

## Certain aspects of the structure and organization of children nutrition in Russia

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**Abstract.** The article deals with issues of catering at preschool institutions in Russia (as exemplified by Yekaterinburg) using special PC software. Catering of children is based on the anatomic and physiological peculiarities of the growing organism. The objective of the work is to estimate the actual nutrition of children based on the daily ration at preschool education institutions of the city of Yekaterinburg using an automated system of computation. The daily rations of children were analyzed by the nutrition value and meeting the natural nutrition standards. Deviations in the nutrition of children were revealed with regard to the recommended values of nutrition value as well as the grocery basket. In the structure of the ration, we revealed overall deficiency of vegetables and, consequently, insufficient quantity of carbohydrates and dietary fibers. The conclusion was made that it is necessary to correct the ration by the macronutrient content with increasing the portion of carbohydrates (including dietary fibers) and reducing the protein share.

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**Keywords:** nutritional standard, rations, dietary fibers, nutrition value, grocery basket, technical documentation for products.

### Introduction

Nutrition is the main factor determining growth, development, and health state of a child [1]. Catering of children is based on the anatomic and physiological peculiarities of the growing organism. For children, the processes of assimilation prevail over dissimilation, the muscle tissue is growing, the skeleton is being formed, as well as other tissues and organs, the enzymatic set is improving, as well as the immune system etc., the intelligence is developing [2]. The processes of acceleration and the permanently growing volume of information load influence on the child organism considerably. In view of intensive muscle activity in the childhood, the energy consumption is very high [3, 4].

### Main part

The federal budget-funded healthcare institution "Center of hygiene and epidemiology in the Sverdlovsk Region" annually monitors the catering and quality of children nutrition at organized groups. For example, in 2012, the majority of preschool education institutions (PIU) provides for conformance of the requirements of sanitary rules and regulations with regard to the recommended daily grocery baskets for catering of children. However, imbalance is noticed with regard to certain macro and micronutrients, as well as excess of nutrition standard (Figure 1) with regard to cereals alimentary pasta, deviation in the quantity of groceries, which provide the organism with animal protein (beef, poultry, milk, curd, and fish). Common trend to growth of the number of cases of exceeding the nutrition standard is noticed with regard to cereals, bean products, and

alimentary pasta (from 18% in 2008 to 36% in 2012). At the same time, considerable growth of the quantity of consumed fruits is observed, which is caused by the increase of the nutrition standard in the SanPiN standard, and, however, beef, poultry and fish consumption decreased (minus 14% and 19.7% accordingly).

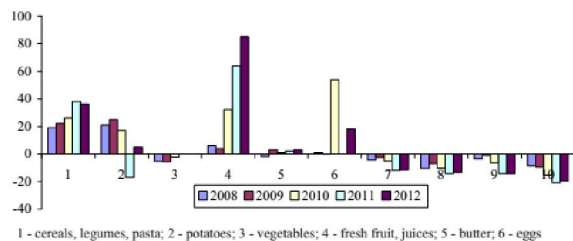
Catering of children at preschool education institutions must be differentiated depending on the age, in compliance with the following requirements: 3 year old and younger (early preschool age), between 3 and 7 years of age (preschool age) [5].

Distribution of energy content and nutrient materials by separate meals for preschool education institutions (depending on the duration of children's stay there) is provided in Table 1. For children who stay at the preschool organization longer than 10 hours, it is allowed to arrange intensified luncheon instead of luncheon and dinner [6].

The menu of rations must provide in the energy content for 12...15% of proteins, 30...32% of fats, and 55...58% of carbohydrates. In the daily ration, the optimal ratio of nutrient materials: proteins, fats, and carbohydrates – must be 1:1:4 [7].

1 - cereals, legumes, pasta; 2 - potatoes; 3 - vegetables; 4 - fresh fruit, juices; 5 - butter; 6 - eggs (pieces); 7 - milk, kefir; 8 - cheese; 9 - the first category of beef, chickens; 10 - fish.

In this view, we find it important to study the state of children in the organized groups, the health of which mainly depends on the offered ration [8]. The volume of nutrition at preschool education institutions is equal to 85-90% of the daily ration.



**Figure 1. Dynamics of compliance with the natural nutritional standards at preschool education institutions**

**Table 1. Distribution of energy content of the daily rations of children depending in the duration of stay**

Meals	For children who stay round-the-clock, %	For children who stay during the daytime for 8...10 hours, %	For children who stay during the daytime for 2 hours, %
Breakfast	20...25	20...25	20...25
Second breakfast	5	5	5
Lunch	30...35	30...35	30...35
Afternoon's luncheon	10...15	10...15	10...15
Intensified afternoon's luncheon	-	-	30...35
Dinner	20...25	-	20...25
Supper	up to 5	-	-

**Materials and methods**

10 preschool organizations in the city of Yekaterinburg were selected as objects of the research, the technical documentation for products (technological charts according to GOST R 53105) and the menu of daily rations of the organized groups (the order-menu according to the OKUD 0504202 form) for two weeks (10 days) for children between 3 and 7 years of age were reproduced. Thus, the analysis of the rations menu was carried out by the timing method, which is known for the best accuracy of the obtained data [9].

Use of the timing method [6] is accompanied by increased labor input (the necessity to prepare documentation for the manufactured products and subsequent calculation of the actual data on the groceries consumption). In this view, we used the PC software "System of calculations for public catering" version 5 [10] in the following set [11]:

- the module of development of technical documentation for the catering products (technological and technical-technological charts);
- the module of composing menus of daily rations for organized groups (with evaluation of quality of the ration by the groceries basket and the nutrition value).

**Results**

The result of calculation of the main irreplaceable macronutrients (essential) and sources of

energy is provided in Table 2.

**Table 2. Result of evaluation of the quality of children's rations by the nutrition value**

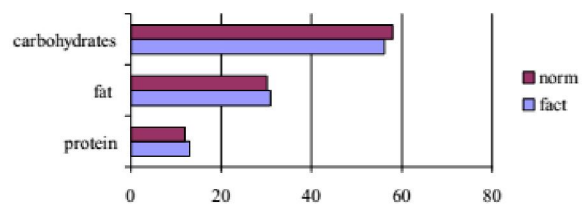
Nutrition value	Actual (on the average for two weeks)	Minimum value	Maximum value	Physiological standard		Deviation	
		g	g	% of the normal value	g	g	%
Protein, g, including animal protein	50.80	44.99	72.80	34.81	54.00	-3.20	-5.93
Fats, g, including vegetable fat	28.88	19.29	54.76	56.01	35.10	-6.22	-17.72
Carbohydrates, g	51.37	39.62	81.73	36.22	60.00	-8.63	-14.38
Energy content, kcal	1,505.22	1,318.66	1,817.55	0.97	1,800.00	-294.78	-16.38
Ratio of protein, fat and carbohydrates	1:1.01:4.2						

The results of analysis of rations by the content of carbohydrates are provided in Table 3.

**Table 3. Evaluation of the quality of rations at preschool education institutions by the content of carbohydrates**

Rated value, g	Actual value, g			Deviation		
	average value for 10 days	minimum	maximum	g	%	
Carbohydrates, g mono and disaccharides, g	261.00	211.49	185.11	235.01	-49.51	-18.97
starch, g		91.30	80.66	110.47		
Dietary fibers, g	10.00	9.2	4.84	19.70	-0.8	-8.1

The content of proteins, fats, and carbohydrates in the menu for two weeks (in percentage of the energy content) is represented in Figure 2.



**Figure 2. The content of proteins, fats, and carbohydrates in the menu of rations (in percentage of the energy content)**

Distribution of energy content by different meals is represented in Table 4.

**Table 4. Distribution of energy content by different meals**

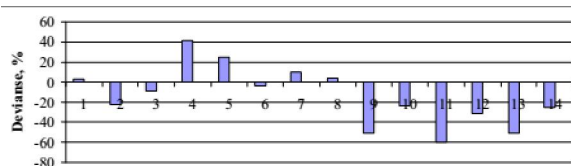
Diet structure	Minimum value, %	Maximum value, %	Average value for 10 days, %	Rated value, %
Breakfast	28	32	29	20-25
Second breakfast	5	7	6	5
Lunch	38	50	46	30-35
Intensified afternoon's luncheon	12	30	19	30-35

The authors provided evaluation of the actual consumption of the main groceries, the situation with

the natural standards of nutrition by main groceries (net weight) is provided in Table 5 and Figure 3.

**Table 5. Situation with standards of the grocery basket (net weight)**

Groceries name	Normal value, g	Average consumption per day, g	Consumption, deviation, g	Consumption of normal value, %
Vegetables, plants	260	160.9	-99.1	61.88
Fresh fruits	100	103.9	3.9	103.9
Dry fruits	11	9.7	-1.3	88.18
Fruit (vegetable) juices	100	100	-100	100
Rye bread (Rye and wheat bread)	50	39.04	-10.96	78.07
Wheat bread or cereals	80	73.24	-6.76	91.55
Cereals, beans	43	61.4	18.4	142.79
Alimentary pasta	12	15.1	3.1	125.83
Baker's wheat flour	29	10.16	-18.84	35.03
Potato flour (starch)	3	0.12	-2.88	4
Cow sweet cream butter	21	20.3	-0.7	96.68
Vegetable oil	11	12.16	1.16	110.53
Confectionery	20	3	-17	15
Tea, including phyto tea	0.6	0.2	-0.4	33.33
Cocoa powder	0.6	2.5	1.9	416.67
Coffee drink	1.2	1	-0.2	83.33
Baker's yeast	0.5	0.3	-0.2	60
Sugar	47	48.93	1.93	104.11
Edible salt	6	4.74	-1.26	78.95
Milk and fermented milk products with fat content 2.5% and higher	450	212.73	-237.3	47.27
Curd, curd products with fat content 5% and higher	40	23.9	-16.1	59.75
Sour cream with fat content 15% and higher	11	8.93	-2.07	81.22
Hard cheese	6	6		100
Meat	55	42.3	-12.7	76.91
Poultry (chickens of 1 category/broiler chickens of 1 category/turkey of 1 category)	34	13.9	-20.1	40.88
Fish (filet), including slightly-salted and light-salted filet	37	25.85	-11.15	69.86
Sausage products	6.9		-6.9	
Edible chicken eggs	24	11.9	-12.1	49.58
Potato	140	139.88	-0.13	99.91



1 - fruits, 2 - rye bread, 3 - wheat bread, 4 - cereals, 5 - pasta, 6 - butter, 7 - vegetable oil, 8 - sugar, 9 - milk, sour-milk products-you, cottage cheese, sour cream, 10 - meat, 11 - bird, 12 - fish, 13 - eggs, 14 - vegetables.

**Figure 3. Situation with the natural nutritional standard by main groceries, %**

## Results and discussion

The criteria of evaluation of daily rations of children in preschool education institutions according to the Sanitary and Epidemiological Rules and Standards are:

- the nutrition value determined by calculation;
- the ratio of nutrient materials;

- abundance by the standards of the grocery basket (by net weight);
- conformance of the volume of products by meals.

By essential macronutrients (Table 2), we detected insufficient consumption of carbohydrates (19%) as well as animal proteins. We noticed overall imbalance of the ration by macronutrients, which reached twofold difference between the minimum and the maximum values. Carbohydrates in children's nutrition are the main energy supplier. The rapid growth of children is associated with large consumption of energy, required for synthetic processes as well, especially for protein synthesis. Besides, it is typical of children to manifest high mobility [12], and, consequently, considerable consumption of energy [3].

Among the carbohydrates (Table 3), the deficiency of which is observed in the analyzed rations, the mono (e.g. glucose, fructose, and galactose) and oligosaccharides (sucrose and lactose), as well as polysaccharides (digestible – starch, glycogen, and non-digestible – dietary fibers (cellulose, hemicellulose, pectin) are emphasized.

The dietary fibers stimulate the motor function of the intestine and biliation, form the dejection, create the feeling of satiation, and assist in excreting cholesterol and harmful substances from the organism. Long deficiency of dietary fibers in nutrition can result in constipation, occurrence of diverticula, polyposis and cancer of the colon and rectum.

For prophylactic and curative purposes, the daily ration of children must contain about 10-20 grams of dietary fibers [13], and for curative purposes, their quantity is to be increased. However, long and excessive intake of them with food [4] can decrease (by 1.5-3%) the adsorption of the irreplaceable macro and microelements (Ca, Fe) and a number of water-soluble vitamins (B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, PP and folic acid). Due to the adsorption and cation exchange properties, dietary fibers reduce penetration of calcium, zinc, phosphorus, iron, magnesium etc. into the organism [14].

It is to be noted that the stay of the children at the preschool education institution lasted 10.5 hours; therefore, the structure of the ration consisted of the breakfast, second breakfast, lunch and intensive luncheon with regulated distribution of energy content between the meals: 20-25%, 5%, 30-35% and 30-35% accordingly (Table 4). Thus, children need to get 85-100% of the daily ration at the preschool education institutions.

The ration is structured so that the lunch would provide 46%, where its maximum rated value is 35%, and the intensified luncheon, which contains 19% of the actual energy content, where the minimum rated value is 30% [15].

Full-value and versatile nutrition, which would include vegetables, fruits, milk, fermented milk products, meat of various sorts, and fish, is an essential condition of growth and health of children.

The groceries basket (Figure 3) shows that consumption of cereals is higher (above 40%) and the vegetables' portion is insufficient (-38%). There is lack of milk (52.7%), curd (about 40.2%), poultry (42.1%), and chicken eggs (50.4%). It is to be noted that the stay of the children at the preschool organization is equal to 10.5 hours, which corresponds to 80% of the daily average nutritional standard.

### Conclusions

Thus, in the rations of the analyzed preschool education institution, we observed general imbalance of the daily average groceries basket, which results in deviation of the nutrition value.

Based on the performed analysis of menus of daily rations at preschool organizations, we can conclude that it is necessary to correct the ration by the macronutrient content with increasing the portion of carbohydrates (including dietary fibers) and reducing the protein share. At formation of the rations of preschool education institutions, easily digested carbohydrates should be preferred, the source of which are fresh fruits and vegetables, fruit and vegetable products, and alcohol-free beverages.

As for the groceries basket, it is necessary to increase the content of vegetables, milk, eggs in the ration, and reduce the share of cereals and alimentary pasta. As for the structure of the ration, reduction of the lunch's share by 11% is required, and an increase in the share of the intensified luncheon.

The next stage of the research will be dedicated to development of ration for children between 3 and 7 years of age at preschool education institutions for 10 days (the stay at the institutions is equal to 10.5 hours) based on introduction of new products for correction of the content of dietary fibers in the ration. Besides this, for overall optimization of the ration by the content of main products (vegetables, meat, milk products, etc.), which will allow to correct the chemical structure.

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