5-2022

Associations of Lifestyle and Sociodemographic Factors With Dietary Supplement Use in College Students

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Introduction

Dietary supplements (DS) are defined as products taken orally that contain one or more dietary ingredient such as vitamins, minerals, herbs and are intended to supplement the diet [1]. In addition to nutrient consumption through diet, DSs are commonly used to provide the body with essential nutrients important for regulating metabolic processes. The National Health and Nutrition Examination Surveys (NHANES) continuously assesses the health and nutritional status of a large representative sample of the United States population. During the 2017-2018 study period, NHANES found that 57.6% of US adults aged 20 and over reported using any DS in the past 30 days [2]. Despite the large examination of nutrition data from the United States population, the dietary and nutritional data collected from NHANES is not a suitable representation for all population subtypes. Additionally, the comprehensive analysis of specific subpopulations such as young adults and elite athletes continues to be difficult. It has been established that patterns of DS use differ in these subpopulations, and these groups use greater amounts and different types of DSs for different reasons than the general population [3, 4]. Previous studies have found DS usage rates at 66% [3] and 70.6% [5] in samples of college students which is considerably higher than the national averages for all adults in the United States.

DS use remains popular among college students despite a lack of scientific evidence on the safety and efficacy of this generally well-nourished population [6]. The increasing use of DSs by the United States population has been driven by both a renewed interested in personal health from consumers for these products as well as changes in the regulation status of DSs [7].The majority of information on DSs targeted to youth comes from media sources such as the internet and television rather than health care providers or nutrition researchers, which can lead to the dissemination of confusing and inconsistent information [8]. Although the claims that dietary supplement manufactures can make on the health benefits of their products are limited, the marketing that manufacturers can use is often misleading to consumers. Previous research has highlighted the asymmetrical relationship held between DSs and the health status of DS users, and the lack of association held between the growing market of DSs and an improvement in public health [9].

Several studies have examined the lifestyle and demographic associations with DS use in the general adult population, finding greater use among women, older adults, and those who engage in increased physical activity [10-12]. Most of these studies have been restricted to examination of older adults, and such findings make college students an important group for further research regarding any relationship between lifestyle behaviors and DS use. The objectives of the current study were to identify (1) the type and frequency of DS use among college students, (2) the reasons for DS use and opinions of students on DSs, (3) main sources of information about nutrition, (4) the differences in DS use between genders and between student athletes and nonathletes, and (5) the associations held between lifestyle/ demographic characteristics and DS use among college students.

Materials and Methods

Subjects

This cross-sectional study was conducted among students enrolled in a college or university between September 2021 and October 2021. Study participants were recruited through sports team groups, social media postings, and academic organization pages at various undergraduate institutions across the United States. The inclusion criteria for the study required participants to be 18 years or older and currently enrolled in a college or university. Survey distribution and data collection was completed electronically using RedCap. The original sample included surveys from 120 students, and the final sample included surveys from 106 students. Due to incomplete responses, 14 collected surveys were not included in the final sample. Participants received the opportunity to enter a raffle to win one of five $100 Amazon gift cards as incentive. Raffle winners were randomly selected using an online program [13] that allowed for the selection of five separate winners out of the participant pool. This study was approved by the University of Rhode Island Institutional Review Board.

Variables

A questionnaire was developed to investigate the patterns of DS use among college students and to assess their demographic and lifestyle characteristics. The questionnaire was divided into 4 sections: a demographic and anthropometric data section, a physical activity and nutritional knowledge section, a DS use assessment section, and an attitude towards DSs section. In the demographic and anthropometric data section, students were questioned about their age, sex, race/ethnicity, height, and weight. The weight and height data was used to calculate body mass index (BMI) values, which divided the students into 4 categories in (kg/m^2): <18.5 (underweight), 18.5 to <25 (healthy weight), 25.0 to <30 (overweight), and >30.0 (obese) per the Centers for Disease Control and Prevention classifications [14]. The physical activity and nutritional knowledge section questioned students about their participation in physical activity in a typical week, participation in collegiate varsity athletics, diet type, nutrition classes taken in college, and primary source of nutrition knowledge. In the dietary supplement assessment, participants were asked if they had taken a DS within the past 30 days and if they selected "yes", a series of follow-up questions would appear. These questions asked about the type of DS used, pattern of usage, reason for taking the DS, and if any other DSs were used within the past 30 days. If participants selected "yes" for another supplement, another series of the same follow-up question for this supplement would appear. The attitudes towards DS section collected information on participants' level of agreement with statements asserting DS are good for health, DS are completely safe, and if the participant would recommend the use of dietary supplements to others.

Statistics

The data was entered and analyzed using statistical software SAS (Version 9.4; SAS Institute Inc). Fisher's exact tests were used to assess significant differences for categorical variables and logistic regression analysis was used to assess significant differences for continuous variables. Frequency counts, percentages and descriptive statistics such as mean and standard deviation (SD) were used. Spearman's rank was used to reveal any correlation among independent and dependent variables. Multiple logistic regression was used to examine independent relationships between DS use and the demographic and lifestyle characteristics of students. The level of significance was set at $p < 0.05$.

Results

Participant characteristics

The majority of the students (N=60, 57.14%) attended the University of Rhode Island, and survey data was collected from students attending 15 institutions in total. The mean age of the students was 20 years (X=20.07, SD = 1.31). The majority of students (N=80, 75.47%) were female, non-Hispanic white (N=67, 63.21%), and in the healthy weight BMI category (N=68, 64.15%) as defined by the Centers for Disease Control and Prevention. The summary of student information is presented in Table 1.

Table 1. Demographic and lifestyle characteristics for DS users and nonusers, males and females

Characteristics	DS users % (n)	DS nonusers % (n)	p-value	Males % (n)	Females % (n)	p-value	Total % (n)
Total	66.04 (70)	33.96 (36)		24.53 (26)	75.47 (80)		100 (106)
Age							
18	5.80 (4)	27.78 (10)	0.0019	23.08 (6)	10.13 (8)	0.6359	13.33 (14)
19	20.29 (14)	22.22 (8)		11.54 (3)	24.05 (19)		20.95 (22)
20	24.64 (17)	27.78 (10)		23.08 (6)	26.58 (19)		25.71 (27)
21	36.23 (25)	16.67 (6)		30.77 (8)	29.11 (23)		29.52 (31)
22+	13.04 (9)	5.56 (2)		11.54 (3)	10.13 (8)		10.48 (11)
Race/Ethnicity							
Non-Hispanic White	61.43 (43)	66.67 (24)	0.1738	61.54 (16)	63.75 (51)	0.2523	63.21 (67)
Non-Hispanic Black	11.43 (8)	2.78 (1)		19.23 (5)	5.00 (4)		8.49 (9)
Non-Hispanic Asian	7.14 (5)	19.44 (7)		3.85 (1)	13.75 (11)		11.32 (12)
Hispanic/Latino	12.86 (9)	5.56 (2)		11.53 (3)	10.00 (8)		10.38 (11)
Other	7.14 (5)	5.56 (2)		3.85 (1!	7.50 (6)		6.60 (7)
Body mass index (BMI)							
Underweight (<18.5)	4.29 (3)	2.78 (1)	0.4495	0.00 (0)	5.00 (4)	0.5131	3.77 (4)
Healthy weight (18.5-24.9)	58.57 (41)	75.00 (27)		57.69 (15)	66.25 (53)		64.15 (68)
Overweight (25.0-29.9)	24.29 (17)	13.89 (5)		26.92 (7)	18.75 (15)		20.75 (22)
Obese (≥30.0)	12.86 (9)	8.33 (3)		15.38 (4)	10.00 (8)		11.32 (12)
Activity level (day/week)							
0 days	10.61 (7)	17.65 (6)	0.0629	8.00 (2)	14.67 (11)	0.0248	13.00 (13)
1 day	9.09 (6)	8.82 (3)		8.00 (2)	9.33 (7)		9.00 (9)
2 days	10.61 (7)	14.71 (5)		4.00 (1)	14.67 (11)		12.00 (12)
3 days	15.15 (10)	29.41 (10)		16.00 (4)	21.33 (16)		20.00 (20)
4 days	12.12 (8)	8.82 (3)		4.00 (1)	13.33 (10)		11.00 (11)
5 days	15.15 (10)	8.82 (3)		24.00 (6)	9.33 (7)		13.00 (13)
6 days	25.76 (10)	5.88 (2)		32.00 (8)	14.67 (11)		19.00 (19)
7 days	1.52 (1)	5.88 (2)		4.00 (1)	2.67 (2)		3.00 (3)
Student athlete							
Yes	15.71 (11)	5.56 (2)	0.2109	26.92 (7)	7.50 (6)	0.0151	12.26 (13)
No	84.29 (59)	94.44 (34)		73.08 (19)	92.50 (74)		87.74 (93)
Type of diet followed							
Not following any diet	70.00 (49)	83.33 (30)	0.2390	57.69 (15)	80.00 (64)	0.0014	74.53 (79)
To gain weight	5.71 (4)	0.00 (0)		7.69 (2)	2.50 (2)		3.77 (4)
To maintain wieght	12.86 (9)	5.56 (2)		30.77 (8)	3.75 (3)		10.38 (11)
To lose weight	10.00 (7)	5.56 (2)		3.85 (1)	10.00 (8)		8.49 (9)
Prefer not to answer	1.43 (1)	5.56 (2)		0.00 (0)	3.75 (3)		2.83 (3)
Nutrition classes taken							
0 classes	76.81 (53)	77.14 (27)	0.3109	88.00 (22)	73.42 (58)	0.2004	76.92 (80)
1 class	14.49 (10)	22.86 (8)		8.00 (2)	20.25 (16)		17.31 (18)
2 classes	4.35 (3)	0.00 (0)		4.00 (1)	2.53 (2)		2.88 (3)
3+ classes	4.35 (3)	0.00 (0)		0.00 (0)	3.80 (3)		2.88 (3)
Primary source of nutrition information							
Family	17.14 (12)	16.67 (6)	0.5192	11.54 (3)	18.75 (15)	0.7184	16.98 (18)
Friends	4.29 (3)	5.56 (2)		3.85 (1)	5.00 (4)		4.72 (5)
Health Care Provider	15.71 (11)	11.11 (4)		7.69 (2)	16.25 (13)		14.15 (15)
School	11.43 (8)	22.22 (8)		15.38 (4)	15.00 (12)		15.09 (16)
Media	45.71 (32)	33.33 (12)		50.00 (13)	38.75 (31)		41.51 (44)
Other	5.71 (4)	11.11 (4)		11.54 (3)	6.25 (5)		7.55 (8)

Types and prevalence of DS use

Approximately 66.04% (N=70) of students reported using a DS as defined by the Dietary Supplement Health and Education Act. Student DS users reported using an average of 1.37 (SD=0.64) different supplements in the month-long period preceding the survey. Over 80% of males (N=21, 80.77%) and 60% of females (N=49, 61.25%) reported DS use; however, this difference in DS use by sex was not significant $p > 0.05$. DS use was most common in students who were classified as overweight (N=17, 77.27%) and least common in students classified as healthy weight (N=41, 60.29%). The observed differences in DS use by BMI classification were not significant $p > 0.05$. DS use appeared to increase with age and the mean age for DS nonusers was 19.5 years (SD=1.23) and 20.36 years (SD=1.26) for DS users. The observed differences in DS use by age were significant $p < 0.01$.

The most frequently reported DSs used alone or in combination among students surveyed were vitamins (N=40, 31.5%), multivitamins/minerals (N=34, 26.77%), and proteins (N=30, 23.62%) (Table 2). When analyzing for sex-based differences in DS type, the most popular DS types were vitamins (N=27, 31.4%) for females and protein (N=14, 34.15%) for males. The differences by sex for DS type were not significant $p > 0.05$. Students primarily reported daily usage of DSs (N=66, 69.47%).

Table 2. Patterns of DS used alone or in combination among males and females

Variables	Males % (n)	Females % (n)	p-value	Total % (n)
Total	30.00 (21)	70.00 (49)		100.00 (70)
Type of DS				
Vitamin	31.71 (13)	31.40 (27)	0.4892	31.50 (40)
Mineral	4.88 (2)	5.81 (5)		5.51 (7)
Multivitamin/mineral	19.51 (8)	30.23 (26)		26.77 (34)
Protein	34.15 (14)	18.60 (16)		23.62 (30)
Herb	2.44 (1)	5.81 (5)		4.72 (6)
Other	7.32 (3)	8.14 (7)		7.87 (10)
Pattern of DS use within the last month				
Daily	62.07 (18)	72.73 (48)	0.5367	69.47 (66)
Weekly	34.48 (10)	24.24 (16)		27.37 (26)
Once a month	0.00 (0)	1.52 (1)		1.05 (1)
Other	3.45 (1)	1.52 (1)		2.11 (2)
Selected reasons for DS use				
Build muscle	18.92 (14)	9.79 (14)	0.2262	12.90 (28)
Weight gain	1.35 (1)	2.10 (3)		1.84 (4)
Get more energy	18.92 (14)	8.39 (12)		11.98 (26)
Improve digestion	5.41 (4)	10.49 (15)		8.76 (19)
Improve overall health	20.27 (15)	26.57 (38)		24.42 (53)
Boost immune system	14.86 (11)	19.58 (28)		17.97 (39)
Supplement diet	14.86 (11)	13.99 (20)		14.29 (31)
Weight loss	1.35 (1)	2.10 (3)		1.84 (4)
Medical needs	4.05 (3)	6.29 (9)		5.53 (12)
Other	0.00 (0)	0.70 (1)		0.46 (1)

Reasons for DS use and source of information

The most frequently reported reasons for using DSs were to improve overall health (N=53, 24.42%), boost the immune system (N=39, 17.97%), and supplement the diet (N=31, 14.29%). Students often stated more than one reason for use for each supplement they reported. The most frequently reported reasons for DS use for females were to improve overall health (N=38, 26.57%) and boost the immune system (N=28, 19.58%), and for males they were to improve overall health (N=15, 20.27%), build muscle (N=14, 18.92%) and get more energy (N=14, 18.92%). The differences by sex for reasons for DS use were not significant $p > 0.05$.

The most frequently reported source of nutrition information was the media (N=44, 41.51%) and the least reported was friends (N=5, 4.72%). When analyzing for differences in source of nutrition information based on DS use, the media remained the highest reported nutrition information source for both groups, with family (N=12, 17.14%) being the next highest for DS users and school (N=8, 22.22%) being the next highest for DS nonusers. These observed differences in source of nutrition information for DS users and nonusers were not significant, $p > 0.05$.

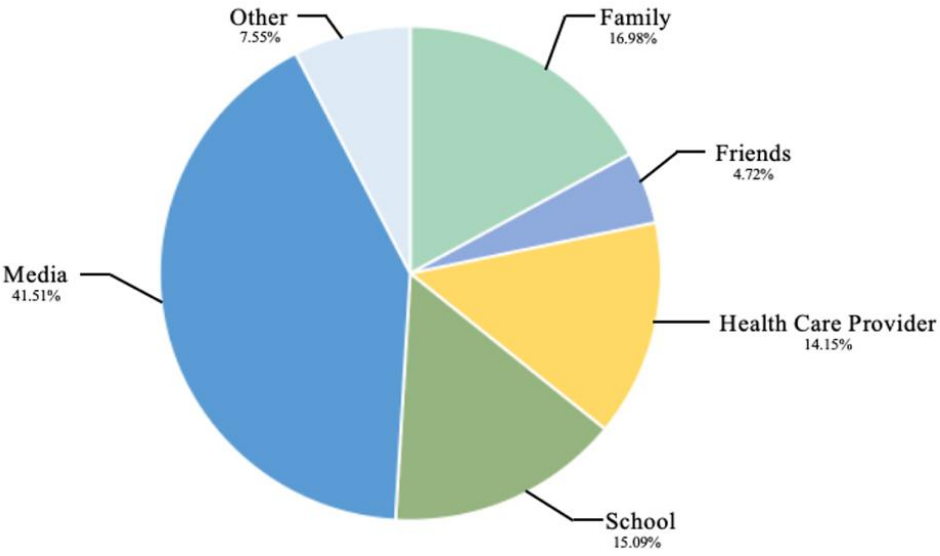

Figure 1. Primary source of nutrition information in college students.

Predictors of DS use and correlation of independent and dependent variables

Multiple logistic regression analysis was performed to identify determinants of DS use. The adjusted odds ratios were calculated for the dependent variable of DS use which had two outcomes of 'yes' or 'no'. The outcome of 'yes' was selected as a reference category. The regression analysis indicated that older students (AOR:1.644; P=0.0175) were significantly more likely to take a DS.

The independent variables of age and activity level were positively correlated with the number of supplements used in participants ($\rho = 0.297$ and $\rho = 0.299$ respectively) and the correlation was significant at $p < 0.005$.

Table 3. Multiple logistic regression model for determinants of DS use for college students

		95% confidence interval		
Factors	**Adjusted odds ratio**	**Lower**	**Upper**	**p-value**
Age	1.644	1.091	2.477	0.0175
Sex				
Male	-	-	-	-
Female	0.276	0.076	1.005	0.0509
BMI group				
Underweight (<18.5)	-	-	-	-
Healthy weight (18.5-24.9)	0.238	0.018	3.222	0.2801
Overweight (25.0-29.9)	0.512	0.034	7.816	0.6302
Obese (≥30.0)	0.624	0.035	11.214	0.7493
Athlete status				
Yes	-	-	-	-
No	1.135	0.152	8.489	0.9019
Nutrition classes taken	1.316	0.643	2.695	0.4527
Activity level (day/week)	1.248	0.933	1.671	0.1359

Opinions and attitudes towards DS

Slightly less than half of the students agreed (N=47, 44.34%) that DSs were good for health, and a similar number reported that it depends (N=39, 36.79%). Most students reported that it depends (N=47, 44.34%) on whether they consider DSs as safe, while the same number agreed (N=21, 19.81%) and disagreed (N=21, 19.81%) on considering DSs as safe. When questioned on how comfortable they would feel recommending supplements to others, most students reported feeling comfortable with the help of a researcher or healthcare provider (N=52, 49.06%).

Stratifying the data based on DS use revealed many differences in opinions between DS users and non-users. More than half of DS users agreed (N=40, 57.14%) that DS are good for health while fewer DS nonusers agreed (N=7, 19.44%) that DS are good for health. These observed differences in opinions between DS users and nonusers about DS impact on health were significant $p < 0.001$. Opinions on the safety of DS remained to be similar for DS users and nonusers, and the differences between the two groups were not significant $p > 0.05$. When questioned on how comfortable they would feel recommending supplements to others, feeling comfortable with the help of a researcher or healthcare provider continued to be the most reported opinion for both DS users and nonusers, while feeling very comfortable (N=16, 22.86%) was the second most reported for DS users and feeling uncomfortable (N=7, 19.44%) was the second most reported for DS nonusers. These observed differences for comfort in recommending DSs were significant $p < 0.05$.

Table 4. Knowledge and beliefs about DSs for DS users and nonusers, males and females

Variables	DS users % (n)	DS nonusers % (n)	p-value	Males % (n)	Females % (n)	p-value	Total % (n)
Total	66.04 (70)	33.96 (36)		24.53 (26)	75.47 (80)		100 (106)
Dietary supplements are good for health							
Agree	57.14 (40)	19.44 (7)	0.0008	50.00 (13)	42.50 (34)	0.5264	44.34 (47)
Disagree	4.29 (3)	5.56 (2)		7.69 (2)	3.75 (3)		4.72 (5)
Unsure	12.86 (9)	16.67 (6)		15.38 (4)	13.75 (11)		14.15 (15)
It depends	25.71 (18)	58.33 (21)		26.92 (7)	40.00 (32)		36.79 (39)
Dietary supplements are completely safe							
Agree	21.43 (15)	16.67 (6)	0.8432	26.92 (7)	17.50 (14)	0.0743	19.81 (21)
Disagree	18.57 (13)	22.22 (8)		26.92 (7)	17.50 (14)		19.81 (21)
Unsure	14.29 (10)	19.44 (7)		23.08 (6)	13.75 (11)		16.04 (17)
It depends	45.71 (32)	41.67 (15)		23.08 (6)	51.25 (41)		44.34 (47)
Level of comfort recommending others to take dietary supplements							
Very comfortable	22.86 (16)	5.56 (2)	0.0170	30.77 (8)	12.50 (10)	0.0702	16.98 (18)
Comfortable with the help of a researcher or healthcare provider	50.00 (35)	47.22 (17)		34.62 (9)	53.75 (43)		49.06 (52)
Uncomfortable	5.71 (4)	19.44 (7)		3.85 (1)	12.50 (10)		10.38 (11)
Very uncomfortable	15.71 (11)	11.11 (4)		23.08 (6)	11.25 (9)		14.15 (15)
Unsure	5.71 (4)	16.67 (6)		7.69 (2)	10.00 (8)		9.43 (10)

Discussion

This study aimed to investigate patterns of DS use in college students as well as the associations held between lifestyle/demographic characteristics and DS use among college students. The prevalence of DS use was 66.04%. Recent data from NHANES has established that 57.6% of adults [2] and 34.0% of children and adolescents [15] in the United States use a DS. Our reports of DS use from the present study are comparatively larger which suggests that college students may be more likely to use DSs than the general population. The observed prevalence of DS use in our population of college students was higher than some studies [16, 17], lower than another [5], but was the same as another study conducted in a college student population [3]. When compared to international data on DS use in college students, our study's prevalence was higher than studies of the same nature reported in UAE (35.6%) [18], Japan (16.8%) [19], and Canada (43.4%) [20].

The primary reason participants reported for using DSs was to improve their overall health. It was surprising to note that only 14% of reports mentioned supplementing the diet as the reason for DS use. DSs are not intended to treat, diagnose, cure, or alleviate the effects of diseases as defined by the FDA [21], and their primary intention is to supplement the diet. The most notable figures for type of DSs used were found to be vitamins in females, and proteins in males. Previous studies have observed that protein supplementation is most common among male college students for improvement of muscle mass and promotion of regeneration after training [22-24].

Our finding that DS use was most common in obese college students was similar to a study conducted in the undergraduate population [16], but generally contradictory to results from studies conducted in adult populations [11, 12]. Additional research should be conducted to examine the potential relationship between increasing BMI and DS use in collegiate samples. Our finding that 84.62% of student athletes reported DS use was considerably higher than findings of previously conducted studies in student athlete samples [16, 17]. This difference in the prevalence of

DS us may be due to our small sample size of student athletes recruited in comparison to other studies. The high proportion of student athletes using DSs may also explain the occurrence of a significantly positive correlation between activity level and DS use in our student sample, since this population has a much higher activity level than what is typically seen in college students.

An important finding of this study was the significant association of age with DS use. Our multiple regression analysis indicated that as age of the students increased, the odds of using a DS increased by a factor of 1.64 ($p < 0.05$). The recent NHANES surveys of the US population has reported similar results to this trend with 74.3% of adults aged 60 and over reporting DS use compared to 42.5% for adults between the ages of 20 and 39 [2]. Age also held a positive correlation with the number of DSs used by college students.

The majority of both DS users (50.0%) and nonusers (47.22%) reported that they would feel comfortable recommending others to take DSs with the help of a researcher or healthcare provider. This was an interesting finding because school and health care providers were infrequently reported for both DS users and nonusers when participants were questioned on their primary sources of information about nutrition. The finding of the media being the most reported source of nutrition information in this study is consistent with findings from many other studies on college students [3, 16] but contradictory to others conducted internationally [25, 26]. Slightly less than half of students agreed that DSs were good for health, and similar results to this have been seen in international studies [27, 28] that used a similar line of questioning. Further research should be conducted to analyze the continued use of DSs in populations hesitant about their efficacy, since DS use remains high in this college student population regardless of the hesitancy on whether DSs are good for health.

Strengths and Limitations

The main strength of the study is that our findings provide further information regarding DS use and lifestyle behaviors and demographic characteristics of users and nonusers of DS products. Previous research has focused on the prevalence and types of DS use in the college population, but this study was distinctive in that it also analyzed student opinions on DSs and their differences in subgroups. Additionally, there is very little current research regarding lifestyle behaviors and demographic characteristics of DS users and nonusers in college samples in the United States, and the results from this study may help to fill this gap. Limitations of this study include the relatively small study population from only 15 colleges and universities which may limit the ability to generalize results. Inclusion of a larger number of student athletes would have helped to provide more generalizable results on how DS use, and associated variables differ in this unique population.

Conclusion

In conclusion, the results of this study demonstrate a widespread use of DSs in college students, greater than that of the general population. Demographic factors such as age might influence the prevalence of DS use. Significant differences exist in the opinions on the health benefits of DSs and comfort in recommending DSs to others between college students who are DS users and nonusers. Additionally, college students appear to rely on often inaccurate sources of information about DSs, with a considerable portion of students using the media as their primary source of information. Extensive nutritional education and consulting should be made available to college students, emphasizing the role of healthcare providers and researchers in determining beneficial plans for nutrient supplementation. Finally, given the frequency with

which college students may use DSs, it is important for campus healthcare providers as well as students to understand the compositions of these products and the potential interactions they may have with prescription medication or over the counter medications.

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