Prevalence, reasons, and determinants of dietary supplements use among undergraduate female students of health and non-health colleges in a Saudi public university

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Abstract

Purpose
The aim of this study was to gather data from female students studying in both health and non-health colleges at Imam Abdulrahman Bin Faisal University and report the prevalence, reasons, and determinants of dietary supplements use.

Methods
A month-long cross-sectional study was conducted in health and non-health colleges affiliated to Imam Abdulrahman Bin Faisal University in Dammam, Saudi Arabia. Convenient sampling was employed, and the data was gathered through an online survey using the English and Arabic versions of the Dietary Supplement Questionnaire (DSQ). The data was
Results

Data from 545 participants was collected. The overall prevalence of dietary supplement use was 32.7% (95% CI: 29.06%–36.51%). The prevalence was 29.77% (95% CI: 25.29%–34.56%) among students at all health colleges combined and, it was 37.50% (95% CI: 31.36%–43.96%) among students at all non-health colleges. Most students used a brand product, spent a monthly cost of SAR 286 (USD 76.3) on supplements and agreed that supplements were good for health (N = 392, 71.9%). Students from non-health colleges agreed that dietary supplements are good for health in greater numbers as compared to non-health college students (p < 0.001). Students aged ≥ 20 years, studying in a non-health college and up to 3rd year of study, were more 2 times more likely to agree that dietary supplements are good for health.

Conclusion

Supplements were commonly used among female students at this university however, it was quite low as compared to students from other local and regional universities. Prevalence was higher in non-health colleges as compared to health colleges and the most commonly used supplements were brand products and multivitamins, used for general health and well-being. This highlights the inclination of students towards supplement use.

Background

Adequate nutrition is essential for maintaining health and well-being. Apart from nutrition intake through diet, supplements are commonly used to replenish the body with essential nutrients that are important in regulating the body’s metabolic processes [1]. Dietary supplements (DS) are available as pharmaceutical dosage forms that contain essential vitamins, minerals, oils, extracts and natural products. It may also contain a combination of these nutrients [2, 3]. These pharmaceutical dosage forms may be a brand which is a research-based pharmaceutical product patented for a certain period of time, or generic form that are prepared after the patent of a brand product has expired. Since generic forms are not research-based they are less expensive than brands [3]. The use of DS may be for general nutritional purposes or for specific purpose such as sports, high endurance exercise, etc. They may be used in pregnancy, aging and, prevention of diseases. The benefits of DS are evident when used in recommended dose and as directed [2, 3].

Evidence highlights that dietary supplements are commonly used in the developed countries such as the US and the UK [3, 4]. For instance, the United States is the biggest market for DS and data from the third National Health and Nutrition Examination Survey (1988–1994) (NHANES III) reported that 40% of population in the US used supplements while NHANES 1999–2000 data reported the figure of 52% for the same [5, 6]. According to the Transparency Market Research, the value of dietary supplement market in US is expected to amount to USD 278.96 billion in 2021 [7]. Several studies highlighted the perceptions of the general public that supplements are beneficial and may prevent chronic illnesses [4, 8, 9]. However, there are negative effects with their use such as adverse drug events (ADEs), adverse drug reactions (ADRs)
and interaction of supplements with either drug or food that may pose health hazard [10].
Patients with some forms of illnesses such as those with kidney damage requiring dialysis and
taking vitamin D and calcium over a large period of time may develop calcification in their
soft tissues [11–14].
Epidemiological studies mention that demographic characteristics may act as determinants
of supplement use [5, 6, 15]. Few notable demographic traits associated with increased DS use
are old age, female gender, level of education, etc. [5]. It was observed in a study that college
students were more frequent users of supplements as compared to the general population [16].
In addition, studying a health and/or non-health subject may have some sort of effect on DS
use [3, 17].
Apart from the North American market, Asia Pacific region is ranked as the second biggest
market for DS [5]. Saudi Arabia is located in the Middle East and is the biggest market for DS
in this region [3]. The estimated worth of DS in Saudi Arabia is over USD 2 billion and DS
accounts for over 4% of all pharmaceuticals sold in the country [3, 7].
Evidence from a Saudi university highlights that DS use was more common among male
students who studied in health colleges [3]. However, previous studies reported prevalence of
DS only and further research to delve into the reasons and determinants of DS use are needed
[18, 19] Data from the female students at a public sector university in Riyadh region
highlighted an increased use of supplements [19]. Another study at this study venue reported a
detailed account of prevalence of supplements use in colleges, years of study etc., along with
students’ attitudes towards the DS use and the monthly cost attributed to their use [3].
However, the findings were limited to male students only. Therefore, a need was felt to report the
same from female students enrolled at this venue. This study followed the methodology of
Naqvi and colleagues [3]. It gathered data from female students studying in colleges of both
health and non-health subjects affiliated to this university. Hence, the aim was to report the
prevalence, reasons, and determinants of dietary supplements use among undergraduate
female students of health and non-health colleges at Imam Abdulrahman Bin Faisal University
(IAU).

Methods
This study was designed as a cross-sectional survey and was conducted for a month (July
2020) at IAU.

Venue of study
All female campuses of the ten health and non-health colleges at Imam Abdulrahman Bin Fai-
sal University in Dammam, Saudi Arabia, served as venues. The health colleges included col-
leges of pharmacy, medicine, nursing, applied medical science and dentistry. The non-health
colleges included colleges of design, engineering, applied studies and community services,
business, and science.

Participants and eligibility criteria
All female undergraduate students who were currently enrolled and studying in any of the
above mentioned colleges of the university and, who were willing to participate in the study,
were identified as target participants. Students who had either graduated, or dropped their
studies and, those who did not consent to participate, were excluded.
Sampling strategy and data collection

A convenient sampling strategy was followed, and students were approached via an online survey. The survey link was distributed through most commonly used social media platforms such as talk and text messaging applications, emails, short message service, etc. A focal person was chosen from each college on a voluntary basis and was appraised regarding the study objectives. The focal person was assigned the task of briefing the students and collecting data. Students who consented to participate were asked to sign an electronic informed consent. After signing of the consent form, they could begin filling their responses in the electronic questionnaire.

Sample size calculation

The sample size was calculated based on the total number of currently enrolled students at the university. Based on the official university figures, the number of active students was 14332 [20]. Hence, this figure was the target population. The sample size was calculated using an online calculator [21]. Considering an error rate of 5% and a confidence level of 95%, the required sample size was 374. However, we aimed to gather as many responses as possible from these colleges.

Research instrument

The Arabic and English versions of the Dietary supplement questionnaire (DSQ) were used to gather students’ responses [2, 3]. The DSQ was previously developed and validated by Naqvi and colleagues in undergraduate students. It was first formulated in English and Urdu languages and was validated in Pakistani undergraduate students. Later, it was translated into Arabic language and was validated in Saudi undergraduate male students [2, 3]. The questionnaire was piloted in 18 students before actual data collection. The pilot data was not included in the final analysis.

Data analyses and presentation

The data were analyzed using IBM SPSS version 23 (Armonk, NY). The data were expressed in frequencies (N) and percentages (%). The continuous data were expressed by mean (X) and standard deviation (SD). The prevalence was calculated using Medcalc [22]. The number of students using a supplement were considered as true positive and vice versa. Participants who were unsure if they used a supplement in the last month were considered as false positive and false negative. The prevalence data were expressed as percentages (%) and in 95% confidence interval ranges. Chi square ($\chi^2$) test/ Fisher exact test, correlations and regression analyses were applied where applicable. Chi square ($\chi^2$) test/ Fisher exact test and correlations were utilized to report any associations and relationships respectively, between independent and dependent variables. Regression analyses were used to determine any determinant of DS use.

Ethics approval and consent

All participants were provided with a written informed consent. The study was approved by Institutional Review Board of Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia (#IRB-UGS-2018-05-074).

Results

A total of 545 female students responded to the study. The Cronbach’s alpha value was 0.634 (N = 6), i.e. acceptable. The mean age of students was 20.56 ± 1.44 years, most students were
were studying in 3rd year of study (N = 226, 41.5%). More than a third of students (N = 206, 37.8%) were from pharmacy college. Students from health colleges accounted for more than half (N = 361, 66.2%). Most students lived with family (N = 510, 93.6%), had 3–5 siblings (N = 266, 48.8%) and did not have any illness (N = 528, 96.9%). Of those (N = 17) who had some sort of illness, most students (N = 8) had Glucose 6-phosphate dehydrogenase (G_{6}PD) deficiency, some (N = 4) had sickle cell disease (SCD), others had diabetes (N = 1), asthma (N = 1), rheumatoid arthritis (N = 1), hypertension (N = 1) and irritable bowel syndrome (N = 1) (Table 1).

### Prevalence of dietary supplement use
The prevalence of dietary supplement use was 32.70% (95% CI: 29.06%–36.51%). The prevalence was 29.77% (95% CI: 25.29%–34.56%) among students at all health colleges combined and similarly, it was 37.50% (95% CI: 31.36%–43.96%) among students at all non-health colleges. Data for college and year-wise prevalence are presented in Table 2.

### Types of DS, reasons for use and experience
Of those students who used supplements (N = 181, 33.2%) and assuming it as 100%. A brand was commonly used (N = 31, 17.2%) while some used generic (N = 26, 14.4%) and both brand and generics (N = 16, 8.4%). Most students did not know the type (N = 108, 59.7%). The most common reason for use of supplements was general health and well-being (N = 116, 21.3%) and the most commonly used supplement was multivitamin (N = 167, 30.6%). The majority of students (N = 126, 23.1%) did not suffer from any adverse drug reaction (ADR) that could be attributed to supplement use (Table 3).

### Monthly expenditure on supplements
A total of 55 students reported the cost incurred on the use of DS. The average monthly expenditure on procurement of supplements was reported at SAR 286 (USD 76.3), i.e., mean = 286.53 ± 397, while the median cost reported was SAR 100 (USD 26.6), [IQR = 250]. The lowest figure for monthly expenditure was reported at SAR 9 (USD 2.4) while the highest was SAR 1800 (USD 479.9). The value of USD corresponds to SAR to USD exchange rate at the time of this writing.

### Student opinions, attitude, and source of information regarding DS
Students were asked to rate their satisfaction with DS on a scale of 0 (worst) to 5 (best). The average rating was 2.57 ± 1.35 (median = 3). Most students (N = 392, 71.9%) agreed that DS were good for health however, recommended their use based on a physician’s recommendation (N = 474, 87%). Most students (N = 262, 48.1%) had an opinion that using DS regularly could prevent the risk of chronic illness. Most students (N = 297, 54.5%) mentioned healthcare professionals as their source of information regarding DS (Table 4).

### Association of students’ demographics with their opinion
The demographics of students were cross tabulated with their opinion of DS being good for health. The variable of students’ age was significantly associated (p<0.02) with opinion as most of them who aged 20 or above, agreed that DS are good for health. Further, there was a significant association (p<0.001) between the variables of ‘college’ and ‘opinion’ as students from medicine, design, engineering, applied studies and community service, science and dentistry colleges agreed that DS are good for health while students from pharmacy, nursing,
applied medical sciences, business colleges disagreed. As a binary variable, a significant association (p<0.001) existed as students from non-health-cluster colleges agreed with opinion more than their counterparts. Participants who studied in the 3rd year and 5th year had favorable opinion (p<0.001) while those who had a major illness had positive opinion of supplements (p<0.05) (Table 5).

Table 1. Participants’ information.

| Demographic information (N = 545) | N  | %   |
|-----------------------------------|----|-----|
| **Marital status**                |    |     |
| Single                            | 451| 82.8|
| Married                           | 92 | 16.9|
| Other                             | 2  | 0.4 |
| **College type**                  |    |     |
| Health                            | 361| 66.2|
| Non-health                        | 184| 38.8|
| **College of study**              |    |     |
| Pharmacy                          | 206| 37.8|
| Medicine                          | 26 | 4.8 |
| Design                            | 27 | 5   |
| Nursing                           | 30 | 5.5 |
| Applied Medical Sciences          | 69 | 12.5|
| Engineering                       | 52 | 9.5 |
| Applied Studies and Community     | 45 | 8.3 |
| Business                          | 52 | 9.5 |
| Science                           | 8  | 1.5 |
| Dentistry                         | 30 | 5.5 |
| **Year of study**                 |    |     |
| Prep year                         | 4  | 0.7 |
| 2nd year                          | 147| 27  |
| 3rd year                          | 226| 41.5|
| 4th year                          | 110| 20.2|
| 5th year                          | 58 | 10.6|
| **Number of children**            |    |     |
| 1–2 children                      | 21 | 3.9 |
| 3 or more children                | 8  | 1.5 |
| Married without children          | 65 | 11.9|
| Not applicable                    | 451| 82.8|
| **Number of siblings**            |    |     |
| Between 1–2 siblings              | 96 | 17.6|
| Between 3–5 siblings              | 266| 48.8|
| Between 6–8 siblings              | 148| 27.2|
| More than 8 siblings              | 22 | 4   |
| No siblings                       | 13 | 2.4 |
| **Residence**                     |    |     |
| Living with family                | 510| 93.6|
| Living alone (university accommodation) | 35 | 6.4 |
| **Illnesses**                     |    |     |
| No, I do not suffer from any illness | 528 | 96.9|
| Yes                               | 17 | 3.1 |

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Multivariate logistic regression analysis was conducted to identify the determinants of opinion regarding DS use. The adjusted odds ratios were calculated for the dependent variable of ‘opinion that dietary supplements are good for health,’ which had two outcomes, i.e., agree

Table 2. Prevalence of dietary supplement used in colleges and study year.

| College of study                  | Prevalence (%) | 95% CI range      |
|-----------------------------------|----------------|--------------------|
| Pharmacy                          | 25.78          | 20.19–32.01        |
| Medicine                          | 30.77          | 14.13–51.79        |
| Design                            | 23.53          | 10.75–41.17        |
| Nursing                           | 33.33          | 17.29–52.81        |
| Applied Medical Sciences          | 36             | 25.23–47.91        |
| Engineering                       | 45.78          | 34.79–57.08        |
| Applied Studies and Community Service | 44.44   | 30.92–58.60        |
| Business                          | 47.44          | 36.01–59.07        |
| Science                           | -              | -                  |
| Dentistry                         | 37.84          | 22.46–55.24        |

| Year of study                     |                 |                    |
|-----------------------------------|-----------------|--------------------|
| Prep year                         | -               | -                  |
| 2nd year                          | 23.39           | 17.27–30.46        |
| 3rd year                          | 41.7            | 35.76–47.82        |
| 4th year                          | 17.36           | 11.08–25.3         |
| 5th year                          | 46.03           | 33.39–59.06        |

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Multivariate logistic regression analysis was conducted to identify the determinants of opinion regarding DS use. The adjusted odds ratios were calculated for the dependent variable of ‘opinion that dietary supplements are good for health,’ which had two outcomes, i.e., agree

Table 3. Reasons for use and experience with supplements.

| Reasons for DS use                | N   | %    |
|-----------------------------------|-----|------|
| General Health and Well Being     | 116 | 21.3 |
| Boost immunity                    | 9   | 1.7  |
| Weight gain                       | 3   | 0.6  |
| Physician’s recommendation        | 33  | 6.1  |
| Enhancement of memory             | 2   | 0.4  |
| Increase performance/sports       | 1   | 0.2  |
| Joint care                        | 2   | 0.4  |
| Poor diet/malnutrition            | 7   | 1.3  |
| Source of energy                  | 3   | 0.6  |
| More than one reason              | 25  | 4.6  |
| Not applicable                    | 344 | 63.1 |

| Types of DS used                  |     |      |
|-----------------------------------|-----|------|
| I did not use                     | 348 | 63.9 |
| Multivitamins                     | 167 | 30.6 |
| Glucosamine/omega 3 FA            | 6   | 1.1  |
| Whey protein                      | 7   | 1.3  |
| Calcium                           | 5   | 0.9  |
| More than one supplement          | 12  | 2.2  |

| Experience with DS use            |     |      |
|-----------------------------------|-----|------|
| Had an ADR attributable to DS use | 3   | 0.6  |
| Had an ADR but not sure if it was attributed to DS use | 38 | 7 |
| No ADR                            | 126 | 23.1 |
| Not applicable                    | 378 | 69.4 |

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and disagree. The outcome of, ‘disagree’ was selected as a reference category. Based on the analysis, students aged 20 years or more, studying in a non-health college and up to 3rd year of study were roughly 2 times more likely to agree while those who had a major illness were 9 times more likely to agree (Table 6).

Discussion

The prevalence of DS use was 32.7% which was higher than the previously reported figures by Albusalih and colleagues, i.e., 30.5% at this venue [23]. Though, Albusalih et al. reported the figures for multivitamin use only, our results may be higher since other supplements were also considered along with multivitamins. Comparatively, the prevalence reported from this venue was low as a study in university students in Riyadh reported a high prevalence of dietary supplements use, i.e., ≥76.6% [19]. In comparison with literature from regional countries, the prevalence obtained in this study was slightly lower than the prevalence reported among college students from in UAE [24]. It was considerably lower than the figures reported for female pharmacy students in Pakistani universities [2]. However, it was higher than the prevalence reported in Japanese students [25].

We further analyzed the prevalence of college based on health and non-background and observed that the prevalence was higher in students at non-health colleges, i.e., 37.50% compared to their counterparts, i.e., 29.77%. Kobayashi et al. and Moore et al. observed a slightly higher trend of supplements use among students of health track [17, 25]. However, in a local study the difference in DS among female students belonging to health sciences and humanities background was not significant [19]. Though, our prevalence calculation method may have been different, the findings still substantiate the possibility that prevalence may not depend on course subjects. On an individual college level, students from the business college had highest prevalence followed by students from the college of engineering. While evaluating prevalence based on years of study, it was observed that the prevalence increased steadily from 2nd year to 3rd year. The prevalence decreased amongst students in their 4th year of study. The highest
Table 5. Cross tabulation between students’ demographic characteristics with opinion.

| Characteristics       | Opinion (Dietary supplements are good for health) | P value |
|-----------------------|--------------------------------------------------|---------|
|                       | Disagree | Agree |                       |         |
| **Age**               |          |       |                       | 0.015   |
| Equal or above 20 years |          |       |                       |         |
| Count                 | 105      | 308   | Expected Count        | 115.9   |
|                      |          |       |                       | 297.1   |
| % within Age group    | 25.4%    | 74.6% | % within Opinion      | 68.6%   |
| Less than 20 years    | 48       | 84    | Expected Count        | 37.1    |
|                      |          |       |                       | 94.9    |
| % within Age group    | 36.4%    | 63.6% | % within Opinion      | 31.4%   |
| **College**           |          | <0.001 |                       |         |
| Pharmacy              |          |       |                       |         |
| Count                 | 60       | 146   | Expected Count        | 57.8    |
|                      |          |       |                       | 148.2   |
| % within College      | 29.1%    | 70.9% | % within Opinion      | 39.2%   |
| Medicine              |          |       |                       |         |
| Count                 | 6        | 20    | Expected Count        | 7.3     |
|                      |          |       |                       | 18.7    |
| % within College      | 23.1%    | 76.9% | % within Opinion      | 3.9%    |
| Design                |          |       |                       |         |
| Count                 | 6        | 21    | Expected Count        | 7.6     |
|                      |          |       |                       | 19.4    |
| % within College      | 3.9%     | 96.1% | % within Opinion      | 3.9%    |
| Nursing               |          |       |                       |         |
| Count                 | 27       | 3     | Expected Count        | 8.4     |
|                      |          |       |                       | 21.6    |
| % within College      | 90%      | 10%   | % within Opinion      | 17.6%   |
| Applied medical sciences |      |       |                       |         |
| Count                 | 26       | 43    | Expected Count        | 19.4    |
|                      |          |       |                       | 49.6    |
| % within College      | 37.7%    | 62.3% | % within Opinion      | 17%     |
| Engineering           |          |       |                       |         |
| Count                 | 8        | 44    | Expected Count        | 14.6    |
|                      |          |       |                       | 37.4    |
| % within College      | 15.4%    | 84.6% | % within Opinion      | 5.2%    |
| Applied studies and community service | | |          |         |
| Count                 | 0        | 45    | Expected Count        | 12.6    |
|                      |          |       |                       | 32.4    |
| % within College      | 0.0%     | 100%  | % within Opinion      | 0.0%    |
| Business              |          |       |                       |         |
| Count                 | 20       | 32    | Expected Count        | 14.6    |
|                      |          |       |                       | 37.4    |
| % within College      | 38.5%    | 61.5% | % within Opinion      | 13.1%   |

(Continued)
| Characteristics        | Opinion (Dietary supplements are good for health) | P value |
|------------------------|--------------------------------------------------|--------|
|                        | Disagree | Agree |        |
| Science                |          |       |        |
| Count                  | 0        | 8     |        |
| Expected Count         | 2.2      | 5.8   |        |
| % within College       | 0%       | 100%  |        |
| % within Opinion       | 0%       | 2%    |        |
| Dentistry              |          |       |        |
| Count                  | 0        | 30    |        |
| Expected Count         | 8.4      | 21.6  |        |
| % within College       | 0%       | 100%  |        |
| % within Opinion       | 0%       | 7.7%  |        |
| College cluster        |          |       | <0.001 |
| Health                 | Count    | 119   | 242    |
| Expected Count         | 101.3    | 259.7 |        |
| % within College cluster | 33%    | 67%   |        |
| % within Opinion       | 77.8%    | 61.7% |        |
| Non-health             | Count    | 34    | 150    |
| Expected Count         | 51.7     | 132.3 |        |
| % within College cluster | 18.5%   | 81.5% |        |
| % within Opinion       | 22.2%    | 38.3% |        |
| Study year             |          |       | <0.001*|
| Preparatory year       | Count    | 2     | 2      |
| Expected Count         | 1.1      | 2.9   |        |
| % within Study year    | 50%      | 50%   |        |
| % within Opinion       | 1.3%     | 0.5%  |        |
| 2nd year               | Count    | 62    | 85     |
| Expected Count         | 41.3     | 105.7 |        |
| % within Study year    | 42.2%    | 57.8% |        |
| % within Opinion       | 40.5%    | 21.7% |        |
| 3rd year               | Count    | 31    | 195    |
| Expected Count         | 63.4     | 162.6 |        |
| % within Study year    | 13.7%    | 86.3% |        |
| % within Opinion       | 20.3%    | 49.7% |        |
| 4th year               | Count    | 43    | 67     |
| Expected Count         | 30.9     | 79.1  |        |
| % within Study year    | 39.1%    | 60.9% |        |
| % within Opinion       | 28.1%    | 17.1% |        |
| 5th year               | Count    | 15    | 43     |
| Expected Count         | 16.3     | 41.7  |        |
| % within Study year    | 25.9%    | 74.1% |        |
| % within Opinion       | 9.8%     | 11%   |        |
| Marital status         |          |       | 0.392  |
| Single                 | Count    | 130   | 321    |
| Expected Count         | 126.6    | 324.4 |        |
| % within Marital status | 28.8%   | 71.2% |        |
| % within Opinion       | 85.0%    | 81.9% |        |

(Continued)
| Characteristics | Opinion (Dietary supplements are good for health) | P value |
|-----------------|-----------------------------------------------|---------|
|                 | Disagree | Agree |       |       |
| Married         | Count    |       |       |       |
|                 | 23       | 71    |       |       |
|                 | Expected Count |       |       |       |
|                 | 26.4    | 67.6 |       |       |
|                 | % within Marital status |       |       |       |
|                 | 24.5%   | 75.5% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 15%     | 18.1% |       |       |
| Number of children | Count |       |       |       |
| 1–2 children    | 6       | 15    |       | 0.049 |
|                 | Expected Count |       |       |       |
|                 | 5.9    | 15.1 |       |       |
|                 | % within Children |       |       |       |
|                 | 28.6%   | 71.4% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 3.9%    | 3.8% |       |       |
| 3 or more children | Count |       |       |       |
|                 | 5       | 3     |       |       |
|                 | Expected Count |       |       |       |
|                 | 2.2    | 5.8  |       |       |
|                 | % within Children |       |       |       |
|                 | 62.5%   | 37.5% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 3.3%    | 0.8% |       |       |
| Married without children | Count |       |       |       |
|                 | 12      | 53    |       |       |
|                 | Expected Count |       |       |       |
|                 | 18.2   | 46.8 |       |       |
|                 | % within Children |       |       |       |
|                 | 18.5%  | 81.5% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 7.8%   | 13.5% |       |       |
| Not applicable to me (single) | Count |       |       |       |
|                 | 130    | 321   |       |       |
|                 | Expected Count |       |       |       |
|                 | 126.6  | 324.4 |       |       |
|                 | % within Children |       |       |       |
|                 | 28.8%  | 71.2% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 85.0%   | 81.9% |       |       |
| Number of Siblings | Count |       |       | 0.042 |
| Between 1–2 siblings |       |       |       |       |
|                 | 25    | 71   |       |       |
|                 | Expected Count |       |       |       |
|                 | 27    | 69   |       |       |
|                 | % within Siblings |       |       |       |
|                 | 26%    | 74%  |       |       |
|                 | % within Opinion |       |       |       |
|                 | 16.3%  | 18.1% |       |       |
| Between 3–5 siblings |       |       |       |       |
|                 | 63    | 203  |       |       |
|                 | Expected Count |       |       |       |
|                 | 74.7  | 191.3 |       |       |
|                 | % within Siblings |       |       |       |
|                 | 23.7%  | 76.3% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 41.2%  | 51.8% |       |       |
| Between 6–8 siblings |       |       |       |       |
|                 | 56    | 92   |       |       |
|                 | Expected Count |       |       |       |
|                 | 41.5  | 106.5 |       |       |
|                 | % within Siblings |       |       |       |
|                 | 37.8%  | 62.2% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 36.6%  | 23.5% |       |       |
| More than 8 siblings |       |       |       |       |
|                 | 6   | 16 |       |       |
|                 | Expected Count |       |       |       |
|                 | 6.2   | 15.8 |       |       |
|                 | % within Siblings |       |       |       |
|                 | 27.3%  | 72.7% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 3.9%   | 4.1% |       |       |
| No siblings     | Count |       |       |       |
|                 | 3   | 10 |       |       |
|                 | Expected Count |       |       |       |
|                 | 3.6   | 9.4  |       |       |
|                 | % within Siblings |       |       |       |
|                 | 23.1%  | 76.9% |       |       |
|                 | % within Opinion |       |       |       |
|                 | 2%    | 2.6% |       |       |
### Table 5. (Continued)

| Characteristics                              | Opinion (Dietary supplements are good for health) | P value |
|----------------------------------------------|--------------------------------------------------|---------|
|                                              | Disagree | Agree |
| Living with family                          | Count    | 141   | 369   |
| Expected Count                               |          | 143.2 | 366.8 |
| % within Residence                           |          | 27.6% | 72.4% |
| % within Opinion                             |          | 92.2% | 94.1% |
| Living alone (University accommodation)      | Count    | 12    | 23    |
| Expected Count                               |          | 9.8   | 25.2  |
| % within Residence                           |          | 34.3% | 65.7% |
| % within Opinion                             |          | 7.8%  | 5.9%  |
| Any major illness                            |          |       |       |
| Do not suffer from any illness               | Count    | 152   | 376   |
| Expected Count                               |          | 148.2 | 379.8 |
| % within illness                             |          | 28.8% | 71.2% |
| % within Opinion                             |          | 99.3% | 95.9% |
| Suffer from a major illness                  | Count    | 1     | 16    |
| Expected Count                               |          | 4.8   | 12.2  |
| % within illness                             |          | 5.9%  | 94.1% |
| % within Opinion                             |          | 0.7%  | 4.1%  |

*Fisher exact test

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### Table 6. Multiple logistic regression model for determinants of opinion regarding DS use.

| Factors                          | Coefficient | SE   | p-value | AOR  | 95% CI for AOR |
|----------------------------------|-------------|------|---------|------|----------------|
|                                  |             |      |         |      | Lower | Upper |
| Age                              |             |      |         |      |       |       |
| Less than 20 Years (R)           |             |      |         |      |       |       |
| 20 years and more                | 0.877       | 0.251| <0.001  | 2.403| 1.468 | 3.933 |
| College cluster                  |             |      |         |      |       |       |
| Health (R)                       |             |      |         |      |       |       |
| Non-health                       | 0.824       | 0.227| <0.001  | 2.281| 1.461 | 3.561 |
| Year of study                    |             |      |         |      |       |       |
| 4<sup>th</sup> year and above (R)|             |      |         |      |       |       |
| Up to 3<sup>rd</sup> Year        | 0.770       | 0.236| 0.001   | 2.159| 1.359 | 3.431 |
| Number of children               |             |      |         |      |       |       |
| No children (R)                  |             |      |         |      |       |       |
| 1–2 children                     | -0.085      | 0.521| 0.870   | 0.918| 0.331 | 2.550 |
| 3 or more children               | -1.713      | 0.804| 0.033   | 0.180| 0.037 | 0.872 |
| Siblings                         |             |      |         |      |       |       |
| Have siblings (R)                |             |      |         |      |       |       |
| Have no siblings                 | 0.061       | 0.717| 0.933   | 1.062| 0.261 | 4.328 |
| Any major illness                |             |      |         |      |       |       |
| No (R)                           |             |      |         |      |       |       |
| Yes                              | 2.230       | 1.089| 0.041   | 9.301| 1.101 | 78.563 |

R = reference case, SE = Standard Error, CI = Confidence Interval, AOR = Adjusted odds ratio.

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prevalence was reported in 5th year of study. In a Japanese study, there was an inclining trend when it came to prevalence based on study years [25].

The most commonly used supplements were multivitamins. This was similar to the findings of a study among female Saudi students as the aforementioned supplements were commonly used [19, 23]. In another study in female students studying in medicine college at this university, a high prevalence of vitamin and minerals supplement use ≥44% was reported [26]. At the same time, a previous study in male colleges at this university highlighted a high prevalence of multivitamins use [3]. This trend in multivitamin use may have been reflected in this study as well.

Most students reasoned general health and well-being for supplement use. This was in line with the findings of study conducted in male students at this university [3]. Contrastingly, Pakistani undergraduate students reasoned physician recommendation for consuming such products [2]. This reason though, was selected but, by a small number of students in this study. The study by Alfawaz and colleagues in Saudi female students highlighted maintenance of healthy hairs and recovery in an illness/injury, as major reasons for use of such products [19]. Similar reasons were also reported by Nigerian and Indian students [27, 28].

With regards the pharmaceutical dosage form, most students used a brand product. This was similar to the preference indicated by male students in another study [3]. This inclination towards brands may be due to the consumers’ perception towards packaging as studies have reported that consumers prefer pharmaceutical products with attractive packaging that are a characteristic feature of brand products [29]. Besides, Zehra et al. highlighted that in Pakistani pharmaceutical market, brands were considered to have better quality when compared to generics as they have had years of research behind them [30]. Moreover, brand products are reasonably priced unlike generic products; an attribute of pharmaceutical grade supplement that sometimes serve as a proxy indicator for product quality. Further to this, online retail pharmacies in Saudi Arabia usually stock brand products and with an increasing use of procurement of these products via online retail drug marts, the consumers are more likely to use brand supplements products. Most participants reported no adverse reactions related to supplement use. This is of particular importance as it was reported in a study that more than a third of Saudi female students may be unaware of potential adverse effects of supplements [19]. It was observed in a study that students at a medical college in a Nigerian university were aware of dietary supplement use [27]. In this study, we observed that less than 1% of students who used supplements reported that they experience an adverse effect attributed to supplements while the proportion for the same among Japanese students was 7.5% [25].

The current study highlighted an average monthly spending of SAR 286, i.e., (USD 76.3) while Naqvi et al. reported an average cost of SAR 278.9, i.e., (USD 74.4) among males [3]. This highlighted no noteworthy change in spending however, the amount spent was substantial. This could be further clarified if it is compared with students at Pakistani universities who spent USD 13.5 on DS use per month. Most participants considered supplements as good for health. This occurrence was similar to the findings of Radwan et al. [24]. In this study, we observed that students who aged 20 years or more, studied in a non-health college and up to 3rd year of study, were roughly 2 times more likely to agree while those who had a major illness were 9 times more likely to agree that supplements are good for health. However, most students indicated that they recommend supplement use to others solely on physician’s advice. This was similar to the response of students from male students at this university as well as from those in Pakistani academia [2, 3]. Female university students in Riyadh also consumed supplements based on physicians’ prescription [19]. We observed that the most common source of information regarding supplements was healthcare professionals unlike the findings of Alfawaz where social media was reported to be the most common source followed by
Moreover, most students in Japan used internet as a source of information for supplements [25].

The study has few limitations such as the use of convenience sampling that substantially limits the generalizability of the results. At the same time, exclusion of the male students renders the study unable to have a gender-based analysis of dietary supplement intake. Further studies are recommended that consider gender perspective in regards to the use of supplements.

**Conclusion**

The data highlighted that dietary supplements were commonly used among female students at this university however, it was quite low as compared to students from other local and regional universities. Moreover, the prevalence was higher in non-health colleges as compared to health colleges which was opposite to the previously reported findings among male students at this venue. The most common supplements were brand products and, multivitamins, and used for general health and well-being. A substantial amount of money was spent monthly on supplements. This highlights the inclination of students towards supplement use.

**Supporting information**

S1 Dataset.
(SPV)

S2 Dataset.
(SPV)

S3 Dataset.
(SPV)

S4 Dataset.
(SPV)

S5 Dataset.
(SPV)

S6 Dataset.
(SPV)

S1 File.
(PDF)

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