

UDC: 613.22

## THE USE OF NUTRACEUTICALS IN CHILDREN. GLOBAL TRENDS (literature review)


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The purpose of the review was to assess global trends in the consumption of nutraceuticals by children and adolescents. The analysis of modern literature is carried out. It has been shown that about 30% of children and adolescents in economically developed countries of the world regularly consume nutraceuticals, there is an increase in the consumption of nutraceuticals with anabolic properties among adolescent girls. Comparisons with idealized bodies on Instagram lead to a decrease in self-confidence and an increase in the frequency of dissatisfaction with one's own body. Accordingly, the demand for protein-containing food supplements is increasing. The highest intake of nutraceuticals in children and adolescents has been reported in the United States. Among other countries, there is also a high rate of nutraceutical use. The most frequently consumed nutraceuticals are multivitamin and mineral complexes, while only in 1/5 of cases the consumption of nutraceuticals by children is initiated by a medical specialist, in other cases, the decision to include nutraceuticals in the diet was made under the influence of advertising. There is a steady global trend towards increasing the consumption of nutraceuticals by children and adolescents. In Ukraine, extensive studies on children's consumption of nutraceuticals have not been conducted. However, these studies were conducted on limited clinical material and do not reflect the actual prevalence of nutraceutical use in children and adolescents in Ukraine. This makes it highly relevant to conduct a population-based study in Ukraine to investigate the role of nutraceuticals in pediatric nutrition.

**Keywords:** nutrition, children and adolescents, health, prevention.

	<p><b>Цитуйте українською:</b> Лотоцька ОВ, Вастьянов РС, Коболев ЄВ, Рожнова АМ. Застосування нутрицевтиків у дітей. Світові тенденції (огляд літератури). Експериментальна і клінічна медицина. 2023;92(2):76-82. <a href="https://doi.org/10.35339/ekm.2023.92.2.lvkk">https://doi.org/10.35339/ekm.2023.92.2.lvkk</a> [англійською].</p>
	<p><b>Cite in English:</b> Lototska OV, Vastyanov RS, Kobolev EV, Rozhnova AM. The use of nutraceuticals in children. Global trends (literature review). Experimental and Clinical Medicine. 2023;92(2):76-82. <a href="https://doi.org/10.35339/ekm.2023.92.2.lvkk">https://doi.org/10.35339/ekm.2023.92.2.lvkk</a></p>

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2023

The modern history of nutraceuticals began with the discovery of vitamins. Kazimierz Funk proposed the idea that various diseases could be treated with nutritional substances, and indeed, significant progress was made in the treatment of avitaminosis through replacement therapy in the following years [1; 2].

The first commercial dietary supplement can be considered Mastin's Yeast Vitamon tablets, which started to be sold in 1916 [1]. The preparation contained vitamins A, B, and C, iron, calcium, and Nux vomica, a homeopathic remedy for indigestion. The label claimed, "This preparation contains vitamins along with other ingredients that are supposed to be useful for improving appetite, aiding digestion, relieving constipation, clearing the skin, increasing energy, and, as a tonic, assisting in gaining weight in weakened, exhausted conditions due to undernutrition". Doctors were not satisfied with consumers buying dietary supplements. "The claims set forth on the labels as to the therapeutic value of these preparations are extravagant and misleading", a 1922 article in the Journal of the American Medical Association stated [1]. However, since then, nutraceuticals have become a significant part of the modern human diet [3–5]. This is due to the changing quality of food products and the reduced content of essential nutrients in them. The poor purchase dietary supplements because they cannot afford quality nutrition, and the wealthy do it because their consumption is part of the image of prosperity created by advertising [3]. The global nutraceutical market was hardly affected even by the COVID-19 pandemic, except for a slight increase in the consumption of vitamins and combination products with immunotropic effects [4].

**The aim** of this review was to assess global trends in the consumption of nutraceuticals by children and adolescents.

The use of dietary supplements is widespread among children and adolescents today [4–10]. Approximately one-third of children and adolescents (aged  $\leq 19$  years) in the United States regularly used dietary supplements during 2013–2014. The latest published data from the National Health and Nutrition Examination Survey (NHANES) during 2017–2018 were used to assess the prevalence of supplement use among children and adolescents in the United States, including the use of any dietary supplements, two or more dietary supplements, and specific types of dietary supplements. Trends in the use of dietary supplements from 2009–2010 to 2017–2018 were calculated. During 2017–2018, 34.0% of children and adolescents used some form of dietary supplement in the 30 days preceding the survey, with no significant changes since 2009–2010. The use of two or more dietary supplements increased from 4.3% in 2009–2010 to 7.1% in 2017–2018. Multivitamin-mineral products were used by 23.8% of children and adolescents, making them the most commonly used supplements [6].

All nutraceuticals were classified according to the following scheme: 1) multivitamin-mineral products containing more than three vitamins and more than one mineral; 2) products containing mainly calcium with or without other ingredients; 3) products containing mainly omega-3 fatty acids with or without other ingredients; 4) products containing mainly probiotics with or without other ingredients; 5) products containing mainly fiber with or without other ingredients; 6) products containing mainly melatonin with or without other ingredients; 7) plant-based products containing more than one plant ingredient and no vitamins or minerals; 8) multivitamins containing more than two vitamins without minerals; 9) amino acid products containing more than one amino acid; 10) other nutritional supplements, classified

separately, such as individual vitamins (e.g., vitamin D, vitamin C) and individual minerals (e.g., iron).

The results are presented for the types of products most commonly consumed by children and adolescents, i.e., those with a prevalence of use greater than 1% [6].

During 2017–2018, the overall prevalence of regular use of dietary supplements among children and adolescents was 34.0%. The use of dietary supplements was higher among girls (37.3%) than among boys (30.8%), and the prevalence of consumption was highest among children aged 2–5 years (43.3%), followed by children aged 6–11 years (37.5%), 12–19 years (29.7%), and under 2 years (21.8%). The prevalence was higher among non-Hispanic Asians (41.1%) and non-Hispanic white children and adolescents (39.9%) compared to non-Hispanic black (20.8%) and Hispanic (26.9%) children and adolescents. The use of dietary supplements increased with increasing household income and the level of education of the household head. The prevalence of using two or more dietary supplements was 7.1%

and varied by age, race, language environment, income, and the level of education of the household head [6].

Among children aged 12–19 years, the consumption of any dietary supplements significantly increased linearly from 22.1% in 2009–2010 to 29.7% in 2017–2018 (Figure) [6]. The use of two or more dietary supplements also significantly increased from 2009–2010 to 2017–2018 among all children and adolescents (from 4.3% to 7.1%) as well as among children aged 2–5 years (from 6.8% to 8.3%) and 12–19 years (from 3.2% to 8.5%).

The most commonly used type of products were multivitamin-mineral complexes (23.8% of children and adolescents) [6]. The prevalence of using single-ingredient vitamin D (3.6%), single-ingredient vitamin C (3.0%), probiotics (1.8%), melatonin (1.3%), omega-3 fatty acids (1.3%), botanical (1.1%), and multivitamin (1.0%) products reached or exceeded 1.0%. The use of multivitamin-mineral supplements, single-ingredient vitamin D, probiotics, and plant-based products varied depending on the age group.

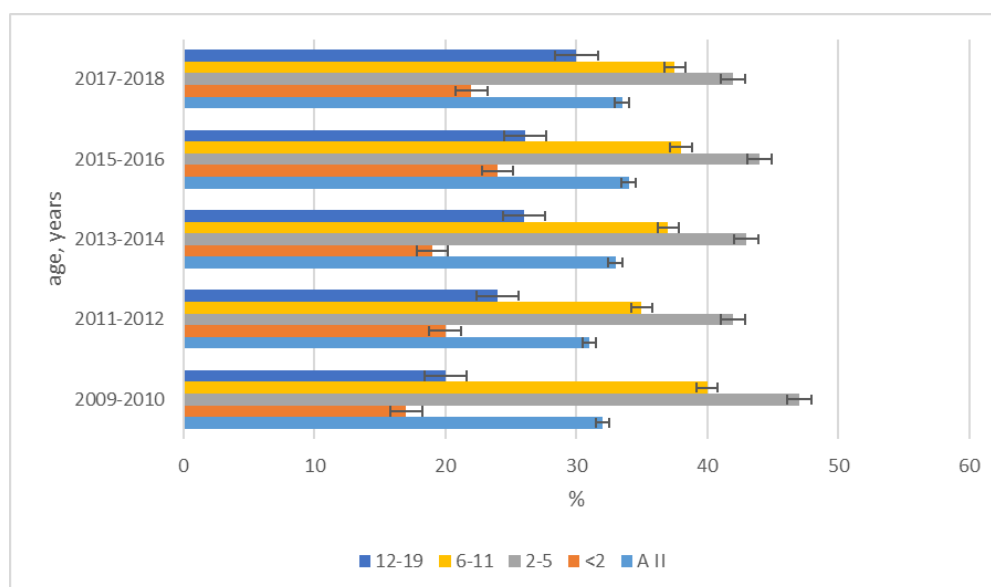


Fig. Age-specific patterns of nutraceutical use among children and adolescents in the USA (2009–2018).

During 2017–2018, approximately one-third of children and adolescents in the USA regularly consumed nutraceuticals, and the number of supplements used increased in accordance with the household income and the level of education of the household head. This can lead to exceeding recommended consumption levels, resulting in the risk of hypervitaminosis and/or micronutrient deficiencies.

According to various studies in the USA, only 18% of children and adolescents who take dietary supplements did so based on the recommendations of health-care professionals. The American Academy of Pediatrics (AAP) recommends that infants older than 4 months who are breastfed receive iron supplements before the introduction of iron-containing solid foods and that all exclusively breastfed infants receive vitamin D supplements. Other circumstances that may require the use of dietary supplements in children or adolescents include specific dietary practices, adolescent pregnancy, and various chronic medical conditions. However, current dietary guidelines emphasize meeting the needs for essential nutrients primarily through the consumption of natural food sources.

Excessive consumption of nutraceuticals and fortified food products by children and adolescents is also observed in other economically developed countries [8–12]. For instance, an Italian study showed that women, higher-income parents, and those with higher levels of education are more inclined to purchase functional foods for their children. 36% of surveyed Italian parents claimed to regularly buy vitamin-enriched fruit juices and other products for their children [8].

In a Swiss study, 60% of preschool-aged children regularly received dietary supplements. Vitamins were the second most popular supplement (17% of children under 3 years and 30% of children

over 4 years). Multivitamin-mineral complexes were the most commonly used. Researchers highlighted the importance of consuming iodized salt and mineral supplements containing adequate iodine. However, only in 20% of cases were nutraceuticals used based on the recommendation of a specialist, with the majority being influenced by advertising when deciding to include nutraceuticals in their diet [9].

A recent study [10] found that 6.8% of Japanese children regularly use dietary supplements. Amino acid and protein complexes were the most common, followed by fish oil, probiotics, and multivitamins. The authors identified a significant relationship between supplement use and sports activities.

Two large German studies, the DONALD and EsKiMo studies, showed that, with a few exceptions, the nutrient intake of children is generally satisfactory. However, in about one-third of cases, there was a relative deficiency of folic acid, vitamin D, iron, iodine, and calcium. These studies revealed that approximately ten percent of children aged two to 18 in Germany regularly received dietary supplements from their parents or consumed products enriched with vitamins or minerals [10]. In contrast to the United States and Japan, boys in Germany more often used nutraceuticals, with the frequency of consumption increasing with age. According to experts at the Coch Institute in Australia, the frequency of nutraceutical consumption by children is 23.5% in Australia, 33.5% in China, 37.5% in Denmark, 25.5% in the UK, 8.0% in Japan, 28.4% in Canada, 54.2% in South Korea, and 34.0% in Poland. In the United States, it ranges from 36.0% to 45.0%, depending on age [10].

In recent years, there has been an increase in the consumption of nutraceuticals with anabolic properties among adolescent girls. Comparisons with idealized bodies on Instagram lead to decreased self-esteem

and increased body dissatisfaction [13]. Consequently, there is a growing demand for protein-rich dietary supplements.

In Ukraine, extensive studies on children's consumption of nutraceuticals have not been conducted. According to domestic standards for sanitary-epidemiological expertise, dietary supplements for children under 3 years of age should not contain identical natural and synthetic substances, meaning they should only consist of natural components [14]. The work by Marushko Y.V. shows that nutrition does not fully meet the need for vitamins and micronutrients, indicating the necessity of additional prescription of vitamin and micronutrient complexes [15]. The work by Zelinska N.B. contains practical recommendations for the prevention and treatment of vitamin D deficiency in children of different ages, including in the presence of obesity [16]. Berezhny V.V. notes the imbalance in the nutrition of children in Ukraine. According to his opinion, the significant deficiency of vitamins and micronutrients in food products dictates the need for the use of vitamin-mineral complexes to correct pathological

conditions associated with vitamin deficiency.

However, these studies were conducted on limited clinical material and do not reflect the actual prevalence of nutraceutical use in children and adolescents in Ukraine. This makes it highly relevant to conduct a population-based study in Ukraine to investigate the role of nutraceuticals in pediatric nutrition.

### Conclusions

1. Approximately 30% of children and adolescents in economically developed countries worldwide regularly consume nutraceuticals.

2. The highest level of nutraceutical consumption among children and adolescents is recorded in the United States.

3. The most commonly consumed nutraceuticals are polyvitamin-mineral complexes.

4. Only in 1 out of 5 cases, the consumption of nutraceuticals by children is initiated by a healthcare professional.

5. There is a consistent global trend towards increased consumption of nutraceuticals by children and adolescents.

**Conflict of interest** is absent.

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#### **ЗАСТОСУВАННЯ НУТРИЦЕВТИКІВ У ДІТЕЙ. СВІТОВІ ТЕНДЕНЦІЇ (огляд літератури)**

Метою огляду була оцінка світових тенденцій у споживанні нутрицевтиків дітьми та підлітками. Проведений аналіз сучасної літератури. Показано, що близька 30 % дітей та підлітків в економічно розвинутих країнах світу регулярно споживають нутрицевтики, відмічається збільшення споживання нутрицевтиків з анаболічними властивостями серед дівчат-підлітків. Порівняння з ідеалізованими тілами в Instagram призводить до зниження впевненості у собі та збільшення частоти незадоволеності власним тілом. Відповідно, збільшується попит на протеїн-місткі харчові добавки. Найвищий рівень споживання нутрицевтиків дітьми та підлітками зареєстрований у США. Серед інших країн також відмічається високий показник вживання нутрицевтиків. Найбільш часто споживаними нутрицевтиками є полівітамінно-мінеральні комплекси, при цьому лише в 1/5 випадків споживання нутрицевтиків дітьми ініційоване фахівцем-медиком, в решті

випадках на рішення про включення у харчування нутрицевтика приймалося під впливом реклами. В Україні масштабні дослідження споживання дітьми нутрицевтиків не проводилися. Дослідження, виконані на обмеженому клінічному матеріалі, не відповідають реальному поширенню застосування нутрицевтиків у дітей та підлітків України. Це робить проведення в Україні популяційного дослідження щодо ролі нутрицевтиків у дитячому харчуванні вельми актуальним. Існує стійкий світовий тренд до збільшення споживання нутрицевтиків дітьми та підлітками.

**Ключові слова:** харчування, діти та підлітки, здоров'я, профілактика.

Надійшла до редакції 12.04.2023

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