INFLUENCE OF NEUROPSYCHOLOGICAL STATUS ON BODY SCHEMA IN EATING DISORDERS

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The study of neuropsychological features that cause eating disorders may provide a starting point for planning complex studies that allow for integral assessment of the internal and external mechanisms and patterns of eating disorders. The work aims to evaluate the influence of the neuropsychological status on features of the body schema in eating disorders. We conducted an analysis of the subjective and objective indicators of the body image on 51 women aged 20–35 years using face-relative hand position reproduction tests, the "Silhouette" method, measurement of the right hand index finger diameter and of the foot length, and a self-image questionnaire. We carried out qualitative and quantitative assessment of the neuropsychological status using the Luriev test battery. For the analysis of control functions, we used the Wisconsin sorting card test, Cantidad-Numér interference task (Canum), and "Block Span". We found that women with atypical eating behaviors noted the following features associated with a subjective attitude towards their own body: prevalence of dissatisfaction in one's emotional evaluation due to the perception of one's own appearance, stemming from the beliefs and ideas about one's ideal appearance, despite the absence of the abnormalities associated with the objectified ideas of one's own body (weight, size, body proportions). We identified modal-nonspecific control function deficiencies characteristic of different types of eating disorders.

Keywords: neuropsychological status, eating disorder, body schema

Author contribution: all authors contributed equally to study design, literature review, data collection, analysis, and interpretation.

Compliance with ethical standards: the study was approved by the ethics review board of the Federal State Autonomous Educational Institution of Higher Education Pirogov Russian National Research Medical University of the Ministry of Health of Russia (protocol # 211 of 18 October 2021) and carried out in accordance with the requirements of the Fundamentals of Legislation "On the protection of the health of citizens"; All participants signed a voluntary informed consent for the examination.

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ВЛИЯНИЕ НЕЙРОПСИХОЛОГИЧЕСКОГО СТАТУСА НА ОСОБЕННОСТИ СХЕМЫ ТЕЛА ПРИ НАРУШЕНИИ ПИЩЕВОГО ПОВЕДЕНИЯ

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Исследование нейропсихологических особенностей, обусловливающих нарушение пищевого поведения, может дать отправную точку для построения комплексных исследований, позволяющих осуществить интегральную оценку внутренних и внешних механизмов и закономерностей нарушения пищевого поведения. Целью работы было выявить влияние нейропсихологического статуса на особенности схемы тела при нарушении пищевого поведения. Обследовали 51 женщину в возрасте 20–35 лет. Оценку субъективных и объективированных показателей образа тела проводили с помощью проб на воспроизведение положения руки по отношению к лицу, методики «Силуэт» и изображения диаметра указательного пальца правой руки и длины стопы, опросника образа собственного тела. Качественную и количественную оценку нейропсихологического статуса осуществляли с помощью Луриевской тестовой батареи. Для анализа управляющих функций использовали Висконсинский тест сортировочных карточек, «Cantidad-Numer interference task» (Canum), «Block span». По результатам исследования было установлено, что у женщин с выраженными типами пищевого поведения, рассматриваемыми как граница нормы, отмечены особенности, связанные с субъективным отношением к собственному телу: с одной стороны, преобладает неудовлетворенность, которая включает в себя эмоциональную оценку, чувства, связанные с внешностью, и убеждения и представления об идеальной внешности; с другой стороны, отсутствуют нарушения, связанные с объективирующими представлениями о собственном теле (вес, размер, пропорции). Выявлены модально-неспецифичные дефициты управляющих функций, характерные для разных типов нарушений пищевого поведения.

Ключевые слова: нейропсихологический статус, нарушение пищевого поведения, схема тела

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Соблюдение этических стандартов: исследование одобрено этическим комитетом ФГАОУ ВО РНИМУ им. Н. И. Пирогова Минздрава России (протокол № 211 от 18 октября 2021 г.), проведено в соответствии с требованиями основ законодательства «Об охране здоровья граждан»; все участники подписали добровольное информированное согласие на обследование.

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To study eating disorders most qualitatively, one must consider the phenomenon in the continuum of norm and pathology. The most blatant manifestation of pathology is summarized by the concepts of "eating disorder" (F50, ICD-10) and "nutrition and eating disorders" (6B8, ICD-11), understood as a class of psychogenic behavioral syndromes characterised by abnormalities in the eating behavior and associated with physiological symptoms. Determining the boundary of the norm is associated with much greater difficulties due to the need to define the concepts of “violation”, “pre-disease”, “donosology” and correlate them with the qualitative and quantitative features manifested in the eating behavior. Aside from the natural and

obvious research- and practice-related reasons for such an approach, we identify one more: in borderline-normal conditions, success of the clinical and psychological assistance will rely on whether the intervention is based on seeing the psychological factors and determinants that underlie the psychogenic nature of the eating behavior as a developing system of phenomena on psychophysiological, neuropsychological, personal, and socio-psychological levels. Thus, by investigating the neuropsychological status on the margins of various types of eating behavior, we attempt to find deficiencies in higher mental functions and to carry out qualitative and quantitative analysis in order to identify systemic characteristics of eating disorders, allowing, in the future, to implement factor analysis that incorporates the neuropsychological point of view.

In research on the degree of disorder severity that allows the affected to remain within the norm, a number of authors identify intermediate states, called "donosology" [1]. Donosology is understood as a change in immunological resistance under the influence of low intensity industrial and domestic factors. Such people are not sick, although assignment to groups with prepathological conditions is recommended [2].

Specialists must timely identify the state of donosology to assist in increasing the body's resistance to adverse conditions [3].

Brekhman singles out the third state as incomplete health, which can last for a very long time and which cannot be identified with premorbid states [4]. Up to half of the entire human population exists in this state [3].

Impaired eating behavior is a broad term, and its characteristics are both substantial and structural. Substantial manifestations include overeating and compensatory energy-consuming forms of behavior (vomiting, abuse of laxatives, diet pills, diuretics, and compulsive weight loss exercises) [1]. These manifestations are habits, which does not allow them to be classified as real disorders, such as anorexia nervosa, bulimia nervosa, atypical eating disorders (or eating disorders not classified elsewhere) [5].

Traditionally, eating disorders are classified as disorders exhibiting the following features:

– a clear change in eating habits or behavior associated with weight control;

– behavior change leading to clinically significant damage to physical health or psychosocial functioning (cardinal symptoms of impaired eating behavior include malnutrition and concomitant overestimation of shape or body weight);

– the aforementioned changes in behavior not being the consequence of any somatic or other mental disorders [6].

The structure of eating behavior as a complex system from the standpoint of determining the safety-violation of the system can be analysed employing the criteria of divergence, coherence, and organization, as proposed in the framework of the metasystem approach to understanding the features of the development and functioning of complex systems, as well as their structural-level organization [7]. Seeing specific forms of behavior, behavior strategies, behavioral patterns as elements of the system at different levels, low divergence is defined as a rigid fixation on a limited number of behavioral food types and strategies, and low coherence is defined as a decrease in the interconnections of both horizontal and vertical elements of the system, which leads to difficulty in flexible switching between them or even complete lack thereof. The disorganization of eating behavior as a system is manifested in the difficulties associated with planning, control and arbitrary regulation of eating behavior [7].

As a rule, three main types of eating behavior are believed to exist: external eating behavior as a reaction to external stimuli, emotional eating behavior as a hyperphagic reaction to stressful situations, and restrained eating behavior as excessive self-restraint and overcontrol [8], the analysis of the severity and stability of which is usually considered as basis for diagnosing the severity of violations. In this framework, disorder is believed to manifest when one of the types of eating behavior [9] begins to noticeably predominate compared to others [6].

In this study we accept the definition of the body scheme as an unconscious internal representation, a complex of information about the structural organization of the body, its dynamic characteristics, the current and changing position of its parts relative to each other, as well as in the horizontal plane [10]. The body scheme is a dynamic subjective entity, since it is formed by the person themselves in the course of their vigorous activity [11]. A person creates a body schema from various manifestations of body awareness in various life situations [12]. The basis of the body schema is a complex of organized information about the dynamic system [13].

Neuropsychologically, the body schema can be considered a functional system, which consists of proprioceptive, gnostic, antipathy-prognostic and control functions.

At the proprioceptive level, the body schema is represented by a joint-muscular feeling and is understood as a complex type of sensitivity that creates the basis for a sense of the relative position and ratio of the sizes of parts of one's own body; the structure of the psyche, reflecting the structure of a person's own body; a flexible, dynamic representation of the subject about his own body, which is continuously created and changed by a person during his life [14]. The gnostic level of the body schema is represented by tactile, muscular, and visual images. Some authors give the following definition:

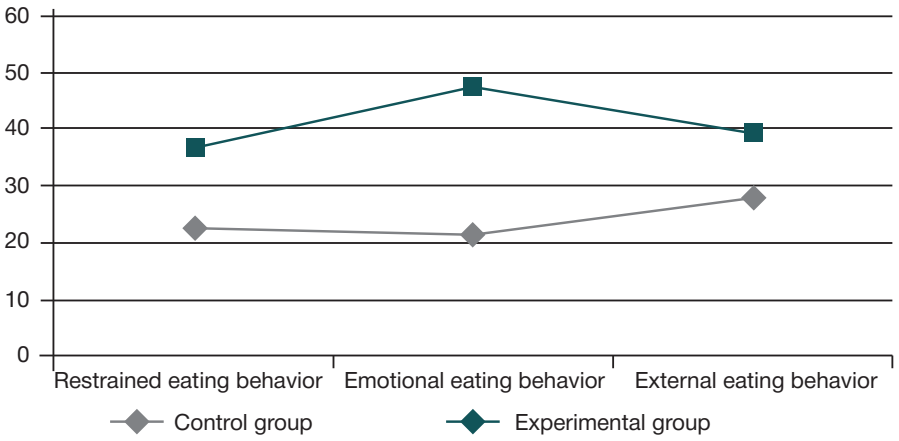

Fig. 1. Diagram of average values of severity of eating behaviors in empirical groups. * — significant difference (i.e. $p \leq 0.05$).

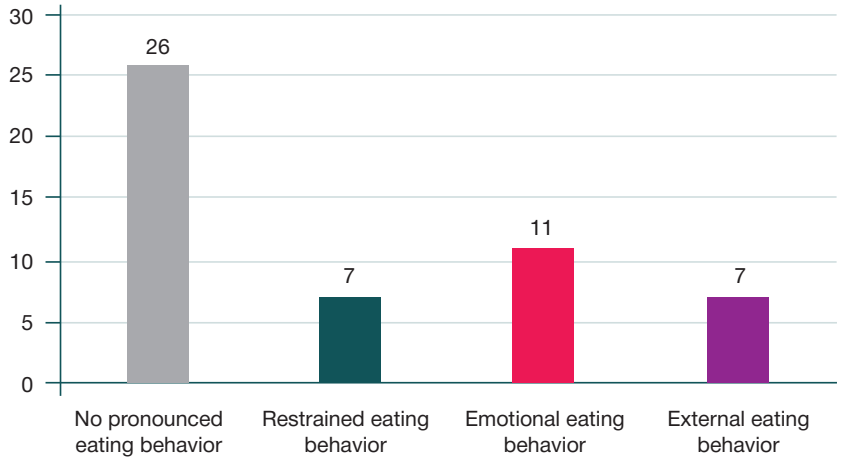

Fig. 2. Diagram of the distribution of the empirical sample in groups

"actively organizing and modifying the impressions produced by incoming sensory signals / stimuli in such a way that the final experience of the position of the body or its location enters consciousness, connecting with what happened before" [15].

Anticipation is understood as the ability of a person to anticipate the course of events with a high probability, predict the development of situations and their own reactions to them, and act with a temporal-spatial lead [16]. Control functions provide arbitrary ways to control behavior: programming, regulation and control [17]. The described level allows for the widest possible analysis and synthesis of ideas about one's own body in the context of the current physical and social situation.

To summarise, we aim to investigate the neuropsychological status on the margins of various types of eating behavior, search for deficiencies in higher mental functions and carry out qualitative and quantitative analysis in order to identify systemic characteristics of eating disorders, allowing to develop a type of factor analysis that incorporates the neuropsychological point of view.

METHODS

The following methods were used: the Dutch Eating Behavior Questionnaire [8]; a test to reproduce the position of the hand in relation to the face [18]; the "Silhouette" technique [18]; image of the diameter of the index finger of the right hand and the length of the foot [19]; self-image questionnaire [20]; Luriev test battery [10]; Wisconsin sorting card test [21]; "Cantidad-Numer interference task" (Canum) [22]; "Block span" [23].

An empirical study on a sample of 51 people (female, age 20–35 years, considered healthy) was carried out from September to December 2021. All study subjects participated voluntarily with informed consent. Experimental group inclusion criteria: >35 points on at least one of the scales corresponding to three different eating behaviors according to the Dutch Eating Behavior Questionnaire: the average value was 36.7 points for restrained eating behavior, 47.7 points for emotional eating behavior, 39.5 points for external eating behavior. In the control group (n = 26), the average values do not exceed 27 points (Fig. 1).

Thus, the total sample was distributed as follows: experimental group 1 (n = 7) — restrained eating behavior; experimental group 2 (n = 11) — emotional eating behavior; experimental group 3 (n = 7) — external eating behavior; control group (n = 26) — no pronounced type of eating behavior (Fig. 2).

RESULTS

As a result of the study of the features of the body schema in eating disorders, statistically significant differences were revealed in the empirical groups in terms of the image of one's own body.

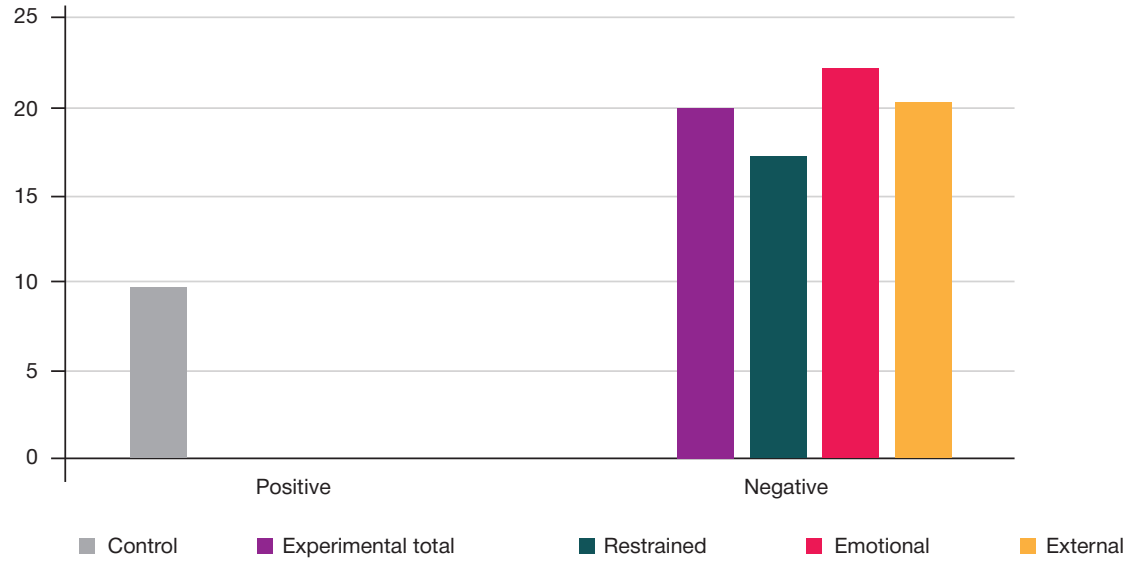

Fig. 3. Diagram of average values of measurements of the image of one's own body in empirical groups

Table 1. Mean values of neuropsychological status indicators (gnosis, praxis, auditory-speech memory) in the empirical groups

	Visual object gnosis			Stereognosis			"Fist-'Side'-Palm" dynamic praxis test			"Fence" graphic test			Oral praxis			Auditory memory	
	Speed	Accuracy	Differentiation	Speed	Accuracy	Differentiation	Speed	Accuracy	Differentiation	Speed	Accuracy	Differentiation	Speed	Accuracy	Differentiation	Speed	Accuracy
Control group (n = 26)	12.4	4	4	4	4	4	3.1	4	4	4.6	4	4	2.8	4	4	3.6	3.5
Restrained eating behavior (n = 7)	16.7	4	4	4	4	4	5.8	4	3.5	4.9	3	4	5.8	4	4	9.3	2.5
Emotional eating behavior (n = 11)	13.4	4	4	4	4	4	3.2	3	3	4.8	2.5	3	3.1	3	3	4.2	3
External eating (n = 7)	14.01	4	4	4	4	4	3.6	3	2.5	4.8	2.5	2.5	3.2	2.5	3	5.3	3

The attitude towards one's own body in subjects with eating disorders is primarily that of dissatisfaction, comprised of two components: an evaluation component includes emotional assessment and feelings associated with appearance, and the cognitive component is comprised of beliefs and ideas about the ideal appearance, a cognitive idea about the body scheme. Dissatisfaction with one's own body is associated with a real change in weight and the sensations generated by this process. Methodologically, the questionnaire aims to make a global assessment of the body, which includes satisfaction or dissatisfaction with one's weight, the shape of the body as a whole and its individual parts.

When comparing the results of the survey in the group without a pronounced type of eating behavior and in the combined group with different severity of types (Fig. 3), the following average values were obtained ($p \leq 0.05$): in the control group, $X_{av.}$ = 9.76 points, i.e., on average, in the group, there is an acceptance of the image of one's body and a positive attitude towards it; in the experimental group, $X_{av.}$ = 19.81 points, i.e. notable dissatisfaction with one's own body, which leads to a significantly low assessment of their appearance ($p \leq 0.05$).

When determining the differences in each of the empirical groups, a significant ($p \leq 0.01$) decrease in indicators associated with satisfaction with one's own body was revealed in groups with emotional ($X_{av.}$ = 22.08) and external ($X_{av.}$ = 20.2) eating behaviors; in the group with restrained eating behavior, a decrease in satisfaction was also noted ($X_{av.}$ = 17.6) at the trend level.

Results of application of methods that objectify the idea of one's own body showed no significant differences between the empirical groups.

To identify neuropsychological features that determine the features of the body scheme, a neuropsychological study was carried out, including an analysis of the state of basic higher mental functions (praxis, gnosis, memory, speech), as well as programming, regulation and control functions (visual working memory, cognitive flexibility, executive attention).

Analyzing in general the results of neuropsychological diagnostics of higher mental functions in the empirical groups, it should be noted that the functions were preserved for all subjects (Table 1). All indicators are within the normal range. Trendwise, however, a steady decrease in the speed in performing tests aimed at studying the features of dynamic

Table 2. Severity of mean values of neuropsychological status indicators (visual working memory, cognitive flexibility, executive attention) in empirical groups

	Visual working memory				Cognitive flexibility									Executive attention		
	Block size	Total score	Amount of correct	Memory size	Correct responses	Total errors	Perseverative responses	Perseverative errors	Corrected errors	Non-perseverative errors	Inability to maintain a set	Ability to learn	Concept-level responses	Mistakes	Speed	Concentration
Control group (n = 26)	6.5	48	9.6	7.2	36	8.1	0*	0	0.7*	0	0	1.29	49.3*	0	8.6	0.67
Restrained eating behavior (n = 7)	5.4	32	4.1	6.4	45	19	17.4*	6.1	16.4*	0	0	–9.01	26.7*	16.4*	19.2*	0.3
Emotional eating behavior (n = 11)	5.3	26	4.6	6.1	53	11	16.2*	7.4	11.8*	1	0	–8.17	21.6*	11.2*	11.4	0.12*
External eating (n = 7)	3.8	34	5.1	3.9	47	17	16.6*	5.8	13.5*	0	0	–14.9	18.8*	15.6*	13.1	0.19*

praxis ($X_{av.}$ = 5.8) and gnosis ($X_{av.}$ = 16.7) for subjects with restrained eating behavior should be noted, in addition to faster exhaustion in the study of auditory memory. It is also necessary to point out a number of cases of the influence of homogeneous interference during delayed reproduction. Subjects in groups with emotional and external eating behaviors characteristically made errors associated with accuracy and differentiation in the following tests aimed at studying serial reproduction: "Fence", oral praxis, and dynamic praxis.

According to the results of the study of visual working memory and executive attention, no statistically significant differences were found among the subjects in the empirical groups (Table 2). At the same time, the control group generally scored higher in total, which indicates greater size and stability of working memory. It should also be noted that in subjects with emotional eating behavior, there is a greater scatter in the average values of visual working memory indicators compared to other empirical groups. For subjects with restrained eating behavior, a monotonically decreasing performance curve is characteristic, which is consistent with previous results of a study of higher mental functions. The subjects of the group with external eating behavior are characterized by a smaller length of the chain of stimuli held in the visual field, indicating reduced visual memory.

The study of cognitive flexibility, based on the results of the Wisconsin sorting card test, showed statistically significant differences in the control group compared to the experimental ones in terms of "perseverative responses" ($p \leq 0.05$), "non-perseverative errors" ($p \leq 0.05$) and “concept-level responses” ($p \leq 0.05$). In the empirical groups, the number of perseverative responses is significantly higher than in the control group. The greatest number of perseverative responses is observed in the restrained eating behavior group. A characteristic feature of all empirical groups is negative learning ability.

The study of executive attention allows us to conclude that rate and attention productivity are significantly reduced in the restrained eating behavior group. Groups with emotional and external types of behavior are characterized by a significant decrease in concentration and productivity.

DISCUSSION

Subjects with pronounced types of eating behavior, seen as only marginally within the norm, noted features associated with a subjective attitude towards their own body: on the one hand, dissatisfaction prevails, which includes emotional assessment, feelings associated with appearance and beliefs and ideas about the ideal appearance, on the other hand, there are no anomalies associated with objectifying ideas about one's own body (weight, size, proportions). The neuropsychological status of subjects in the restrained eating behavior group is characterized by modally nonspecific deficits: test performance speed decrease, exhaustion and homogeneous interference during delayed reproduction, a steady working capacity decrease, inertia, and significantly reduced rate and productivity of attention. The revealed features allow us to conclude that the modal-nonspecific factor predominates, which is associated with a decrease in the dynamic characteristics of control functions with restrained eating behavior. In the group with emotional eating behavior, the features of the neuropsychological status are most often manifested, associated with the accuracy and differentiation of the performance of tests, as well as deficits associated with the retention of the motor program, and serial movements. Visual working memory is characterized by instability, executive attention is characterized by a decrease in concentration and productivity. The revealed features allow us to conclude that the modal-nonspecific factor predominates, associated with a decrease in the controlling characteristics of executive functions in the emotional type of eating behavior. In the group with an external type of eating disorder, along with a decrease in the accuracy and differentiation of the performance of tests, there is a pronounced decrease in the volume of visual working memory, as well as a significant number of perseverative errors and perseverative responses, which indicates a decrease in cognitive flexibility. Executive attention is characterized by decreased concentration and productivity. The identified features allow us to conclude that the modal-nonspecific factor predominates, associated with a decrease in the programming of mental activity in the external type of eating behavior.

CONCLUSIONS

The conducted study can be considered an exploratory stage in studying a broader problem: the construction of a neuropsychological model of control functions that determine the features of the body schema in eating disorders.

The study results allow us to identify the found neuropsychological features as subtle deficiencies in the functioning of the third functional block of the brain (which performs programming, regulation and control over ongoing activities) manifested in the work of a modal-non-specific factor. This can be used to determine the targets of clinical and psychological prevention and eating disorder correction programs.

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