ASSESSMENT OF THE ACTUAL NUTRITION OF RURAL ADOLESCENTS OF THE IRKUTSK REGION BECAUSE OF REVISION OF THE NORMS OF PHYSIOLOGICAL NEEDS FOR ENERGY AND NUTRIENTS

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ABSTRACT

Background. *The rational nutrition of the child population is given great medical importance as a factor in preserving the health and development of the child. A complete and balanced diet in terms of the content of basic nutrients ensures the normal growth and development of the child's body.*

The aim of the study. *To analyze the actual nutrition of adolescents living in rural areas of the Irkutsk region.*

Materials and methods. *The study involved 69 rural adolescents aged 11–17 years (34 boys, 35 girls). The actual nutrition was studied by the method of 24-hour nutrition reproduction. The energy value of the diet was determined, the nature of the provision of the diet with basic macro- and microelements was studied. The obtained values were compared with the norms of physiological needs for energy and nutrients in 2008 and 2021.*

Results. *The analysis of actual nutrition revealed deviations from the principles of healthy nutrition: insufficient energy value of the diet, deficiency of proteins and fats. The diet of adolescents was characterized by an insufficient content of the main groups of macro- and micronutrients – vitamins A, C and D, essential trace elements, and a deficiency of dietary fiber. The diet of adolescents was characterized by increased sodium intake. The calculated ratio of proteins, fats, carbohydrates indicated a carbohydrate type of diet.*

Conclusion. *Despite the great attention to the problem of balanced nutrition of adolescents, the question of the impact of nutrition on the health of a teenager, considering the regional factor, remains open. Recommendations for the development of a regional program for the organization of proper nutrition for school-age children are of great practical importance.*

Key words: *rural adolescents, actual nutrition, nutrient intake*

Received: 10.11.2023
Accepted: 08.12.2023
Published: 29.12.2023

For citation: Rychkova L.V., Pogodina A.V., Astakhova T.A., Lebedeva L.N. Assessment of the actual nutrition of rural adolescents of the Irkutsk region because of revision of the norms of physiological needs for energy and nutrients. *Acta biomedica scientifica*. 2023; 8(6): 194-203. doi: 10.29413/ABS.2023-8.6.19

ОЦЕНКА ФАКТИЧЕСКОГО ПИТАНИЯ СЕЛЬСКИХ ПОДРОСТКОВ ИРКУТСКОЙ ОБЛАСТИ В СВЯЗИ С ПЕРЕСМОТРОМ НОРМ ФИЗИОЛОГИЧЕСКИХ ПОТРЕБНОСТЕЙ В ЭНЕРГИИ И ПИЩЕВЫХ ВЕЩЕСТВАХ

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РЕЗЮМЕ

Обоснование. *Рациональному питанию детского населения придаётся огромное практическое значение как основному фактору укрепления здоровья и полноценного развития подрастающего поколения. Полноценное и сбалансированное по содержанию основных пищевых веществ питание обеспечивает нормальный рост и развитие детского организма.*

Цель исследования. *Анализ фактического питания подростков, проживающих в сельской местности Иркутской области.*

Материалы и методы. *В исследовании приняли участие 69 сельских подростков 11–17 лет (34 мальчика, 35 девочек). Фактическое питание было изучено методом 24-часового воспроизведения питания. Определена энергетическая ценность рациона, изучен характер обеспеченности рациона основными макро- и микроэлементами. Полученные значения сравнивали с нормами физиологических потребностей в энергии и пищевых веществах 2008 и 2021 гг.*

Результаты. *Анализ фактического питания выявил отклонения от принципов здорового питания: недостаточная энергетическая ценность рациона, дефицит белков и жиров. Рацион подростков характеризуется недостаточным содержанием основных групп макро- и микронутриентов – витаминов A, C и D, эссенциальных микроэлементов, дефицитом пищевых волокон. Рацион подростков характеризуется повышенным потреблением натрия. Расчётное соотношение белков, жиров, углеводов свидетельствует об углеводном типе питания.*

Заключение. *Несмотря на большое внимание к проблеме сбалансированного питания подростков, вопрос о влиянии питания на состояние здоровья подростка с учётом регионального фактора остаётся открытым. Большое практическое значение приобретают рекомендации для разработки региональной программы по организации правильного питания детей школьного возраста.*

Ключевые слова: *сельские подростки, фактическое питание, потребление нутриентов*

Для цитирования: Рычкова Л.В., Погодина А.В., Астахова Т.А., Лебедева Л.Н. Оценка фактического питания сельских подростков Иркутской области в связи с пересмотром норм физиологических потребностей в энергии и пищевых веществах. *Acta biomedica scientifica*. 2023; 8(6): 194-203. doi: 10.29413/ABS.2023-8.6.19

Статья поступила: 10.11.2023
Статья принята: 08.12.2023
Статья опубликована: 29.12.2023

INTRODUCTION

Balanced nutrition is one of the main factors in supporting the health of the younger generation. The nutritional structure of the population has changed in the last decade: energy expenditures have sharply decreased, and the consumption of the main macro- and microelements has decreased [1]. Russians began to consume less meat, dairy products, vegetables and fruit, while consuming more bakery products and refined products. This has resulted in an increase in the number of nutrient-dependent diseases [2].

Actual nutrition is assessed in most cases among residents of large industrial centres, while research about the actual nutrition of rural residents is fragmentary. A negative trend of decreasing consumption of essential nutrients – dietary fibres and vitamins – by schoolchildren has been revealed according to the studies of the actual nutrition of urban adolescents in different regions of Russia [3]. Similar changes were also revealed in adolescents living in rural areas. Feeding habits are shaped by the child's immediate environment. Ethnicity, family affluence and parents' knowledge of balanced nutrition are essential in this process.

In assessing actual nutrition, the values of the average daily energy and nutrient intake are used and compared with the Physiological Requirements Standards (PRS) adopted in Russia. PRS, approved in 1951, 1968, 1987, 1991 and 2008, periodically undergo the procedure of revision, which is associated with changes in the structure of morbidity of both adult and child population, changes in the socio-economic structure of society and other factors [4, 5].

The study of regional peculiarities of the children's and adolescents' actual nutrition, based on the place of residence, ethnic characteristics, together with the analysis of morbidity is an urgent task.

THE AIM OF THE STUDY

An assessment of the actual nutritional status of rural adolescents.

METHODS

Study design: a single-stage continuous cross-sectional study.

Inclusion criteria for the study group:

- 11–17 years of age;
- permanent residence of the child in the territory of the settlement since birth;
- informed voluntary consent from parents/legal representatives and adolescents over 15 years of age to participate in the study.

Exclusion criteria for the study group:

- age less than 11 years and older than 17 years;
- Failure to thrive (SDS (standard deviation score) < 2 for age and sex according to the World Health Organisation (WHO) reference tables);
- weight deficit (SDS body mass index (BMI) < 5th percentile).

Procedure situation. The study was conducted in November 2020 on the territory of Bayandai settlement, Irkutsk region. Adolescents who attended school during the survey days participated in the study. Informed voluntary consent for participation in the study and processing of personal data was obtained from the participants' legal representatives (parents or guardians) and from children over 15 years of age.

Duration of the study: from November 1, 2020, to December 1, 2020.

Outcomes of the study: the dietary intake – energy value, chemical composition (proteins, fats, carbohydrates, vitamins, microelements, dietary fibre) was assessed.

Ethical review. The study was approved by the Ethics Committee of the Scientific Centre for Family Health and Human Reproduction Problems (Protocol No. 2 dated February 18, 2020).

Assessment of actual nutrition

Actual nutrition was assessed using the 24-hour nutritional replication method [6]. Adolescent surveys were conducted by physicians. According to the instructions received, the physician filled out food diaries that recorded the meals and foods that the adolescent consumed at the main and additional meals during 2 days (1 school day and 1 weekend). Food portion size was assessed using the Food and Meal Portion Album tool, which was shown to the adolescent during the survey [7].

Results obtained by summing the data from the two-day recordings were then averaged. In order to analyse the obtained information about the energy value, quantitative composition of each dish, the data concerning the chemical composition of Russian food products [8] in the information supplement "My Healthy Diet" [9] were used. The data available on the Internet service "My Healthy Diet" regarding the composition of foods are based on the reference book of I.M. Skurikhin and V.A. Tutelian [8].

The data obtained in the study were verified for plausibility. To determine the plausibility of the provided information about the actual nutrition, thresholds corresponding to one standard deviation of the ratio of energy consumption calculated from the questionnaire to the required energy expenditure in per cent for a given sex and age were calculated using the formula:

$$\pm 1SD = \frac{\sqrt{CV_{rEI}^2}}{d} + CV_{pER}^2 + CV_{mTEE}^2,$$

where CV_{rEI} is the variation coefficient of actual energy intake; CV_{pER} – the variation coefficient of the required energy expenditure for a particular age, sex and corresponding physical activity; CV_{mTEE} – the error variation coefficient of daily biological changes in total energy expenditure measured by the water method [10]. If the percentage ratio of actual energy intake to required energy

expenditure was within one standard deviation, the data were considered plausible.

A total of 75 food diaries were included in the study, which provided information about the adolescent's diet. Sixty-nine diaries with plausible information provided were considered for further study.

Energy value and chemical composition data were assessed with consideration of methodical recommendations 2.3.1.2432-08 and 2.3.1.0253-21 "Physiological requirements standards in energy and food substances for different population groups of the Russian Federation" [4, 5].

Statistical analysis

Data were analysed using the IBM SPSS Statistics 21 statistical software package (IBM Corp., USA). The median (*Me*) and 95 % confidence interval (95 % CI) were calculated to compare daily energy and nutrient intake between the formed groups and the general population. A statistically significant difference was considered if the calculated 95 % CI did not include the population mean.

RESULTS

Study sample characteristics

A total of 69 rural adolescents were involved in the study and they provided complete and plausible information about dietary intake: 50.7 % girls, 49.3 % boys (Table 1). Adolescents were divided into age groups: younger schoolchildren – 11–14 years old; older schoolchildren – 15–17 years old [5].

TABLE 1

CHARACTERISTICS OF THE STUDY PARTICIPANTS

Parameters	Adolescents (*n* = 69)
Male, *n* (%)	34 (49.3)
Female, *n* (%)	25 (50.7)
Age, years	15.1 ± 0.8
Sports activities, *n* (%)	16 (23.2)
PAL, *n* (%)	
low	13 (18.8)
average	39 (56.5)
high	16 (23.2)
Body weight, kg	60.6 ± 9.0
BMI, kg/m^2	21.9 ± 2.8
SDS BMI	0.3 ± 0.9
Obesity, *n* (%)	5 (7.2)
WC, cm	73.9 ± 6.8
SDS WC	0.3 ± 0.8

Note: PAL – physical activity level; WC – waist circumference.

Actual consumption of nutrients and energy

The study results of adolescent actual dietary intake are summarised in Tables 2 and 3.

The results of the performed study showed that the energy value of diets, the content of proteins, fats and carbohydrates do not meet the PRS in all adolescents, except for boys 11–14 years old. In this group, the median values of dietary calories as well as protein and fat were above the physiological requirements.

Median values of vitamin intake were below the recommended standards for both boys and girls: there was a deficiency of vitamin A (in terms of retinol – by 41.5–50.2 %) and vitamin C (by 41.2–68.6 %). Considering the fact that the prevalence of vitamin D deficiency is high among the child population of the Russian Federation (RF) and in order to reduce the risk of developing a number of non-communicable diseases, the value of the physiological requirement in the methodical recommendations of the new revision (2021) [5] for this vitamin was increased from 10 to 15 μg/day; thus, the median values of vitamin D intake in our study are 0.7–2.9 μg/day, which is 4.6–9.3 % of the PRS. Mean vitamin E values were within normal limits only in boys in all age groups.

A number of studies have shown an association between insufficient potassium content in the diet of the child population and an increased risk of cardiovascular pathology in adulthood [11–13]. Therefore, the value of the physiological requirement of potassium was increased from 1500 to 2500 mg/day for adolescents in the age group of 11–14 years [5] and from 2500 to 3200 mg/day for adolescents aged 15–17 years; thus, the diet of the studied adolescents was characterised by a deficiency of this element by 18.6–34.1 %. To optimise the calcium : phosphorus ratio, the physiological phosphorus requirement in the methodical recommendations of the new revision was increased to 900 mg/day for all age and gender groups [5]. Considering these changes, the median intake values of this micronutrient were lower than the PRS in the diet of the studied schoolchildren.

A study of mineral intake revealed significant calcium and iodine deficiency in all age and gender groups. Deviations from PRS are more observed in girls in the older age group. The significant excess of sodium intake in all age groups of adolescents is noteworthy.

Physicians have recently started to pay great attention to dietary fibre as one of the important compo-

TABLE 2

ENERGY VALUE AND CHEMICAL COMPOSITION OF ADOLESCENT BOYS' DIETS

Indicators	Boys aged 11–14 (*n* = 9)				Boys aged 15–17 (*n* = 25)			
	PRS-2021/PRS-2008	Me	95 % CI		PRS-2021/PRS-2008	Me	95 % CI	
Energy value, kcal	2500.0/2500	2615.5	2289.1	2941.8	2900.0/2900.0	2714.4	2608.2	2820.7
Proteins, g	75.0/75.0	79.1	69.6	88.6	87.0/87.0	77.0	68.9	85.2
Fats, g	83.0/83.0	85.5	74.6	96.4	97.0/97.0	91.1	83.5	98.8
Carbohydrates, g	363.0/363.0	324.2	280.5	367.8	421.0/421.0	355.7	330.2	381.2
P : F : C		1 : 1.2 : 4.2				1 : 1.2 : 4.6		
Dietary fiber, g	20.0/20.0	13.0	10.7	15.3	22.0/ 20.0	16.4	14.6	18.3
Vitamin A (estrogen receptor), μg	1000.0/1000.0	433.1	122.4	743.8	1000.0/1000.0	568.1	416.0	720.1
Vitamin B_1, mg	1.3/1.3	0.8	0.6	0.9	1.5/1.5	1.1	0.8	1.5
Vitamin B_2, mg	1.5/1.5	0.9	0.7	1.0	1.8/1.8	1.1	0.9	1.3
Vitamin B_5, mg	3.5/3.5	2.0	1.5	2.4	5.0/5.0	2.6	2.0	3.2
Vitamin B_6, mg	1.7/1.7	1.1	0.8	1.3	2.0/2.0	1.3	1.1	1.5
Vitamin B_9, μg	300.0/300.0	62.8	48.3	77.3	400.0/400.0	123.4	73.1	173.8
Vitamin B_{12}, μg	3.0/3.0	3.1	1.6	4.6	3.0/3.0	3.1	2.4	3.9
Vitamin C, mg	70.0/70.0	35.7	11.5	59.9	90.0/90.0	37.1	25.7	48.6
Vitamin D, μg	15.0/10.0	0.7	0.1	1.3	15.0/10.0	0.7	0.4	1.1
Vitamin E (tocopherol equivalent), mg	12.0/12.0	12.2	8.3	16.2	15.0/15.0	15.1	11.6	18.6
Potassium, mg	2500.0/1500.0	2013.9	1586.5	2441.4	3200.0/2500.0	2342.4	2039.3	2645.4
Calcium, mg	1200.0/1200.0	494.3	363.7	624.8	1200.0/1200.0	612.4	518.9	706.0
Magnesium, mg	300.0/300.0	222.3	182.7	261.9	400.0/400.0	318.5	263.4	373.7
Sodium, mg	1100.0/1100.0	2481.2	1716.4	3245.9	1300.0/1300.0	2588.6	2278.9	2898.3
Phosphorus, mg	900.0/1200.0	856.7	680.5	1032.9	900.0/1200.0	1131.4	1001.4	1261.4
Ferrum, mg	12.0/12.0	17.9	13.3	22.6	15.0/15.0	20.1	16.4	23.7
Iodine, μg	130.0/130.0	25.7	19.0	32.4	150.0/150.0	41.9	28.1	55.6

Note. PRS-2021 and PRS-2008 – physiological requirement standards (tabular data according to "Physiological Requirement Standards for Energy and Nutrients for Different Population Groups of the Russian Federation") as of 2021 and 2008, respectively; Me – median; 95 % CI – 95 % confidence interval for the sample median; P : F : C – protein, fat and carbohydrate ratio.

TABLE 3

ENERGY VALUE AND CHEMICAL COMPOSITION OF DIETS OF ADOLESCENT GIRLS

Indicators	Girls aged 11–14 (*n* = 13)				Girls aged 15–17 (*n* = 22)			
	PRS-2021/PRS-2008	Me	95 % CI		PRS-2021/PRS-2008	Me	95 % CI	
Energy value, kcal	2300.0/2300.0	2275.7	2077.7	2473.8	2500.0/2500.0	2373.6	2230.6	2516.7
Proteins, g	69.0/69.0	68.9	64.0	73.8	75.0/75.0	72.2	66.8	77.7
Fats, g	77.0/77.0	74.6	66.0	83.1	83.0/83.0	79.3	73.2	85.4
Carbohydrates, g	334.0/334.0	311.4	282.1	340.7	363.0	315.0	293.0	337.0
P : F : C		1 : 1.1 : 5.1				1 : 1.2 : 4.9		
Dietary fiber, g	20.0/20.0	13.5	11.1	16.0	22.0/20.0	14.5	12.9	16.2
Vitamin A (estrogen receptor), μg	800.0/800.0	332.1	244.9	419.3	800.0/800.0	401.3	282.4	520.2
Vitamin B_1, mg	1.3/1.3	0.7	0.6	0.8	1.3/1.3	1.3	0.3	2.4
Vitamin B_2, mg	1.5/1.5	0.9	0.7	1.1	1.5/1.5	0.9	0.8	1.0
Vitamin B_5, mg	3.5/3.5	1.9	1.6	2.3	4.0/4.0	4.7	-1.3	10.8
Vitamin B_6, mg	1.6/1.6	2.7	-1.0	6.4	1.6/1.6	1.1	0.9	1.3
Vitamin B_9, μg	300.0/300.0	69.7	47.6	91.8	400.0/400.0	86.8	59.1	114.5
Vitamin B_{12}, μg	3.0/3.0	3.1	1.4	4.7	3.0/3.0	4.7	0.1	9.3
Vitamin C, mg	60.0/60.0	41.2	10.0	72.4	70.0/70.0	36.3	26.2	46.5
Vitamin D, μg	15.0/10.0	1.4	0.7	3.5	15.0/10.0	1.0	0.3	2.3
Vitamin E (tocopherol equivalent), mg	12.0/12.0	10.0	7.7	12.4	15.0/15.0	12.5	9.2	15.8
Potassium, mg	2500.0/1500.0	2037.6	1643.6	2431.6	3200.0/2500.0	2131.7	1849.9	2413.6
Calcium, mg	1200.0/1200.0	625.0	436.8	813.2	1200.0/1200.0	561.5	454.0	669.0
Magnesium, mg	300.0/300.0	267.7	222.6	312.8	400.0/400.0	250.9	208.2	293.7
Sodium, mg	1100.0/1100.0	1799.8	1379.7	2219.9	1300.0/1300.0	2064.7	1746.7	2382.8
Phosphorus, mg	900.0/1200.0	914.7	800.4	1029.0	900.0/1200.0	902.9	799.4	1006.3
Ferrum, mg	15.0/15.0	14.5	12.6	16.4	18.0/18.0	17.8	14.2	21.3
Iodine, μg	130.0/130.0	41.0	15.4	66.7	150.0/150.0	29.0	21.2	36.8

Note. PRS-2021 and PRS-2008 – physiological requirement standards (tabular data according to "Physiological Requirement Standards for Energy and Nutrients for Different Population Groups of the Russian Federation") as of 2021 and 2008, respectively; Me – median; 95 % CI – 95 % confidence interval for the sample median; P : F : C – protein, fat and carbohydrate ratio.

nents of nutrition, which contributes to the normalisation of gastrointestinal tract function, reducing the risk of cardiovascular pathology in adulthood, therefore, in the methodical recommendations of 2021 the PRS of dietary fibre constitutes 22 g/day in the age group of 15–17 years [5]. In our study, the median values of dietary fibre intake range from 13.0–16.4 g/day.

In a balanced diet, the calculated ratio of proteins : fats : carbohydrates (P : F : C) should be 1 : 1 : 4. This ratio in our study indicated the predominance of carbohydrate component in the diet of adolescents, especially in girls of 11–14 years of age.

Analysis of consumption of individual products has shown that protein-rich products (meat, fish, poultry) are consumed by an insignificant number of adolescents. For instance, fish is included in the diet in 8.8 % of the studied adolescents, poultry meat – in 17.5 % (Table 4).

TABLE 4

DAILY DIETARY INTAKE CHARACTERISTICS OF THE STUDIED ADOLESCENTS

Indicators	Adolescents (*n* = 69)
1 portion of vegetable/fruit intake, *n* (%)	42 (60.1)
1 portion of fish intake, *n* (%)	5 (7.2)
1 portion of red lean meat intake, *n* (%)	33 (47.8)
1 portion of dairy products intake, *n* (%)	13 (18.8)
1 portion of poultry meat intake, *n* (%)	15 (21.7)
1 portion of sweets and sweetened drinks intake, *n* (%)	63 (91.3)

The leading positions are occupied by sweets and sweetened beverages – 91.3 %.

DISCUSSION

Many studies indicate the presence of changes in the structure and nature of nutrition of the child population in different regions of Russia [14, 15], which is expressed in inadequate intake of energy, macro- and microelements. The results of this study support this fact. In particular, according to I.I. Saldan et al., among adolescents of Altai Territory there is a decrease in the energy value of the diet together with a low consumption of proteins and fats [16]. There are similar changes characterising the diet of adolescents in the Tomsk, Saratov regions and the Republic of Sakha (Yakutia) [17, 18].

Deficiency of vitamins is one of the reasons for the deterioration of children's health, which is associated with impaired metabolism and reduced physical and mental performance. According to Federal Research Center of Nutrition and Biotechnology, the population of the Russian Federation is increasingly deficient in vitamins and microelements. Deficiency of vitamins B is found in 30–40 %, beta-carotene in more than 40 %, and vitamin C in 70–90 % of studied children and adolescents [19]. The results of this study revealed the highest deficiency in vitamins A, C and D among rural adolescents. Similar findings have been revealed by other studies as well. H. Wang et al. revealed vitamin A and C deficiency in Chinese adolescents – 36.1 and 75.5 %, respectively [20]. According to the NHANES (National Health and Nutrition Examination Survey), 95 % of the adolescents studied were diagnosed with vitamin D deficiency [21].

Low vitamin D sufficiency in the child population is a "global, silent, non-communicable pandemic". The results of Russian and international epidemiological studies convincingly prove that the frequency of low vitamin D concentration is at least 70 % (50–90 %) in both adult and child populations [15, 22]. In particular, according to the data of D. Wahl et al., vitamin D deficiency was found in 23.3 % of adolescents under 18 years of age living in Southeast China [22]. A UK study revealed that 70 % of adolescents aged from 14.7 to 16.6 years were vitamin D deficient [15, 23]. Insufficient intake of fatty fish and seafood is one of the causes of this vitamin deficiency.

Micronutrient deficiency in the diet of a modern adolescent is an objective reality of the present time. The organisation of rational nutrition, oriented to adolescent's individual health characteristics, is the foundation for reducing deficiencies in essential nutrients.

An assessment of the micronutrient intake of the rural adolescents' diet revealed an increased intake of sodium. Among rural adolescents in Primorsky Territory, sodium excess significantly exceeded PRS; 72 % of Omsk adolescents were found to exceed the recommended sodium intake standards; about 30 % of adolescents in the Republic of Belarus prefer to salt their food [24]. The proportion of average daily sodium intake in 12–17 years old Chinese adolescents exceeded the corresponding intake rate by 94.4 % [25]. The standard of salt intake in adolescents recommended by WHO experts should be no more than 5 g/day, which is equivalent to 2 g of Na [5].

It is proved that excessive salt intake with food is one of the leading determinants of the formation of high blood pressure and the risk of cardiovascular diseases in adulthood [26, 27]. A number of studies have evidenced an indirect association of excess salt intake on the development of excess body weight: each additional 1 g of salt increased the volume of fluid drunk and also led to an increase in the volume of portions eat-

en [27]. In a number of countries, salt intake is several times higher than the recommended levels, and the addition of salt to cooked food is part of a family tradition rather than a physiological necessity [28].

Calcium intake of the adolescents studied was below the PRS, which may be associated with inadequate intake of milk and dairy products. Low calcium intake is noted among adolescents in Penza and the Republic of Adygea [29]; among adolescents in the Irkutsk Region, calcium content is two times lower than the PRS for adolescents of primary school age [18].

One of the main natural sources of iodine for humans are products of plant and animal origin – milk, eggs, meat, cereals, vegetables. The Irkutsk Region is an iodine-deficient area, and local products cannot fully serve as a source of sufficient intake of this trace element into the body. According to WHO recommendations, iodised salt is used for mass prophylaxis of iodine deficiency, but despite these measures, a significant deficiency of this essential trace element is being observed everywhere among children and adults.

CONCLUSION

The actual nutrition of school-age children remains currently an urgent topic. The results of the study reveal that in rural conditions the diet of adolescents is characterised by imbalance in the main macro- and microelements. Low energy values and predominance of carbohydrate type of nutrition are observed. Deficiency of the most important vitamins (A, C, D), as well as microelements (calcium, iodine) has been revealed. Excessive sodium intake is particularly alarming. Data on the actual diet of rural adolescents may become an important component for the development of methodological recommendations for improving the nutrition of children and adolescents, followed by health education among the child population.

Conflict of interest

The authors of this article declare no conflicts of interest.

REFERENCES

1. Kolesnikov SI, Kolesnikova LI, Dolgikh VV, Bugun OV, Koroleva NV, Mikhnovich VI, et al. *Functional activity of the brain and processes of lipid peroxidation in children in the formation of psychosomatic disorders.* Novosibirsk; 2008. (In Russ.). [Колесников С.И., Колесникова Л.И., Долгих В.В., Бугун О.В., Королева Н.В., Михнович В.И., и др. *Функциональная активность мозга и процессы перекисного окисления липидов у детей при формировании психосоматических расстройств.* Новосибирск; 2008].

2. Esaulenko IE, Nastausheva TL, Zhdanova OA, Minakova OV. Characteristics of Voronezh schoolchildren physical development and nutrition behavior. *Problems of Nutrition.* 2017; 86(4): 85-92. [Есауленко И.Э., Настаушева Т.Л., Жданова О.А., Минакова О.В. Характеристика физического развития и режима питания школьников Воронежа. *Вопросы питания.* 2017; 86(4): 85-92]. doi: 10.24411/0042-8833-2017-00063

3. Vazhenina AA, Petrov VA, Ivanova IL. Home diet during weekends of preschool children. *Pacific Medical Journal.* 2016; 61(3): 45-48. (In Russ.). [Важенина А.А., Петров В.А., Иванова И.Л. Особенности домашних рационов выходного дня у дошкольников – воспитанников дошкольных образовательных организаций. *Тихоокеанский медицинский журнал.* 2016; 61(3): 45-48]. doi: 10.17238/PmJ1609-1175.2016.3.45-48

4. *Norms of physiological needs for energy and nutrients for various groups of the population of the Russian Federation: Methodological recommendations MR 2.3.1.2432-08.* Moscow; 200. (In Russ.). [*Нормы физиологических потребностей в энергии и пищевых веществах для различных групп населения Российской Федерации: Методические рекомендации МР 2.3.1.2432-08.* М.: Федеральный центр гигиены и эпидемиологии Роспотребнадзора; 2009].

5. *Norms of physiological needs for energy and nutrients for various groups of the population of the Russian Federation: Methodological recommendations MR 2.3.1.0253-21*. Moscow; 2021. (In Russ.). [*Нормы физиологических потребностей в энергии и пищевых веществах для различных групп населения Российской Федерации: Методические рекомендации МР 2.3.1.0253-21*. М.; 2021].

6. Sorvacheva TN, Martinchik AN, Pyryeva EA. *Comprehensive assessment of actual nutrition and nutritional status of children and adolescents.* Moscow; 2014. (In Russ.). [Сорвачева Т.Н., Мартинчик А.Н., Пырьева Е.А. *Комплексная оценка фактического питания и пищевого статуса детей и подростков.* М.; 2014].

7. Martinchik AN, Baturin AK, Baeva VS, Peskova EV. *Album of portions of food and dishes.* Moscow; 1995. (In Russ.). [Мартинчик А.Н., Батурин А.К., Баева В.С., Пескова Е.В. *Альбом порций продуктов и блюд.* М.: Институт питания РАМН; 1995].

8. Skurikhin IM, Tutelyan VA (eds). *Chemical composition of Russian food products.* Moscow; 2002. (In Russ.). [Скурихин И.М., Тутельян В.А. (ред.). *Химический состав российских пищевых продуктов.* М.: ДеЛи принт; 2002].

9. *Tables of calorie content of foods.* [*Таблицы калорийности продуктов*]. URL: https://health-diet.ru/ [дата доступа: 9.11.2023].

10. McCrory MA, Hajduk CL, Roberts SB. Procedures for screening out inaccurate reports of dietary energy intake. *Public Health Nutr.* 2002; (5): 873-882. doi: 10.1079/PHN2002387

11. Darenskaya MA, Rychkova LV, Astakhova TA, Pogodina AV, Dolgikh ON, Klimkina YuN, et al. Correlation between actual nutrition and lipid peroxidation and antioxidant defense parameters in aged 14–17 years adolescents living in rural area. *Siberian Scientific Medical Journal*. 2022; 42(5): 25-36. (In Russ.). [Даренская М.А., Рычкова Л.В., Астахова Т.А., Погодина А.В., Долгих О.Н., Климкина Ю.Н., и др. Взаимосвязь показателей фактического питания и параметров системы липопероксидации и антиоксидантной защиты крови у подростков 14–17 лет, проживающих в сельской местности. *Сибирский научный медицинский журнал.* 2022; 42(5): 25-36]. doi: 10.18699/SSMJ20220504

12. Pogozheva AV. The role of potassium and magnesium for prevention and treatment of cardiovascular disease. *Consilium Medicum*. 2020; 22(10): 76-79. (In Russ.). [Погожева А.В. Роль калия и магния в профилактике и лечении сердечно-сосудистых заболеваний. *Consilium Medicum*. 2020; 22(10): 76-79]. doi: 10.26442/20751753.2020.10.200336

13. Bugun OV, Rychkova LV, Dolgikh VV. Twenty-four-hour blood pressure monitoring in the diagnosis of essential arterial hypertension in childhood. *Byulleten' Sibirskogo otdeleniya Rossiyskoy akademii meditsinskikh nauk*. 2003; 23(2): 49-53. (In Russ.). [Бугун О.В., Рычкова Л.В., Долгих В.В Двадцатичетырехчасовое мониторирование артериального давления в диагностике эссенциальной артериальной гипертензии в детском возрасте. *Бюллетень Сибирского отделения Российской академии медицинских наук*. 2003; 23(2): 49-53].

14. Rychkova LV, Dolgikh OA, Pogodina AV, Astakhova TA, Ayurova ZhG. Dietary intake in indigenous adolescents in rural Buryatia, Russia. *Acta biomedica scientifica*. 2021; 6(4): 160-172. (In Russ.). [Рычкова Л.В., Долгих О.А., Погодина А.В., Астахова Т.А., Аюрова Ж.Г. Питание подростков – жителей сельских районов Республики Бурятия. *Acta biomedica scintifica*. 2021; 6(4): 160-172]. doi: 10.29413/ABS.2021-6.4.14

15. Nazarova LSh, Daukaev RA, Karimov DO, Musabirov DE, Smolyankin DA, Ziatdinova MM, et al. Monitoring the nutritional status of adolescents and older parents in Ufa and Ufa district of the Republic of Bashkortostan. *Occupational Medicine and Human Ecology*. 2022; (1): 206-219. (In Russ.). [Назарова Л.Ш., Даукаев Р.А., Каримов Д.О., Мусабиров Д.Э., Смолянкин Д.А., Зиатдинова М.М., и др. Мониторинг состояния питания подростков и их родителей в г. Уфе и Уфимском районе Республики Башкортостан. *Медицина труда и экология человека*. 2022; (1): 206-219]. doi: 10.24411/2411-3794-2022-10114

16. Saldan IP, Filippova SP, Turchaninov DV, Okolelova OV, Vilms EA. Hygienic evaluation of the efficacy of the regional program of the modernization of school meals (on the example of Altai Krai). *Hygiene and Sanitation*. 2014; 93(4): 95-100. (In Russ.). [Салдан И.П., Филиппова С.П., Турчанинов Д.В., Околелова О.В., Вильмс Е.А. Гигиеническая оценка эффективности региональной программы модернизации школьного питания в Алтайском крае. *Гигиена и санитария*. 2014; 93(4): 95-100].

17. Evseeva SA, Egorova AG, Savvina MS, Burtseva TE, Slobodchikova MP. Features of nutrition of school-age children in rural areas of the Republic of Sakha (Yakutia). *Yakut Medical Journal*. 2019; (4): 78-81. (In Russ.). [Евсеева С.А., Егорова А.Г., Саввина М.С., Бурцева Т.Е., Слободчикова М.П. Особенности питания детей школьного возраста в сельской местности РС (Я). *Якутский медицинский журнал*. 2019; (4): 78-81]. doi: 10.25789/YMJ.2019.68.22

18. Efimova NV, Myl'nikova IV, Turov VM. Hygienic conditions of supplementary educational organizations and health of children. *Human Ecology*. 2020; (3): 23-30. (In Russ.). [Ефимова Н.В., Мыльникова И.В., Туров В.М. Питание школьников, проживающих на городских и сельских территориях Иркутской области. *Экология человека*. 2020; (3): 23-30]. doi: 1033396/1728-0869-2020-3-23-30

19. Reider CA, Chung RY, Devarshi PP, Grant RW, Hazels Mitmesser S. Inadequacy of immune health nutrients: Intakes in US adults, the 2005–2016 NHANES. *Nutrients*. 2020; 12(6): 1735. doi: 10.3390/nu12061735

20. Wang H, Wang D, Ouyang Y, Huang F, Ding G, Zhang B. Do Chinese children get enough micronutrients? *Nutrients*. 2017; 9(4): 397. doi: 10.3390/nu9040397

21. Looker AC, Dawson-Hughes B, Calvo MS, Gunter EW, Sahyoun NR. Serum 25-hydroxyvitamin D status of adolescents and adults in two seasonal subpopulations from NHANES III. *Bone*. 2002; 30(5): 771-777. doi: 10.1016/s8756-3282(02)00692-0

22. Wahl DA, Cooper C, Ebeling PR, Eggersdorfer M, Hilger J, Hoffmann K, et al. A global representation of vitamin D status in healthy populations. *Arch Osteoporos*. 2012; 7: 155-172. doi: 10.1007/s11657-012-0093-0

23. Van Schoor NM, Lips P. Worldwide vitamin D status. *Best Pract Res Clin Endocrinol Metab*. 2011; 25(4): 671-680. doi: 10.1016/j.beem.2011.06.007

24. Grimes CA, Campbell K, Riddell L, Nowson CA. Sources of sodium in Australian children's diets and the effect of the application of sodium targets to food products to reduce sodium intake. *Br J Nutr*. 2011; 105(3): 468-477. doi: 10.1017 / S0007114510003673

25. Koval'chuk VK, Yamilova OYu, Saenko AG, Semaniv EV, Perelomova OV. Territorial analysis of the actual nutrition of adolescents in Primorsky territory. *Pacific Medical Journal*. 2016; 4(66): 40-45. (In Russ.). [Ковальчук В.К., Ямилова О.Ю., Саенко А.Г., Семанив Е.В., Переломова О.В. Территориальный анализ фактического питания подростков в Приморском крае. *Тихоокеанский медицинский журнал*. 2016; 4(66): 40-45]. doi: 10.17238/PmJ1609-1175.2016.4.40-45

26. Pogodina AV, Dolgikh VV, Rychkova LV. Epidemiological aspects of arterial hypertension in children and adolescents. *Kardiologiya 2006: Materialy Vserossiiyskogo nauchno-obrazovatel'nogo foruma*. 2006; 111-112. (In Russ.). [Погодина А.В., Долгих В.В., Рычкова Л.В. Эпидемиологические аспекты артериальной гипертензии у детей и подростков. *Кардиология 2006: Материалы Всероссийского научно-образовательного форума*. 2006; 111-112].

27. World Health Organization. *Effect reduced sodium intake on cardiovascular disease, coronary heart disease, and stroke*. Geneva: World Health Organization; 2012.

28. Bouhlal S, Issanchou S, Nicklaus S. The impact of salt, fat and sugar levels on toddler food intake. *Br J Nutr*. 2011; 105(4): 645-653. doi: 10.1017/S0007114510003752

29. Kisel'nikova LP, Alekseeva IA, Shchepliagina LA. The estimation of calcium availability for the adolescent children with high caries activity. *Russian Stomatology*. 2013; 6(2): 31-34. (In Russ.). [Кисельникова Л.П., Алексеева И.А., Щеплягина Л.А. Оценка обеспеченности кальцием детей подросткового возраста с высокой активностью кариеса. *Российская стоматология*. 2013; 6(2): 3134].

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