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Nutritional supplement use among Slovenian adolescents

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Abstracts

Objective: Little is known about the prevalence of nutritional supplement use in European adolescents. We conducted the present study to analyse the prevalence of nutritional supplement use and factors associated with this use among Slovenian adolescents.

Design: The nutritional supplementation practices of 818 adolescents were studied using an anonymous questionnaire. Information was sought on the type of supplements used, frequency of use and sources of information.

Setting: The region of north-west Slovenia.

Subjects: Schoolchildren from twenty primary schools and twelve secondary schools.

Results: Some 19·3% of all adolescents reported using at least one nutritional supplement and the prevalence of use was significantly higher in adolescents who were members of sports clubs. Multivitamins were the most common nutritional supplement. Older adolescents were significantly more likely to be supplementing with iron, protein and minerals. Less than 16% of supplement users in our study sought information from health-care professionals. Nearly 62% obtained information from parents and coaches, and many adolescents appear to decide on nutritional supplementation themselves, without advice. Older adolescents were significantly more likely to combine supplements than younger adolescents.

Conclusions: One-fifth of Slovenian adolescents use nutritional supplements. There are clear differences in supplement use between younger (age 12 years) and older (age 17 years) adolescents. Multiple use of supplements, coupled with self-managed supplementation in older adolescents, is concerning. Hence, there is an urgent need to provide accurate information regarding nutritional supplements, which will help adolescents, their parents and coaches to make informed choices about their use.

Keywords
Adolescents
Nutritional supplements
Sport

Nutritional supplements are increasingly being used to compensate for inadequate diet, to improve immunity and prevent diseases, and to increase sports performance or body image. Despite the lack of scientific evidence to support their alleged benefits[1], worldwide marketing and advertising of several different supplements is intense and far exceeds the data supporting their use.

Although it has been emphasised that a balanced diet is the best source of nutrition for healthy adolescents[2], many studies have shown that the use of supplements is widespread[3–6]. The prevalence of nutritional supplement use among adolescents has been studied mainly in the USA. The 1988–1994 National Health and Nutrition Survey (NHANES) found that 23·9% of US adolescents (age 12–19 years) used supplements[7]. Further studies based on the 1999–2004 NHANES reported similar rates (age 9–19 years; 26–29%)[6,8,9]. Two studies differentiated between younger and older adolescents[6,8] and found conflicting results. Picciano *et al.*[6] found that the prevalence of nutritional supplement use was highest among young adolescents (9–13 years; 29%) and declined among older adolescents (14–18 years; 26%). Gardiner *et al.*[8], on the other hand, found that 26% of 11–15-year-old and 28% of 16–19-year-old respondents used nutritional supplements. Both studies were based on the same data (1999–2004 NHANES), hence the reason for these conflicting results probably lies in the different age ranges examined. The most popular supplements used were vitamins, minerals and iron[6,9].

Data on the prevalence of nutritional supplement use among adolescents outside the USA are scarce and mainly from countries of northern Europe. A large study from Finland showed that almost half (45%) of adolescents (age 12–18 years) use nutritional supplements[4]. Recently

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published data of the German National Nutrition Survey II showed that 16–19 % of German adolescents (age 14–18 years) reported using supplements[10]. The most common substances used were vitamins and herbal products[4]. Supplement use among young athletes from Europe is better documented. A recent investigation among German elite athletes revealed widespread use (80 %) of nutritional supplements[11] and that athletes are likely to use supplements in combinations. Among Norwegian athletes, 76 % of males and 92 % of females reported consuming nutritional supplements[12], and a high prevalence of supplement use was found among elite young athletes (48·1–62·0 %) in the UK[13,14]. Supplements commonly ingested by athletes include vitamins, creatine, protein and iron[11,13,14]. Investigating nutritional supplement use for the purpose of enhancing performance is particularly important, as a recent study claims the existence of a link between supplement use and doping[15]. Research among tertiary education students in six countries showed that high-risk behaviour and supplement use increased the probability of doping: those athletes who took supplements were four times more likely to use doping than those who used no supplements[15].

Supplement use (or misuse) by adolescents is, in itself, an especially troubling phenomenon, since there is little direct experimental data based specifically on the physiological consequences of supplementation in adolescents[16]. Adolescents are at risk of significant adverse effects, as some of the nutritional supplements they use have been associated with cancer, gastrointestinal and cardiovascular problems[17–19]. The fact that some vitamins/minerals, the most frequently consumed supplements by the adolescent population, are toxic in adults, if consumed in excess[17,20], is raising concern. Furthermore, adolescents use supplements in an infinite number of combinations, and although the individual agents may be well studied in isolation, there may not be any good scientific information to guide their use in combination.

In Europe, especially in southern countries, the supplementation practices of adolescents remain relatively unknown and it is therefore difficult to decide if findings from US studies and countries from northern Europe are applicable here. Because of the risks associated with supplement use outlined above, it was considered important to gather basic data on the prevalence and types of supplements used among Slovenian adolescents. Previous studies showed that variance in age could affect the results[5,6,8], as older adolescents may have more access to supplements and younger adolescents are more likely to be monitored by their parents[21]. Therefore it was decided to study two age populations, one representing young adolescents (age 12 years) and the other representing older adolescents (age 17 years).

The objectives of the study were to determine: (i) the prevalence and types of supplements used by the adolescents; (ii) sources of information on nutritional supplements; and (iii) if gender, age or membership in a sports club influences supplement use.

Methods

Participants

A sample of 818 adolescents from the region of north-west Slovenia participated in the study. Of these, 495 adolescents (61 %) were enrolled in the seventh year of primary school (age 12 years) and 323 adolescents (39 %) in the third year of secondary school (age 17 years). Two hundred and forty-four (49 %) participants in primary school were female and 248 (50 %) were male. Gender information was not provided in 1 % of the questionnaires. In secondary school, 193 (60 %) participants were female and 130 (40 %) male. Forty-three per cent of younger adolescents (age 12 years) and significantly less, 28 %, of older adolescents (age 17 years) were members of sports clubs ($\chi^2 = 19{\cdot}77$; df = 1; $P < 0{\cdot}0001$)[22].

Measures

To provide data on supplementation patterns and resources in the study population, participants completed a questionnaire, designed by the authors for the present study, which requested demographic information, physical activity data and current use of nutritional supplements. Respondents were asked to respond 'yes' or 'no' to 'Do you use nutritional supplements?' They were then asked to indicate which supplements they currently used on a regular basis, and whom they asked for advice on nutritional supplements. The participants also provided data on their physical activity in hours per week, separately for organised (sports training) and non-organised (self-engagement) physical activity, and data on their membership in sports clubs. The questionnaires were distributed to the adolescents, who were asked to take them to their parents and bring the filled-in questionnaires back to school. All of the questionnaires were anonymous and each of the parents/adolescents could decide voluntarily whether they would participate in the study or not. It is expected that at least some of the adolescents completed the questionnaires on their own. The questionnaire and study protocol were approved by the Ethics Committee of the Republic of Slovenia.

Analysis

The completed questionnaires were analysed using a program application in Microsoft® Office Excel 2003 (Microsoft Corporation, Redmond, WA, USA). Statistical analysis was performed by the χ^2 test. The level of statistical significance was set to 0·05. As seen in Tables 1–3, two types of comparisons were performed: first, differences in nutritional supplement use between members and non-members of sports clubs were evaluated; and second, differences in supplement use between 12-year-old and

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17-year-old adolescents were examined. The data were also analysed according to gender of the adolescents (Table 4).

Results

Overall, 19·3 % of adolescents participating in the present study supplemented their diet (Table 1). In general, there were no significant differences in the prevalence of supplement use with respect to the age of adolescents ($\chi^2 = 0{\cdot}31$; df = 1; $P = 0{\cdot}5777$); however, the use of nutritional supplements was significantly higher in adolescents who were members of sports clubs (24·6 %) compared with their non-member peers (16·2 %; $\chi^2 = 8{\cdot}48$; df = 1; $P = 0{\cdot}0036$), irrespective of their age. Although data on the physical activity of these adolescents, both members and non-members of sports clubs, are reported elsewhere[22], it is worth noting for the purpose of the present study that cumulative weekly physical activity of adolescent members of sports clubs was on average two to three times higher than that of their non-member peers[22].

Table 2 demonstrates that, within the group of adolescents who used nutritional supplements, the most popular supplements were multivitamins (16·7 %), followed by iron (2·3 %), protein supplements (2·0 %) and minerals (0·6 %). Among other supplements, fish oils, omega oils, *Echinacea*, *Chlorella*, weight-loss supplements, energy drinks, royal jelly and carbohydrates were listed.

When looking at specific nutritional supplements, very few differences in nutritional supplement use were observed across the age range (Table 2). Age differences in use of specific nutritional supplements were evident for iron (1·2 % of 12-year-olds *v.* 4·0 % of 17-year-olds; $\chi^2 = 6{\cdot}93$; df = 1; $P = 0{\cdot}0085$) and minerals (0 % of 12-year-olds *v.* 1·5 % of 17-year-olds; $\chi^2 = 7{\cdot}82$; df = 1; $P = 0{\cdot}0052$). Adolescents who participated in sports clubs were more

Table 1 Frequency of nutritional supplement use by Slovenian adolescents

	n	% users (all ages)	% users (age 12 years)	% users (age 17 years)	*P* value* (between columns)
Total number of participants	818	19·3	18·8	20·1	0·5777
Members of sports clubs	301	24·6	23·6	27·0	0·522
Non-members of sports clubs	517	16·2	15·2	17·5	0·4708
P value* (between rows)		0·0036†	0·0181†	0·0588	

*Derived from χ^2 test (df = 1).
†Statistically significant.

Table 2 Prevalence of supplement use by supplement type among Slovenian adolescents

Nutritional supplement	% of all adolescents	% members of sports club	% non-members of sports club	*P* value* (between columns)
Multivitamins				
All adolescents	16·7	21·3	14·1	0·0083†
12 years	17·0	21·2	13·8	0·029†
17 years	16·4	21·3	14·5	0·138
P value* (between rows)	0·7184	0·8625	0·7913	
Iron				
All adolescents	2·3	2·0	2·5	0·6242
12 years	1·2	1·4	1·1	0·7184
17 years	4·0	3·4	4·3	0·6801
P value* (between rows)	0·0085†	0·2655	0·0199†	
Protein supplements				
All adolescents	2·0	2·0	1·9	0·0541
12 years	1·2	0·9	1·4	0·6315
17 years	3·1	4·5	2·6	0·3652
P value* (between rows)	0·0541	0·0444†	0·3401	
Minerals				
All adolescents	0·6	1·3	0·2	0·0444†
12 years	0·0	0·0	0·0	–
17 years	1·5	4·5	0·4	0·0083†
P value* (between rows)	0·0052†	0·0019†	0·2674	
Other				
All adolescents	2·3	3·0	1·9	0·3297
12 years	1·8	1·9	1·8	0·8875
17 years	3·1	5·6	1·0	0·1062
P value* (between rows)	0·2222	0·0828	0·7401	

*Derived from χ^2 test (df = 1).
†Statistically significant.

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likely to use multivitamins ($\chi^2 = 6{\cdot}96$; df = 1; $P = 0{\cdot}0083$) and minerals ($\chi^2 = 4{\cdot}04$; df = 1; $P = 0{\cdot}0444$) compared with their non-member peers (Table 2). In addition, older adolescent sports-club members used more protein supplements ($\chi^2 = 4{\cdot}04$; df = 1; $P = 0{\cdot}0444$) and minerals ($\chi^2 = 9{\cdot}6$; df = 1; $P = 0{\cdot}0019$) than younger adolescent sports-club members. In contrast, older adolescents who were non-members of sports clubs used more iron ($\chi^2 = 5{\cdot}42$; df = 1; $P = 0{\cdot}0199$) than younger adolescent non-members.

Most adolescents had been recommended to use supplements by their parents (58·2%; Table 3). It is worrying that professionals' advice appears to carry very little weight in terms of adolescents' decision to take supplements (15·8%) and that many teenagers appear to decide on nutritional supplementation on their own, without any advice (26·6%). The coaches' role in advising young athletes (members of sports clubs) on supplements was also evidenced (3·2%). Younger adolescents more often checked with their parents for supplement information and guidance than older adolescents ($\chi^2 = 5{\cdot}05$; df = 1; $P = 0{\cdot}0246$). On the contrary, older adolescents tended to decide on the use of nutritional supplements on their own significantly more often than younger adolescents ($\chi^2 = 4{\cdot}39$; df = 1; $P = 0{\cdot}0362$). Older members of sports clubs were more likely to gain advice from their coaches (16·7%) than younger (2·0%) members ($\chi^2 = 5{\cdot}58$; df = 1; $P = 0{\cdot}0182$).

Table 4 demonstrates the distribution of supplement use by gender. Multivitamins were the most ingested supplements by adolescents of both genders, with a similar prevalence for both males and females. Boys aged 17 years (25·0%) reported protein use significantly more often than 17-year-old girls (6·1%; $\chi^2 = 4{\cdot}48$; df = 1; $P = 0{\cdot}0343$). The use of iron and protein supplements among boys increased with age: among 12-year-olds, 3·9% used iron and 3·9% used protein supplements, while among 17-year-olds 21·9% used iron ($\chi^2 = 6{\cdot}54$; df = 1; $P = 0{\cdot}0105$) and 25·0% used protein supplements ($\chi^2 = 8{\cdot}22$; df = 1; $P = 0{\cdot}0041$). In addition, 12-year-old boys who participated in sports clubs were significantly ($\chi^2 = 4{\cdot}13$; df = 1; $P = 0{\cdot}0421$) more likely to use nutritional supplements in general than their non-member peers (data not shown). Among girls, none of those aged 12 years reported mineral use, while 9·1% of the 17-year-old girls reported mineral use ($\chi^2 = 3{\cdot}98$; df = 1; $P = 0{\cdot}046$).

The average number of supplements used by adolescents in the sample of nutritional supplement users was 1·3, indicating that supplements are used in combinations. Namely, of the 158 supplement users, 17·7% reported the use of more than one supplement (Table 5). Among them, 9·5% used two, 6·3% used three and a further 1·9% used four supplements. Younger adolescents (age 12 years) were significantly more likely to take one supplement (89·2%) than older (age 17 years) adolescents (72·3%; $\chi^2 = 7{\cdot}54$; df = 1; $P = 0{\cdot}006$). On the contrary, older adolescents (age 17 years) were more likely to take two ($\chi^2 = 4{\cdot}47$; df = 1; $P = 0{\cdot}0345$) or three supplements ($\chi^2 = 3{\cdot}68$; df = 1; $P = 0{\cdot}0551$) compared with younger adolescents. Physical activity and gender did not influence the prevalence of supplement usage (data not shown).

Discussion

As seen from the findings of the present study, the use of nutritional supplements among Slovenian adolescents

Table 3 Sources of information about nutritional supplements among Slovenian adolescent supplement users

Source	% of all adolescents	% members of sports club	% non-members of sports club	*P* value* (between columns)
Parents				
All adolescents	58·2	59·5	57·1	0·7642
12 years	65·6	66·0	65·1	0·9203
17 years	47·7	45·8	48·8	0·8231
P value* (between rows)	0·0246†	0·0966	0·1302	
Physician				
All adolescents	15·8	14·9	16·7	0·7518
12 years	16·1	16·0	16·3	1·000
17 years	15·4	12·5	17·1	0·6242
P value* (between rows)	0·8875	0·6892	0·9203	
Coach/trainer				
All adolescents	3·2	6·8	0·0	0·0155†
12 years	1·1	2·0	0·0	0·3510
17 years	6·2	16·7	0·0	0·0070†
P value* (between rows)	0·0727	0·0182†		
Personal opinion				
All adolescents	26·6	20·3	32·1	0·0919
12 years	20·4	18·0	23·3	0·5271
17 years	35·4	25·0	41·5	0·1809
P value* (between rows)	0·0362†	0·4795	0·0741	

*Derived from χ^2 test (df = 1).
†Statistically significant.

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Table 4 Differences in the use of nutritional supplements by gender among Slovenian adolescents

Nutritional supplement	Females (%)	Males (%)	*P* value* (between columns)
Multivitamins			
All adolescents	88·0	85·5	0·6390
12 years	90·5	90·2	1
17 years	84·8	78·1	0·4839
P value* (between rows)	0·4583	0·1285	
Iron			
All adolescents	13·3	10·8	0·6171
12 years	9·5	3·9	0·2733
17 years	18·2	21·9	0·5271
P value* (between rows)	0·2733	0·0105†	
Protein supplements			
All adolescents	8·0	12·0	0·3961
12 years	9·5	3·9	0·2733
17 years	6·1	25·0	0·0343†
P value* (between rows)	0·5839	0·0041†	
Minerals			
All adolescents	4·0	2·4	0·5598
12 years	0·0	0·0	–
17 years	9·1	6·25	0·6629
P value* (between rows)	0·0460†	0·0710	
Other			
All adolescents	12·0	14·5	0·6390
12 years	11·9	11·8	1
17 years	12·1	10·8	0·4583
P value* (between rows)	1	0·3771	

*Derived from χ^2 test (df = 1).
†Statistically significant.

Table 5 Prevalence of multiple nutritional supplement use by age among Slovenian adolescent supplement users (*n* 158)

Number of supplements reported	% of all supplement users	% of 12-year-old supplement users	% of 17-year-old supplement users	*P* value* (between columns)
1 supplement	82·3	89·2	72·3	0·0060†
2 supplements	9·5	5·4	15·4	0·0345†
3 supplements	6·3 } 17·7	3·2 } 10·8	10·8 } 27·7	0·0551
4 supplements	1·9	2·2	1·5	0·7913

**P*-value derived from χ^2 test (df = 1).
†Statistically significant.

is widespread. Our results indicate that about one in five adolescents (19·3 %) was regularly using nutritional supplements at the time of the present survey. This is less than reported rates for adolescents in the USA, where nutritional supplement use of 26 % to 29 % was observed[6,8]. In Europe, Mattila *et al.*[4] found that almost half (45 %) of Finnish adolescents used nutritional supplements in 1991–2005. Lower levels of use were found in a dietary survey in the UK and Scotland, where there was a 10 % level of supplement use[23], whereas findings from a German National Nutrition Survey were similar to ours[10].

The aforementioned studies demonstrate that the rate of nutritional supplement use ranges from 10 % to 45 %. This marked difference may be explained by different study designs, particularly in the sample selection (age of the subjects) and definition of supplement use (regularity). A further explanation may be associated with individuals' sociodemographic characteristics, such as economic status and lifestyle variables.

In the present study, the overall prevalence of nutritional supplement use was significantly higher for adolescent members of sports clubs (24·6 %) than non-members (16·2 %). This observation is similar to those of previous studies, and a possible explanation includes athletes being more susceptible to advertising[4,6,9] or encouragement (from whatever source) to engage in the use of nutritional supplements.

Multivitamins were the most common nutritional supplement consumed among Slovenian adolescents (16·7 %), which is in accordance with previous studies performed in both Europe and the USA[3,4,6,8]. We also confirmed findings of a survey in which athletes were more likely than their peers to use multivitamins[9]. In addition, we demonstrated that older adolescent sports-club members used significantly more protein supplements than younger sports-club members. Interestingly, among adolescent non-members of sports clubs, higher prevalence of iron use was observed in older adolescents compared with younger adolescents.

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The finding that the most commonly used nutritional supplements by adolescents were multivitamins is reassuring in terms of potential health risks. However, adolescents could potentially start out using vitamin supplements and then progress to more dangerous substances[24]. Further, not all supplements are tested by the appropriate institutions, therefore claims of safeness and reliability cannot be simply trusted[25]; and moreover, taking single vitamin doses can lead to toxicity and interactions with other nutrients[26–28].

Less than 16 % of supplement users in our study sought information from health-care professionals, the majority obtained information from either parents (58·2 %) or coaches (3·2 %). The coaches' role in advising about nutritional supplements was significantly higher in older than younger athletes. Furthermore, many adolescents (26·6 %) appear to decide on nutritional supplementation on their own, either combining their personal opinion with other information sources or relying completely on their personal opinion. The fact that professionals' advice appears to carry very little weight in terms of adolescents' decision to take supplements is a rather worrying sign. Most parents and coaches have little or no specialised nutrition knowledge[29–31]; hence their advice may be inappropriate.

In the current study, older boys used protein supplementation significantly more often than older girls. This is in agreement with other studies[4,12,13], confirming that males tend to use supplements claiming a more ergogenic effect[5]. This finding may also be explained by the pursuit of muscularity, which is more popular in boys than girls. Apart from protein supplementation, no other gender-dependent use of any other specific supplement was observed. Interestingly, older boys used iron significantly more often than younger boys. Iron supplementation is unlikely to be required by men and if taken excessively can have negative health consequences[32].

It is of note that older adolescents used two or more supplements significantly more often than younger adolescents. The use of multiple supplements is a common practice, which can be manifested both in a higher number of adverse reactions and in those reactions being more severe[19]. While the potentially adverse effects of long-term use of supplements and concomitant use in adolescents are yet to be established, the reported multiple use of supplements, coupled with self-managed supplementation in older teens, is concerning.

It should be noted that our study has some limitations. First, parents/guardians could have answered on behalf of their children and they could have underestimated the use of products adolescents might have purchased on their own. Second, the list of supplements examined was not exhaustive and may have missed products containing supplements. Finally, we do not know why adolescents used certain supplements and how the use was reflected in their health. Future research should therefore be directed to investigate supplement combinations, dosages and length of supplementation, as well as reasons for supplement use.

This descriptive analysis helps to provide a clearer picture of nutritional supplement use among adolescents in southern Europe, Slovenia in particular. Not only does it indicate that several adolescents are using supplements, but it also provides data on which products are most likely to be used by younger and older adolescents. The results point out which individuals are most in need of education and information concerning the use and abuse of certain nutritional supplements. An urgent need seems to exist to provide accurate information which will help adolescents, their parents and coaches make informed choices about the use of supplements. Future research, therefore, needs to focus also on how information on nutritional supplement use can be applied to specific user groups.

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