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ORIGINAL ARTICLE

FACTORS INFLUENCED SUPPLEMENTS USE IN A CHOSEN GROUP OF CHILDREN

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ABSTRACT

Introduction. Dietary supplements have become a common practice, including among children. It is worth noting that supplementation can have a twofold effect: a pro-health effect – improving the nutritional status of the body, or a harmful effect – increasing the risk of nutrient overdose, such as when several preparations are used simultaneously.

Objective. The aim of the study was to assess the determinants of dietary supplement consumption by children aged 3-10.

Material and Methods. The study used a questionnaire method among parents of 151 children attending kindergarten and elementary schools in the Mazovia Province.

Results. Dietary supplements were used by 54.3% of the children surveyed the year before the study. Women with a university education were significantly more likely to supplement their children than women with a secondary or primary education (60.6% and 42.3%, respectively). More children with normal body weight (58.6%) were given supplements than those with overweight and obesity (27.3%). The vast majority of children (66%) took one supplement daily. Concomitant use of supplements with fortified products was observed in 71.4% of respondents. The decision to use a supplement was mainly made by the parents themselves (62%).

Conclusions. Educating parents about the benefits and risks of using dietary supplements is necessary. The use of such preparations should be consulted with a specialist, i.e., a doctor or dietician. It is worth noting that a well-balanced diet should provide all the nutrients, vitamins, and minerals for the child's proper development.

Keywords: *dietary supplements, vitamins, minerals, school children, preschool children*

INTRODUCTION

A well-balanced diet is one of the most important factors influencing human health. Adequate nutrition during childhood determines normal physical and mental development and the development of good eating habits in the future. The role of parents in shaping children's eating behavior and habits is important. Caregivers, who want their children to receive all the necessary nutrients every day, are increasingly looking for an easy and quick way to provide them. To this end, they are turning to dietary supplements (DS). According to the Food and Nutrition Safety Act of 25 August 2006, a dietary supplement is a foodstuff that is a concentrated source of vitamins or minerals or other substances that have a nutritional or other physiological effect [1]. It should be stressed that the purpose of using these foods is only to supplement the daily diet and not to replace regular meals prepared by the principles of proper nutrition.

Based on epidemiological studies, children and adolescents worldwide, including in Poland, may be at risk of certain nutritional deficiencies, mainly vitamin D [2-4]. Therefore, according to the recommendations of the Polish multidisciplinary group, it is mandatory to supplement with vitamin D_3 at a dose of 600-1000 IU/d (15-25 μg) for children aged 2-10 years and 800-2000 UI/d (20-50 μg) for adolescents and adults throughout the year [5].

The use of dietary supplements has become very popular around the world [6-8], as well as in Poland [9, 10], so the market for these foods is growing rapidly.

Manufacturers are offering an increasing number of preparations exclusively for children, which, in addition to nutrients, contain additional substances in their composition, i.e. sweetening agents e.g. sucrose, fructose, honey, molasses and sweeteners e.g. cyclamate, aspartame, isomalt, mannitol, sorbitol, xylitol, erythritol. The results show that more than 75% of the supplements for children available on the Polish market contain at least one sweetening agents

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or sweeteners [11]. Components such as sucrose or glucose syrup can even constitute more than 90% of the DS weight, as in the case of lollipops [12]. Consumption of these substances in excessive amounts may cause adverse health effects, such as tooth decay or obesity [13].

Most dietary supplements are consumed in the United States of America, while in Europe, the leaders are Italy, Russia, and Germany [14].

The decision to use dietary supplements should be made consciously and responsibly, preferably after consultation with a doctor or dietitian who will determine its justification after analyzing the nutritional status. The aim of this study was to analyze the influence of various socio-economic, health, nutritional, and physical activity factors on the use of dietary supplements in a selected group of children aged 3-10 years.

MATERIAL AND METHODS

Study design and data collection

The study was conducted among parents/guardians of 151 children attending kindergartens and primary schools in the Mazovia region. The data necessary for the analysis were obtained using a survey questionnaire, which was completed in the presence of the interviewer during parents' meetings in educational and upbringing facilities. The role of the interviewer was to explain precisely what we call DS (according to the applicable law) and to explain how to complete the survey and provide answers to questions from parents.

The questionnaire consisted of three parts. The first part contained questions on children's metrics and family socioeconomic data i.e. place of living and economic status; parents' education; child's age and gender; and factors related to the child's health and physical activity.

The second part of the questionnaire contained questions about the children's eating habits i.e. the number and regularity of meal consumption, the deliberate exclusion and inclusion of products from/in the diet, and the consumption of fortified products.

The third part of the questionnaire contained questions on the intake of dietary supplements during the year before the study i.e. name of preparation, form (tablets, capsules, drops, etc.), frequency and duration of consumption, recommendations, and motives for use. They were also asked about the preparations they were currently taking, and if they were taking more than one, they were asked to indicate whether and which were used concurrently.

Based on the children's weight and height declared by the parents, the Body Mass Index (BMI) was calculated. The BMI indice was categorized in accordance with the cut-off values for children and adolescents depending on age and gender based on percentile charts, assuming values $\leq$ 10th percentile as underweight, between the 10th and 90th percentile as normal weight, and $\geq$ 90th percentile as overweight or obesity [15, 16].

Statistical analysis

Statistical analysis of the results was performed using Statistica 13.0 PL by StatSoft. The results were presented separately for the children in kindergarten (3-6 years) and the children in elementary schools (7-10 years). The association between the use of supplements and quantitative characteristics (age, BMI) was assessed using the Student t-test for independent samples, and for qualitative characteristics, the *Chi*-square test using, where necessary, the Yates correction or Fisher's exact test. In the case of a significant association between factors with more than one category and the use of dietary supplements, a post hoc analysis was performed. The level of statistical significance was set at $p < 0.05$.

RESULTS

The study included 151 children, 46.4% boys and 53.6% girls, with an average age of 6.8 ± 2.5 years.

The vast majority of children lived in cities (83.4%) in families with declared a good financial situation (58.9%). Their parents usually had higher education (65.6% of mothers, 51.7% of fathers) (Table 1). The children in the study were characterized by good (57%) or very good (36.4%) health, without chronic diseases (86.8%) (Table 2).

Among the analyzed socio-economic factors, a statistically significant relationship was found only between the mother's education and the use of DS. It was shown that women with university education administered this type of preparation to children significantly more often than those with secondary and primary education (60.6% vs. 42.3%, respectively, $p = 0.0319$) (Table 1). It was also found that statistically more children with normal body weight received dietary supplements compared to children with overweight and obesity (58.6% vs. 27.3%, respectively, $p = 0.0396$) (Table 2).

Nearly half of the children (49%) surveyed consumed the recommended number of meals daily (i.e. ≥ 5) and almost all children regularly ate their main meals. A small percentage of parents intentionally included specific foods in their children's diet (12.6%), mainly vegetables, fruit, and fish. On the other hand, 29.1% of parents deliberately excluded products such as sweets, fast food, fizzy drinks, and milk and milk products because of their children's allergies (Table 3). Of the eating habits, only consuming fortified foods

Table 1. Characteristics of the group of examined children about dietary supplement use

Parameters		Total[1]		Use of dietary supplements[2]				p-value
				Yes		No		
		n	%	n	%	n	%	
Total		151	100	82	54.3	69	45.7	-
Gender	male	70	46.4	38	54.3	32	45.7	0.9965
	female	81	53.6	44	54.3	37	45.7	
Age (years)	3-6	66	43.7	40	60.6	26	39.4	0.1708
	7-10	85	56.3	42	49.4	43	50.6	
Residential area	urban	126	83.4	67	53.2	59	46.8	0.5314
	rural	25	16.6	15	60.0	10	40.0	
Mother's education level	primary/high school	52	34.4	22	42.3	30	57.7	0.0319
	university	99	65.6	60	60.6	39	39.4	
Father's education level	primary/high school	73	48.3	35	47.9	38	52.1	0.1291
	university	78	51.7	47	60.3	31	39.7	
Socio-economic status	very good	30	19.9	15	50.0	15	50.0	0.4277
	good	89	58.9	51	57.3	38	42.7	
	average	29	19.2	14	48.3	15	51.7	
	poor	3	2.0	2	66.7	1	33.3	

[1] – % calculated for all respondents; [2] – % calculated for a given category; p-value was determined using *Chi*-square test, statistical significance at the level $p < 0.05$

Table 2. The use of dietary supplements in the studied group of children and selected factors related to health and physical activity

Parameters		Total[1]		Use of dietary supplements[2]				p-value
		n	%	Yes		No		
				n	%	n	%	
Health status	very good	55	36.4	25	45.5	30	54.5	0.1968
	good	86	57.0	53	61.6	33	38.4	
	average	8	5.3	4	50.0	4	50.0	
	poor	2	1.3	-	-	2	100.0	
Current chronic diseases	yes	20	13.2	13	65.0	7	35.0	0.3026
	no	131	86.8	69	52.7	62	47.4	
Physical activity (rated by parents) n = 85[3]	high	39	45.9	22	56.4	17	43.6	0.5042
	medium	42	49.4	19	45.2	23	54.8	
	low	4	4.7	1	25.0	3	75.0	
Extracurricular sports activities n = 85[3]	yes	56	65.9	31	55.4	25	44.6	0.1276
	no	29	34.1	11	37.9	18	62.1	
Body Mass Index n = 85[3]	underweight [a, b]	5	5.9	2	40.0	3	60.0	0.0396
	normal weight [a]	58	68.2	34	58.6	24	41.4	
	overweight/obesity [b]	22	25.9	6	27.3	16	72.7	

[1] – % calculated for all respondents; [2] – % calculated for a given category; [3] – factors assessed only in the group of children of early school age (7-10 years old); [a, b] – different letters indicate statistically significant differences between groups at the level of $p < 0.05$ determined by the *Chi*-square test

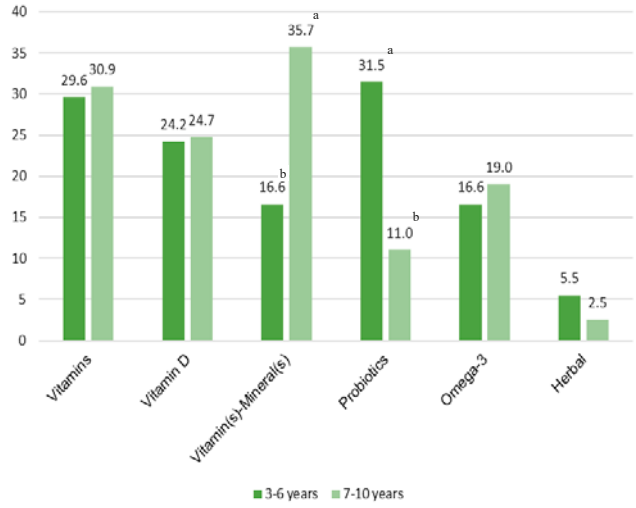
was significantly associated with dietary supplements. Concomitant use of supplements with fortified products was observed in 71.4% of subjects and was significantly higher compared to children not consuming fortified foods.

Dietary supplements were taken by 54.3% of the children studied during the year before the study. It was shown that younger children (3-6 years old) used probiotics significantly more often than older children (7-10 years old) (31.5% vs. 11.0%). On the other hand,

Table 3. The use of dietary supplements in the studied group of children and factors related to selected eating habits

Parameters		Total[1]		Use of dietary supplements[2]				p-value
		n	%	Yes		No		
				n	%	n	%	
Number of meals/day	≤ 3	12	7.9	4	33.3	8	66.7	0.2775
	4	65	43.1	35	53.8	30	46.2	
	≥ 5	74	49.0	43	58.1	31	41.9	
Consumption of I breakfasts	yes	144	95.3	81	56.3	63	43.7	0.1742
	no	1	0.7	-	-	1	100.0	
	differently	6	4.0	1	16.7	5	83.3	
Consumption of II breakfasts	yes	104	68.9	56	53.8	48	46.2	0.4523
	no	10	6.6	6	60.0	4	40.0	
	differently	37	24.5	20	54.1	17	45.9	
Consumption of dinner	yes	149	98.6	81	54.4	68	45.6	0.3624
	no	1	0.7	1	100.0	-	-	
	differently	1	0.7	-	-	1	100.0	
Consumption of afternoon snacks	yes	88	58.3	55	62.5	33	37.5	0.0706
	no	15	9.9	6	40.0	9	60.0	
	differently	48	31.8	21	43.7	27	56.3	
Consumption of supper	yes	145	96.0	79	54.5	66	45.5	0.2156
	no	4	2.7	3	75.0	1	25.0	
	differently	2	1.3	-	-	2	100.0	
Excluding some food products	yes	44	29.1	27	61.4	17	38.6	0.2642
	no	107	70.9	55	51.4	52	48.6	
Including some food products	yes	19	12.6	12	63.2	7	36.8	0.2678
	no	132	87.4	70	53.0	62	47.0	
Fortified food consumption	yes	98	64.9	70	71.4	28	28.6	< 0.0001
	no	53	35.1	12	22.6	41	77.4	

[1] – % calculated for all respondents; [2] – % calculated for a given category; p-value was determined using *Chi*-square test, statistical significance at the level $p < 0.05$



percentages add to > 100 as participants were able to select > 1 dietary supplement; a, b – different letters indicate statistically significant differences between children`s age groups at the level of $p < 0.05$ determined by the *Chi*-square test

Figure 1. Percentages of different types of dietary supplements among children using dietary supplements

older children took vitamin and mineral supplements significantly more often than younger children (35.7% vs. 16.6%). Vitamin preparations were in second place in terms of popularity (about 30%), and omega-3 acids were in third place (16.6-19%), regardless of the age of the study participants. In both the younger group of children (3-6 years old) and the older group (7-10 years old), approximately 24% consumed vitamin D supplements. Herbal preparations were among the least frequently used supplements (Figure 1).

Most often, dietary supplements were used for a relatively short period, up to 1 month (44%). At the same time, a large group of children (40%) took them for a more extended period (over six months). The vast majority of children (66%) took one preparation daily. Two preparations were used by about 28% of children, and three – almost 6%.

Most often, parents decided to supplement themselves (62%), only 35% on a doctor's recommendation or after consultation with a pharmacist (3%). Among the main motives for

Table 4. Reasons for using dietary supplements or not using them by children

Parameters	Children 3-6 years	Children 7-10 years	p-value
	%[1]	%[1]	
Reasons for using DS[2]			
Improve overall health	82.5	73.8	NS
Diet poor in nutrients	25.0	59.4	0.0008
Increase immunity	17.5	21.4	NS
Necessary when medicines are used	23.1	2.4	0.0047
Reason for avoiding DS[2]			
No effect on health improvement	18.5	27.3	NS
No need for use due to proper nutrition	88.9	56.8	0.0046
It can be harmful	7.4	18.2	NS
Too high price	3.7	9.1	NS

[1] – % calculated for the number of children using SD in a given age group; [2] – percentages add to > 100 as participants were able to select > 1 reason for using; p-value was determined using *Chi*-square test, statistical significance at the level $p < 0.05$; NS – non-significant; DS – dietary supplements

using dietary supplements in children, parents mentioned improvement in health after the use of these preparations (in the group of 3-6-year-olds – 82.5%, in the group of 7-10-year-olds – 73.8%) and the belief that their child's diet was deficient in nutrients (in the group of 3-6-year-olds – 25.0%, in the group of 7-10-year-olds – 59.4%). Another reason for supplementation was the desire to increase children's immunity (in the group of 3-6-year-olds – 17.5%, in the group of 7-10-year-olds – 21.4%). It was found that supplementation in younger children was significantly more often due to the need for medicines, compared to older children (23.1% vs. 2.4% respectively, $p = 0.0047$). Parents' reasons for deciding not to use dietary supplementation in their children were also analyzed. The most frequently cited reasons were that there was no legitimate need for their use and that these preparations did not benefit health. Another answer, which was also often given, was that supplements may harm health and that they are too expensive (Table 4).

DISCUSSION

The use of dietary supplements depends on various factors, which may differ depending on the population group and country. Many studies show that the frequency of DS use may depend on the price and availability of the product in the market, the season, or the consumer's lifestyle. Dietary supplements are consumed more often by people characterized by greater physical activity, a healthy lifestyle, and those who avoid addictions. It has been shown that in the American population, slim women with a higher level of education and socio-economic status use supplements more often than other population groups. Adults who consume DS are also more likely to give them to their children. Unfortunately, there are few studies on the problems and effectiveness of using dietary supplements in children [7].

The results of this study indicate that the use of dietary supplements in children aged 3-10 was relatively frequent; 54.3% of children received at least one preparation during the year preceding the study. A similar percentage of children (54.9%) using dietary supplements was found in a study conducted in Wrocław (Poland) among 532 children aged 3 to 12 years [17]. Also, a national survey of children aged 1-10 years in the USA estimated that 52% of children used dietary supplements regularly, while about 33% took them occasionally [8]. However, studies conducted in Turkey in a group of healthy children aged 2-18 years showed that 32.5% of the children were using DS on the day of the study, and 11.6% had used it before [18]. Studies conducted in Korea in 2015-2017 showed a decreasing trend in the use of supplements with the age of children. About 39.2% of 1-3 year olds received dietary supplements, while only 12.3% of youth aged 10-18 received them [19]. In the Australian population, 20.1% of adolescents (aged 10-17) and 23.5% of children (< 9 years) used at least one dietary supplement in the last two weeks [20]. Studies conducted in various countries have reported that the use of dietary supplements in children is 7.6–32% [21-23]. Unfortunately, despite recommendations for vitamin D supplementation, in this study, only around 24% of each age group were taking the vitamin (in the group of 3-6-year-olds – 24.2%, and in the group of 7-10-year-olds – 24.7%). Similar results were obtained in the study by Koç et al. [18]. Significantly lower vitamin D supplementation was found among US children, where around 1.6% used it [23].

In this study, among the analyzed socioeconomic factors, a statistically significant effect was found

only for the mother's education level. Women with university education were significantly more likely to give their children this type of preparation than those with secondary and primary education (60.6% vs. 42.3%, respectively, p = 0.0319). A similar relationship was also found in Turkey and China in school-age children [18, 24]. In addition, such a relationship was related to the fact that the parents were healthcare workers with better economic status and were themselves taking DS [18]. In contrast, a cross-sectional study among students aged 7 to 18 in Iran showed that children with a higher level of father's education used fewer supplements. However, living area, family size, and paternal occupation indicated no significant association [25]. Slightly different trends were found in the US study, where not only the level of education of parents but also higher financial status and higher household food security levels and private health insurance coverage influenced the administration of dietary supplements to children. In addition, there was a significant trend toward lower DS use with increasing age in this study [23].

In our study also found that school-aged children with normal body weight were statistically more likely to use supplements than children with overweight and obesity (58.6% vs. 27.3% respectively, p = 0.0396). Results from a USA study also showed that weight status in children was inversely associated with DS use [23]. A similar relationship was also found in Korean children, in whom DS intake was associated with lower BMI and lower birth weight [19]. A similar trend was also observed among children in Turkey [18] and adolescents in Germany [22].

Numerous studies on the determinants of dietary supplementation indicate that users of dietary supplements are more likely to have a more proper diet [17, 19]. Health-promoting behaviors also include consuming fortified products, which can be a significant source of nutrients. This study showed that among people using fortified products, 71.4% were also receiving vitamin/mineral preparations. This creates a risk of exceeding the upper limit of intake (UL) of a nutrient, which is particularly dangerous for children. It was proven that the excessive supply of e.g., iron, zinc, vitamin A or vitamin D [26-29] – nutrients, which play a crucial role in the functioning of the immune system, may have a synergistic or antagonistic influence on other ingredients found in food.

Improperly using dietary supplements, e.g., taking several preparations simultaneously, not following the recommended doses, or supplementing an adequately composed diet, may lead to health consequences such as hypervitaminosis. The most frequently reported side effects of DS include diarrhea, constipation, nausea/vomiting, and abdominal pain [21]. Our results confirm, the duration of use of the dietary supplement was often short and amounted to 1 month (44%). While at the same time, a large group of children (40%) took DS longer, even over six months. In turn, in the study conducted by Sicinska et al. [10] among Polish public school students, it was found that DS was most often used for 1-3 months.

In our research we have shown, most children (66%) took one preparation daily, and about 34% took more than one. Similar results were obtained among German adolescents, where most users had consumed only one kind of dietary supplement (72.7%), and about a quarter (27.3%) had consumed more than one [22]. In contrast, a study involving Turkish children showed a higher percentage of people (49.9%) using more than one DS at the same time [18].

The most frequently used dietary supplements among younger children were probiotics; among older children, they were vitamin-mineral preparations, which is consistent with other literature [17, 19, 21]. The use of probiotics is undoubtedly related to doctors' recommendations in regards to the protective measures of such products during antibiotic therapy and also on the increasing of nutrition absorption capacities in healthy children [30, 31].

In this study, the parents of children indicated the improvement of the general health of children and a diet poor in nutrients, as well as increased immunity as the main reasons for using DS; at the same time, parents of preschool children significantly more often declared the supply of supplements due to the necessity of taking medications. Similarly, in the Japanese [21] and American populations [23], the main motivation for using DS in children and adolescents was improving general health and preventing nutrient deficiencies.

CONCLUSIONS

Based on the study, it can be concluded that using dietary supplements in children aged 3-10 years was common, and in most cases, the decision was made alone. The higher mother's education, children's BMI, and consumption of fortified foods were predictors of DS use. The decision to use dietary supplements should be made consciously and responsibly, preferably after consultation with a specialist. Supplementation should be selected individually and rationally, and a properly balanced diet should be the basis. The administration of food supplements to children can only be justified in the case of vitamin D. It, therefore, seems appropriate to increase parents' knowledge of the use and how to choose the best possible supplement, as dietary supplementation should always be tailored to individual needs. Understanding the determinants affecting the use of dietary supplements in children may determine the risk of their incorrect use and allow

the planning of appropriate public health education; therefore, further research is warranted.

Conflict of interest

Author declares no conflicts of interest.

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