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Original article

## The consumption of nutritional supplements and herbal products for the prevention and treatment of COVID-19 infection among the Saudi population in Riyadh

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### ARTICLE INFO

*Article history:*

Received 9 April 2021

Accepted 16 September 2021

Available online 24 September 2021

*Keywords:*

COVID-19

Nutritional supplements

Herbal products

### SUMMARY

**Objective:** This study aimed to assess the Saudi population's beliefs regarding the consumption of nutritional supplements and herbal products for the prevention and treatment of COVID-19 in Riyadh. **Methods:** A cross-sectional study that included 1460 participants aged between 12 and 86 years was conducted in Riyadh, Saudi Arabia, between October 01, 2020, and October 30, 2020, via an online survey using a questionnaire. The questionnaire was uploaded as a Google Doc file on Google Drive, and a link to the survey was distributed to respondents via social media platforms (Twitter, WhatsApp, and Instagram). The survey instrument included 30 questions, including sociodemographic characteristics and the use of nutritional supplements and herbal products.

**Results:** The findings of our study revealed a significant increase in intake and the frequency of consumption of nutritional supplements and herbal products during the COVID-19 pandemic period than before the COVID-19 pandemic. Social media and the Internet (29.7%) and relatives or friends (14.7%) were the main motivators for the participants to try herbal products. The majority of the participants reported using zinc (72.9%), vitamin C (56.0%), garlic (*Allium sativum*) (53.8%), and cinnamon (52.0%) during the COVID-19 pandemic period.

**Conclusion:** In conclusion, the findings of our study demonstrated that the intake of nutritional supplements and herbal products increased among the general population in Saudi Arabia during the COVID-19 pandemic period to protect them from the disease. In

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addition, the intake of nutritional supplements and herbal products should be evidence-based to ensure patient safety.

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## 1. Introduction

Coronaviruses (CoVs) comprise a large family of enveloped, single-stranded, zoonotic RNA viruses belonging to the family *Coronaviridae*, order *Nidovirales* [1], causing systemic infections of pneumonia and upper/lower respiratory, intestine, liver, and nervous system [2,3]. The commencement of the 21<sup>st</sup> century has witnessed deadly coronavirus infections: severe acute respiratory syndrome coronavirus (SARS-CoV-1), thought to have been transmitted from civet cats or bats to humans in Guangdong (southern China) in 2002 [4,5], and Middle East respiratory syndrome coronavirus (MERS-CoV), which is transmitted from dromedary camels to humans in Saudi Arabia in September 2012 [6,7].

Alarmingly, in late December 2019, a novel CoV was identified as a pathogen that caused the outbreak of an illness in Wuhan city, Hubei Province of China. Within a short period and owing to the number of countries reporting cases, the World Health Organization (WHO) declared it a pandemic on March 11, 2020, which was officially named coronavirus disease 2019 (COVID-19) [8–10]. Globally, since December 31, 2019, and as of November 17, 2020, the virus has affected more than 205 countries with over 55 million confirmed cases and more than 1.3 million deaths [11]. Although the case fatality rate of COVID-19 (estimated at 2.3%) is lower than that of SARS (9.5%) and much lower than that of MERS (34.4%) [4–7,12,13].

In Saudi Arabia, within three months of the outbreak, despite the Saudi Government's early decision for a bunch of restrictions, including restrictions in the educational sectors and broad restrictions in the transportation sector (nationally and internationally), Saudi Arabia reported the first case of COVID-19 in March 2020, with the virus spreading to most regions of the nation. Subsequently, partial curfew or lockdown and then 24-h lockdowns were implemented on the residents and citizens of Saudi Arabia to limit the spread of the virus. However, with the high rate of transmission, there were over 350,000 confirmed COVID-19 cases, with more than 5000 deaths by November 18, 2020 [14].

The global outbreak of COVID-19, for which there is few effective evidence-based vaccine or treatment yet, has raised many concerns among people worldwide, which has led to many attempts to find alternative options, including handwashing and hand antiseptics, wearing face masks [15], and social distancing strategies [16] to prevent the transmission of the disease. Additionally, the use of natural products and herbal extracts strengthens immunity and decreases the risk of contracting COVID-19 [17–19]. Despite the poor data quality in clinical trials, compelling evidence from the literature suggests that several dietary nutraceuticals (omega-3 polyunsaturated fatty acids, vitamins, minerals, amino acids, and peptides) and plant-based compounds derived from herbal extracts may potentially be used in the treatment of COVID-19 [20,21]. Moreover, natural products were used to improve the immune response, and they are still widely used nowadays mainly without the need for a prescription. Unfortunately, currently, it is estimated that about 80% of people in developing countries still rely on traditional herbal medicines based largely on species of plants for their primary health care without any control [22]. This study aimed to assess the Saudi population's beliefs regarding the consumption of nutritional supplements and herbal products for the prevention and treatment of COVID-19 in Riyadh.

## 2. Materials and methods

### 2.1. Study design and population

This is a cross-sectional study with convenience sampling based on an online survey conducted using the Google Forms web survey platform conducted among the general population of Riyadh.

The link to the online survey was shared through social media platforms (Twitter, WhatsApp, and Instagram). A total of 1460 participants have been included in the study aged between 12 and 86 years. Participants were asked to share the link to the survey with other populations in Riyadh. Participation in the online survey was entirely voluntary and anonymous. Participants were informed about the purpose of the research and asked for permission to use and publish the data from the study before starting the questionnaire. Participants were also given the option to withdraw their data at this point. The questionnaire was available online between October 1 and October 30, 2020. A predesigned Arabic language questionnaire was used. The questionnaire was divided into three major sections. A predesigned Arabic language questionnaire was used. The questionnaire was divided into three major sections. On the first page of the questionnaire, respondents were informed regarding the background and purpose of the study. The survey instrument contained 30 questions, including sociodemographic characteristics and the use of nutritional supplements and herbal products. The first section of the questionnaire included data on sociodemographic characteristics such as gender, age, social status, educational level, and occupation. The second section of the survey assessed the nutritional supplements and herbal products in terms of usage, type, source of information, and belief in the protective effects of the nutritional supplements and herbal products against COVID-19. Once completed, each questionnaire was transmitted to the Google platform, and the final database was downloaded as a Microsoft Excel sheet. Ethical approval was obtained from the Ethics Committee of the College of Science Research Center of the King Saud University, Riyadh, Saudi Arabia.

## 2.2. Sample size and strategy

According to the latest Saudi Arabia census, Riyadh has a population of around 4.21 million [23]. To achieve the study objectives and sufficient statistical power, the sample size was calculated using a sample size calculator [24], and the required sample size was 1460 using a margin of error of 5%, a confidence level of 99%, and a 50% response distribution. All participants voluntarily participated in the study. Completion of the questionnaire was considered as written consent for participation in the study.

## 2.3. Statistical analyses

Data were analyzed using the Statistical Package for Social Science (SPSS) version 25 (SPSS Inc., Chicago, IL, USA). Continuous variables were reported as mean ( $\pm$ standard deviation [SD]) for normally distributed variables, and non-Gaussian variables were presented as median (interquartile range). Categorical data were presented as frequencies and percentages (%). A paired-sample t-test and the chi-square independence test were used to determine differences between variables. Values of  $P < 0.05$  were considered statistically significant.

# 3. Results

## 3.1. Participants

A total of 1460 participants, 497 (34.0%) men, and 963 (66.0%) women have completed the questionnaire, aged between 12 and 86 years that live in Riyadh city, the majority were females (76.9%). The majority were females (66%) and (61.4%) were married. 64.7% had a university education, and 47.9% were employees. Approximately 3.42% of them reported that they had been or were currently infected with COVID-19 (Table 1).

## 3.2. Use of nutritional supplements and herbal products during the COVID-19 pandemic

The nutritional supplement and herbal product intakes were significantly increased during the COVID-19 pandemic as compared to before the pandemic ( $P = 0.000$ ). Furthermore, the frequency of

**Table 1**  
Characteristics of the study participants (n = 1460).

Variable	Category	N	%
Gender	Men	497	34.0
	Women	963	66.0
Age	18–20	251	17.2
	21–30	345	23.6
	31–40	335	22.9
	41–50	374	25.6
	51–60	132	9.0
	61 years and over	23	1.6
Social status	Unmarried	511	35.0
	Married	897	61.4
	Separated	52	3.6
Education	Secondary and lower	382	26.2
	University	944	64.7
	Postgraduate	134	9.2
Occupation	Student	325	22.3
	Employed	700	47.9
	Retired	128	8.8
	Unemployed	307	21.0
Infected with COVID-19	Yes	50	3.42
	No	1410	96.56

Data presented in N (%).

consumption of nutritional supplements and herbal products was significantly higher during the COVID-19 pandemic period than before the pandemic ( $P = 0.000$ ) these significant differences were not lost after adjusting for gender. When the participants were asked regarding who suggested the use of nutritional supplements and herbal products, they mentioned that the suggestion came from the Internet and social networking sites in 29.7% of cases, from friends and relatives in 13.5% of cases, from healthcare practitioners in 14.7% of cases, from previous experiences in 14.0% of cases, from books in 12.8% of cases, and a mixture of the above in 15.4% of cases (Table 2).

### 3.3. Type of nutritional supplements and herbal products used during the COVID-19 pandemic period

With regard to the participants who use nutritional supplements and herbal products, the majority of them (56.0%) used vitamin C during the COVID-19 pandemic period. Only 2.4% of the participants used vitamin A. Concerning herbal product intake, the majority of the participants (72.9%) used zinc, and approximately 53.8% of the participants reported using garlic. In addition, 52.0% of them reported that they had used cinnamon, as well as black seed/*Nigella sativa* (Table 3).

### 3.4. The impact of gender on the use of nutritional supplements and herbal products

There was a significant increase in the rate of use of nutritional supplements and herbal products before the COVID-19 pandemic period among women than among men. This tendency persisted during the COVID-19 pandemic period ( $P = 0.000$ ) these significant differences were not lost after adjusting for gender as shown in Table 4.

### 3.5. The impact of age on the use of nutritional supplements and herbal products

The rate of use of nutritional supplements and herbal products was higher before the COVID-19 pandemic period and during the COVID-19 pandemic period among people aged 61 years and above than among those under 61 years of age ( $P = 0.000$ ) these significant differences were not lost after adjusting for gender, as shown in Table 5.

**Table 2**

The impact of the COVID-19 pandemic on the use of nutritional supplements and herbal products.

Variable	Category	Before COVID-19	During COVID-19	Chi-square	P-value	Adjusted for gender
Do you use nutritional supplements and herbal products?	I do not use	53.2%	42.1%	48.65	0.000**	0.000**
	Rarely	13.6%	13.0%			
	Sometimes	23.8%	29.2%			
	Always	9.5%	15.6%			
How often do you take nutritional supplements or herbal products?	I do not use	19.1%	-	191.68	0.000**	0.000**
	1–2 a day	47.1%	66.5%			
	1–3 a week	19.8%	17.4%			
	4–6 times a week	5.6%	6.9%			
	Irregularly	8.5%	9.2%			
Who suggested the use of nutritional supplements and herbal products?	From the Internet and social networking sites			251	29.7	
	Relative or friend			114	13.5	
	Health practitioner			124	14.7	
	Based on previous experiences			118	14.0	
	By reading books			108	12.8	
	More than one			130	15.4	

Note: Data presented as number (%). \* Denotes significance at  $P < 0.05$ , \*\*denotes significance at 0.01 level.

### 3.6. The impact of education on the use of nutritional supplements and herbal products

There was a significant increase in the use of nutritional supplements and herbal products during the COVID-19 pandemic period among people with university and postgraduate educational qualifications than among people with secondary and lower educational qualifications ( $P = 0.000$ ), these significant differences were not lost after adjusting for gender as shown in Table 6.

## 4. Discussion

This cross-sectional study aimed to assess the Saudi population's beliefs regarding the consumption of nutritional supplements and herbal products for the prevention and treatment of COVID-19 in Riyadh. The web-based survey was conducted from October 01 to October 30, 2020. In addition, the level of knowledge regarding COVID-19 was assessed between users and nonusers of nutritional supplements and herbal products.

The findings of our study indicated that the intake of nutritional supplements and herbal products during the COVID-19 pandemic period was significantly higher than that before the COVID-19 pandemic period ( $P = 0.000$ ). In addition, the frequency of consumption of nutritional supplements and herbal products during the COVID-19 pandemic was higher than that before the COVID-19 pandemic period ( $P = 0.000$ ). These observations, in parallel with the recent study, reported that around (22.1%) of the participants claimed that they have used or are currently using herbal products or nutritional supplements during the COVID-19 pandemic period to decrease the risk of contracting the disease [25]. At present, there is no specific antiviral recommended for the treatment of COVID-19, and few currently available vaccine has been reported. Only supportive care and personal protection are available [21,26]. With the increased popularity of dietary supplements and herbal products, previous studies reported that they are safer than prescription medications and are of good quality to enhance health or prevent most chronic diseases [27–29]. Few clinical studies have reported on food and herb combinations or the traditional Chinese formulas to prevent influenza virus and SARS-CoV-1 [30–32].

Our study demonstrated that social media and the Internet (29.7%) and relatives or friends (14.7%) were the main motivators for the participants to try herbal products. These findings are consistent with a recent cross-sectional study that reported that social media and the Internet (39.4%) were the main sources of suggestions for the participants to take nutritional supplements and herbal products [25].

The present study reported that the majority of the participants claimed that they used vitamin C (56.0%), zinc (72.9%), garlic (*Allium sativum*) (53.8%), and cinnamon (52.0%) during the COVID-19 pandemic period. Dietary supplementation with selected vitamins (e.g., A, B, C, and D) were

**Table 3**

The type of nutritional supplement and herbal products used during the COVID-19 pandemic period.

Variable	Category	N	%	
Nutritional supplement	Vitamin A	I do not use	749	88.6
		During COVID-19	20	2.4
		Before and during COVID-19	76	9.0
	Vitamin C	I do not use	170	20.1
		During COVID-19	473	56.0
		Before and during COVID-19	202	23.9
	Vitamin D	I do not use	415	49.1
		During COVID-19	80	9.5
		Before and during COVID-19	350	41.4
	Vitamin B complex	I do not use	570	67.5
		During COVID-19	75	8.9
		Before and during COVID-19	200	23.7
Herbal products	Zinc	I do not use	106	12.5
		During COVID-19	616	72.9
		Before and during COVID-19	123	14.6
	Selenium	I do not use	715	84.6
		During COVID-19	59	7.0
		Before and during COVID-19	71	8.4
	Calcium	I do not use	611	72.3
		During COVID-19	63	7.5
		Before and during COVID-19	171	20.2
	Turmeric	I do not use	429	50.8
		During COVID-19	92	10.9
		Before and during COVID-19	324	38.3
	Honey	I do not use	261	30.9
		During COVID-19	145	17.2
		Before and during COVID-19	439	52.0
	Cinnamon	I do not use	77	9.1
		During COVID-19	439	52.0
		Before and during COVID-19	329	38.9
	Ginger	I do not use	337	39.9
		During COVID-19	156	18.5
		Before and during COVID-19	352	41.7
	Garlic	I do not use	85	10.1
		During COVID-19	455	53.8
		Before and during COVID-19	305	36.1
Black Seed/ <i>Nigella sativa</i>	I do not use	153	18.1	
	During COVID-19	439	52.0	
	Before and during COVID-19	253	29.9	

Data presented in N (%).

suggested as a treatment option for COVID-19 patients and as preventive therapy against lung infection [33]. Vitamin C is one of the most commonly used vitamins across different populations because of its crucial role in innate (nonspecific) and acquired (specific) immunity [28,29,34]. In addition, owing to its antiviral and immunomodulatory properties, vitamin C supports immune functions and protects against infection caused by SARS [35].

Dietary supplementation with herbal products, including minerals (e.g., selenium, zinc, and iron), and omega-3 fatty acids was also suggested to boost immunity against COVID-19 infection [33]. Zinc supplementation is important for the maintenance and growth of adaptive and innate immune cells [36]. Low zinc status might be a risk factor for pneumonia in the elderly due to its anti-inflammatory and antioxidant activities, along with its ability to regulate tight junction proteins, including claudin-1 and zonula occludens-1 [37]. Natural product supplements that contain garlic are also commonly used among the general population for their antiparasitic [38], antiapoptotic [39], proapoptotic, anti-cancerogenic [40], and immunomodulatory effects on different cells [41,42]. Garlic extracts have been reported to have potent antiviral activity against different viruses by blocking viral entry into host cells, inhibiting viral RNA polymerase, reverse transcriptase, DNA synthesis, and immediate-early gene 1(IEG1) transcription [43]. Furthermore, compounds derived from garlic have been shown to reduce

**Table 4**  
The impact of gender on the use of nutritional supplements and herbal products.

Variable	Category	Men	Women	P-value	Adjusted for gender
Do you use nutritional supplements and herbal products before COVID-19?	I do not use	66.2%	46.4%	0.000**	0.000**
	Rarely	12.1%	14.3%		
	Sometimes	14.7%	28.5%		
	Always	7.0%	10.8%		
Do you use nutritional supplements and herbal products during COVID-19?	I do not use	54.5%	35.7%	0.000**	0.000**
	Rarely	11.9%	13.6%		
	Sometimes	20.3%	33.9%		
How often do you take nutritional supplements or herbal products before COVID-19?	1–2 a day	51.8%	60.2%	0.220	0.140
	1–3 a week	29.2%	22.9%		
	4–6 times a week	6.5%	7.0%		
	Irregularly	12.5%	9.9%		
How often do you take nutritional supplements or herbal products during COVID-19?	1–2 a day	65.9%	66.7%	0.411	0.241
	1–3 a week	20.4%	16.3%		
	4–6 times a week	5.3%	7.4%		
	Irregularly	8.4%	9.5%		

Note: Data presented as number (%). \* Denotes significance at  $P < 0.05$ , \*\*denotes significance at 0.01 level.

**Table 5**  
The impact of age on the use of nutritional supplements and herbal products.

Variable	Category	18–20 years	21–30 years	31–40 years	41–50 years	51–60 years	61 years and over	P-value	Adjusted for gender
Do you use nutritional supplements and herbal products before COVID-19?	I do not use	64.9%	60.9%	49.0%	47.3%	41.7%	30.4%	0.000**	0.000**
	Rarely	12.7%	10.7%	12.5%	16.8%	15.9%	13.0%		
	Sometimes	14.7%	20.9%	26.0%	28.1%	31.1%	21.7%		
Do you use nutritional supplements and herbal products during COVID-19?	I do not use	51.8%	46.1%	37.9%	39.6%	34.1%	26.1%	0.000**	0.000**
	Rarely	14.3%	12.2%	12.8%	14.4%	9.8%	8.7%		
	Sometimes	20.3%	26.4%	31.6%	33.2%	37.1%	26.1%		
How often do you take nutritional supplements or herbal products before COVID-19?	1–2/day	53.4%	57.0%	59.1%	61.7%	54.5%	56.3%	0.102	0.07
	1–3/week	25.0%	23.7%	22.2%	23.5%	35.1%	12.5%		
	4–6 times/week	6.8%	9.6%	9.9%	3.1%	2.6%	18.8%		
How often do you take nutritional supplements or herbal products during COVID-19?	1–2/day	14.8%	9.6%	8.8%	11.7%	7.8%	12.5%	0.251	0.132
	1–3/week	65.3%	64.0%	66.8%	69.9%	65.5%	58.8%		
	4–6 times/week	3.3%	8.1%	11.1%	4.0%	4.6%	17.6%		
	Irregularly	18.2%	9.1%	7.2%	7.5%	5.7%	11.8%		

Note: Data presented as number (%). \* Denotes significance at  $P < 0.05$ , \*\*denotes significance at 0.01 level.

the expression of pro-inflammatory cytokines, as well as the adipose tissue-derived hormone leptin, having the pro-inflammatory nature in relieving some symptoms detected during COVID-19 infection [44]. There is insufficient clinical trial evidence regarding the role of garlic in the treatment of upper respiratory infections, only in the prevention and improvement of the symptoms of common cold [45]. Selenium is a naturally occurring element that is crucial in the defense against infectious diseases [46]. Dietary selenium supplementation has been shown to improve the antiviral immune responses to lethal H1N1 influenza virus infection [47–49] and can also be potentially used in the current battle against this novel virus of COVID-19 [50]. Furthermore, dietary selenium deficiency induces not only impairment of the host immune system but also a rapid mutation of benign variants of RNA viruses to virulence [51]. Cinnamaldehyde is an essential oil of cinnamon that possesses anti-inflammatory properties [52,53], which could be useful in the mitigation of hyper-inflammation in the lung caused by COVID-19 [54].

Natural honey has been demonstrated to be a potent antimicrobial approved by the Food and Drug Administration (FDA) for topical wound treatment in 2007 [55]. The natural honey supplement has



**Table 6**

The impact of education on the use of nutritional supplements and herbal products.

Variable	Category	Secondary and lower	University	Postgraduate	P-value	Adjusted for gender
Do you use nutritional supplements and herbal products before COVID-19?	I do not use	59.7%	52.9%	36.6%	0.000**	0.000**
	Rarely	14.4%	11.9%	23.1%		
	Sometimes	15.7%	26.4%	28.4%		
	Always	10.2%	8.9%	11.9%		
Do you use nutritional supplements and herbal products during COVID-19?	I do not use	49.7%	41.0%	28.4%	0.000**	0.000**
	Rarely	14.9%	11.7%	17.2%		
	Sometimes	20.2%	32.2%	34.3%		
	Always	15.2%	15.1%	20.1%		
How often do you take nutritional supplements or herbal products before COVID-19?	1–2 a day	57.1%	57.4%	63.5%	0.186	0.087
	1–3 a week	22.1%	25.7%	22.4%		
	4–6 times a week	7.1%	6.1%	10.6%		
	Irregularly	13.6%	10.8%	3.5%		
	Always	15.2%	15.1%	20.1%		
How often do you take nutritional supplements or herbal products during COVID-19?	1–2 a day	65.6%	67.7%	61.5%	0.144	0.413
	1–3 a week	16.1%	17.1%	21.9%		
	4–6 times a week	5.2%	6.5%	12.5%		
	Irregularly	13.0%	8.8%	4.2%		
	Always	15.2%	15.1%	20.1%		

Note: Data presented as number (%). \* Denotes significance at  $P < 0.05$ , \*\*denotes significance at 0.01 level.

been demonstrated to be a potent antimicrobial in many research investigations and has been considered a good alternative for antiviral drugs for the treatment of some viral infections [56]. A clinical trial reported that natural honey significantly reduced the symptoms of 1000 COVID-19 patients of both sexes (aged 5–75 years, treated with standard therapy) [57]. Similar trials also suggested that natural honey and black cumin seeds significantly improved symptoms, viral clearance, and mortality of 313 COVID-19 patients of both sexes (18 years and older, treated with standard care) [58].

This study acknowledges a few limitations. The small sample size and cross-sectional survey design cannot suggest any causal relationships between study variables. Limited studies on the benefits of the consumption of nutritional supplements and herbal products for the prevention and treatment of COVID-19 infection have been conducted among the general population worldwide and in Saudi Arabia, which limited our ability to compare our findings with those of these countries. Additionally, the use of an online survey for data collection might have led to misreporting of data and might have excluded some vulnerable populations. Another limitation is the skewing in the geographical distribution of participants, who were all from Riyadh. Large-scale prospective studies are required to determine the exact predictive value of these findings.

In conclusion, the findings of our study demonstrated that the rate of intake of nutritional supplements and herbal products increased among the general population in Saudi Arabia during the COVID-19 pandemic period to protect themselves from the disease. In addition, the intake of nutritional supplements and herbal products should be evidence-based to ensure patient safety.

### Conflicts of interest

There is no conflict of interest in our current research.

### Acknowledgements

The author gratefully acknowledges the support of Deanship of Scientific Research at Prince Sattam bin Abdulaziz University, Riyadh, Kingdom of Saudi Arabia.

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