

MEDICAL AND SOCIAL PROBLEMS OF OPTIMIZING THE NUTRITION OF CHILDREN AND ADOLESCENTS UNDER THE CONDITIONS OF TODAY

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The article reviews publications devoted to the issue of optimization of nutrition of children and adolescents including school nutrition, various ways of formation of eating habits, succession of home and school nutrition, nutrition of children with alimentary-dependent diseases and children who go in for sports, quality of raw materials and products for school nutrition, and nutrition using new products. The information was searched for with eLIBRARY.RU, PUBMED, Web of Science and Scopus information portals and platforms from 2007 to 2021. Publications related to the issue were assessed while studying at school and during distance learning. Modern issues of nutrition of schoolchildren such as disturbances of alimentary behavior and underdeveloped skills of nutritional culture, dietary habits of schoolchildren with alimentary-dependent diseases and approaches to nutrition optimization at educational institutions are highlighted. The ways of prevention of alimentary-dependent diseases are estimated by way of inclusion of functional products into the diet of schoolchildren. Principal methodical and regulatory documents that can help reduce risks of alimentary-dependent diseases are mentioned. Pressing trends of researches regarding the reviewed topic were suggested to preserve health of schoolchildren as far as healthy nutrition goes.

Keywords: literature review, nutrition of schoolchildren, alimentary-dependent diseases, distance learning, nutrition optimization, new products

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МЕДИКО-СОЦИАЛЬНЫЕ ПРОБЛЕМЫ ОПТИМИЗАЦИИ ПИТАНИЯ ДЕТЕЙ И ПОДРОСТКОВ В СОВРЕМЕННЫХ УСЛОВИЯХ

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В статье представлен обзор публикаций по проблеме оптимизации питания детей и подростков, включая школьное питание различными способами, формирование пищевых привычек, преимущества домашнего и школьного питания, питания детей с алиментарно-зависимыми заболеваниями и детей, занимающихся спортом, качества сырья и продукции для школьного питания, питания с использованием новых продуктов. Поиск информации осуществлялся с использованием информационных порталов и платформ eLIBRARY.RU, PUBMED, Web of Science и Scopus за период 2007–2021 гг. Оценивались публикации по данной проблеме в обычных условиях обучения детей и во время дистанционного обучения. Показаны современные проблемы в питании школьников: нарушение пищевого поведения и несформированность навыков культуры питания, выделены и освещены особенности питания школьников с алиментарно-зависимыми заболеваниями, подходы к оптимизации питания в образовательных организациях. Оценены способы профилактики алиментарно-зависимых заболеваний путем включения в рацион школьников функциональных продуктов питания. Указаны основные методические и нормативные документы, использование которых позволит снизить риски возникновения алиментарно-зависимых заболеваний. Предложены актуальные направления исследований по теме обзора для сохранения здоровья обучающихся с позиции здорового питания.

Ключевые слова: обзор литературы, питание школьников, алиментарно-зависимые заболевания, дистанционное обучение, оптимизация питания, новые продукты

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Schoolchildren of today have accelerated rates of growth and development. Earlier puberty (occurring two years earlier as compared to students of the XX century) is typical of modern schoolchildren. The rate of growth and development of the skeleton and endocrine system usually outpace the ones of their peers in the beginning of the XX century. For instance, in 15-year-old teenagers the body length and the body mass are averagely increased by 6–10 cm and 3–10 kg respectively. Thus, children and adolescents have more frequently accelerated rates of growth and development of various systems of the body such as cardiovascular, respiratory and locomotor ones. This explains why certain diseases (hypertension, osteoporosis, diabetes) become younger. The majority of such issues in children and adolescents is commonly associated with a lifestyle such as disturbed type of nutrition, low physical activity,

economic condition of the family, shortcomings in organization of preventive work of medical workers [1]. The last 50–70 years are characterized by changes in nutrition of schoolchildren associated with unbalanced content of basic micronutrients (proteins, fats, carbohydrates and micronutrients — vitamins, mineral substances and microelements). It should be noted that certain disbalance is found among students of different ages; this does not correspond to the normal ratio of proteins, fats and carbohydrates (1: 1, 1: 4,8). The diet of modern children often consists of excessive amounts of meat products, fats, sugar, but lacks phosphorus, calcium, iron and magnesium, which fails to restore the daily physiological need of a body in a number of cases [2, 3]. According to the National projects approved by Order of the President of the Russian Federation No. 204 as of May 07, 2018, it is necessary to improve

life quality of population and create conditions to increase life expectancy using the healthy way of life and harmonic development^{1,2}.

Adequate balanced nutrition is a condition of normal functioning of all organs and systems. This is especially important during the period of intensive growth and hormonal transformation of a growing body, which depend on developed standards and habits in the field of healthy nutrition. The children who are 7 to 18 years old and who attend general educational organizations spend most time at school. Thus, organized school nutrition is an essential part of nutrition of a modern student and should be economically affordable, take into account the present diseases and preferences of children, and rely on local traditions [4].

The purpose of the present review is to determine problematic aspects in organization of nutrition among children and adolescents, its possible optimization at school and home, nature of nutrition considering the existing diseases and going in for sports.

Performed analysis of contextual information posted on official sites of the regions of the Russian Federation has shown that the most problematic issues involve implementation of activities on modernization of regional and municipal nutrition systems among students of educational institutions, determination of cost of school nutrition, condition of infrastructure used to organize school nutrition, ensuring quality control and safety of nutrition at educational institutions^{1,2}.

While studying provision of warm food to children of Yuzhno-Sakhalinsk, it has been found out that breakfasts were provided to 82%, dinners to 11.6%, breakfasts and dinners (two meals a day) to 14%, other forms of nutrition (lunch, buffet food) to 19.2% of children [5]. Another problem consists in non-correspondence of the nature of food taken by modern students to the rules of healthy nutrition: meat is daily consumed by 63% of students only, milk and dairy products by 71% of students, fruits and vegetables are consumed by 55%, whereas 82% of those interviewed eat confectionary on a daily basis. Other factors include hypodynamia and long stay in front of a computer, tablet, mobile phone and TV monitor. For instance, 45% of schoolchildren watch TV for 2 and more hours per day, whereas 18% of students spend 3–4 hours on the same [6]. Similar data are quoted by other authors describing hypodynamia, excessive use of carbohydrates, violation of sleep and wakefulness, reduced night sleep, most commonly resulting not just in neurotization, but also in metabolic disorders and increases the risk of obesity among schoolchildren several times [7, 8].

Examining the features of formation of eating behavior in preschool children with an excessive body mass and obesity by survey of parents revealed disturbed nutrition regimen, frequency of food intake and volume of food. Only 37% of children with excessive body mass and obesity had three warm meals a day, 14% of children with excessive body mass and obesity ate at the same time of the day, 17% of children with excessive body mass and obesity had a meal with other members of the family. Authors revealed the factors that promoted disturbed formation of eating behavior, including violation of the diet, etc. [9]. Examination of regional information posted on official sites in relation to organization of school nutrition has shown that in a number of cases normative and

methodological documentation at educational institutions, information about possible organization of the so-called inclusive nutrition of students with various diseases such as diabetes and celiac disease are lacking [10, 11]³.

While assessing inclusive nutrition of children and disabled adolescents by questioning it has been found out that 38% are exempt from parental payment in a kindergarten, 29% obtained free two meals a day at an educational institution, whereas one third part of parents reported that they came across nothing of the abovementioned [12]. While organizing inclusive nutrition it should be noted that it is important to develop skills (not throwing bread crumbs, proper use cutlery and wiper cloth, chewing thoroughly with your mouth closed) associated with food intake in disabled children. It should be noted that wishing bon appetite is an obligatory condition [13, 14]. The study authors provided offers concerning nutrition of disabled children such as limitation and regulation of marketing of food products with high content of saturated fats, free sugars, salt and drinks high in sugar and limitation of the amount of advertising, types of advertised products and urging to purchase calls used to improve product attractiveness [15].

Basic trends of state policy in childhood protection including production of qualitative products for children and food products are incorporated as part of measures of the Decade of childhood (2018–2027) as basic constituents of harmonic growth and development and health preservation among the younger generation of the Russians [2, 13].

When interviewing the schoolchildren, assessment of actual nutrition has shown that their nutrition is characterized by low consumption of biologically valuable products. Schoolchildren get meat and fish products, dairy products and fruits with vegetables twice a week in 40.3%, 15.6% and 28.6% of cases respectively. It should be noted that schoolchildren often go to school without having breakfast (25%). Only 70.1% have warm food at school; every day they consume fast food (18.2%), chips (16.8%), sweet carbonated beverages (21.6%), with no starters (13.9%), with supplementary intake of vitamin preparations (38.2%). A tendency to increased consumption of bread and pastries and disturbed food regimen (less than 4 times a day) was observed in 40.2% of students [16].

Due to a growing number of children with obesity mainly associated with improper feeding, growth of cardiovascular and gastrointestinal diseases, decreased immunity, predominance in the diet of food with insufficient content of vitamins and mineral substances due to certain reasons (low family income, large families, vegan children, and those with disturbed food behavior (only high-carbohydrate fast food), limited health-related nutrition (intolerance of certain food products and their exclusion from the diet), modern products are not just food, but rather substances that produce an effect on human health and well-being. Food products should contain all necessary constituents for healthy nutrition of children and adolescents: proteins, fats, carbohydrates, macro- and micronutrients, microorganisms (lacto- and bifidobacterial), mineral substances, vitamins and food fibers.

Eating habits vary depending on the region. While studying the nutritional status in children from the Komi Republic (KR) and Khanty-Mansi Autonomous Okrug — Yugra aged 7 to 17 in 2018–2019, differences in the ratio of insufficient and excessive body mass (including obesity) was found among inhabitants of the KR as compared with KHMAO small settlements ($p = 0.004$), cities ($p = 0.017$) and villages.

¹ <https://yandex.ru/search/?lr=213&text=04.rospotrebnadzor.ru> date of referral 02.07.2022

² <https://www.garant.ru/hotlaw/federal/1195467/> date of referral: 22.07.2022

³ <https://www.nsportal.ru/detskiy-sad/raznoe/2017/12/03/organizatsiya-kormleniya-v-inklyuzivnoy-gruppe> date of referral: 22.07.2022

Children from the KR have a higher percentage of excessive weight and obesity (26.6 vs 25.7 and 24.8% in cities and villages of the KHMAO respectively) but a significantly lower percentage of insignificant weight (1.9 vs 5.0 and 6.8%). In remote areas of the KR, a number of schoolchildren with obesity is higher than in large settlements of the KHMAO and large areas of the KR (13.1, 7.7 and 9.2% respectively). It should be noted that no significant differences were found between the ethnic groups [17].

A relevant area includes organization of nutrition of children who visit sports sections and schools. Popov OS and Shatnova AA carried out research related to analysis and estimation of risks during organization of nutrition, labor and rest of adolescents who go in for sports. During the research, it was found out that adolescents who go in for sports have food 4–5 times a day, whereas schoolchildren who are not professional sportsmen eat 3–4 times a day. The regimen of nutrition is used because energy expenditure among sportsmen is much higher and they require energy to maintain a physical form [18]. Schoolchildren who do not go in for sports have 5–6 hour-intervals between food intakes. In the majority of cases, sportsmen have supper at least 2 hours before sleep. Intense trainings without qualitative restoration including good nutrition can reduce the physical level of a sportsman. To the contrary, training sessions combined with proper nutrition improve results of sportsmen consistently [19].

New standards of nutrition are accepted in developed countries. According to the new standards in the USA, schoolchildren can be offered skimmed flavored milk (1%) in addition to other variants of skimmed and low-fat milk. Breakfasts and lunches at school should include whole-grain products with at least 80% of grains. Meanwhile, it is planned to decrease the amount of salt in school breakfasts and lunches by 10%. According to the Ministry of Agriculture of the USA, a weekly limit of sodium for 2022–2023 remains at the same level [20]. In 2024, introduction of supplementary long-term standards related to school nutrition in the USA is expected.

In recent decades, many developing countries could significantly improve their position in the area of nutrition.

Both malnutrition, and incidence of obesity constitute a serious problem. In some countries it currently reaches the level of developed countries.

Information about double malnutrition (DBMN) (i. e. excessive/insufficient weight), and delay in the growth was updated. In developing countries, the DBMN ratio was increased as per capita income. In its turn, poor nutrition in early childhood is one of the leading obesity factors among children and adolescents in future [21].

Another nutritional constituent is use of drinking water. Survey of schoolchildren and parents from two schools in Zapopan (Mexico) has shown that total consumption of drinking water by children aged 9 to 18 years reaches just 30% of the total liquid consumption [22].

Use of the so-called functional food products such as products with certain specified properties (for instance, sweet sausages for dessert) is currently relevant. According to GOST, the product has an updated technology of making and changing organoleptic values while introducing biologically active substances such as Perga, a beekeeping product [23]. In the Republic of Kazakhstan, technologies of getting fruit and vegetable jams, puree, fruit and vegetable juices (apples, carrots, table beet, etc.) enriched with pectin extract from secondary raw products of sugar industry with functional, bioecological and natural healing properties were developed. The products containing pectin extract make it possible to

create more acceptable compositions to achieve an effective balanced composition of the target product [24].

It is known that temperature and way of preparation produce a great effect on organoleptic properties and taste of food products. In another research, the effect of thermal treatment and addition of sunflower oil on the functional properties of meat products was assessed. During the work, data indicating that temperature and duration of cooking influence the physical properties and taste of meat and meat products were obtained. Properties of processed meat products (juiciness and taste) depend on the functional properties of meat protein. Modern manufacturers use a wide specter of herbal supplements including vegetable oil to improve both organoleptic and functional properties of these products [25]. In the Russian market, the functional products are divided into four groups: grain products (porridge, flakes), including bakery and confectionary; soft drinks; milk products; oil and fat products. There are a few products related to other subbranches of food industry. In 2007 to 2013, manufacture of functional products increased by 160% [26].

Food of a functional purpose (for instance, local fruits of sea buckthorn) can be found among recipes and production technologies of desserts. It should be noted that the product was dehydrated at 45°, with no addition of sugar, making it possible to reduce the calorie content and create a functional dessert [27]. New fruit and vegetable pectin-containing drinks with milk serum are found in nutrition of schoolchildren. The product value consists in a balanced composition of micronutrients, functional activity and good taste. Moreover, the product contains an optimal amount of fruit and vegetable fillers and milk serum. Model samples contained 0–24% of fruit juice, 0–24% of pumpkin juice (puree) and 0–24% of serum fermented with Bifilact-Plus sourdough [28]. The product was rated on a 10-point scale with assessment of color, taste, aroma and consistency.

The samples having fruit and pumpkin juice in their recipe in the ratio of 16 to 4 and 4 to 16 are considered the best by their organoleptic properties. They had a pronounced taste and odor, natural color typical of this raw material. Pectin-containing drinks of a functional purpose require no complex production technology and special conditions of storage. They improve health of schoolchildren at the expense of functional constituents and can/should be used in school nutrition as well [29].

Other studies have shown that addition of GBF (guava peel and flesh flour) into guava juice increases acidity and changes color and rheological parameters, especially in higher concentrations (3% and 5%). It should be noted that the product has an increased content of food fibers, anthocyanins and antioxidants when GBF is added, with no changes in soluble dry substances, total amount of phenol compounds and content of ascorbic acid [30]. In the literature, possible use of pectin extract of fruits of forage watermelon as a biologically active supplement is described to enrich flour and production of bread with functional properties. During the study of this bread, a positive effect of pectin extract on physical properties of dough and bread quality was established. The use of pectin extract as an enriching additive enables to expand the range of preventive purpose bread products, which is associated with necessary correction of micronutrient deficiency in the body [31]. Besides, principal requirements to quality of food products of a functional purpose on the basis of products obtained after conversion of grains are described in literature [31].

School nutrition under modern conditions is optimized using novel recipes of dishes (combined products) with

an optimal and balanced amino acid composition. In the context of steamed beef, lamb and cabbage balls it has been established that they are better than steamed beef and lamb balls by 7.61% and as compared to steamed beef balls by 9.38%. The products have a high biological value (95 to 99%). Amino acid analysis of these balls displayed a maximum specter of amino acids for steamed balls with beef, lamb and cabbage. The authors have found out that meat minced products made of beef, lamb and plants (carrots, pumpkin, white cabbage) have a better balance of amino acids and biological value [32].

The next publication was about development of functional melted cheese products for specialized food for children. The products created using a complex technology have high quality, nutritional value, safety, and content of special food substances such as bioflavonoids and food fibers to improve absorption. All formulation components are selected based on the product designation: food for schools, nutrition for older and elderly people, sports nutrition, massive nutrition, etc. [33].

Perspective trend of expanded assortment of food products for functional and specialized purposes consists of the use of germinated seeds of cereal crops as part of multi-component food supplement (phospholipid nutritional complex). The technology of obtaining a complex and physiologically functional ingredient made of sprouted seeds of naked oats, non-fat rape phospholipids and melissa and succinic acid concentrate

was developed. Combination of components in these food products enables to increase resistance to stress and exercise intolerance, which is essential under modern conditions [34].

CONCLUSION

Optimized nutrition of modern schoolchildren includes a set of measures aimed at provision of students with good nutrition that corresponds to physiological standards and rules of balanced nutrition. The fact is displayed in respective sanitary norms and rules [35].

It should be noted that schoolchildren require nutrition which is similar to the one provided at school to prevent alimentary-dependent disorders among healthy children and reduce the risk of exacerbation of the principal disease in children with such diseases.

Moreover, proper nutrition plays a leading role in normal functioning of various organs and systems of a child's growing body, including alimentary, endocrine, cardiovascular, urinary, locomotor, nervous, reproductive and other systems.

Modern technologies of nutrition optimization, including enrichment, up-to-date ways of treatment of products and dishes while storing, instruments on learning about and motivation for proper nutrition and a healthy way of life can be used to create an environment for healthy growth of children and adolescents reducing the risk of alimentary-dependent diseases.

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