

## DETERMINANTS OF THE USE OF DIETARY SUPPLEMENTS AMONG SECONDARY AND HIGH SCHOOL STUDENTS

Karolina Gajda, Monika Zielińska, Anna Ciecierska, Jadwiga Hamułka\*

Department of Human Nutrition, Faculty of Human Nutrition and Consumer Sciences,  
Warsaw University of Life Sciences (SGGW), Warsaw, Poland

### ABSTRACT

**Background.** All over the world, including Poland, the sale of dietary supplements is increasing. More and more often, people including children and youths, use dietary supplements on their own initiative and without any medical indications or knowledge in this field.

**Objectives.** Analysis of the conditions of using the dietary supplements with vitamins and minerals among secondary school and high school students in Poland.

**Material and methods.** The study included 396 students aged 13-18 years (249 girls and 147 boys). Authors' questionnaire was used to evaluate the intake of dietary supplements. The use of cluster analysis allowed to distinguish groups of students with similar socio-demographic characteristics and the frequency of use of dietary supplements.

**Results.** In the studied population of students three clusters were created that significantly differed in socio-demographic characteristics. In cluster 1 and 2, were mostly students who used dietary supplements (respectively, 56% of respondents and 100%). In cluster 1 there were mostly students coming from rural areas and small city, with a worse financial situation, mainly boys (56%), while cluster 2 was dominated by girls (81%) living in a big city, coming from families with a good financial situation and who were more likely to be underweight (28.8%). In cluster 3 there were mostly older students (62%), not taking dietary supplements. In comparison to cluster 2, they had lower frequency of breakfast consumption (55% vs. 69%), but higher frequency of the consumption of soft drinks, fast-food, coffee as well as salt use at the table.

**Conclusions.** The results show that the use of dietary supplements in adolescence is a common phenomenon and slightly conditioned by eating behaviors. This unfavorable habit of common dietary supplements intake observed among students indicates the need for education on the benefits and risks of the supplements usage.

**Key words:** *dietary supplements, vitamins, minerals, students, nutritional behaviors*

### STRESZCZENIE

**Wprowadzenie.** Na całym świecie, również w Polsce rośnie sprzedaż suplementów diety. Coraz częściej sięgają po nie osoby, w tym również dzieci i młodzież bez odpowiednich zaleceń (wskazań medycznych) oraz wiedzy w tym zakresie.

**Cel.** Analiza uwarunkowań stosowania suplementów diety zawierających witaminy i składniki mineralne przez uczniów gimnazjum oraz szkół ponadgimnazjalnych w Polsce.

**Material i metody.** Badaniem objęto 396 uczniów w wieku 13–18 lat (249 dziewcząt i 147 chłopców). Do oceny spożycia suplementów diety zastosowano autorski kwestionariusz ankiety. Zastosowanie metody analizy skupień pozwoliło na wyodrębnienie grup uczniów o podobnych cechach socjo-demograficznych oraz częstotliwości stosowania suplementów diety.

**Wyniki.** W badanej grupie uczniów wyodrębniono trzy skupienia różniące się między sobą istotnie w obszarze cech socjo-demograficznych. W skupieniu 1 i 2 dominowali uczniowie stosujący suplementy diety (1 - 56%; 2 - 100% badanych). W skupieniu 1 przeważali uczniowie pochodzący ze wsi i mniejszego miasta, o słabszej sytuacji finansowej, głównie chłopcy (56%), natomiast w skupieniu 2 przeważały dziewczęta (81%) mieszkające w dużym mieście, pochodzące z rodzin o dobrej sytuacji materialnej oraz, u których częściej występowała niedowaga (28,8%). W skupieniu 3 przeważali uczniowie starsi (62%), nie stosujący suplementów diety. Charakteryzowali się oni, w porównaniu do uczniów ze skupienia 2, niższą częstotliwością spożywania I śniadań (55% vs. 69%), natomiast wyższą konsumpcją napojów słodzonych, dań typu *fast-food*, kawy oraz częstszym dosalaniem potraw.

**Wnioski.** Uzyskane wyniki wskazują, że stosowanie suplementów diety w okresie młodzieńczym jest zjawiskiem powszechnym i w niewielkim stopniu uwarunkowanym zachowaniami żywieniowymi. Zaobserwowany niekorzystny zwyczaj przyjmowania suplementów przez uczniów wskazuje na konieczność edukacji w zakresie korzyści i zagrożeń wynikających z bezpiecznego stosowania suplementów diety.

**Słowa kluczowe:** *suplementy diety, witaminy, składniki mineralne, młodzież szkolna, zachowania żywieniowe*

\*Corresponding author: Jadwiga Hamułka, Chair of Nutritional Assessment, Department of Human Nutrition, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences (SGGW), Nowoursynowska Street 159C, 02-776 Warsaw, Poland, phone +48 22 59 37 112, fax +48 22 59 37 123, e-mail: [jadwiga\\_hamułka@sggw.pl](mailto:jadwiga_hamułka@sggw.pl)

## INTRODUCTION

The source of nutrients should be well balanced diet reach in vegetables and fruits and with limited amounts of highly processed foods. Research shows, however, that lifestyle, rush, exposure to stress, low physical activity, use of stimulants and poor diet can lead to vitamin and mineral deficiencies, and numerous diseases [3, 7, 17, 21]. A group particularly vulnerable to the effects of poor nutrition, including nutrients deficiencies, are children and youth. Other nutritional strategies to overcome nutrients deficiencies, beside improving the diet *per se*, are to consume fortified food products or dietary supplements [1, 4, 15]. However, the usage of dietary supplements should be undertaken consciously and should be justified from the health perspective. Numerous studies indicate, that supplementation is coming more and more popular, even among children and adolescents [6, 8, 11, 23]. Daily diet is supplemented, on average, by 10 to 80% of people [9, 11, 18, 20, 26], and taking dietary supplements stems mainly from the conviction that they complement inadequate diet, or reduce the risk of serious health complications [13]. On the other hand, one should keep in mind the unjustified usage of supplements without consultations with a doctor or dietitian may impair balance in the organism, lead to hyperalimentation or numerous diseases. Therefore, it is recommended that the taken amounts of supplements would not exceed doses recognized as safe, according to the current knowledge, in order to eliminate the effects of poor nutrition [1, 4, 22].

The increasing number of dietary supplements available on the market in Poland, more and more aggressive advertising in the media and increasing percentage of people taking supplements indicate the need of continues monitoring of this phenomenon and of inclusion this question into nutritional studies. Hence the aim of this study was to analyze the conditions of use of dietary supplements containing vitamins and minerals among secondary school and high schools students.

## MATERIAL AND METHODS

For this study, students were selected from secondary and high schools, that principals had agreed to conduct the research in their schools. The purposive sampling was used for participants selection, and the study was carried out after obtaining the written consent from the student's parents or guardians. Finally, in the study 396 students in the aged of 13-18 years old participated, including 249 girls (63%) and 147 boys (37%), from Warsaw and surrounding areas. The survey was conducted in years 2013-2014, in autumn-winter period. Data were collected by direct

interview by the questionnaire. The questionnaire contained questions about socio-demographic situation of students, selected elements of their lifestyle, including diet, usage of stimulants and dietary supplements, and physical activity. On the basis of data on height and weight BMI z-score was calculated for the appropriate age and the classification by *Kulaga* et al. [16] was applied to assess the accuracy of body weight. BMI z-score  $\leq -2SD$  was used as a threshold value for the weight deficiency,  $\geq +1SD$  for overweight and  $\geq +2SD$  for obesity [16].

Statistical analysis was performed with STATISTICA ver. 10. In order to distinguish clusters of students differing in the use of dietary supplements as well as socio-demographic characteristics, self-organizing *Kohonen's* network model was used. The analysis was conducted using a random sampling method; sample size parameter equaled 100% for the training set and the 0% for test and validation sets; the epoch number was set at 200.

The input variables for analysis were: usage of dietary supplements and selected socio-demographic determinants like gender, age, BMI category, place of residence, self-estimated material situation and parents' level of education. Characteristics of each cluster was also carried out in terms of some features of diet and lifestyle, including consumption of stimulants, and physical activity. *Chi*<sup>2</sup> test was used to assess the differences between clusters and p-value  $\leq 0.05$  was applied as the level of significance for all statistical analysis.

## RESULTS

The characteristic of the population in terms of socio-demographic features is presented in Table 1. Youths 16-18 years old, girls, coming from families of average financial situation, whose parents had mainly secondary or higher education predominated in the studied group. The majority of respondents (85%) had normal body mass index as BMI z-score was in the range between -1,0 and +1,0, with the highest percentage (89%) found in cluster 2. Excessive body weight was observed in 14% of the whole population.

In the present study more than 40% of youths took dietary supplements, more girls (53%) than boys (37%;  $p \leq 0.001$ ), and the percentage was higher among older students and as well as coming from a big city.

The *Kohonen's* network model analysis has allowed to separate 3 clusters differing significantly in the use of dietary supplements as well as socio-demographic characteristics (Table 1), selected eating behaviors (Table 2) and certain aspects of lifestyle (Table 3).

Table 1. Socio-demographic characteristic of study group according to cluster classification (percentage of respondents)

Demographic features	Total n=396	Cluster			p-value
		1 n=86	2 n=139	3 n=171	
Total (%)	100	21.7	35.1	43.2	-
Age (years):					
13 – 15	32.1	15.1	35.3	38.0	≤ 0.001
16 – 18	67.9	84.9	64.7	62.0	
Gender:					
girls	62.9	34.9	81.3	62.0	≤ 0.001
boys	37.1	65.1	18.7	38.0	
Place of residence:					
village	30.6	72.1	18.0	19.9	≤ 0.001
city <100 thousand inhabitants	21.0	15.1	23.0	22.2	
city >100 thousand inhabitants	48.5	12.8	59.0	57.9	
Household size (number of person):					
2 – 3	26.6	19.8	26.6	30.4	NS
4	36.0	39.5	36.0	32.2	
≥5	37.4	40.7	37.4	37.4	
Self- assessments of socioeconomic status:					
poor	25.3	72.1	7.9	15.8	≤ 0.001
average	49.7	10.5	68.3	54.4	
very good	17.7	8.1	20.1	20.5	
difficult to say	7.3	9.3	3.6	9.4	
Parental education:					
higher	36.9	2.3	48.2	45.0	≤ 0.001
incomplete higher	10.9	4.7	13.7	11.7	
secondary	37.9	70.9	26.6	30.4	
vocational	14.4	22.1	11.5	12.9	
BMI z-score:					
underweight	0.8	0	1.4	0.6	NS
normal	85.1	82.6	89.2	83.0	
overweight and obesity	14.1	17.4	9.4	16.4	
Dietary supplements users:					
yes	47.2	55.8	100	-	≤ 0.001
no	52.8	44.2	-	100	

Distinguished clusters can be characterized as follows:

– *Cluster 1* (n=86; 22%) – in this cluster, the use of dietary supplements was declared by 56% of the students, and not taking them by 44%. In comparison to clusters 2 and 3, there was the highest proportion of young people aged 16-18 years old, male, living in rural areas, with poor financial situation, and with excessive body weight. Parents of those students had lower education level.

– *Cluster 2* (n=139; 35%) – all students in this cluster used dietary supplements. When comparing to other clusters, there can be found the highest percentage of girls, habitants of cities > 100.000 residents, students of average financial situation, whose parents had higher education level. Besides, in this cluster there was the highest percentage of students with normal weight, and the lowest percentage of those being overweight or obese.

– *Cluster 3* (n=171; 43%) – none of the member of this cluster used dietary supplements.

There were mostly students aged 16-18 years old, girls, living in cities > 100.000 residents, with an average financial situation, whose parents had higher education level. Excessive body weight had 16.4% of students.

Analysis of data on eating behavior has also showed a high percentage of youths who declared the consumption of fortified foods (62%), and it was slightly higher in cluster 2 than in other ones (differences not statistically significant). In addition, a high percentage of adolescents exhibited inadequate eating habits, including irregular consumption of meals (69%) with 1-2 meals throughout the day (30%), snacking between meals (68%), frequent consumption of sweetened drinks (everyday consumption declared by 19%) and fast-foods. In contrast, a relatively low percentage (51%) of young people declared eating fruit and vegetables every day (Table 2).

Table 2. Characteristic of study group in terms of selected eating habits according to cluster classification (percentage of respondents)

Characteristics	Total n=396	Cluster			p-value
		1 n=86	2 n=139	3 n=171	
Consumption of fortified food:					
yes	62.1	60.5	64.7	60.8	NS
no	10.4	14.0	11.5	7.6	
not sure	27.5	25.6	23.7	31.6	
Number of meals during the day:					
1 – 2	29.6	29.0	27.3	31.6	NS
3	59.1	64.0	59.7	56.1	
4	11.4	7.0	12.9	12.3	
Regularity of meals:					
yes	31.1	34.9	33.8	26.9	NS
no	68.9	65.1	66.2	73.1	
Snacking between meals:					
yes	67.7	58.1	71.9	69.0	NS
no	32.3	41.9	28.1	31.0	
Regularity of breakfast consumption:					
yes	61.4	61.6	69.1	55.0	0.04
no	38.6	38.4	30.9	45.0	
Frequency of consumption of fruits and vegetables:					
everyday	50.8	44.2	56.8	49.1	NS
2-3 x per week	37.4	39.5	38.1	35.7	
few times per month	10.4	14.0	5.0	12.9	
never	1.5	2.3	-	2.3	
Frequency of consumption of fast-food:					
everyday	2.3	3.4	0.7	2.9	NS
2-3 x per week	16.4	17.4	15.1	17.0	
few times per month	64.1	62.8	64.0	64.9	
never	17.2	16.3	20.1	15.2	
Frequency of consumption of soft drinks:					
everyday	18.7	15.1		22.8	NS
2-3 x per week	36.4	43.0	34.5	34.5	
few times per month	31.1	29.1	33.1	30.4	
never	13.9	12.8	16.5	12.3	
Adding salt to food:					
yes	45.5	40.7	45.3	48.0	NS
no	54.4	59.3	54.7	52.0	

Except for regular consumption of breakfast, what was declared by 69% of young people in cluster 2 (compared to 55.0% in cluster 3 and 61.6% in cluster 1;  $p=0.04$ ), there were no statistically significant differences found for other features of eating habits. However, there was a tendency to exhibit better dietary behaviors in cluster 2 in terms of frequency consumption of fruit and vegetables, fast-foods and sweetened beverages. In cluster 3, there were mostly students who had the lowest frequency of eating breakfasts. Besides, in this cluster greater percentage of students consumed everyday sweetened beverages and added salt to dishes at the table 2.

A similar correlation was also observed in relation to the use of stimulants (Table 3). The lowest percentage (11%) of youths reported smoking cigarettes was found in cluster 2, in which all persons used dietary supplements, while the highest percentage was in cluster 3 (81.9%  $p\leq 0.001$ ) in which no one took dietary supplements. Energy and isotonic drinks were less popular in cluster 2, in which higher percentage of

young people spending their free time actively were found. Alarming is, however, a high proportion of young people (59%; comparable figure in all clusters), that declared the consumption of alcohol.

The most common cause for the use of dietary supplements was a period with increased incidence of colds (autumn-winter period – 52.4%). Taking more than one dietary supplement at the same time was declared by 31.0% of respondents, and adherence to the manufacturer's instructions declared 86.6%. Pharmacies, followed by hypermarkets were the most common places for purchasing the dietary supplements, namely 85.6% and 20.9%, respectively. Buying online declared 5% of students. Most of young people took dietary supplement in the form of tablets (66%), of powder (23%), gummy (17%), the capsules (14%) or syrup (12%). The source of information on dietary supplements were mainly TV advertisements (55%) and the Internet (48%), and to less extent – doctors (17%), leaflets (16%) and popular magazines (15%).

Table 3. Characteristic of study group in terms of selected lifestyle factors and to cluster classification (percentage of respondents)

Characteristics	Total n=396	Cluster			p-value
		1 n=86	2 n=139	3 n=171	
Consumption of tea:					
yes	89.4	87.2	89.9	90.1	NS
no	10.6	12.8	10.1	9.9	
Consumption of coffee:					
yes	47.7	45.3	45.3	50.9	NS
no	52.3	54.7	54.7	49.1	
Consumption of energy drink:					
yes	48.6	50.0	44.2	51.5	NS
no	51.4	50.0	55.8	48.5	
Consumption of isotonic drinks:					
yes	31.1	38.4	27.5	30.4	NS
no	68.9	61.6	72.5	69.6	
Consumption of alcohol:					
yes	59.1	60.5	59.0	58.5	NS
no	40.9	39.5	41.0	41.5	
Cigarette smoking:					
yes	18.2	30.2	10.8	81.9	≤ 0.001
no	81.8	69.8	89.2	18.1	
Self-assessment of physical activity:					
low	25.8	26.7	28.1	23.4	NS
moderate	50.8	46.5	47.5	55.6	
high	23.5	26.7	21.1	21.1	
Spending of leisure time:					
active	48.0	47.7	50.4	46.2	NS
passive	52.0	52.3	49.6	53.8	

## DISCUSSION

Nutrition and dietary habits of young people is one of the most important environmental factors determining the growth, development, psychophysical activity, learning ability and good health in adulthood. Modern model of nutrition widespread among young people do not allow to meet the requirements of certain nutrients and differs remarkably from the dietary guidelines. Deficiencies of vitamins and minerals conduce to develop of a number of diet-related diseases. Undoubtedly, the use of dietary supplements is becoming more and more common among the actions to correct those abnormalities [11, 13]. It is important, however, that the dietary supplementation is adequate to the needs and correct the nutritional mistakes properly. Inadequate intake of nutrients in the form of dietary supplements and also fortified foods may cause the excessive intake, beyond the recommended levels, which in turn may lead to, i.a. serious health consequences [20, 22]. The use of dietary supplements is a common phenomenon conditioned by many factors, derived from nutrition, socio-demographic as well as the desire to maintain or improve the health status.

Given the socio-economic factors, in present study and in others we demonstrated the relationship between the level of parental education and the use of dietary supplements by children [5, 10, 26]. Parents with higher and secondary education level gave the supplements to their children more often. In the survey of *Jeżewska-Zychowicz* [12], the most important reasons for the use of dietary supplements by young people were: the desire to maintain good health, the need for diet improvement, care about the physical appearance and improper nutrition. Similarly, in a study conducted in post-secondary school students and university students, the desire to: increase the intake of deficient nutrients, enhance immunity, support the nervous system, improve memory and concentration, improve of hair, skin and nails conditions, and reduce weight body, were mainly reported reasons for the use of dietary supplements [14, 29]. Also in the research of the *Bailey et al.* [2] it has been shown that the most common causes of dietary supplements intake were improving and maintaining health status, improving the diet and improving the immunity system.

As results of surveys indicate, TV advertising, Internet and medical consultation are the most

popular sources of information that have meaningful impacts on the consumer decisions to purchase dietary supplements [24]. Data from our study showed that the use of supplements is often a consequence of own decision taken without a consultation with a doctor, dietician or nutritionist. It was also demonstrated that dietary supplements were rarely used because of doctor's recommendation (only 2.2%) in the survey conducted in 7-12 years old children [15]. In the foreign studies 15% were observed, where a small group of supplements was used by the children in accordance with doctors' recommendations [2]. Undoubtedly, insufficient knowledge of the parents on dietary supplements poses a risk of excessive or insufficient intake of vitamins or minerals. For example, in the study conducted in children 11-12 years old, higher than recommended intake of minerals were found for copper (236% of RDA), iron (114% of RDA) and zinc (111% of RDA) in the form of pharmaceutical preparations [9]. American research demonstrated that the upper level (UL) had been exceeded for zinc, folic acid, vitamin A in children aged 9-13 years, and for iron, zinc and folic acid in youths 14-18 years old. At the same time, in the diets of children inappropriate, lower than recommended, amounts of magnesium, phosphorus, vitamin C, and vitamin E were observed [1]. Improper use of dietary supplements, i.e. combining several preparations at the same time, the intake of excessive doses and simultaneous consumption of fortified foods predisposes to disturbance of body homeostasis and appearance of side effects. For instance, high doses of iron can impede the absorption and utilization of zinc, calcium and copper, and high doses of zinc can hinder the absorption of vitamin E [22]. On the other hand, due to the poor nutrition and too low nutrient density of the diets observed among children and adolescents, the use of dietary supplements becomes reasonable, but there is a need to pay attention to the appropriate proportions of vitamins and minerals in the diet.

The present study revealed many incorrect nutritional habits among young people. Those results confirm observations obtained by other researchers. In the study of *Sitko et al.* [21] more than 50% of secondary and high school students admitted that they did not apply to the dietary guidelines, and 30% of them indicated some abnormalities in their body weight. Their diets were characterized by many nutritional errors, i.e.: irregular meals, snacking between meals (mainly sweet and salty snacks) and regular drinking of soft drinks. Similarly, numerous inadequacies were found in the diets of adolescents 13-15 years of age [25]. In turn, irregularities in the structure of food groups consumption among school children were also recorded [3]. They concerned mainly low consumption of dairy products, vegetables and fruit, grain products, seeds

and legumes, while a high intake of fast-foods, sugar and sweets, meat and meat products.

Analyzing factors that may determine the use of dietary supplements, it was observed that young people taken them had proper both nutrition and body mass index (BMI) more often. Besides, we also observed a tendency that in the group of adolescents taking dietary supplements, mainly girls, in spite of a normal body weight and better eating habits the vitamin and mineral preparations were used. In the study of *Bylinowska et al.* [5] more children characterized by better nutrition were given supplements than children with poor nutrition. Moreover, it was found that more children being on special diets, like therapeutic, weight reducing or vegetarian, received dietary supplements. Supplementation was also more frequent in underweight than obese children. Similarly, in the study of *Wojtyła-Buciora and Marcinkowski* [27] a desire to reduce body weight among young people with adequate BMI and a good nutrition knowledge was demonstrated. Undoubtedly, it is related to the impact of advertising and nutritional trends to improve the physical appearance during adolescence.

In this study no significant relationship between physical activity and the use of dietary supplements was found, wherein the number of students with high physical activity was too low. The survey of *Bylinowska et al.* [5] showed, however, that supplements received more children participating in extracurricular sport activities. Also *Seidler and Sobczak* [18] found that students of sport mastery school used dietary supplementation due to a chance to achieve satisfactory sport results much faster. This is also confirmed by the results of research conducted in the United States, which revealed the relationship between the level of physical activity and the use of supplementation [19].

## CONCLUSIONS

1. The use of dietary supplements was declared by 47% of the students, and it conditioned by gender, place of residence, the family's financial situation and parental education level.
2. Eating habits and selected elements of lifestyle, except for breakfast eating and smoking, slightly affected the use of dietary supplements by youths.
3. It is essential to monitor continuously eating behaviors of students, including the use of dietary supplements, as well as to undertake among youths and their parents the broad educational activities on the benefits and possible risks of voluntary decisions on the safe use of dietary supplements with vitamins and/or minerals, and other bioactive substances.

### Conflict of interest

*The authors declare no conflict of interest.*

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