

The Status of Dietary Supplements Intake in Korean Preschool Children: Data from the Korea National Health and Nutrition Examination Survey 2010-2012

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Purpose: The use of dietary supplements (DS) has increased in most nations. We investigated the amount of DS intake in the Korean population by analyzing a national survey, to support the preparation of a national institutional strategy regarding DS intake and marketing.

Methods: The data of the fifth Korea National Health and Nutrition Examination Survey (a year between 2010 and 2012) were investigated, analyzing the rate of DS intake, and the characteristics of the intake group and non-intake group in Korean preschool children.

Results: The intake rate of DS was 49.0-54.2% (1,313,874-1,491,240) and 19.6-30.3% (250,603-421,922) in children from 1 to 6 years old and in those less than 1 year, respectively, from 2010 to 2012. The highest intake rate was observed in the age group of five. The mean age was significantly higher in the DS intake group than in the non-intake group. Intake of essential nutrients, minerals, and vitamins were also higher in the DS intake group. The level of family income was significantly associated with the intake rate ($p < 0.001$). In children less than 1 year, probiotics accounted for the highest intake of DS.

Conclusion: Korean preschool children have high consumption of DS. Therefore, problems may arise from the waste of money purchasing unnecessary DS, and from the overuse of DS in preschoolers who do not require DS intake. We hope these results can be used to produce an appropriate national institutional strategy regarding DS intake and marketing.

Key Words: Dietary supplements, Preschool, Nutrition surveys

INTRODUCTION

Dietary supplements (DS) or nutritional supplements contain vitamins, minerals, fiber, fatty acids,

and amino-acid products, for meal replacement [1]. The use of DS has been increasing in most nations [2-5]. One-third of children in the United States, from infants to adolescents, have been reported to

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use DS [6]. Bailey et al. [6] reported that the major reason for using DS was for the improvement of overall health, and that multivitamins with minerals were the most highly used supplements by children in the United States.

The general principles for the use of vitamins or other supplements recommend use for only children, those with chronic diseases, malabsorption, eating disorders and vegetarians, but there is no need for healthy children who can fully intake these nutrients from their various diets to use these supplements [5]. Infants and young children from 6 to 24 months have the risk of nutritional vulnerability due to lack of and the poor quality of complementary foods [7]. For these reasons, developing countries experience the problem of nutritional deficiency, especially in iron, zinc, and vitamin B₆ [7]. Accordingly, the children in developing countries require DS. However, it is rare for children to have nutritional deficiency in the present age in Korea, but the use of DS has overflowed since they have not been closely regulated. Most DS are classified as functional health foods in Korea; therefore, if the efficacy and safety have not been properly checked, there could be a high probability of the risk of side effects due to overuse, and wasted expense [1]. Park and Kim [1] reported that the age group with the highest DS intake was children 2 to 6 years. Preschool aged children have a higher risk of excessive intake leading to complications from toxicity.

To date, there have been few papers about the current state of DS intake in Korean children [2,3]. However, the currently available reports have not included a nationwide study that was confined to children. Therefore, we analyzed the data from the fifth Korea National Health and Nutrition Examination Survey (KNHANES V), 2010-2012, conducted by the Korea Centers for Disease Control and Prevention. From these data, we profiled the rate of DS intake, the characteristics of the DS intake and non-intake groups, and the kinds of DS ingested by Korean preschool children. We hope that this study will provide a reference of DS intake for developing principle for DS regulation for Korean children.

MATERIALS AND METHODS

Subject

The KNHANES, a nationally representative cross-sectional survey, has been performed every year since 1998, and the sixth examination is currently being conducted. The cluster for the KNHANES V investigation consisted of 11,400 households, excluding foreigners, which were extracted from all over the country, with a total of 31,596 survey participants. Primary sampling units (PSUs) were drawn from 200,000 geographically PSUs for the whole country with using stratified multistage cluster sampling. A PSU consisted of an average of 60 households. The participants of survey were over aged one year. The range of subjects used for this analysis was children from 1-6 years old. Detailed descriptions of a classification method in this survey have been able to identify on the KNHANES website (<http://knhanes.cdc.go.kr/>).

Contents of investigation

All participants answered a questionnaire about health condition, and were asked to undergo an anthropometry evaluation in a mobile examination center. After 1 week, a nutritional survey was performed by a nutritional investigator via household interview. Informed consent was obtained from the parents of all children participating before all investigations. The investigation was approved by the Korea Center for Disease Control and Prevention institutional review board (2010-02CON-21-C, 2011-02CON-06-C).

Children between the ages of 1 and 6, who were found via questionnaire to have ingested DS for periods longer than 2 weeks during the previous year, were classified into the DS intake group. In addition, the history of DS consumption when the children were less than one year of age, and the kinds of DS ingested were examined in children from one to three years of age. Height, weight, and body mass index were measured by an anthropometry investigator in a mobile examination center. Data about gender, residential region, level of household income, and the presence of diseases which had been

diagnosed by a physician were collected by a health examination questionnaire. The total daily intake of vitamins, carbohydrates, protein, fat, calcium, phosphorus, iron, and energy were acquired and estimated using the one-day 24-hr recall data based on the age-specific energy intake reference [8].

Statistical analysis

All data were analyzed using IBM SPSS Statistics ver. 21.0 (IBM Co., Armonk, NY, USA), with the complex sample design method. The rate of DS intake was calculated and presented as a percent based on the dietary supplement questionnaire. Difference of the characteristics from the anthropometric data and dietary intake behavior between the DS intake and non-intake groups were presented as mean±standard error (SE), and were analyzed using complex sample general linear models. Analysis of data for locational differences, life style characteristics, physical differences, and nutritional behavior between the two groups was performed with using the complex sample cross analysis process. *p*-values less than 0.05 were considered statistically significant for all analyses.

RESULTS

This study included 1,912 children below six years of age. The 1,912 children represented 8,167,462±296,461 (SE) of Korean children below six years old,

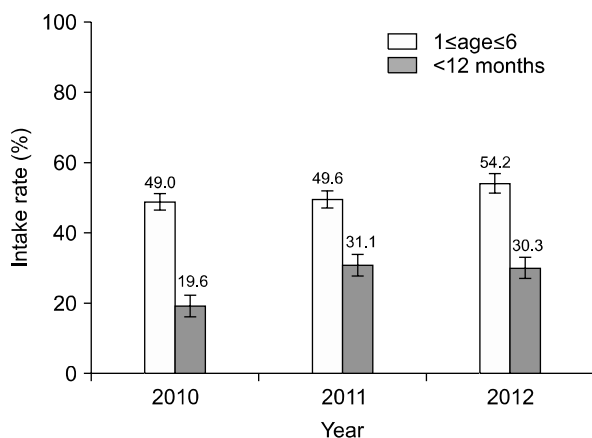


Fig 1. Change in the rate of dietary supplement intake in children from 1 to 6 years, and less than 1 year from 2010 to 2012.

when sampling weight was applied.

The intake rate of dietary supplements

The intake of DS was reported by 49.0-54.2% (1,313,874-1,491,240) and 19.6-30.3% (250,603-421,922) of the Korean preschool children (aged 1 year to 6 years, and less than 1 year, respectively) from 2010 to 2012 (Fig. 1). The highest intake rate was observed in children aged five in 2011 and 2012 (Fig. 2).

Difference of characteristics between the dietary supplements intake group and non-intake group

The mean age was significantly higher in the DS intake group than in the non-intake group, 3.68±0.06 and 3.26±0.07, respectively (*p*<0.001) (Table 1). Intake of essential nutrition (carbohydrates, protein, and fat) was also higher in the intake group. In addition, intake of minerals (calcium, phosphorous, iron) and vitamins were also higher in the DS intake group, except for vitamin A.

Analysis of locational differences, life style characteristics, physical differences, and nutritional behavior between the dietary supplements intake group and non-intake group

The frequency of DS intake was greater in urban

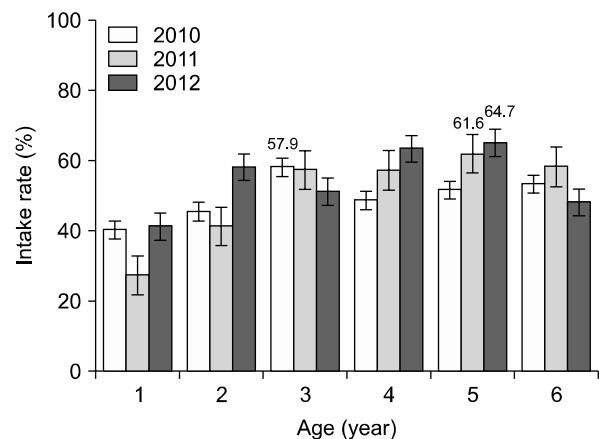


Fig 2. Comparison of the intake rate of dietary supplements based on age, according to the year of survey.

Table 1. Differences in the Characteristics of Anthropometric Data and Dietary Intake Behavior between the Dietary Supplements Intake Group and Non-Intake Group

	Intake group (n=4,160,800)	Non-intake group (n=4,006,662)	p-value
Mean age	3.68±0.061	3.26±0.069	< 0.001
Energy intake (kcal/day)	1,356±20.6	1,228±22	< 0.001
Protein intake (g/day)	47.7±0.9	41.6±0.8	< 0.001
Fat intake (g/day)	33.9±0.8	30.7±0.8	0.002
Carbohydrate intake (g/day)	216.6±3.4	197.4±3.8	< 0.001
Calcium intake (mg/day)	521.1±14.2	451.7±13.4	< 0.001
Phosphorous intake (mg/day)	880.5±14.8	774.2±14.2	< 0.001
Iron intake (mg/day)	7.9±0.2	7.2±0.1	0.005
Vitamin C intake (mg/day)*	86.0±5.1*	70.1±3.4*	0.008
Vitamin A intake (μgRE)*	473.2±15.1*	509.7±39.0*	0.370

Values are presented as mean±standard error.

RE: retinal activity equivalents.

*Intake over a recommend dietary allowance.

Table 2. Comparison of the Lifestyle Characteristics of Preschool Children Who Used Dietary Supplements with Those Who Did Not

	Used supplements	Not used supplements	p-value	OR (95% CI)
Residential area			0.252	
Urban	3,544,554 (52.0)	3,277,949 (48.0)		1.279 (0.839-1.950)
Rural	616,245 (45.8)	728,712 (54.2)		1
Sex			0.019	
Boys	2,269,830 (53.9)	1,720,269 (46.1)		1.279 (1.041-1.573)
Girls	1,890,969 (47.8)	2,067,211 (52.2)		1
Level of family income			< 0.001	
Low	207,770 (27.7)	541,287 (72.3)		
Middle-low	1,437,008 (50.3)	1,420,979 (49.7)		
Middle-high	1,443,529 (53.9)	1,237,083 (46.1)		
High	975,450 (55.7)	775,920 (44.3)		
Age group			< 0.001	
1≤age≤3 (group 1)	1,874,063 (45.7)	2,223,208 (54.3)		0.657 (0.523-0.827)
3<age≤6 (group 2)	2,286,736 (56.2)	1,783,453 (43.8)		1
Disease			< 0.001	
No	1,915,519 (53.8)	1,642,098 (46.2)		1.236 (0.963-1.585)
Present	1,990,257 (48.6)	2,108,184 (52.0)		1

Values are presented as estimated number (%).

OR: odds ratio, CI: confidence interval.

areas than in rural areas, but the difference was not statistically significant ($p=0.252$). However, gender significantly affect the intake (boys: 53.9% and girls: 47.8%, odds ratio [OR]=1.279 [1.041-1.573], and $p=0.019$). Also, the level of family income was significantly associated with the rate of DS intake ($p < 0.001$). Intake was higher in families with high income than with lower income. In addition, the age groups of one to three were less likely to use DS than

three to six year olds (OR=0.657 [0.523-0.827], $p < 0.001$). The frequency of DS use in children with chronic disease was less than in children without chronic disease, but this difference was also not statistically significant (OR=1.236 [0.963-1.585]) (Table 2).

Kinds of dietary supplements consumed

Overall, probiotics had the highest rate of in-

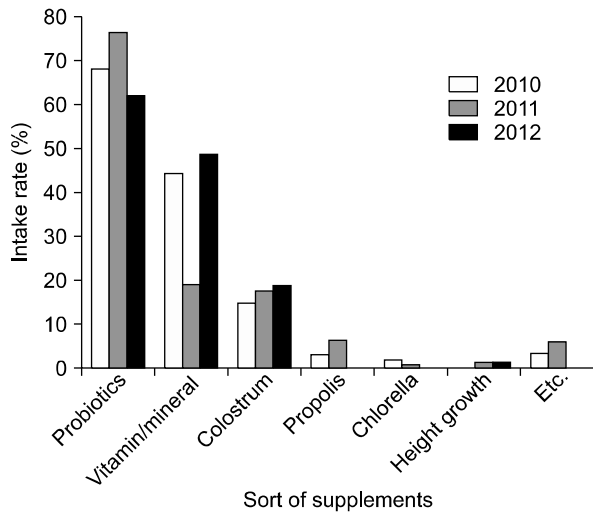


Fig. 3. Kind of dietary supplements consumed by infants.

take among DS, with no difference between the years of investigation. Vitamin supplements were the next highest consumed, followed by colostrum supplements (Fig. 3).

DISCUSSION

Nutritional habits are the most important concern, determining what kind of food to give to a child or how much food supply to provide a child in the period of toddlerhood. If the acquisition of good habits, self-feeding skills and table behavior is insufficient, nutritional imbalance and deficiency will be created [9]. The nutritional problem is the most important point on the issue of childcare.

The intake of DS has recently gained attention, thus increasing therapeutic use [1,10]. General recommendations suggest that DS should be supplied to high-risk children with chronic disease, low-income families, and vegetarians. Supplementation with DS is not required for healthy children who ingest a variety of foods [9]. In spite of the presence of these general principles, the rate of DS intake has been increasing in the United States [4,11]. The prevalence of DS use in the 2007 National Health Interview Survey of the United States was 34% in children aged 0 to 4 years, and 44.1% in those aged five to eleven years [12]. In a Japanese survey in 2007, the prevalence DS

use by preschool children was revealed to be 15% [10]. In Korea, Yoon et al. [3] reported that the prevalence of DS use in children aged two to six, obtained from KNHANES 2007-2009, was 41-48.4%. Our study showed that the rate of DS intake in children aged one to six during 2010-2012 increased from 49% to 54.2%. The rate of DS consumption in infants was further investigated with another questionnaire to the parents of one to three year olds, asking "Did your baby ever consume DS before turning one year old?" The DS intake rate of infants was found to be 19.6%, 31.1%, and 30.3% in 2010, 2011, and 2012, respectively. This rate is the higher than rate of NS intake reported for infants in the United States (11.9%) [11,13]. Similar to other countries, the growing trend of DS intake was also observed in Korean children, though the prevalence intake was higher than other countries (the United States and Japan). The highest intake rate of DS was observed in children aged five, while consumption by those aged three to six was higher than those under three in our study.

In this study, analysis of the characteristic factors of the DS intake group was conducted, considering their residential area, sex, the level of family income, the presence of chronic disease, and age group. The study by Kim et al. [2], including only a small number of children from only three cities, showed no relation between family income and DS intake. However, a large number of children with a stratified multistage cluster sampling were analyzed in this study, showing significant association between the level of family income and the DS intake rate. The rate of DS intake was higher in families with higher income than with lower income. This finding agrees well with other reports [3,9,12,14]. No significant difference in DS intake was found according to residential areas (urban and rural) and the presence of chronic disease. These results differ from Yoon et al.'s report [3] on the 2007-2009 KNHANES, which suggested that the prevalence of DS intake was higher in groups which had chronic disease and lived in urban areas. The differences in the results are suspected to be due to widening of the study population in the previous study (including 2 to 18 years). The

study by Ball et al. [15] revealed that two thirds of parents gave DS to chronically ill children in the United States, and the mean age of the children was nine years old. The greatest users were children with cystic fibrosis, while children with leukemia used DS the least [15].

A study on the reason for DS intake reported that the major reason in children was “to improve overall health”, followed by “to maintain health”, while “to boost immunity” was the least common reason [6]. Kim et al. [16] reported that most parents gave DS to children (one to three years old) following the recommend of friends or relatives, without advice by doctors. That is to say, there were no definite purposes or reasons for the ingestion of DS in most children. The reason for DS intake could not be examined in this study, as the item was not included in the KNHANES 2010-2012 questionnaire. Therefore, we could indirectly recognize that there was a lack of children with nutritional deficiency who needed support through DS.

The market range of DS in Korea is very wide, and is not well controlled. Thus, the distribution and use of uncertified DS can induce serious complications, and are a waste of time and money [1]. The legislation of functional health food was enacted in Korea in 2003 [17]. Vitamin and mineral supplements belong to the category of functional health food, and have been regulated in this legislation [17]. However, over five thousand DS products seem to be on the market in Korea [17]. Therefore, it is difficult to absolutely regulate and control the quality and safety of the DS in circulation. Furthermore, in spite of the use of DS by children with chronic diseases, most of them did not discuss the use with physicians [15]. These problems can induce indiscriminate use of DS, which may cause side effects. Briefel et al. [18] reported that toddlers aged 12 to 24 months with frequent intake of DS (vitamin and mineral supplements) were at risk for excessive usual intake of vitamin A and zinc, while no differences in mean daily intake of nutrients were found between supplement users and non-users. The problem of overuse in children is very important. Our study indicated that the intake group

took in more energy, carbohydrates, fat, iron, calcium, phosphorus, and vitamin C than the non-intake group. We could guess that the DS intake group has a much higher risk of excessive ingestion of nutrients than the non-intake group, and that children who do not require DS intake more than those who have an actual requirement due to nutritional deficiency or poor eating habits. Therefore, practical and exact advice for the ingestion of DS is required.

One study in the United States revealed that the most highly consumed DS was multivitamin-mineral (84%) in children younger than 18 years of age [12]. Other studies of Korea children and adolescents revealed similar results, that multivitamins-mineral were the most highly ingested DS, followed by ginseng and colostrum supplements, or probiotics [2,3]. A population study of preschoolers showed that probiotics were ingested more frequently than colostrum supplements [2]. Our study, with data from 2010 to 2012, did not contain a questionnaire of the kinds of DS ingested by one to six year olds, but instead investigated the history of DS intake in those below one year old. Probiotics were the most highly ingested DS by Korea infants, followed by vitamins-minerals and colostrum supplements. Probiotics have been known to cause acute infectious diarrhea, antibiotic associated diarrhea, and preventing the occurrence of atopic dermatitis [15]. Many probiotic products have been sold in Korea, but they should be well selected, obtaining probiotics which are permitted by the ministry of food and drug safety. Vitamin-mineral supplements contributed meaningfully to the total daily intake of minerals and vitamins [5]. Shaikh et al. [5] reported that greater physical activity, health insurance coverage, and better health care access were related with greater use of vitamin-mineral supplements. In other words, children who absolutely do not require the supply of vitamins-minerals intake more supplements, which can induce excessive intake of vitamins and minerals. Also, our study was shown vitamin C and A were overtaken a recommend dietary allowance (RDA) in both groups. Lubetzky et al. [19] described that RDA for infants are overestimated and cannot be met for

most vitamins and minerals present in human milk or formula. Therefore, human milk-fed infants do not need supplements, except for iron and vitamin D. That is to say, it is unnecessary to indiscreetly supply DS to infants. Ginseng, a herbal medicine, was not mentioned in this study, but many children in Korea have used one item among the supplements. A study of the prevalence of herbal medicine use in the capital area of Korea revealed that about 59.2% of primary school children took herbal medicine [20]. However, the use of unapproved herbal medicine requires more attention in children [2].

The limitation of this study was the deficiency of questionnaire items, especially the kinds and purpose of ingesting DS. Also, the weaknesses of recall bias and the lack of a relationship with variables were present, due to the nature of the questionnaire-based study. However, this study has significance by providing a difference from previous studies, in that the population with large and used stratified multistage cluster sampling, which can represent Korean preschool children and generalize the results of this survey.

In conclusion, Korean preschool children took in more DS than preschool children of the United States and Japan. The group using DS ingested more calories, major nutrients, and minerals than the group not using DS. Therefore, the problems of wasted money and overuse in preschool children who do not require DS can be encountered. We hope that an appropriate national institutional strategy regarding DS intake and DS marketing will be developed.

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