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Morphofunctional and psychological features of girls in refined carbohydrates exclusion from food ration

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ABSTRACT

Overweight precedes obesity initiation which is considered as a complex of hormonal and metabolic disturbances including cardiorespiratory system disturbances, diabetes mellitus 2 type, osteoarthritis, etc. The aim of our research was the study of morphofunctional and psychoemotional features of the girls with different mass-height ratio and motor activity level when excluding the refined carbohydrates from food ration.

Three groups were under the study: girls without overweight (control group), girls with overweight, and sports-girls with normal body weight. A positive dynamics of studied indices was noted in all the groups. The control group was characterized by the changes of morphological (the decrease of total fat rate and chest circumference) and functional indices (the decrease of heart beat rate, tension index) and the improvement of psychoemotional state.

In students with overweight both the most marked decrease of morphological indices (body weight, fat rate, body circumferences) and functional state improvement were revealed in comparison with other groups. In sports-girls group both the reliable hip circumference decrease and the tendency to the decrease of other morphological indices and also the essential vegetative status improvement were observed.

The most marked changes were observed in complex diet impact excluding the refined carbohydrates and physical exertions. The exclusion of the refined carbohydrates from the food ration can be used for overweight correction, the improvement of cardiovascular system state and psychoemotional indices.

Introduction

Obesity is a serious problem in many developed countries among people of all ages and social classes. Russia assumes the 19th spot in the rankings of obesity prevalence in the world (on average obesity is revealed in 25% of population) [1, 2].

Case study related to the obesity has centuries-old history [3]. Obesity is one of the major factors in the pathogenesis of a great number of disorders resulting in invalidity and disability [1]. In obesity the risk of development of such disorders as hypertension, dislipodemia, diabetes mellitus 2 type, obstructive apnea during sleep, cardiovascular diseases, osteoarthritis, etc. is high [4–8]. In persons with overweight or being obese the reproductive performance proved to be forced down [9].

Rational nutrition is one of the most important factors in population health organization. In the excess of carbohydrates and fats

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in food rational the energy amount coming with food exceeds its consumption and positive energy balance takes place. The excess of energy coming through the food is deposited in fat cells (depot) called adipocytes causing the upsizing and the increase of body weight accordingly. In conjunction not only the energy balance is of a great importance but also a quantity, quality, time and principles of food intake [10]. In connection with high food value and low content of dietary fibers one of the major risk factors of overweight gaining is refined carbohydrates [11, 12].

At present students of higher education often purchase the food items in fast food vending machines. The most of food items being sold through the fast food vending machines and sideboards have a high food value mainly due to refined carbohydrates and are characterized by average and high glycemic load along with a low protein content [12].

Excess consumption of refined carbohydrates can be due to the substitution of emotional discomfort, compensating of unsatisfied needs, the absence of nutritional education that eventually results in the decrease of anxiety and brings the feeling of delight [13, 1]. As it is known from the literature girls-students incline to the feeding behavior disorder [14, 15].

While the number of reports devoted to the research of refined carbohydrates influence on different human body parameters within the framework of juvenile stage of ontogenesis especially in females is not sufficient. The research of L.F. Chang et al. points at negative influence of a diet containing high amount of carbohydrates with a liberal share of refined products on insulin secretion in males and females at the age of 20–60 [4] D. Yu et al. studied the correlation between refined carbohydrates consumption level and the risk of stroke development in females at the age of 40–70 [7].

Aim of the Research

The study of morphofunctional and psychoemotional features of the girls-students with different weight-height ratio and activity level when excluding the refined carbohydrates from food ration.

Materials and Methods

Examination was carried out in morphofunctional laboratory of the anatomy, physiology and life activity safety chair, Novosibirsk State Pedagogical University (NSPU).

26 girls-students at the age of 17–26 from NSPU were examined.

3 groups were defined:

1. Girls-students going in for sports in the main group according to the standard program of the university (4 class periods a week) with regular body weight ($20 \leq$ Ketle index (KI) < 25), n = 11 persons. It was a control group.

2. Girls-students going in for sports in special medical group (4 class periods a week) and having overweight (KI ≥ 25), n = 7 persons.

3. Girls-students going in for professional sports of athletics (10 class periods a week) with regular body weight ($20 \leq$ KI < 25), n = 8 persons.

At the first step of our investigation the anthropometric, functional and psychoemotional indices had been studied in girls-students before the refined carbohydrate exclusion was launched. Girls-students were supplied with nutrition guidelines and the list of food items being excluded for the investigation period.

At the second step of our investigation the girls-students were following the offered nutrition guidelines for 2 months:

1. Food items with high refined carbohydrates (sugar, refined flour, pastry (sweet and non-sweet), non-fresh juices in cartos, chocolate, sweet carbonated beverages, etc.) were excluded. Cereals (cereal products), small loafs of bred, whole milled bread without sugar, honey, fruit were offered as substitute food items. The consumption of excluded food items in small amount was allowed not more than once a week.

2. Meals should be excluded 3–4 hours before sleep.

At the third step we investigated repeatedly the indices studied before after the two months of nutritional guidelines following and estimated their effectiveness.

All the examined persons signed voluntary inform consent to the research that corresponds to the regulations of Helsinki declaration, 1964. Test data sheet was approved by ethics committee of NSPU as a part of project scientific research work of SEC "Physiology of ontogenesis".

Main anthropometric indices: body weight and body length (BW, BL), Ketle index, Pinie index, waist circumference, chest circumference and hip circumference (WC, CC, HC) were studied with the help of standard methods. Component body composition was estimated by means of bioimpedance analysis using Omron BF-508 analyzer and quantity of total and visceral fat was determined.

The functional state of cardiovascular system was estimated. Blood pressure was measured by oscillometric method using the automatic electronic analyzer Omron-907. The functional state of vegetative nervous system was studied by the method of cardiac rhythm variability recording using "VNS-Micro" device ("Neurosoft", Ivanovo) taking into consideration the methodical references elaborated by the group of Russian experts. Also the indices of variation pulsometry to Bayevskiy R.M. [16, 17] were taken into consideration.

A standard questionnaire "WAM" (well-being, activity, mood) [18] was used to estimate the psychoemotional indices.

All the obtained data were processed by means of standard methods of mathematical statistics with the using of Microsoft Excel 2010 soft. To reveal the significance of differences in the observation dynamics we used Student's t-test for free sampling. The differences considered to be reliable at the significance rate $p \le 0.05$.

Results and Discussion

As the study began all the students' groups didn't reliably differ from each other in body length index (Table 1) and at that basing on Pinie index the girls-students of normosthenic somatotype were included into the control group, the girls-students of hypersthenic somatotype were included into the experimental group, the girls-students of asthenic somatotype 50% and of normosthenic somatotype 50% were included into the sports group.

By the end of our research conjugate morphological changes were observed in all the groups that was an evidence of unidirectional influence of guidelines on the girls' bodies. However the rate of changes differed substantially in the groups. So both the reliable decrease of total fat and WC and the tendency to BW, KI, CC, HC decrease were revealed in the group of girls with RBW. More marked changes were revealed in the group with overweight that most of all can be connected with higher initial anthropometric measurements.

By the end of the research the reliable decrease of all the studied indices: both BW, KI, total fat and CC, WC and HC was revealed. The indices of girls' body built from athletics group were in normal rate however on average their indices were a little lower than RBW ones, in our opinion that is due to a higher physical activity rate (see Table 1). Lower initial body sizes predefined the lower number of reliable changes. So after 2 month of following the guidelines a reliable decrease only of HC was revealed that can be due to the nature of physical activity whereas only the tendency to the decrease was observed when other indices being estimated. The revealed dynamics of anthropometric measurement decrease confirms the effectiveness of refined carbohydrates exclusion from the food intake in girls with average and high physical activity [19].

The indices of functional state of the body are also closely connected with body weight change. The physiological decrease of body weight is known in particular to be followed by the change of cardiac rhythm variability (the increase of total power and quality of neurohormonal control mechanisms) [20].

The reliable change of studied functional indices was revealed in examined girls by the end of our research (Table 2).

The increase of cardiac performance economy and the amplification of parasympathetic influence contribution into the cardiac rhythm control were observed in regular body weight group so the reliable decrease of CR and TI was the evidence. More marked changes took place in the students' group with overweight above all that was caused by the decrease of activity of adrenergic regulatory influence and the strengthening of vagal ones. This fact agrees with literary data that vegetative disorders can be reversible, the weight being reduced in patients with overweight, obesity and metabolic disturbances [20]. First of all the impact of guidelines using became apparent in the weakening of central regulation of cardiac function and amplification of parasympathetic influence (TI decrease, R increase) (see Table 2). This dynamics gives evidence of cardiac rhythm variability rise, the decentralization of mechanisms of cardiac rhythm control and the reduction of

Table 1

Morphological indices in studied groups

Index	Regular body weight (RBW)		Overweight		Athletics (A)	
	Before	After	Before	After	Before	After
Body length, cm	167.3 ± 2.0	167.3 ± 2.0	169.4 ± 2.8	169.4 ± 2.8	167.5 ± 2.7	167.5 ± 2.7
Body weight, kg	64.6 ± 1.2	62.2 ± 1.4	85.4 ± 1.2***	76.9 ± 1.9*****	63.9 ± 3.0	61.1 ± 2.8
KI, kg/m^2	23.3 ± 0.5	22.5 ± 0.8	30.2 ± 1.0***	26.3 ± 0.2*****	22.7 ± 0.6	21.7 ± 0.6
Total weight, %	35.4 ± 0.7	32.3 ± 0.9*	44.4 ± 1.4***	36.3 ± 0.7******	30.3 ± 1.5**	27.8 ± 1.1*
Total weight, kg	22.9 ± 0.8	19.5 ± 0.7**	33.7 ± 0.7***	27.9 ± 0,7******	19.5 ± 1.5	17.1 ± 1.5
CC, cm	87.7 ± 2.3	85.5 ± 3.2	98.7 ± 1.4***	91.6 ± 1,7**	76.8 ± 1.5**	74.6 ± 1.7**
WC, cm	72.0 ± 1.3	68.2 ± 1.4*	84.7 ± 3.0**	74.0 ± 0.4*****	70.9 ± 2.1	67.7 ± 1.7
HC, cm	98.6 ± 1.0	96.8 ± 1.2	108.7 ± 1.5***	101.2 ± 1.2***	98 ± 1.3	94.1 ± 1.1*

Note. In this and other tables — the reliability of intra- and intergroup differences in the study dynamics is

* $p \le 0.05$, ** $p \le 0.01$, *** $p \le 0.001$ — changes inside the group;

* $p \le 0.05$, ** $p \le 0.01$, *** $p \le 0.001$ — changes in comparison with control group.

Table 2
Functional indices in studied groups

Index	Regular body weight		Overweight		Athletics	
	Before	After	Before	After	Before	After
Cardiac rate (CR), b /min	77.3 ± 2.7	67.7 ± 3.1*	77 ± 2.0	70.9 ± 1.8*	68.5 ± 2.1*	61.2 ± 2.1*
Mode (Mo), s	0.82 ± 0.04	0.90 ± 0.04	0.77 ± 0.03	0.80 ± 0.04	0.86 ± 0.02	1.01 ± 0.03***
Mode amplitude (MoA), %	34.4 ± 1.6	31.5 ± 2.4	36.9 ± 4.8	33.3 ± 4.9	31.7 ± 4.0	26.4 ± 2.7
Range (R), s	0.32 ± 0.02	0.38 ± 0.03	0.29 ± 0.02	0.40 ± 0.04*	0.29 ± 0.03	0.41 ± 0.05*
Tension index (TI), c.u.	84.3 ± 11.1	49.9 ± 8.9*	100.9 ± 15.6	43.4 ± 11.1**	87.9 ± 24.7	33.4 ± 6.1*
Systolic blood pressure (SBP), mm of m.c.	112.0 ± 3.1	105.0 ± 1.9	117.0 ± 1.7	109.6 ± 2.7*	114.2 ± 3.2	103.6 ± 1.9*
Dyastolic blood pressure (DBP), mm of m.c.	73.8 ± 1.3	71.5 ± 2.9	86.0 ± 5.9	74.1 ± 1.4	81.9 ± 2.5	70.2 ± 1.9**
Pulse pressure (PP), mm of m.c.	38.2 ± 2.4	33.5 ± 3.0	31.0 ± 3.5	35.5 ± 1.3	32.0 ± 3.0	33.3 ± 2.0

regulation mechanism tension. The described changes resulted in the increase of economy of cardiovascular system work which was conveyed in the reliable decrease of CR and SBP.

In sports-girls in comparison with other groups the most marked amplification of parasympathetic influence in cardiac rhythm formation was found. The reliable decrease of CR and TI, blood pressure and the increase of R and Mo were observed (see Table 2). This dynamics gives evidence of vegetative status optimization of the students going in for sports when the refined carbohydrates being excluded from the food intake. The described guidelines have a combined optimizing impact on cardiovascular system state and activity of regulatory processes under the adaptation to systemic sports training.

In connection with the possibility of an excess consumption of refined carbohydrates in students being connected with emotional discomfort replacement and compensation of unsatisfied needs we have estimated the change of their psychoemotional state. The indices of well-being, activity and mood estimated after the first and second months changed unequally (Table 3).

During the first month of our study the tendency of the well-being and activity improvement in RBW group was observed at the same time the mood slightly got worth that apparently was due to the changing of habitual regimen and food ration. By the end of the study well-being and activity reliably increased that gave the evidence of habituation of established regimen and food ration. Our obtained data correspond to literary data about psychoemotional improvement in body weight reduction [21].

In the group of students with overweight the similar tendency of well-being and activity improvement by the 1st month and the reliable increase of activity by the 2nd month of the study was revealed at that the mood index slightly decreased during the 1st month and trended to the increase for the 2nd month. They can conclude that psychoemotional tension related to the refusal of common habitual food items had a great impact on mood index that had an analogous dynamics in the groups of students with regular weight and overweight [22].

In athletics group unlike other groups the tendency of well-being, activity and mood improvement was revealed during all the period of the study. In conjunction a reliably increase of activity index takes place by the 1st month, all the studied indices reliably improve by the 2nd month of the study. Thus the exclusion of refined carbohydrates from the food ration in the athletics group was not accompanied by a psychoemotional stress formation [21].

Table 3
Psychoemotional indices in studied groups

Index	Regular body weight			Overweight			Athletics		
	Before	1 month	2 month	Before	1 month	2 month	Before	1 month	2 month
Well-being	4.9 ± 0.4	5.0 ± 0.1	5.8 ± 0.2*	4.8 ± 0.3	5.3 ± 0.4	5.4 ± 0.3	5.1 ± 0.2	5.7 ± 0.3	5.8 ± 0.3**
Activity	4.3 ± 0.4	4.9 ± 0.3	5.7 ± 0.2*	4.5 ± 0.3	4.8 ± 0.3	5.3 ± 0.1*	4.5 ± 0.2	5.2 ± 0.2*	5.3 ± 0.2*
Mood	5.4 ± 0.3	5.2 ± 0.3	5.6 ± 0.2	5.2 ± 0.2	5.1 ± 0.3	5.7 ± 0.3	5.0 ± 0.3	5.7 ± 0.3	6.0 ± 0.1*

Conclusion

The conducted study allows to draw the following conclusions:

1. In all the groups body weight decrease at the expense of fat component reduction is estimated that is the evidence of the effectiveness of refined carbohydrates exclusion from the food ration.

2. In the athletics group and group with overweight the significant decrease of regulatory mechanism tension, the strengthening of parasympathetic influence on the cardiac rhythm formation and the decrease of SBP were revealed.

3. In students' group with regular body weight and overweight mood decreased in connection with emotional stress formation after the first month of refined carbohydrates exclusion from food ration. By the end of the study this index increased up to the previous level and the index of well-being reliably increased in students' group with regular body weight and overweight that is the evidence of habituation to the diet regimen. Athletics group was characterized by gradual increase of all the psychoemotional indices during the first month and reliable improvement by the end of the study.

4. The exclusion of refined carbohydrates from the food ration can be recommended when having overweight for morphological indices correction and vegetative status improvement.

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