Suboptimal Health, Dietary Supplementation, and Public Health Approaches to Regulatory Challenges in Dubai

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Abstract

Objectives: Presently, limited data are available on dietary supplements (DSs) and their associated effects on health status although the consumption of DS continues to expand. This study is aimed to explore the possible relationship between DSs consumption and suboptimal health status (SHS) in Dubai, United Arab Emirates (UAE). Methods: This study was a cross-sectional research held among a sample of citizens and residents in the Emirate of Dubai in the UAE using a well-structured, self-administered, anonymous survey. Frequency tables, odds ratios, and confidence intervals were generated during the data analysis using SPSS version 23. Results: A total of 618 participants were enrolled in this study and fully completed the questionnaire. In this study, 317 participants (51.3%) (95% CI: 47.3%-55.3%) reported the use of DS products. A significant association between DS consumption and suboptimal health status was detected ($P < .001$). DS consumers had a 1.5-fold increased odds of suboptimal health status when compared with non-DS consumers (95% CI 1.4-1.7). Conclusion: The findings of this study suggest a need to develop policies and programs that will help minimize the risk of possible adverse events that are associated with the utilization of DSs.

Keywords

health status, dietary supplements, adverse events, suboptimal health

Introduction

Slesinski et al.1, Millen et al.2 and Wu et al.3 all observed that the utilization of dietary supplements (DSs) has risen across the globe over the past 20 years, especially in the United States. Alahmad et al.4 noted that this pattern has increased awareness and discussion of these supplements among researchers, health care professionals, and regulatory organizations. Pertaining to the US Dietary Supplements Health and Education Act 1994 (DSHEA) and the World Health Organization (WHO),5 a DS is defined as a product, excluding tobacco, meant to supplement an individual’s diet. Supplements thus include minerals, herbs, vitamins, amino acids, dietary substances, and botanical products. Order No. 11 of the Public Health and Safety of the Society in the Emirate of Dubai and its 2007 Administrative Resolution No. 30 refer to DSs as health supplements (HSs), and this terminology will be used in this article.

Alongside the increase in consumption seen in the United States, Aina and Ojedokun6 reported that DSs such
as herbal supplements are becoming increasingly popular in developing nations. DSs are closely linked to health and can include approximately 1000 distinct chemicals. These can have adverse outcomes for users as a result of damaging chemical reactions occurring within the body. However, minerals and vitamins can be purchased easily over the counter, and consumers often do not have the input of health care professionals before taking supplements. Su and Li7 and Rossler et al8 explain that, prior to the arrival of modern medicine, health care worldwide relied heavily on herbs, and many underserved health care populations continue to rely on herbs for medical purposes, while the Consumer Products Safety Section (CPSS)9 finds that consumers generally take DSs for a variety of reasons, including losing weight and boosting energy. Researchers, including Moyad,10 Izzo and Ernst,11 Van Strater and Bogers,12 and Tsai et al13 have all studied the potential for DSs to interact with other drugs, with Kemper et al14 and Piening et al15 arguing that the potential for damaging interactions demands diligence from health care professionals and greater awareness among consumers.

According to Chitturi and Farrell,16 DSs are a key constituent of general health care services in many developing nations and are increasingly popular in these countries. A WHO17 estimate asserts that 8 out of 10 people living in Africa and Asia depend on traditional medicines as their primary health care resource. Similarly, in developed nations, 7 to 8 out of every 10 people use alternative or complementary forms of medicine in their primary care. Barnes et al18 argued that the majority of DSs are safe for use provided consumers are appropriately educated on the supplements and receive accurate advice. Thus, as Neerghen-Bhujun19 stated, health care professionals must be prepared to discuss DSs with patients and advise them on their effective and safe use.

According to Tsai et al,13 the wide variety of potential actions of DSs makes the safety and effectiveness of these products a key concern, as the use of some DS products has been observed to cause adverse side effects. To illustrate, studies by Shaw and Palmer,20 Izzo and Ernst,11 and Alahmad et al4 have implicated gingko biloba in the occurrence of epileptic seizures and found that anemia can result from the chronic usage of zinc. Moreover, the DS products themselves, as Tachjian et al21 have reported, can have negative side effects, including allergic reactions, drug interactions, toxicity (in particular contaminant and adulterant) reactions and heavy metal poisoning. Managing these outcomes can necessitate resuscitation as well as the care of symptoms and other support.

The specific reason why a DS product has had an adverse effect can be indicated by the clinical features. According to the Ministry of Health (MOH),22 DSs with marked toxic components or pharmacological effects can, by their nature, be poisonous, and health care professionals who treat patients who consume DSs must anticipate the potential for toxicity reactions. Moreover, Tsai et al13 have highlighted that consuming DSs alongside certain medications can result in harmful interactions, and they reported that poisoning, synergistic effects, and the inactivation of one or more of the products being taken can occur. To illustrate, St John’s wort is typically consumed to alleviate depression of a mild to moderate scale, but Van Strater and Bogers12 find that it has the potential to induce liver enzymes and can thus interact with several targeted therapy medications metabolized through the liver, including antidepressants. In addition, Moyad10 has reported that taking gingko biloba, ginger, garlic, and other substances in conjunction with anticoagulants introduces a bleeding risk.

The state between good health and illness is titled suboptimal health status (SHS), and this state is considered a reversible, subclinical phase of chronic illness. Any integrated preventative treatment plan must aim to achieve a customized, predictive and preventative medical regimen for a patient. Similarly, SHS involves the evaluation of a patient’s health and the provision of effective steps to improve health, prevent disease, and address the early stages of illness. SHS is a concept that is now emerging in a range of countries such as Australia (Davy and Patrickson23), Canada,24 and Japan.25 Creating a DS health regimen that satisfies the needs and concerns of DS consumers specifically requires that knowledge about the health of these consumers be obtained and analyzed. Furthermore, counseling and other interventions targeted at enhancing consumers’ health will be required.

Presently, only a small amount of data are available on DSs and their associated effects on health. Dubai currently does not have a DS surveillance program. Elsewhere, the detection of safety concerns related to DS use are centered on the spontaneous reporting of problems or vigilance systems. Gavaza et al26 and Piening et al15 have explain that, when suspected adverse effects related to DSs are not reported within a relevant system by health care professionals or patients themselves, the recognition of threats to consumer safety can be delayed or missed entirely. Unsurprisingly, this can have a severe influence on public health. Consequently, the extent of the issue and its underlying causes must be identified, and public health policies must be adapted based on these findings. This study will examine the link between SHS and the consumption of DSs.

**Methodology**

**Setting and Design**

This is a survey-based cross-sectional research study conducted in 2 major Public Service Centers in the Emirate of Dubai, where the customer service employees invited the participants to complete the questionnaire. These 2 public service centers are considered major centers in Dubai that people regularly seek clearance and completion of
their services. The questionnaires were administered to the participants during their visit to the service centers. The nature and main objectives of the study were clearly explained to every participant, and those willing to participate in the study were asked to clearly sign the provided consent form immediately before completing the study questionnaire. The study was conducted from June 2017 to October 2018.

Study Population (Inclusion and Exclusion Criteria)

The target population to be studied contained both nationals and nonnational residents in Dubai, UAE. All residents aged 18 years and older who had the will to participate were directly included in this study. Participants aged less than 18 years and those who did not want to participate were excluded. Participation was voluntary, and no incentives were offered to any participant who completed the survey form. Participants who had allergies and/or chronic disease and/or had taken prescription drugs during the last week were excluded from the study.

Sample Size

Because the prevalence of DS product consumption may range from 10% to 30% according to Kemper et al.14 and approximately 19% according to Hara et al.,27 we expected the current prevalence rate to reach almost 30% in this study. We set the alpha level to 5% in order to generate 95% confidence intervals. In addition, the precision (D) of the mentioned 95% confidence intervals was set to 5% in order to maximize the spectrum of the 95% at 10%. Pertaining to the aforementioned assumptions, the minimum acceptable sample size needed was \( n = 539 \) candidates if we assumed a nonresponse rate of approximately 40%. The final sample size was 618 participants.

Research Instrument Development

The validated questionnaire was tailored to the UAE population,28,29 and a well-structured, self-administered questionnaire was created and enhanced to highlight all the basic key points of the study in ways that were suitable to the local population of the UAE. The questionnaire was then examined by subject experts for content, layout, and relevance. The questionnaire was subsequently validated by 2 lecturers from the disciplines of medicine and clinical pharmacy at Ajman University; it was tested for content relevance and appropriateness, and small modifications were carried out according to their final comments. In addition, the questionnaire was piloted by 20 of the participants immediately before commencing the general distribution, and essential modifications were performed accordingly. Data that were collected from the pilot examination were not included in the final analysis of the data. The analysis of reliability of our instrument was carried out by calculating Cronbach’s \( \alpha \) value. Cronbach’s \( \alpha \) value of the questionnaire was .76, indicating acceptable internal validity.

Research Questionnaire Sections

The questionnaire was available in English or Arabic, depending on the respondent’s choice, and the questionnaire consisted of 4 main sections. The first section covered demographic information, such as age, sex, marital status, nationality, employment status, educational level, and monthly income. The second section evaluated the health and lifestyle characteristics, such as allergies (yes/no), chronic medical conditions (yes/no), prescription drug use in the past week (yes/no), smoking status (yes/no), and physical activity (yes/no). The third section assessed the consumption of different groups and categories of DSs. The fourth section assessed the SHS and included 25 questions in which the candidates were asked to explore how often they experienced any of different complaints listed in the prior month; the 25 questions were answered on a 5-point Likert-type scale (1 = never or almost never, 2 = occasionally, 3 = often, 4 = very often, 5 = always).

Ethical Considerations

The study was approved by the Institutional Ethical Review Committee of Ajman University, and an official approval letter was released to facilitate the distribution and collection of the questionnaire. Enrollment in this study was completely voluntary and without any compensation. Prior to collection of the data, the exact objective of the questionnaire was discussed, and the participants were also informed that completion and submission of the questionnaire required their official consent; as such, all participants signed the given informed consent form. Moreover, anonymity of all participants was preserved in the study, as the data were deidentified.

Data Analysis

The collected data were analyzed using SPSS version 23. We summarized the qualitative variables using frequencies (percentages) as needed. Quantitative variables were analyzed using the mean ± standard deviation (±SD). A suboptimal health status score was created to examine the health status of the study subjects. A SHS score was defined as the proportion of questions for which the answers were “occasionally,” “often,” “very often,” and “always.” The SHS score ranges from 0% to 100% and may be utilized as a good representative of the total SHS. We used a simple binary logistic regression to test the possible association between DS product consumption and SHS. A \( P \) value < .05 was selected as the criteria on which to build decisions regarding statistical significance.
Results

Demographic and Socioeconomic Characteristics

A total of 618 participants were enrolled in the study and answered the full questionnaire. Among these, 51.8% (n = 320) were female and 48.2% (n = 298) were male. Of the total, 14.1% (n = 87) were aged 18 to 24 years, 36.4% (n = 225) were aged 25 to 34 years, 28.3% (n = 175) were aged 35 to 44 years, and 21.2% (n = 131) were aged >44 years. More than half of the participants were married; 67.8% (n = 419) were married and 32.2% (n = 199) were single. The vast majority were employed (84.1%; n = 520). Regarding education, 18.8% (n = 116) had a high school education, 61.2% (n = 378) had a bachelor’s degree, and 20.1% (n = 124) had a postgraduate education. The monthly income was ≤5000 AED for 18.1% (n = 112), 5000 to 9999 AED for 23.5% (n = 145), 10 000 to 14 999 AED for 25.9% (n = 160), and ≥15000 AED for 32.5% (n = 201).

Table 1. Number and Percentage Summaries of the Demographic, Health, and Lifestyle Characteristics.

| Demographic                        | Group         | Frequency | Percentage |
|------------------------------------|---------------|-----------|------------|
| Age (years)                        | 18-24         | 87        | 14.1       |
|                                    | 25-34         | 225       | 36.4       |
|                                    | 35-44         | 175       | 28.3       |
|                                    | ≥44           | 131       | 21.2       |
| Sex                                | Male          | 298       | 48.2       |
|                                    | Female        | 320       | 51.8       |
| Marital status                     | Single        | 199       | 32.2       |
|                                    | Married       | 419       | 67.8       |
| Employment status                  | Employed      | 520       | 84.1       |
|                                    | Unemployed    | 98        | 15.9       |
| Educational level                  | Higher school | 116       | 18.8       |
|                                    | Bachelor’s degree | 378 | 61.2   |
|                                    | Postgraduate  | 124       | 20.1       |
| Monthly family income (AED)        | ≤5000         | 112       | 18.1       |
|                                    | 5000-9999     | 145       | 23.5       |
|                                    | 10 000-14 999 | 160       | 25.9       |
|                                    | ≥15000        | 201       | 32.5       |
| Smoking status                     | Nonsmoker     | 393       | 63.6       |
|                                    | Smoker        | 225       | 36.4       |
| Any allergy                        | No            | 508       | 82.2       |
|                                    | Yes           | 110       | 17.8       |
| Diseases                           | Yes           | 85        | 13.8       |
|                                    | No            | 533       | 86.2       |
| Prescription drugs in the past week| Yes           | 144       | 23.3       |
|                                    | No            | 474       | 76.7       |
| Physical activity/week             | Yes           | 174       | 28.2       |
|                                    | No            | 444       | 71.8       |

(71.8%) reported weekly physical activity. For more details, see Table 1.

Prevalence and Use of Dietary Supplements

In this study, 317 participants (51.3%; 95% CI: 47.3%-55.3%) reported the use of DSs. The categories of DSs used by the participants are shown in Table 2. Among the 317 participants who ever used DSs, vitamins (89.9%) and minerals (58.7%) followed by dietary fibers (30.6%) and herbal/botanical supplements (30%) were the most commonly used among all categories of DS products. For more details on the other categories, see Table 2.

The Influence of DS Consumption on Suboptimal Health Status

Of the total, 236 participants (38.2%) had allergies or/and chronic disease or/and had taken prescription drugs within the past week. To control for the effect of these confounding variables on suboptimal health status, we excluded those participants, and those remaining (n = 382, 61.8%) were considered valid for subsequent analyses.
There was a significant association between DS consumption and suboptimal health status (P < .001). DS consumers were more likely to score higher in suboptimal health status compared with non-DS consumers. The average suboptimal health status score was 64.6% (95% CI: 60.6%-68.6%) for DS consumers compared with 54.4% (95% CI: 50.8%-58%) for non-DS consumers. Moreover, DS consumers had a 1.5-fold increased odds of suboptimal health status when compared with non-DS consumers (95% CI: 1.4-1.7).

The results of each of the questions related to suboptimal health status for DS consumers and non-DS consumers are shown in Tables 3 and 4.

Table 5 displays the results of the binary logistic regression model to determine the effect of DS consumption on the suboptimal health status of the participants. All variables suspected to be associated with suboptimal health status were included and adjusted for DS consumption. The crude and adjusted odds ratios in this table show the magnitude of the association, and their corresponding P values indicate whether the association was statistically significant by using the cutoff value of .05. The results of this analysis showed that the consumption of DSs has a statistically significant statistical, even after the adjustment of all confounding factors.

**Discussion**

The use of DSs is on the rise globally and presents a significant concern for public health authorities. Many people regard DSs as a safer and more efficacious alternative to standard prescription medicines. DSs are widely available, do not require a prescription and are heavily marketed, meaning many people choose them for numerous illnesses. This research has examined the consumption of DSs and their association with poor health. As far as we can ascertain, no research similar to this has been previously undertaken in the UAE.

The findings of this research study have demonstrated that using DSs is widespread in the UAE, with 51.3% (95% CI: 47.3%-54.3%) of respondents stating that they had at some point used a DS. This is similar to the findings from the United States (52%), 30 the findings from Australia (56%)31 and the findings of the Health and Nutrition Examination Survey (53%).32-34 The results also indicated that, compared with other nationalities such as Iranians (36.3%),35 Irish (23%),36 Croatians (30.5%),37 Jordanians (27.4%),38 and Portuguese (16%) (Marques-Vidal),39 UAE citizens utilized DSs at a greater rate; however, the UAE participants did not use DSs as much as those in Columbia (73%)40 or Serbia (68.1%).41 The fact that this research does not match previous findings may be attributable to lifestyle elements and socioeconomic variations among the respondents.

The findings of this research have also demonstrated that the types of supplements most commonly employed by the subjects were vitamin and mineral supplements. This is in line with the findings of many other studies that have demonstrated that multivitamins and minerals are widely used.32-34,37,40,42-48

Research in 2012 assessed the use of supplements containing ephedra, which has been suggested to have a correlation with certain conditions and unexpected death. Among the 48 deaths that had a temporal relationship with using supplements, 18 subjects died from atherosclerotic coronary disease (37.5%), 16 subjects died from sudden unexplained death (33.3%), and 6 subjects died from hypertrophic cardiomyopathy (12.5%). This research came to the conclusion that idiopathic sudden death and atherosclerotic coronary disease were more common among those taking supplements.49

As this research is epidemiological, it is hard to ascertain the relationship between the use of DSs and their impacts on managing disease and malnutrition because supplements cannot be separated from other efforts to improve health. In the work we have reported, we have examined the relationship between using DSs and SHS. Our results demonstrated that SHS was considerably more prevalent for subjects who had sometimes used DSs in comparison to those who had never used them (P < .001).

DSs are becoming more popular globally, and the expansion of the market for such products in Dubai mirrors this. Consuming any pharmacologically active substances could have a potential negative impact on health. Additional hazards regarding the consumption of DSs are the possibility of DS interactions with medicinal drugs or other supplements, contamination, or adulteration. Investigation into the potentially negative influence of health supplements on public health is required.

### Table 2. Number and Percentage Summaries of the Dietary Supplement (DS) Product Categories (n = 317).

| DS Categories                  | Frequency | Percentage |
|-------------------------------|-----------|------------|
| Vitamins                      | 285       | 89.9       |
| Minerals                      | 186       | 58.7       |
| Hydrating and electrolyte     | 57        | 18.0       |
| formulas                      |           |            |
| Amino acids                   | 73        | 23.0       |
| Dietary fiber                 | 97        | 30.6       |
| Enzymes                       | 38        | 12.0       |
| Probiotics                    | 74        | 23.3       |
| Fatty acids                   | 42        | 13.2       |
| Herbal/botanical supplements  | 95        | 30.0       |
| Sports nutrition              | 45        | 14.2       |
| Energy drinks                 | 67        | 21.1       |
| Dietetic foods                | 74        | 23.3       |
| Slimming supplements          | 41        | 12.9       |
| Sexual enhancement            | 13        | 4.1        |

Jairoun et al.
Table 3. Number and Percentage Summaries of Suboptimal Health Status for All Consumers and Nonconsumers Without Allergies, Chronic Diseases, or Medications (n = 382).

| How Often Is It That:                                                                 | Never, n (%) | Occasionally, n (%) | Often, n (%) | Very Often, n (%) | Always, n (%) |
|--------------------------------------------------------------------------------------|--------------|----------------------|--------------|-------------------|---------------|
| You are exhausted without greatly increasing your physical activity?                  | 123 (32.2)   | 194 (50.8)           | 35 (9.2)     | 20 (5.2)          | 10 (2.6)      |
| Your fatigue cannot be substantially alleviated by rest?                             | 140 (36.6)   | 178 (46.6)           | 37 (9.7)     | 19 (5.0)          | 8 (2.1)       |
| You are lethargic when working?                                                      | 98 (25.7)    | 180 (47.1)           | 69 (18.1)    | 23 (6.0)          | 12 (3.1)      |
| You suffer from headaches?                                                           | 67 (17.5)    | 185 (48.4)           | 66 (17.3)    | 56 (14.7)         | 8 (2.1)       |
| You suffer from dizziness?                                                           | 138 (36.1)   | 165 (43.2)           | 52 (13.6)    | 27 (7.1)          | 0 (0.0)       |
| Your eyes ache or are tired?                                                          | 129 (33.8)   | 167 (43.7)           | 55 (14.4)    | 27 (7.1)          | 4 (1.0)       |
| You suffer from a sore throat?                                                        | 121 (31.7)   | 191 (50.0)           | 51 (13.4)    | 15 (3.9)          | 4 (1.0)       |
| Your muscles or joints feel stiff?                                                    | 115 (30.1)   | 168 (44.0)           | 58 (15.2)    | 27 (7.1)          | 14 (3.7)      |
| You have pain in your shoulder/neck/waist?                                           | 91 (23.85)   | 172 (45.0)           | 80 (20.9)    | 31 (8.1)          | 8 (2.1)       |
| You have a heavy feeling in your legs when walking?                                  | 193 (50.5)   | 122 (31.9)           | 44 (11.5)    | 15 (3.9)          | 8 (2.1)       |
| You feel out of breath while sitting still?                                          | 267 (69.9)   | 86 (22.5)            | 18 (4.7)     | 7 (1.8)           | 4 (1.0)       |
| You suffer from chest congestion?                                                    | 250 (65.4)   | 117 (30.6)           | 14 (3.7)     | 14 (3.7)          | 1 (0.3)       |
| You are bothered by heart palpitations?                                              | 203 (53.1)   | 127 (33.25)          | 37 (9.7)     | 11 (2.9)          | 4 (1.0)       |
| Your appetite is poor?                                                                | 175 (45.8)   | 164 (42.9)           | 26 (6.8)     | 14 (3.7)          | 3 (0.8)       |
| You suffer from heartburn?                                                           | 123 (32.2)   | 186 (48.7)           | 32 (8.4)     | 21 (5.5)          | 20 (5.2)      |
| You suffer from nausea?                                                               | 186 (48.7)   | 155 (40.6)           | 26 (6.8)     | 11 (2.9)          | 4 (1.0)       |
| You cannot tolerate the cold?                                                        | 148 (38.7)   | 163 (42.7)           | 37 (9.7)     | 24 (6.3)          | 10 (2.6)      |
| You have difficulty falling asleep?                                                  | 127 (33.2)   | 185 (48.4)           | 33 (8.6)     | 28 (7.3)          | 9 (2.4)       |
| You have trouble with waking up during night?                                        | 186 (48.7)   | 146 (38.2)           | 22 (5.8)     | 19 (5.0)          | 9 (2.4)       |
| You have trouble with your short-term memory?                                        | 174 (45.5)   | 155 (40.6)           | 38 (9.9)     | 11 (2.9)          | 4 (1.0)       |
| You cannot respond quickly?                                                          | 212 (55.5)   | 141 (36.9)           | 22 (5.8)     | 3 (0.8)           | 4 (1.0)       |
| You have difficulty concentrating?                                                   | 163 (42.7)   | 173 (45.3)           | 25 (6.5)     | 17 (4.5)          | 4 (1.0)       |
| You are distracted for no reason?                                                    | 186 (49.2)   | 145 (38.0)           | 28 (7.3)     | 17 (4.5)          | 4 (1.0)       |
| You feel nervous or jittery?                                                         | 129 (33.8)   | 182 (47.6)           | 49 (12.8)    | 18 (4.7)          | 4 (1.0)       |
| You caught a cold in the past month?                                                 | 177 (46.3)   | 155 (40.6)           | 26 (6.8)     | 22 (5.8)          | 2 (0.5)       |

Table 4. Mean Score for the Questions on Suboptimal Health Status for All Consumers and Nonconsumers Without Allergies, Chronic Diseases, or Medications (n = 382).

| How Often Is It That:                                                                 | Consumers (n = 169) Mean ± SD | Nonconsumers (n = 213) Mean ± SD | All (n = 382) Mean ± SD |
|--------------------------------------------------------------------------------------|-------------------------------|----------------------------------|------------------------|
| You are exhausted without greatly increasing your physical activity?                  | 2.19 ± 0.98                  | 1.76 ± 0.84                      | 2.05 ± 0.97            |
| Your fatigue could not be substantially alleviated by rest?                           | 1.98 ± 0.98                  | 1.82 ± 0.86                      | 1.98 ± 0.93            |
| You are lethargic when working?                                                      | 2.35 ± 1.04                  | 1.97 ± 0.88                      | 2.23 ± 0.96            |
| You suffer from headaches?                                                           | 2.41 ± 0.98                  | 2.31 ± 1.01                      | 2.39 ± 1.00            |
| You suffer from dizziness?                                                           | 2.01 ± 0.86                  | 1.85 ± 0.89                      | 1.89 ± 0.86            |
| Your eyes ache or are tired?                                                         | 2.05 ± 0.91                  | 1.92 ± 0.94                      | 2.04 ± 0.94            |
| You suffer from a sore throat?                                                       | 1.91 ± 0.75                  | 1.93 ± 0.89                      | 1.98 ± 0.80            |
| Your muscles or joints felt stiff?                                                    | 2.14 ± 0.99                  | 2.07 ± 1.05                      | 2.26 ± 1.07            |
| You have pain in your shoulder/neck/waist?                                           | 2.25 ± 0.93                  | 2.15 ± 0.98                      | 2.33 ± 1.04            |
| You have a heavy feeling in your legs when walking?                                  | 1.73 ± 0.92                  | 1.76 ± 0.98                      | 1.93 ± 1.03            |
| You feel out of breath while sitting still?                                          | 1.46 ± 0.77                  | 1.38 ± 0.75                      | 1.46 ± 0.79            |
There were a number of limitations to this research. First, as with all cross-sectional designs, cause and effect cannot be inferred, and the direction of the correlations between the independent and dependent variables cannot be inferred. Although there is reasonable confidence that the results can be generalized, the results may have been influenced by selection and response bias. This possible bias has not been further investigated by comparing the nonresponders with the responders. As the research was undertaken in Dubai, it cannot be directly generalized to other states in the UAE.
Conclusions
This research has offered significant new information regarding the use of DSs and their associations with SHS in Dubai and the UAE, filling a gap in the available knowledge. The results of this research may be employed for the development of health policies and programs regarding dietary supplements in Dubai that will assist in minimizing the risks and possible adverse effects of using such supplements. This research also demonstrated that an educational program for the population of Dubai with information regarding the health risks of using supplements would be ideal. The resulting program could make the population more aware; it could help the healthcare professionals in Dubai to develop policies regarding the use of health supplements; and deal with the negative health outcomes from DS use.

Acknowledgments
We would like to thank our colleagues for their participation in this study and their support of our work in this way; they helped us obtain results of better quality.

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.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

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References
1. Slesinski MJ, Subar AF, Kahle LL. Trends in use of vitamin and mineral supplements in the United States: the 1987 and 1992 national health interview surveys. J Am Diet Assoc. 1995;95:921-923. doi:10.1016/s0002-8223(95)00255-3
2. Millen AE, Dodd KW, Subar AF. Use of vitamin, mineral, nonvitamin, and nonmineral supplements in the United States: the 1987, 1992, and 2000 National Health Interview Survey results. J Am Diet Assoc. 2004;104:942-950. doi:10.1016/j.jada.2004.03.022
3. Wu CH, Wang CC, Kennedy J. Changes in herb and dietary supplement use in the US adult population: a comparison of the 2002 and 2007 National Health Interview Surveys. Clin Ther. 2011;33:1749-1758. doi:10.1016/j.clinthera.2011.09.024
4. Alahmad G, Al-Jumah M, Dierickx K. Review of national research ethics regulations and guidelines in Middle Eastern Arab countries. BMC Med Ethics. 2012;13:34. doi:10.1186/1472-6939-13-34
5. National Institute of Health (NIH). Dietary Supplement Health and Education Act of 1994. Public Law No. 105-417 (Codified at 42 USC 287C-11). Bethesda, MD: National Institutes of Health; 1994.
6. Aina BA, Ojedokun OA. Knowledge and use of dietary supplements by students of college of medicine, University of Lagos, Iyi-Araba, Lagos, Nigeria. J Basic Clin Pharm. 2014;5:34-39. doi:10.4103/0976-0105.134952
7. Su D, Li L. Trends in the use of complementary and alternative medicine in the United States: 2002-2007. J Health Care Poor Underserved. 2011;22:296-310. doi:10.1353/hpu.2011.0002
8. Rossler W, Lauber C, Angst J, et al. The use of complementary and alternative medicine in the general population: results from a longitudinal community study. Psychol Med. 2007;37:73-84. doi:10.1017/s0033291706008841
9. Consumer Products Safety Section (CPSS). Health Supplements Registration Procedures, DM-PH&SD-P-TG2. Irvine, CA: Public Health and Safety Department; 2016.
10. Moyad MA. Under-hyped and over-hyped drug-supplement interactions and issues. Urol Nurs. 2010;30:85-87. doi:10.7257/1053-816X.2010.30.1.85
11. Izzo AA, Ernst E. Interactions between herbal medicines and prescribed drugs: an updated systematic review. Drugs. 2009;69:1777-1798. doi:10.2165/11317010-000000000-0000
12. Van Strater AC, Bogers JP. Interaction of St John’s wort (Hypericum perforatum) with clozapine. Int Clin Psychopharmacol. 2012;27:121-124. doi:10.1097/YIC.0b13e32834e8afad
13. Tsai HH, Lin HW, Lu YH, Chen YL, Mahady GB. A review of potential harmful interactions between anticoagulant/anti-platelet agents and Chinese herbal medicines. PLoS One. 2013;8:e64255. doi:10.1371/journal.pone.0064255
14. Kemper KJ, Gardiner P, Gobble J, Woods C. Expertise about herbs and dietary supplements among diverse health professionals. BMC Complement Altern Med. 2006;6:15. doi:10.1186/1472-6882-6-15
15. Piening S, Haaijer-Ruskamp FM, de Graaff PA, Straus SM, Mol PG. Healthcare professionals’ self-reported experiences and preferences related to direct healthcare professional communications: a survey conducted in the Netherlands. Drug Saf. 2012;35:1061-1072. doi:10.2165/11635750-000000000-0000
16. Chitturi S, Farrell GC. Hepatotoxic slimming aids and other herbal hepatotoxins. J Gastroenterol Hepatol. 2008;23:366-373. doi:10.1111/j.1440-1746.2008.05310.x
17. World Health Organization. Dietary Supplements. Geneva, Switzerland: World Health Organization; 2008.
18. Barnes PM, Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. 2002;37:73-84. doi:10.1016/j.sigm.2004.07.003
19. Neerghaen-Bhujun VS. Underestimating the toxicological challenges associated with the use of herbal medicinal products in developing countries. Biomed Res Int. 2013;2013:804086. doi:10.1155/2013/804086
20. Shaw D, Palmer M. US poisons control centers and reports of adverse events associated with dietary supplements. Focus Altern Complement Ther. 2003;8:317-319. doi:10.1211/ fact.2003.00311
21. Tachjian A, Maria V, Jahangir A. Use of herbal products and potential interactions in patients with cardiovascular diseases. *J Am Coll Cardiol.* 2010;55:515-525. doi:10.1016/j.jacc.2009.07.074

22. Ministry of Health. *Management of Poisoning: MOH Singapore Clinical Practice Guidelines December/2011.* Singapore: Ministry of Health; 2011.

23. Davy CP, Patrickson M. Implementation of evidence-based healthcare in Papua New Guinea. *Int J Evid Based Healthc.* 2012;10:361-368. doi:10.1111/j.1744-1609.2012.00294.x

24. Dunstan RH, Sparkes DL, Roberts TK, Crompton MJ, Gottfrieds J, Dascombe BJ. Development of a complex amino acid supplement, Fatigue Reviva™, for oral ingestion: initial evaluations of product concept and impact on symptoms of sub-health in a group of males. *Nutr J.* 2013;12:115. doi:10.1186/1475-2891-12-115

25. Ke B, Liang Y. Anti-aging and complete suboptimal health checkup. *Clin Funct Nutr.* 2011;3:137-140.

26. Gavaza P, Brown CM, Lawson KA, Rascati KL, Wilson JP, Steinhardt M. Influence of attitudes on pharmacists’ intention to report serious adverse drug events to the food and drug administration. *Br J Clin Pharmacol.* 2011;72:143-152. doi:10.1111/j.1365-2125.2011.03944.x

27. Hara A, Sasazuki S, Inoue M, et al. Association of lifestyle factors and risk of total cancer and cardiovascular disease among the Japanese general population: a population-based survey. *BMC Public Health.* 2011;11:540. doi:10.1186/1471-2458-11-540

28. Bi J, Huang Y, Xiao Y, et al. Association of lifestyle factors and suboptimal health status: a cross-sectional study of Chinese students. *BMJ Open.* 2014;4:e005156. doi:10.1136/bmjopen-2014-005156

29. Jawadi AH, Addar AM, Alazzam AS, et al. Prevalence of dietary supplement use among gymnasium users. *Int J Nutr.* 2011;20:327-336.

30. Hara A, Sasazuki S, Inoue M, et al. Use of vitamin supplements and risk of total cancer and cardiovascular disease among the Japanese general population: a population-based survey. *BMC Public Health.* 2011;11:540. doi:10.1186/1471-2458-11-540

31. Miljkovic M, Stojiljkovic M, Radulovic O. Knowledge, attitudes and use of dietary supplement among students of the University of Nis (Serbia) [in Serbian]. *Med Pregl.* 2013;66:163-169. doi:10.2298/mprms1304163m

32. Bailey RL, Gahche JJ, Lentino CV, et al. Dietary supplement use in the United States, 2003-2006. *J Nutr.* 2011;141:261-266. doi:10.3945/jn.110.133025

33. Gahche J, Bailey R, Burt V, et al. Dietary supplement use among US adults has increased since NHANES III (1988-1994). *NCHS Data Brief.* 2011;61:1-8.

34. Sekhri K, Kaur K. Public knowledge, use and attitude toward multivitamin supplementation: a cross-sectional study among general public. *Int J Appl Basic Med Res.* 2014;4:77-80. doi:10.4103/2229-516x.136780

35. Babanejad M, Azizian M, Azizian R, et al. Factors affecting dietary supplement consumption in residents of Southern Tehran. *Res Med.* 2013;37:93-97.

36. Kiely M, Flynn A, Harrington KE, et al. The efficacy and safety of nutritional supplement use in a representative sample of adults in the North/South Ireland food consumption survey. *Public Health Nutr.* 2001;4:1089-1097. doi:10.1079/PHN2001190

37. Zezelj SP, Tomljanovic A, Jovanovic GK, et al. Prevalence, knowledge and attitudes concerning dietary supplements among a student population in Croatia. *Int J Environ Res Public Health.* 2018;15:E1058. doi:10.3390/ijerph15061058

38. Sulaiman AA, Alboqai OK, Yasein N, Al-Essa MK, El Masri K. Prevalence of vitamin-mineral supplement use among Jordan University students. *Saudi Med J.* 2008;29:1326-1331.

39. Marques-Vidal P. Vitamin supplement use and nutritional knowledge in a sample of Portuguese health science students. *Nutr Res.* 2004;24:165-172. doi:10.1016/j.nutres.2003.10.001

40. Timbo BB, Ross MP, McCarthy PV, Lin CT. Dietary supplements in a national survey: prevalence of use and reports of adverse events. *J Am Diet Assoc.* 2006;106:1966-1974. doi:10.1016/j.jada.2006.09.002

41. Wiltgren AR, Booth AO, Kaur G, et al. Micronutrient supplement use and diet quality in university students. *Nutrients.* 2015;7:1094-1107. doi:10.3390/nu7071094

42. Al-Naggar RA, Chen R. Prevalence of vitamin-mineral supplements use and associated factors among young Malaysians. *Asian Pac J Cancer Prev.* 2011;12:1023-1029.

43. Block G, Jensen CD, Norkus EP, et al. Usage patterns, health, and nutritional status of long-term multiple dietary supplement users: a cross-sectional study. *Nutr J.* 2007;6:30. doi:10.1186/1475-2891-6-30

44. Chen SY, Lin JR, Chen TH, Guo SG, Kao MD, Pan WH. Dietary supplements usage among elderly Taiwanese during 2005-2008. *Asia Pac J Clin Nutr.* 2011;20:327-336.

45. Fattahzadeh-Ardalani G, Farzaneh E, Fathi A, Molaei B, Valizadeh M. Determining the prevalence of dietary supplement consumption among Ardabil university students and related factors, 2014. 2017. *Int J Commun Med Public Health.* 2017;3:6. doi:10.18203/2394-6040.ijcmph20151567

46. Mirmira P, Mohammadi F, Allahverdian S, Azizi F. Association of educational level and marital status with dietary intake and cardiovascular risk factors in Tehranian adults: *Tehran Lipid and Glucose Study* (TLGS). *Nutr Res.* 2002;22:1365-1375. doi:10.1016/S0271-5317(02)00440-2

47. Reinert A, Rohrmann S, Becker N, Linseisen J. Lifestyle and diet in people using dietary supplements: a German cohort study. *Eur J Nutr.* 2007;46:165-173. doi:10.1007/s00394-007-0650-2

48. Stanojevic-Ristic Z, Stevic S, Rasic J, Valjarevic D, Dejanovic M, Valjarevic A. Influence of pharmacological education on perceptions, attitudes and use of dietary supplements by medical students. *BM Complement Altern Med.* 2017;17:527. doi:10.1186/s12906-017-2031-6

49. Appel DA, McNear JA, Shry EA, Gentlesk PJ, Reich SS, Eckart RE; Department of Defense Cardiovascular Death Registry Group. Thermogenic supplement use does not alter characteristics of sudden death in the young. *Pacing Clin Electrophysiol.* 2012;35:1332-1337. doi:10.1111/j.1540-8159.2012.03510.x