


Knowledge and Patterns of Dietary Supplement Use among Students Attending King Abdulaziz University in Saudi Arabia: A Cross-Sectional Study

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Abstract

Oral dietary supplements (DSs) include vitamins, minerals, amino acids, energy drinks, and herbal products. The use of DSs is increasing and their manufacturers promote their benefits. Studies have validated some of these benefits, but have also indicated that some DSs can have adverse effects, especially if used without the appropriate supervision. Little information on DS use among Saudis is available. This study assessed the use of dietary supplements among male and female university students with the goal of educating the community about DSs and the dangers associated with their misuse. Online and paper validated questionnaires were administered to King Abdulaziz University (KAU) students between September 2019 and January 2020. The responses were collected and analyzed statistically. Of the 954 KAU students who completed the survey, one-third used DSs (42.9% women vs 25.7% men). Of these, 51.7% believed that DSs are essential for health, 41.7% classified them as both food and drugs, 67.2% were aware that DSs could not replace a healthy diet, and 25.8% were aware of their potentially harmful effects. Multivitamins and minerals were the most used DSs. DS awareness among KAU students is limited. Additional health education is necessary to assist students in their selection of the most suitable DSs.

Keywords

knowledge, cross-sectional, King Abdulaziz University, students, Saudi Arabia, dietary supplements, vitamins, minerals, energy drinks

What do we already know about this topic?

Limited information is available regarding the use of DSs in the Saudi population, particularly among women.

How does your research contribute to the field?

Interpretation of the knowledge level and pattern of DS usage among University students will help offer better guidance to the students regarding the benefits and drawbacks of DS use, consequently achieving a higher awareness level among them.

What are your research's implications toward theory, practice, or policy?

The research will implicit the practice by offering better information on the most used dietary supplements.

Introduction

Oral dietary supplements (DSs) include vitamins, minerals, amino acids, energy drinks, and herbal products that are formulated as tablets, capsules, powders, or liquids.^{1,2} DS manufacturing companies claim that their products promote a healthier lifestyle by increasing physical and mental performance.¹ More than 50% of the adults in the United States use

DSs, mainly to improve or maintain individual health, with vitamins being the most consumed type of DS. However, less than 25% of DSs are consumed based on the recommendations of a physician.³ Studies have found that vitamins and minerals have several benefits, including decreasing the incidence of cancer,⁴ protecting fetuses from some congenital



anomalies,⁵ and lowering blood pressure via various physiological mechanisms.⁶⁻⁹ Oral magnesium supplements can also decrease blood pressure in hypertensive patients.¹⁰ As 60% of the Saudi adult population is vitamin D-deficient,¹¹ oral supplementation with this vitamin improves physical performance and decreases pain in individuals with osteoarthritis.¹² Furthermore, vitamin D can serve as a potential immune-modulator in COVID-19 infection due to its immune regulating function.^{13,14} Athletes who have a high protein diet have a higher fatigue resistance and better muscle performance,¹⁵ while caffeine can increase endurance and prolong training intervals.¹⁶ Herbal supplements can be used to treat chronic liver disease, lower cholesterol levels, and increase wound healing.¹⁷

Despite all their advantages, the excess consumption of DSs can cause adverse effects. For example, hypervitaminosis D can cause kidney stones, atherosclerotic vascular calcification, hypertension, and cardiac arrhythmia.¹⁸ Excess caffeine intake can cause insomnia, tachycardia, and anxiety.¹⁶ Energy drinks in high doses can encourage suicidal tendencies.¹⁹

Several studies evaluating DSs usage among university students have been conducted.^{20,21} A study carried among Kazakhstan university students showed that one-third of regularly exercising university students use any kind of sports supplements. Vitamins were the commonest supplements in use, associated with a healthy lifestyle as a primary goal of exercising regularly.²⁰ Herbal supplements (mostly ginger, mint, and olive oil) are used by 27.7% of Qatar College students for conditions related to weight loss and common digestive and respiratory ailments.²²

Due to recent economic and cultural changes, Saudi Arabia is the largest market for DSs in the Arabian Peninsula, with a market of approximately US \$80 million.²³ In a study conducted at the Imam Abdulrahman Bin Faisal University (IAU) in Dammam, Saudi Arabia, Naqvi et al found that 29.4% of their study population took DSs.²¹ However, limited information is available regarding the use of DSs in the Saudi population, particularly among women, especially as 26.2% of Saudis between the ages of 15 to 29 participate in physical activity (PA).²⁴

This study aimed to assess the level of knowledge on DSs among students who attend King Abdulaziz University (KAU) and usage patterns and reasons for their use. Since

enrollment at KAU in 2019 comprised 6.1% of all higher education students in Saudi Arabia,^{25,26} the findings of this study will provide important information about which are the most widely used supplements among university students. This, in turn, will enable the promotion of awareness and education programs about the best supplements to use for improving the overall health of the community. Furthermore, increasing awareness about the hazards that can be associated with the excessive intake of certain supplements is also an important goal.

Materials and Methods

This cross-sectional study consisted of 1000 of the 77 095 students enrolled at KAU between September 2019 and January 2020. The sampling frame included all students enrolled at KAU during the 2019 academic year. The minimal sample size, determined using the Raosoft sample size calculator,²⁷ ensured that the number of respondents was representative of the entire KAU student body, with a 0.50 indicator percentage, 5% margin of error, and 95% confidence interval. The student population, including both undergraduate and postgraduate students, was divided into 5 college clusters: the preparatory year cluster (22.3%), health-related colleges cluster (22.7%), administrative colleges cluster (21.6%), science colleges cluster (19.4%), and engineering colleges cluster (14%).

A questionnaire was developed to investigate the trends and patterns of DS usage among the university students and to determine their exercise habits. The questions were developed *de novo* and reviewed by a panel that comprised of health care professionals from the community medicine, clinical biochemistry, and internal medicine departments of KAU. Based on the panel reviews, modifications to the arrangement and structure of the questions were made. The content validation ensured that the questions were not ambiguous and that the content was appropriate. To ensure the questionnaire's reliability, a pilot study was conducted among 100 randomly selected university students, of whom 68% used DSs.

The final questionnaire was divided into 4 sections: a demographic information section, a PA information section, a DS knowledge section, and an attitude toward/consumption of DSs section. In the demographic information section,

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students were asked about their age, sex, weight, and height to calculate the body mass index (BMI), according to which they were divided into 6 categories (in kg/m²): <18 (underweight), 18 to 24.9 (normal weight), 25 to 29.9 (pre-obesity), 30 to 34.9 (obesity class I), 35 to 39.9 (obesity class II), and >40 (obesity class III) per the World Health Organization and the Centers for Disease Control and Prevention classifications.^{28,29} The demographic section also inquired about the student's marital status, city of residence and living conditions, colleges attended, and their year or level of study at the university.

Participants who performed PA completed the PA information section, which inquired about the types, places, and reasons for performing PA. The DS knowledge section consisted of 4 questions regarding the student's knowledge of the importance of DSs, their classification, and adverse effects.

The final section was completed only by students who used DSs, and collected information on the types of DSs used during the previous 6 months, reasons for use, sources of information, whether a medical doctor was consulted or laboratory investigations were performed before commencing the supplement use, whether the desired effect was achieved and/or whether any adverse effects were observed, and whether they would recommend DSs to others.

The survey was distributed to the students as either a printed document or in an online format using Google Forms, which students responded to according to their ease of accessibility. Prior to the administration of the paper questionnaire, students were given a brief explanation of the study's goals and provided with an assurance that the information would be used without disclosure of their personal data. Upon receipt of oral consent, the questionnaire was administered. For the online form, an explanation of the purpose of the survey and assurance that no personal information would be disclosed or used was provided on the first page.

Descriptive statistics, cross-tabulations, and correlation analyses were used to plot and analyze the data. The Statistical Package for Social Studies software (SPSS version 25.0; IBM Corp., Armonk, NY, USA) was used for all statistical analyses. Descriptive statistics were used to summarize the basic features of the collected data. We checked the data for normality using the Shapiro-Wilk test. The data were distributed normally. To examine the relationship between the variables, we used the Pearson correlation coefficient for parametric data and the Spearman correlation coefficient for non-parametric. We used different statistical tests to examine the difference between the variable according to the data parametric status and the number of groups. In all the tests, a *P*-value $\leq .05$ was considered statistically significant.

Results

All Students Demographic Information

A total of 1000 questionnaires were collected from the KAU students, 631 in paper form and 369 in the online form. Forty-six paper forms were excluded because they were incomplete, resulting in 954 completed forms. Among the respondents, 56.7% were men and 43.3% were women. The mean age was 21.2 ± 2.6 years, and the mean BMI was 24.3 ± 6.2 kg/m². The BMIs of 50.4% of the students were within the normal range, 9.3% were underweight, 18.8% were pre-obese, 8.1% were obese class I, 3.7% were obese class II, and 2.9% were obese class III. Moreover, 3.7% of the population were married, and most of the students (82.2%) lived in Jeddah, while 11.3% lived in Rabigh. Most of the students (84.1%) lived with their families, and 95.3% were undergraduate students.

All Students PA Information

Furthermore, 551 (57.8%) students performed PA, a plurality of whom were men from science colleges (15.2%); the mean number of active days was 3.6 ± 1.7 per week. Moreover, 44.1% of students who performed PA reported attending a fitness center. The most performed type of PA was walking (63.5%), and 68.8% of the participants who performed PA did so to maintain their health.

All Students DS Knowledge

In terms of awareness about DSs, 51.7% of all students considered them essential for health, and 41.7% classified them as both food and drugs. The majority (67.2%) did not agree that DSs can substitute for a healthy diet, and notably, 38.5% thought that DSs were not harmful to health (Figure 1).

All DSs Users Pattern of Use

Among the surveyed students, 316 (33.1%) reported using DSs during the last 6 months, mostly multivitamins and minerals (56%), followed by vitamin D and caffeine (41.1% each) (Figure 2), and 42.5% used the supplements regularly. The most common reason for taking DSs was to correct a deficiency (80.6%), and 50.6% considered taking DSs based on a medical doctor's advice. Furthermore, 47.2% consulted a medical doctor before taking the supplements, and 52.8% had undergone medical tests beforehand. Only 6.3% of the students using DSs did not inform their families that they did so; the plurality (45%) had no specific reason for withholding this information. Interestingly, 74.8% were satisfied with the results they obtained from taking DSs, and 64.8% did not report any adverse effects. Among those who did, sleep

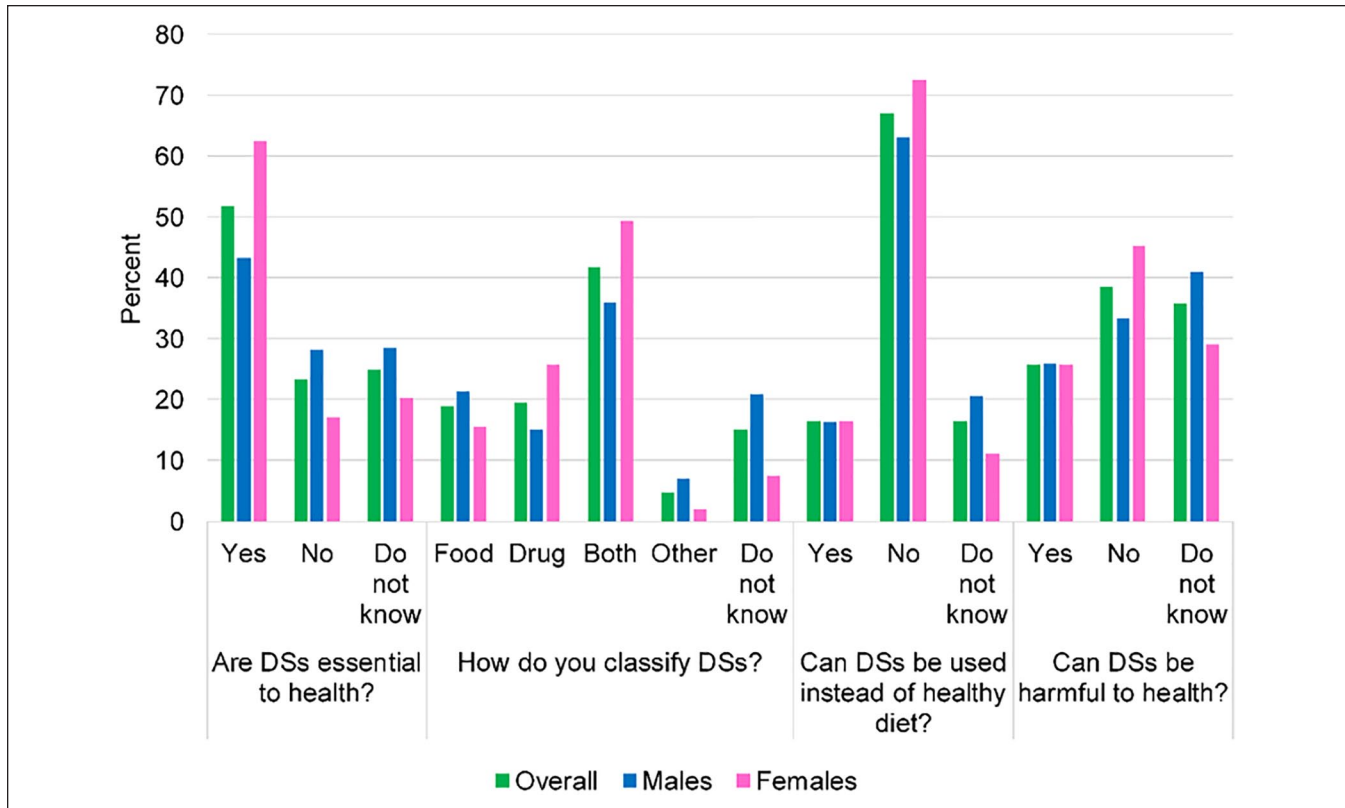


Figure 1. Responses of students to the DS knowledge section in the questionnaire by gender. DS= dietary supplement.

disturbance was the most common (14.8%). Although some of the participants experienced adverse effects without obtaining the desired results, 84.2% of those who used DSs would recommend them to others.

Male Students PA Information and DSs Knowledge

Of the 541 male students surveyed, 67.1% performed PA 3.7 ± 1.7 days a week, mostly at a fitness center (54.5%). Walking was the most commonly performed PA (55.6%), and the main reason for performing PA was to maintain health (65%). With respect to men's awareness of DSs, 43.4% claimed that they are essential for health, and 35.9% considered them as both food and drugs. The largest percentage of male participants (63.2%) did not believe that DSs can substitute for a healthy diet, and 40.9% were not aware of their harmful effects (Figure 3).

Male DSs Users Pattern of Use

Furthermore, 25.7% of the male students used DSs during the previous 6 months. Amino acids/proteins and caffeine were the most commonly used DSs by men (59% and 54%, respectively), followed by multivitamins and minerals (48.2%). Moreover, 46.4% of the men who used DSs during

the past 6 months used them regularly, mostly to correct a deficiency (74.6%). The primary sources of information about DSs were the internet and social media (42.4%), whereas only 33.1% consulted a medical doctor before taking them, and 38.8% underwent medical tests. While 7.2% of men did not inform their families that they were taking DSs, 40% had no specific reason for withholding this information. Among DS takers, 78.3% achieved the desired result, and 70.5% reported no adverse effects. The most commonly reported adverse effect was sleep disturbance (12.2%). Finally, 84.9% of the male participants who used DSs indicated that they would recommend them to others.

Female Students PA Information and DSs Knowledge

Four hundred thirteen female students completed the questionnaire; almost half (45.5%) performed PA (mean: 3.5 ± 1.7 days per week). Unlike the men, the majority (77.1%) performed PA at home, although similarly to men, walking was the most commonly performed activity (78.7%). The main reason for performing PA was to maintain health (76.1%).

In assessing women's knowledge of DSs, it was found that 62.5% agreed that DSs were essential for health, and almost half classified them as both food and drugs (49.4%).

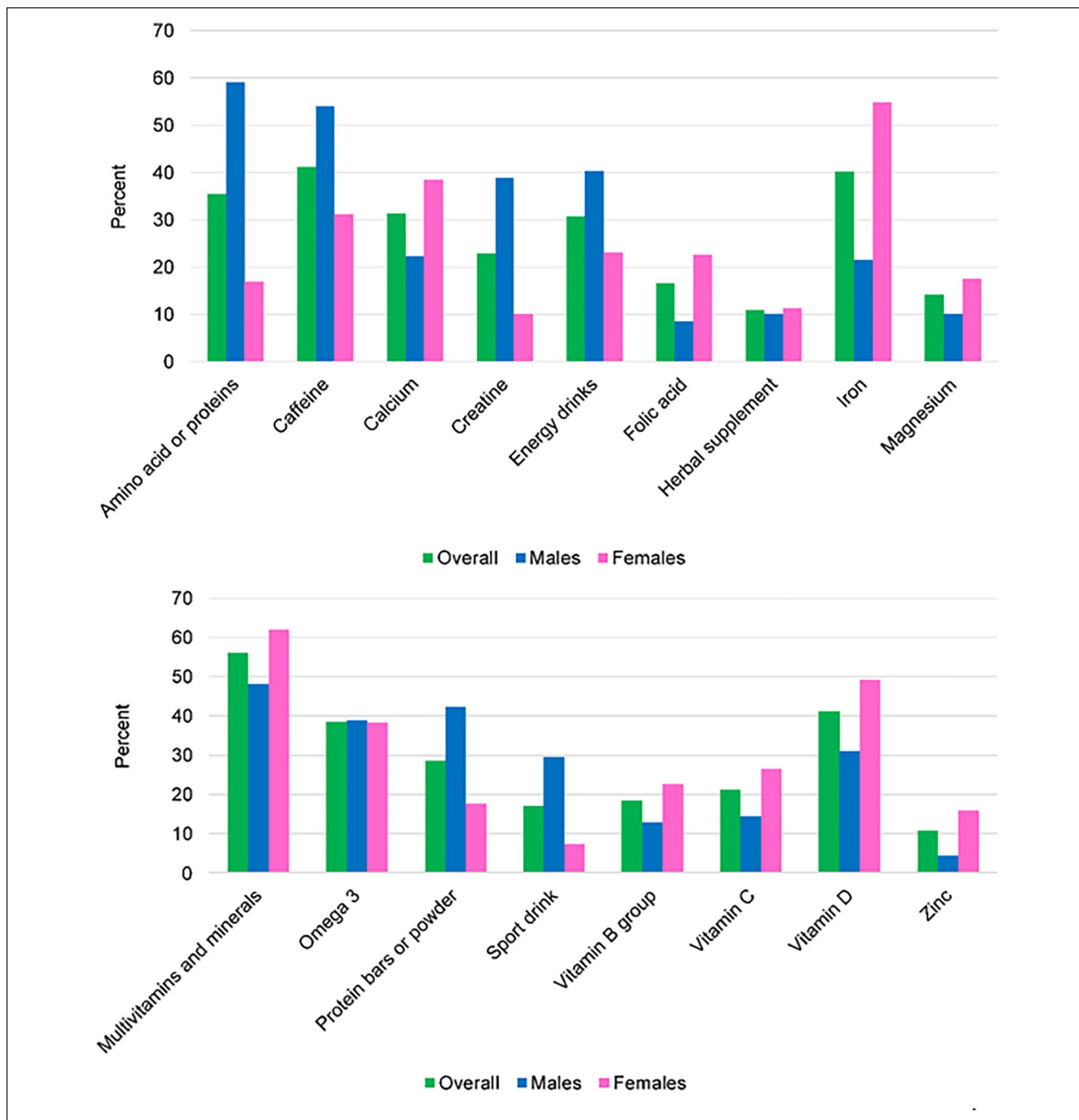


Figure 2. Categories of dietary supplements consumed by the students in this study grouped by gender.

The majority (72.4%) stated that DSs could not substitute for a healthy diet, and 45.3% believed that they are safe (Figure 4).

Female DSs Users Pattern of Use

Furthermore, 177 of the 413 female participants (42.9%) had used DSs during the previous 6 months; multivitamins and

minerals were the most commonly used (62.1%), followed by iron (54.8%) and vitamin D (49.2%). Additionally, 39.5% of women who used DSs took them regularly, mostly to correct a deficiency (85.3%). In contrast to men, 65.5% of the women had heard about the supplements they used from a physician. In fact, 58.2% had consulted a doctor before using DSs, and 63.8% underwent medical tests beforehand. Only 5.6% did not want their families to know that they took DSs

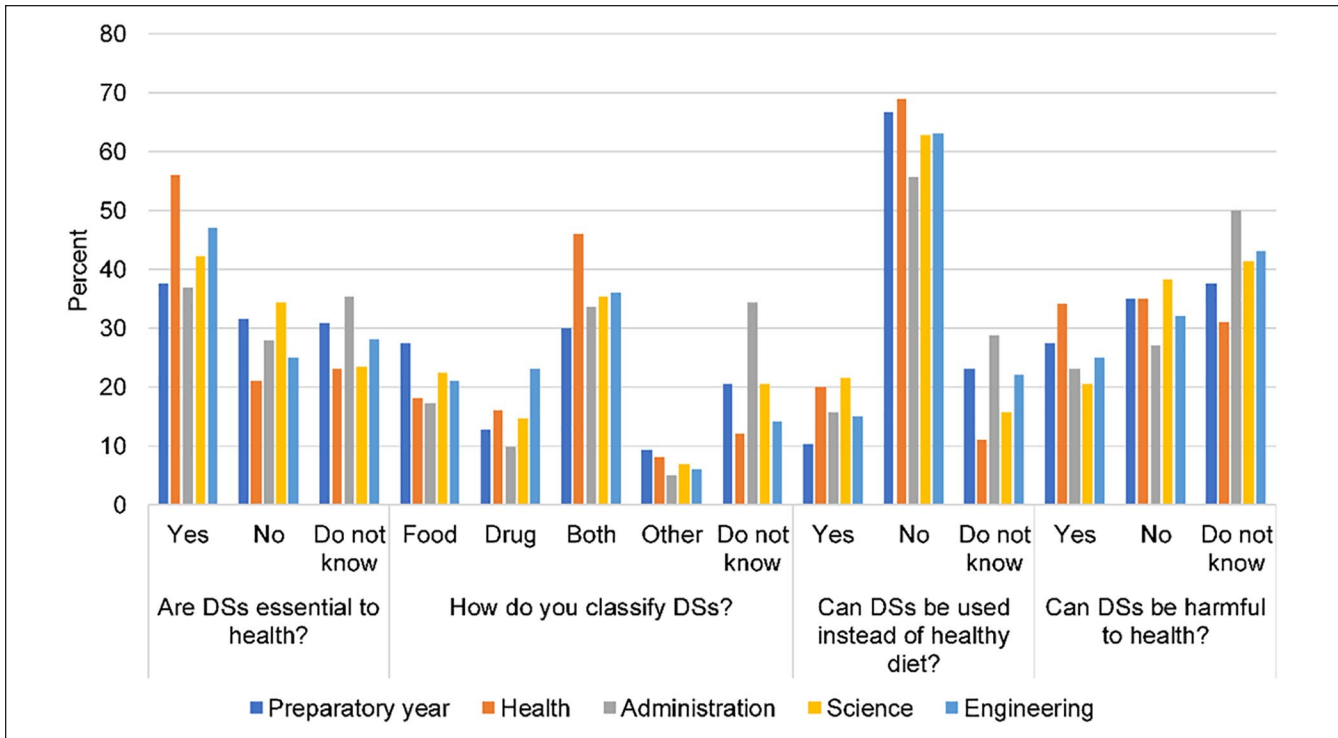


Figure 3. Responses of male students to the DS knowledge section in the questionnaire, classified per field of study (college attended). Note. Statistically significant difference with P -value $< .05$ for all questions. DS= dietary supplement.

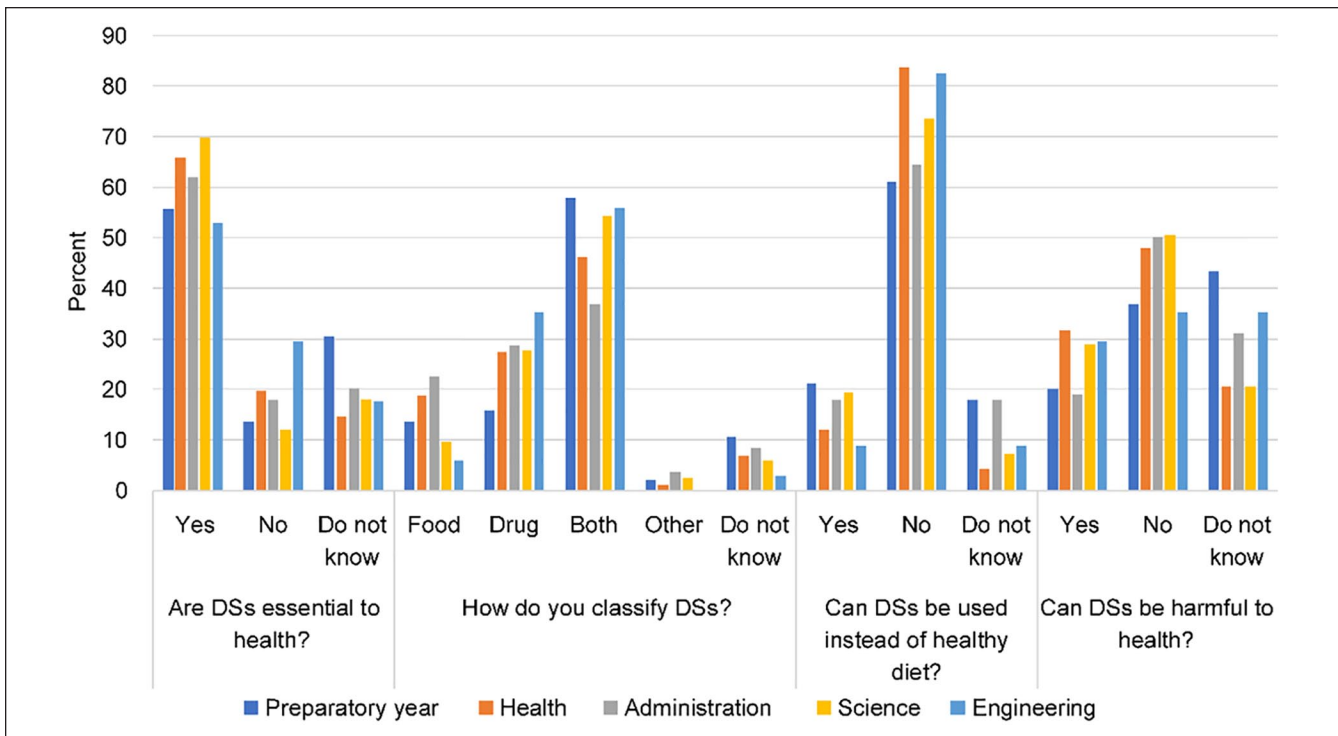


Figure 4. Responses of female students to the DS knowledge section in the questionnaire, classified per field of study (college attended). Statistically significant difference with P -value $< .05$ for all questions. DS= dietary supplement.

Table 1. Comparison Between Male and Female Student DS Users in Terms of Attitude and Practice.

	Male students	Female students	P-value
	(n= 139)	(n= 177)	
Use DSs regularly, n (%)			
Yes	64 (46.4)	70 (39.5)	.224
Reasons for using DSs, n (%)			
Correction of deficiency	103 (74.6)	151 (85.3)	.017*
Muscle bulking	68 (49.3)	22 (12.4)	<.001*
Relief of fatigue	20 (14.5)	42 (23.7)	.041*
Focus enhancement	26 (18.8)	42 (23.7)	.295
Other	9 (6.5)	7 (4)	.303
Heard about the DSs from, n (%)			
Doctor	44 (31.7)	116 (65.5)	<.001*
Relative or a friend	48 (34.5)	51 (28.8)	.277
Gym trainer	38 (27.3)	7 (4)	<.001*
Internet and social media	59 (42.4)	48 (27.1)	.004*
Consulted a doctor before starting DSs, n (%)			
Yes	46 (33.1)	103 (58.2)	<.001*
Underwent medical tests before starting DSs, n (%)			
Yes	54 (38.8)	113 (63.8)	<.001*
Obtained the desired result from DSs, n (%)			
Yes	108 (78.3)	127 (72.2)	.216
Experienced adverse effects from DSs, n (%)			
None	98 (70.5)	107 (62.2)	.063
Sleep disturbance	17 (12.2)	29 (16.9)	.299
Palpitation	16 (11.5)	25 (14.5)	.493
Mood changes	13 (9.4)	24 (14)	.248
Constipation	10 (7.2)	32 (18.6)	.005*
Generalized fatigue	10 (7.2)	19 (11)	.279
Muscles pain	12 (8.6)	18 (10.5)	.644
Other adverse effects	1 (.7)	2 (1.2)	.709
Do you recommend DSs to others? n (%)			
Yes	118 (84.9)	148 (83.6)	.758

*Statistically significant P-value (<.05). Mann-Whitney test was used to measure the P-value. DS= dietary supplement.

(half of these had no specific reason for this). Moreover, 72.2% of the women achieved their desired result, and 62.2% had no adverse effects. Among those who experienced such effects, constipation was the most common (18.6%). Similar to men, 83.6% of women stated that they would recommend the DSs that they used to others (Table 1).

Statistically Different Variables

Of all the variables, we found that the variables with the most statistically significant differences in the students' knowledge of DSs were between the sexes, those who attended medical versus non-medical colleges, and those who performed PA versus those who did not (Table 2).

We also found significant differences in the types of DSs used between the sexes as well between those who perform PA and those who do not (Table 3).

Finally, we observed significant differences in sources of information about DSs and in the rates of pre-use physician consultations and medical tests between the sexes as well as between students who performed PA and those who did not (Table 4).

Discussion

The present study is considered a leading study comprising the largest sample size among male and female university students in western Saudi Arabia and being carried out in KAU, one of the globally distinguished universities. Most of the previous studies among university students in Saudi Arabia were conducted either among males or female students only.

Our study has shown that 33.1% of the participants have consumed Ds during the previous 6 months, with higher

Table 2. Differences in the Students' Knowledge of DSs as a Function of Sex, College Attended, and Physical Activity Performance.

	Are DSs essential for health?	How do you classify DSs?	Can DSs substitute for a healthy diet?	Can DSs be harmful to health?
Sex (male vs female students)				
Chi-square	34.530	68.442	15.464	17.896
P-value	<.001*	<.001*	<.001*	<.001*
College (medical vs non-medical)				
Chi-square	10.955	8.901	18.153	14.610
P-value	.004*	.064	<.001*	.001*
Perform physical activity (yes vs no)				
Chi-square	5.602	17.401	8.443	3.758
P-value	.061	.002*	.015*	.153

*Statistically significant P-value (<.05). Mann-Whitney test was used to measure the P-value.
DS= dietary supplement.

Table 3. Differences in the Most Used Types of DSs Used as a Function of Sex, College Attended, and Physical Activity Performance.

	Amino acids or proteins	Caffeine	Calcium	Creatine	Energy drinks	Folic acid	Iron	Multivitamins and minerals	Vitamin D
Sex (male vs female students)									
Chi-square	60.149	16.837	9.399	36.399	10.732	11.046	35.743	6.145	10.671
P-value	<.001*	<.001*	.002*	<.001*	.001*	.001*	<.001*	.013*	.001*
College (medical vs non-medical)									
Chi-square	4.991	0.741	1.733	0.956	0.008	0.308	1.480	1.093	0.024
P-value	.025*	.389	.188	.328	.931	.579	.224	.296	.876
Perform physical activity (yes vs no)									
Chi-square	53.362	14.452	0.196	26.815	9.727	1.495	5.519	0.150	2.557
P-value	<.001*	<.001*	.658	<.001*	.002*	.221	.019*	.698	.110

*Statistically significant P-value (<.05). Mann-Whitney test was used to measure the P-value.
DS= dietary supplement.

usage among females than males (42.9% vs 25.7%). The discrepancy among both genders can be explained in part by the high female usage of iron supplements during their menstrual periods.³⁰

The study performed by Alowais and Selim³¹ that was published in 2019 found an overall higher proportion of DSs users among students attending Qassim University in addition to other population (55.3%). Their study also found that 85.9% of their female students used DSs, which is a much higher percentage than in our study. On the other hand, only 13.9% of their male students used DSs. This study selection criteria may be the explanation for this discrepancy as the study population included just 138 health science studies, with the rest being non-university students. As regards the gender of the participants, a big difference was observed as the females represented 84%.

A study carried among male students at IAU in Damman²¹ showed higher DSs usage than our male students.

In addition, two studies held at King Saud University (KSU)³² and at Nourah bint Abdulrahman University (PNU), both located in Riyadh, Saudi Arabia,²³ showed also higher rates of usage than our female students.

Generally, the use of DSs was lower among our students than among the general public in Riyadh.³³ Internationally, KAU students have a lower rate of DS use than university students in the United Arab Emirates (UAE) (39%),³⁴ Serbia (53%),³⁵ and Australia (74%),³⁶ but a higher rate than university students in Jordan in 2008 (27.4%).³⁷

Knowledge

In general, DSs are not essential for health and are only necessary if a person does not consume a well-rounded diet or else has a particular medical condition. Situations where DSs are essential include folic acid supplementation by pregnant women to protect their fetuses from neural tube malformations³⁸ and vitamin B12 supplementation by individuals after gastric sleeve surgery or by vegetarians to avoid pernicious anemia.³⁹⁻⁴¹ Approximately one-quarter of the study population was aware that DSs are not usually essential.

The United States Food and Drug Administration and The Saudi Food and Drug Authority classify DSs as food.^{1,42} In contrast, most of the students in our study classified them as

Table 4. Differences in Sources of Information About DSs, Physician Consultations, and Medical Investigations with Respect to Students' Gender, Type of College (Medical versus Non-Medical), and PA.

	Source of information				Consulted a doctor before starting DSs?	Underwent any medical tests before starting DSs?
	Doctor	Relative or a friend	Gym trainer	Internet and social media		
Sex (male vs female students)						
Chi-square	35.758	1.184	34.858	8.167	19.682	19.517
P-value	<.001*	.277	<.001*	.004*	<.001*	<.001*
College (medical vs non-medical)						
Chi-square	0.540	0.057	5.705	0.001	1.591	0.067
P-value	.463	.812	.017*	.971	.207	.795
Perform PA (yes vs no)						
Chi-square	19.748	0.306	32.998	13.974	7.055	5.936
P-value	<.001*	.580	<.001*	<.001*	.008*	.015*

*Statistically significant P-value (<.05). Mann-Whitney test was used to measure the P-value. DS = dietary supplement. PA = physical activity.

both food and drugs (41.7%); only 18.8% classified them as food only.

A balanced and healthy diet contains all the nutrients required to live a healthy life without the need for supplements.⁴¹ Reliance on DSs leads to a poor diet, which can lead to complications over time.⁴³ Most of the students in our study were aware that taking DSs could not substitute for a healthy diet.

DSs have many harmful effects on health if taken in excess or without medical supervision. Some supplements contain herbs that have been associated with liver injuries. DSs can also interact with some types of medications, leading to harmful adverse effects.^{38,44} Although folic acid protects fetuses from neural tube deformities, in excess, it has been linked to insulin resistance in children and to cancer.³⁸ Only 25.8% of KAU students were aware of the harmful effect of DSs.

Overall, our students had a low level of knowledge of DSs, as was the case with other university students in Riyadh³² and Qassim.³¹ Similar to university students in the UAE,³⁴ our medical students had better knowledge of DSs than non-medical students, and a greater proportion of our medical students believed that DSs are essential for health.

Use of Dietary Supplements

The most commonly used DSs at our university (as well as at many other universities around the world) were found to be multivitamins and minerals,^{31,33,35-37,45} including among 62.1% of our female students population. More men than women in our study used DSs that enhance their performance during PA and improve their body image and muscle bulk; these included branched-chain amino acids, protein bars and powder, caffeine, energy drinks, and creatine.⁴⁶⁻⁵⁰ Calcium and vitamin D were used more frequently by women; this can be explained by their lower exposure to the sun, which

makes them prone to a vitamin D deficiency.⁵¹ Women used iron supplements 4 times more frequently than men; iron loss through menstruation can explain this finding,³⁰ and a similar conclusion was reached by Barnes et al.³⁶ Although only 6% of the women were married, 10% (or 22.6% of those using DSs) took folic acid supplements.

Reasons for Taking DSs

The students in our study reported that their reason for using DSs was to maintain their health (80.6%), which was also the reason provided by students at many other universities worldwide.^{31,34-36,45,52} Half of the DS-using male students in our study did so to gain muscle bulk, whereas only 12% of female students did so for the same reason. This could be because more male students at KAU are engaged in bodybuilding. The majority of PNU students reported using DSs for aesthetic purposes,²³ while the most common reason for their use by Jordanian university students was medical treatment.³⁷

Sources of Information

We found that 50.6% of our students relied on medical doctors for information and recommendations regarding DSs. Physicians were the primary source of information on DSs for 65.5% of the female students at KAU, as well as for the general population in Riyadh³³ and university students in both the UAE³⁴ and Jordan.³⁷ Furthermore, 42.4% of the male students in the present study relied on the internet and social media for information, which is similar to the proportions found among students attending other Saudi universities,^{31,32} Japanese university students,⁵² and Serbian medical students who had not yet completed their pharmacology courses.³⁵ The university curriculum was the primary source of information for Nigerian medical students⁴⁵ as well as for

Serbian medical students who passed their pharmacology courses.³⁵ Among Australian university students, family and friends were the main sources of information about DSs.³⁶

Prior Consultations with Physicians and Medical Testing

In contrast to the findings of Alowais and Selim,³¹ a greater proportion of students attending the Health College consulted a doctor before starting DS use than did those attending other colleges. A higher percentage of women than men consulted a physician and underwent medical tests before starting DSs; this can be attributable to more women becoming aware of DSs through their doctors, and the majority were using them to correct a deficiency. Generally, a lower percentage of our students consulted a doctor before starting DSs than did those at KSU,³² as well as the general population of Riyadh.³³

Desired Effects

Our data showed that 25.2% of our students did not achieve their desired effect from DSs, which was a much lower percentage than that of university students in Australia.³⁶ General reasons for health maintenance often are reported to justify the use of dietary supplements. This may suggest that many dietary supplement users perceive supplements to be healthy but are uncertain as to how they influence the functioning of their body systems. The use of calcium supplements for bone strength and the use of fiber supplements for intestinal health is widely accepted. However, the scientific evidence to support nutrient function claims such as vitamin C for increased immunity and vitamin B for stress relief is highly contradictory.

Adverse Effects

In previous studies, the most prevalent adverse effects from the use of DSs was gastrointestinal disturbance.^{31,45,52} In our study, however, sleep disturbance was the most reported symptom overall (14.8% of all the students using DSs). Constipation was the most reported adverse effect of DS use among women in our study (18.6%); as mentioned above, this could be owing to the fact that 4 times as many women use iron supplements (which cause constipation) than men.³⁰ The most reported adverse effects among men were sleep disturbances and heart palpitations, which could be because men use more caffeine and energy drinks (which cause such symptoms) than women.^{19,53-55}

Recommending DSs to Others

Of the 316 students using DSs, 34% reported some adverse effects, while 25.2% were not satisfied with the results they

obtained. Interestingly, however, 84.2% responded that they would recommend the use of DSs to others.

Strengths and Limitations

One of the important strengths of this study is the support offered by the Deanship of Scientific Research (DSR), KAU, one of the highly ranked universities internationally. This study is one of the pioneer studies among universities on the west side of SA. To the best of our knowledge, with a sample representing 1.24% of KAU students, our study has the largest sample size among both male and female university students in SA. The large sample size provided adequate power for detailed statistical analysis. The findings of this study are limited to KAU students. For generalization of these findings, further studies among different universities in different regions of SA have to be performed.

Conclusions

Compared to other universities, a smaller proportion of KAU students used DSs within a 6-month period, and their overall knowledge about them was low. Further studies with a larger sample size among different populations will be valuable for validating the findings of our study. More studies should be done to cover a wider proportion of the community. Awareness campaigns and educational programs for both university students and the general public should be designed to increase awareness around DSs and improve the attitudes and practices associated with them.

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Author Contributions

Study Design, A.A., M.M., T.G., and H.A.; Data Collection, A.A., O.G., Z.G., and N.K.; Statistical Analysis, A.A.; Literature Review, O.G. and Z.G.; Writing the Manuscript, A.A. and M.M.; Final Revision of the Manuscript, T.G. and H.A.; Supervised the Work, T.G. and H.A.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical Approval

Ethical approval for this study was obtained from the Biomedical Ethics Research Committee, KAU, Saudi Arabia (Reference No 292-19).

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Availability of Data and Materials

The datasets that were used and analyzed during the current study are available from the corresponding author upon request.

Supplemental Material

Supplemental material for this article is available online.

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