabilities and individual structure of an individual; individual approach when solving either a certain individual can perform the designated work by conducting the personality test; psychological preparation aimed at strengthening the most significant professional qualities and preventing emotional overstrain of the neuropsychic and cardiovascular systems.

3. Early detection of indicators of an unfavourable course of pregnancy and elimination of pre- and perinatal traumatism; early organization of thorough surveillance of the children who were born with abnormalities in the labor, aimed at elucidating the initial features of changes in nerve function and preventing the formation of neurotic responses; improvement of children's health; family protection (prevention of family breakdown); structurization of intra-family relationships (fostering of high consciousness, morality and culture between the spouses); elimination of interpersonal conflicts via the advocacy disclosing the negative effects of the conflicts in families on the surrounding people and the negative impacts of family breakdown on neuropsychic health of children; improvement of living conditions (elimination of living in overcrowded conditions); prevention of alcoholic and familial & household neurotization of children, adolescents, young men; foresting of the will and habits of overcoming difficulties during early childhood.

4. Prevention of neurophysiological disorders via the elimination of intellectual and emotional overstrain, reduction of specific risks (response stress) associated with an acute effect of professional extremal conditions; creation of the adequate conditions for studying and simultaneous reduction of physical, intellectual, emotional, and neuropsychic overstrain; elimination of interpersonal conflicts at work, thorough professional selection; dispanserization of the adolescents with undergoing chronic extremal effects; and conducting health promotion programs using training with biological feedback among individuals with neurotic responses.

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