



## Original article

## Prevalence of using herbs and natural products as a protective measure during the COVID-19 pandemic among the Saudi population: an online cross-sectional survey

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## ABSTRACT

Considering that no food or supplement has been authorised to prevent COVID-19, individuals continue to search for and consume specific herbs, foods and commercial supplements for this purpose. This study aimed to estimate the prevalence of using such alternatives, determine their usage reasons and evaluate their potential side effects. An online cross-sectional survey of 1,054 participants was conducted from 1 May to 31 July 2020 and focused on respondents' chronic disease histories, socio-demographic characteristics and frequency and trends of using these products. Descriptive and univariate analyses were performed to determine prevalence and associations between various products used and respondents' socio-demographic data. Relationships were tested using Pearson's chi-square test or an exact probability test. The use of herbs and natural products merely because of the COVID-19 pandemic was significantly increased ( $p=0.036$ ) among Saudi populations. The products included honey (84%), black seeds (63%), lemon (54%) and ginger (41%). Furthermore, the distribution of using herbs and natural products was not linked with any socio-demographic factors other than age. Among the population, 69.30% were aware that herbs can improve their immunity but will not protect them from COVID-19. Finally, the current study highlights the undesirable side effects associated with using herbs and natural products in patients with chronic disease and recommends future research to assess the undesirable effects of using herbs in patients with diabetes with a control group.

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## 1. Introduction

Coronavirus disease (COVID-19) is a viral infection caused by a novel coronavirus that was first detected in Wuhan, China, at the end of December 2019. Coronavirus belongs to the common cold virus family that causes respiratory tract infection. COVID-19 infection results in cases that vary from asymptomatic to severe illness that might lead to death (Cascella et al., 2020; Nikolich-Zugich et al., 2020; WHO, 2020c). The World Health Organization (WHO) on 12 March 2020 declared COVID-19 a pandemic disease due to its fast spread worldwide, accompanied by high mortality and morbidity (WHO, 2020b).

An individual's immune system can be likened to an army of antibodies fighting infections and guarding against diseases (Braciale and Hahn, 2013; McComb et al., 2019). Medical informa-

tion about herbs and natural products and the protection they offer from COVID-19 is circulated through social media without much evidence. Most people believe this information and start using the recommended herbs and natural products without any knowledge or awareness of their side effects, thinking that these will protect them from infection. Studies report that natural remedies can help maintain and/or promote individuals' health status, if taken correctly, but cannot prevent infections or cure diseases (Al Akeel et al., 2018; Ang et al., 2020; Lissiman et al., 2014; Mahish et al., 2016). The pathophysiologic mechanisms of COVID-19 are not yet well understood. However, clinical studies have suggested that patients infected with COVID-19 often show increased levels in cytokines, termed 'cytokine storm' (Lordan et al., 2021; Kunnumakkara et al., 2021). This abnormal level of cytokines occurs together with severe deterioration of health in infected patients (Ye et al., 2020). Therefore, suppressing the elevated inflammatory response produced during this disease may be crucial in preventing the severity of COVID-19 in infected patients (Liu et al., 2020). Clinical outcomes demonstrate that a well-

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functioning immune system is established when optimal nutritional status is achieved (Calder et al., 2020). Given the lack of food or supplements authorised to prevent COVID-19, people continue to search for and consume specific herbs, foods and commercial supplements for this purpose (Günalan et al., 2021).

Although natural remedies, such as herbs or natural products can benefit humans, they can also cause severe health problems, especially in elderly (Canter and Ernst, 2004; Dergal et al., 2002) or chronic disease individuals (Benzie and wachtel-galor, 2011). Besides, some of these natural remedies, such as herbs, might interact with conventional drugs if individuals are on treatment (Blalock et al., 2009; Djuv et al., 2013; Izzo and Ernst, 2009). To the best of our knowledge, there is no evidence that natural remedies protect from COVID-19 or cure the disease. The WHO also confirmed lack of evidence of natural remedies protecting from or curing COVID-19 (WHO, 2020a). In general, the Saudi Arabian population tends to use natural remedies, particularly herbs, as traditional medicine in the treatment of chronic or non-curable diseases (Aljofan and Alkhamaiseh, 2020; Alkhamaiseh and Aljofan, 2020). Consequently, the prevalence of using natural remedies in the Saudi population is expected to increase due to the COVID-19 pandemic, particularly during its beginning, when no clear treatment plan or vaccine exists. To the best of the authors' knowledge, only one previous study with limitations has assessed the natural remedies used by the Saudi population during the COVID-19 outbreak (Alyami et al., 2020). Therefore, the current study aimed to cover the broad choice of natural products not included in the previous study, in order to estimate the prevalence of using herbs and natural products during the COVID-19 pandemic, determine reasons for using them, and evaluate their potential side effects.

## 2. Methods

### 2.1. Study design and study population

The current study involves an online cross-sectional study applied to a Saudi Arabian population between 1 May and 31 July 2020. Data were collected online using Google Forms. The survey was modified in accordance with a previously published survey (Al Akeel et al., 2018; Awad and Al-Shaye, 2014; Mahish et al., 2016). The format and content of the questionnaire were validated by four experts' assistant professors of molecular and medical immunology, family and pain medicine, preventive medicine and public health, and clinical nutrition. The questionnaire was designed in English and translated into Arabic. The final Arabic questionnaire was pre-tested by the four experts (Arabic native speakers) and 10 volunteers from the general population. The final questionnaire was modified and piloted with 100 target samples based on their feedback. The pilot study population was not included in the main study. In the questionnaire, the definitions of hypertension and hyperglycaemia were written between brackets in front of the terms. Blood pressure is considered high when it is more than 139/89 mmHg (Chobanian et al., 2003; DeGuire et al., 2019), whereas hyperglycaemia is considered when a random plasma level glucose is 200 mg/dL or higher according to the American Diabetes Association.

The questionnaire was designed to start by asking the participants if they had used herbs and natural products as protective measures against the COVID-19 pandemic. If they answered yes, they were requested to proceed to the next part of the survey, which asked them if they were 18 years of age or older. Participants who answered yes in the two previous questions were asked to continue the questionnaire; otherwise, the questionnaire was closed. The next part of the questionnaire consisted of two main sections. The first section (six items) focused on participants'

chronic disease histories and socio-demographic characteristics, such as nationality, age, education level, region of residence in Saudi Arabia and gender. The second section (seven items) enquired about participants' frequency, reason, source of information, pattern, frequency, duration, and undesirable effects of using herbs and natural products as protective measures during the COVID-19 pandemic.

### 2.2. Sampling strategy

Participation in this study was voluntary and undertaken through social media as a convenience sampling method. The questionnaire link was distributed to all participants via Twitter, Snapchat and WhatsApp groups. The beginning of the survey outlined the purpose of the study and the estimated completion time. Participants were included in this study if they were 18 years of age and above, resided in Saudi Arabia, and used herbs and natural products during the COVID-19 pandemic as protective measures. Participants were excluded if they were below 18 years of age and did not use herbs or natural products as protective measures against the pandemic.

### 2.3. Sample size

The sample size was calculated using OpenEpi version 3.0 (Dean et al., 2013), considering the total population of Saudi Arabia, which is about 34.22 million (General Authority for Statistics in Saudi Arabia, 2020). The minimum sample size required for this study to achieve a 5% margin of error, and a 95% confidence interval was 385 participants. However, this study had a larger sample size of 1,054 to minimize the errors.

### 2.4. Ethical approval

Ethical approval was obtained from the Biomedical Ethics Committee, Faculty of Medicine, Umm Alqura University, Approval No. (HAPO-02-K-012-2020-04-378).

### 2.5. Statistical analysis

After the data were extracted, they were revised, coded, and fed into the statistical software IBM SPSS version 22 (SPSS, Inc., Chicago, IL). All statistical analyses were conducted using the two-tailed tests. A P-value of less than 0.05 was considered statistically significant. Descriptive analysis based on the frequency and percentage distribution was performed for all variables, including demographic data, use rates of herbs and natural products, usage patterns, reasons behind usage, and symptoms. Crosstabulation was used to assess the associations between the types of herbs and natural products used and the respondents' socio-demographic data. Moreover, it was used to assess the distribution of reasons for using herbs and natural products according to the participants' education level. Relationships were tested using Pearson's chi-squared test or an exact probability test (for small frequencies).

## 3. Results

### 3.1. Socio-demographic characteristics of the study participants

This study enrolled 1,054 participants who used herbs and natural products during the COVID-19 pandemic. The mean age of the respondents was  $35.1 \pm 12.9$  years (ranging from 18 to 70 years). Most participants were Saudis (95.5%; 1007) and women (77.7%; 819). Regarding region, 491 (46.6%) participants were from the

western region, 318 (30.2%) were from the central region, and the remaining were from other regions. In terms of education levels, most participants had a bachelor’s degree (58.1%; 612) while (17.4%; 183) were postgraduates. Majority of the study population (80.05%; 848) did not report the presence of any chronic diseases, whereas hypertension and diabetes were reported among 73 (6.9%) and 79 (7.5%) participants, respectively (Table 1 in the supplementary data).

3.2. Prevalence and factors influencing the use of herbs and natural products during the COVID-19 pandemic

Results of the current study reveal that 977 of the total 1,054 participants (92.70%) reported using herbs and natural products during the COVID-19 pandemic. Approximately 494 (46.9%) participants, of the total 977, reported using herbs and natural products regularly, whereas 483 (45.8%) reported irregular use. Interestingly, only 77 of the 1,054 participants (7.30%) reported routinely using herbs and natural products before the COVID-19 pandemic. The difference between those who used herbs and natural products before and during the COVID-19 pandemic was statistically significant (P=0.036; Figure 1). This finding indicates that the trend of using herbs and natural products as a protective measure clearly increased during the COVID-19 pandemic among the Saudi population.

Herbs and natural products used most frequently by the participants were honey (84%), black seeds (63%), lemons (54%), ginger (41%), garlic (31%), turmeric (31%), oranges (20%), and onions (17%). The least frequently used herbs and natural products were chilli peppers (5%), sesame oil (4%), and black pepper (3%), as shown in Figure 2.

Regarding the factors influencing the protective use of herbs and natural products in participants during the COVID-19 pandemic, the current study found that 69.3% of participants used them to improve their immunity but not as protection from the COVID-19 infection, 17.2% used them as healthy items to improve their general health, followed by 8.7% who used them to help alleviate COVID-19 symptoms, but not to cure the infection, whereas 3.8% used herbs and food supplements to both reduce the infection’s symptoms and cure it. A mere 1% of the study population

used these natural products to protect themselves from being infected with COVID-19 and felt no need to follow any hygiene precautions. Interestingly, none of the participants selected ‘using herbs and natural products was not related to the strength of the immune system’ option (as shown in Table 1). This indicates that the main factor influencing most of the study population is that herbs and natural products improve the immune system. Considering the source of knowledge that herbs and natural products help improve immunity and might protect from the COVID-19 infection, the three top sources were social media (25.2%), followed by family/friend (21.6%) and previous experience (20.3%), more details about other sources are presented in Table 2.

3.3. Patterns and frequency of using herbs and natural products as protective measures during the COVID-19 pandemic

Based on the analysed data on the methods of using herbs and natural products during COVID-19 pandemic, most participants reported consuming these products directly, uncooked (36.1%), followed by uncooked mixed with honey (17.2%), consuming after soaking them in water for a specified period (16.1%), and boiling in water before consumption (13.8%). Other methods with a low percentage of users are presented in Table 3. Regarding their frequency of use during COVID-19 pandemic, 44.8% of the participants reported having them once daily, 17% had them once weekly, 13.7% had them twice weekly, 11.2% had them irregularly, and 8.5% had them twice daily other frequencies are presented in Table 4.

3.4. Potential adverse effects associated with herbs and natural products’ intake during the COVID-19 pandemic from the participants’ perspective

Figure 3A shows that approximately 16% of the participants experienced adverse effects associated with using herbs and natural products, whereas 84% had no symptoms. The most common adverse effect reported was diarrhoea, which affected 4.5% of the participants, followed by abdominal pain (4.4%), and throat pain (2.5%).

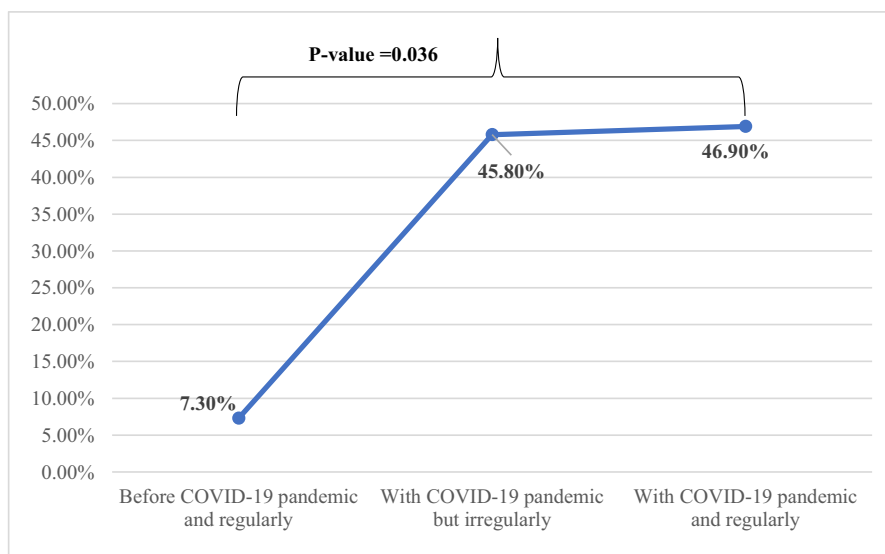


Figure 1. Trend of using herbs and natural products before and during COVID-19 pandemic among population in Saudi Arabia. \*P-value is statistically significant when it is ≤ 0.05.

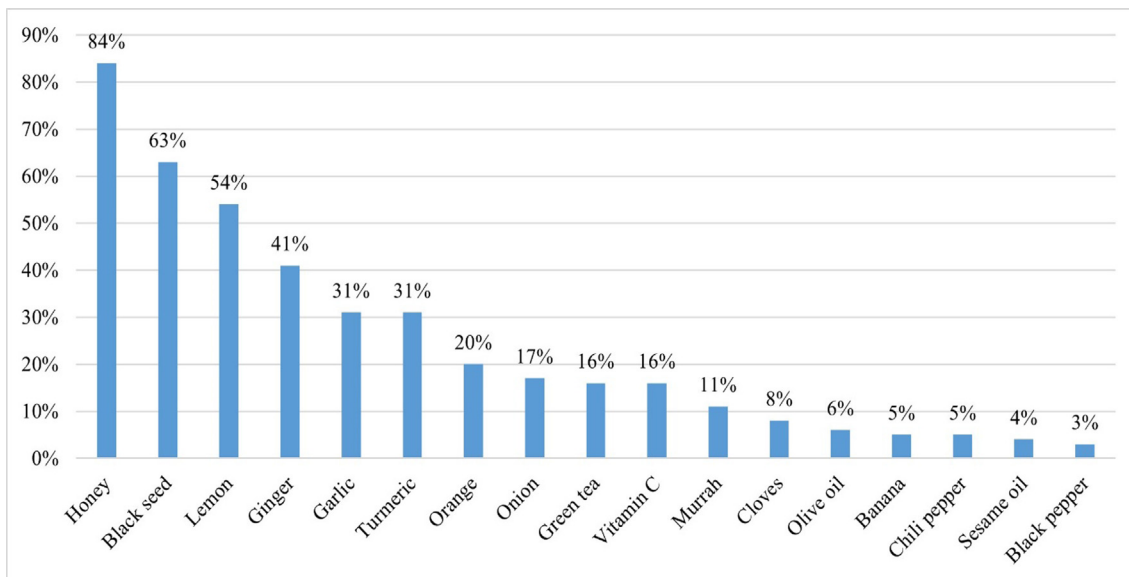


Figure 2. Herbs and natural products used as protective measures against COVID-19 during the pandemic among the population in Saudi Arabia.

Table 1  
Influencing factors for using herbs and natural products in all participants during the COVID-19 pandemic as a protective measure

	%
Improve immunity but do not protect from the COVID-19 infection	69.30%
Healthy item generally improves the health	17.20%
Reduce symptoms but do not cure the infection	8.70%
Reduce symptoms and cure the infection	3.80%
Protect against the COVID-19 infection with no need to follow hygiene precautions	1.00%
Herbs and natural products are not related to the strength of the immune system	0%

Table 2  
Sources of knowing that herbs and natural products can be used as a protective measure during the COVID-19 pandemic

	%
Social media	25.20%
Family/ friend	21.60%
Previous experience	20.30%
Published paper	16.40%
Health care staff	6.90%
Internet (YouTube/ google)	4.70%

Table 3  
Methods of having herbs and natural products as protective measures during the COVID-19 pandemic

	%
Not cooked raw product	36.1%
Not cooked mixed with honey	17.2%
Having after soaking it in water for a specified period	16.1%
Boiled in water and then consumed	13.8%
Not cooked with milk or yoghurt	6.5%
Not cooked with salad	5.9%
All these methods	2.8%
Cooked with milk	0.9%
Cooked with meals	0.7%
Cooked on steam	0.2%

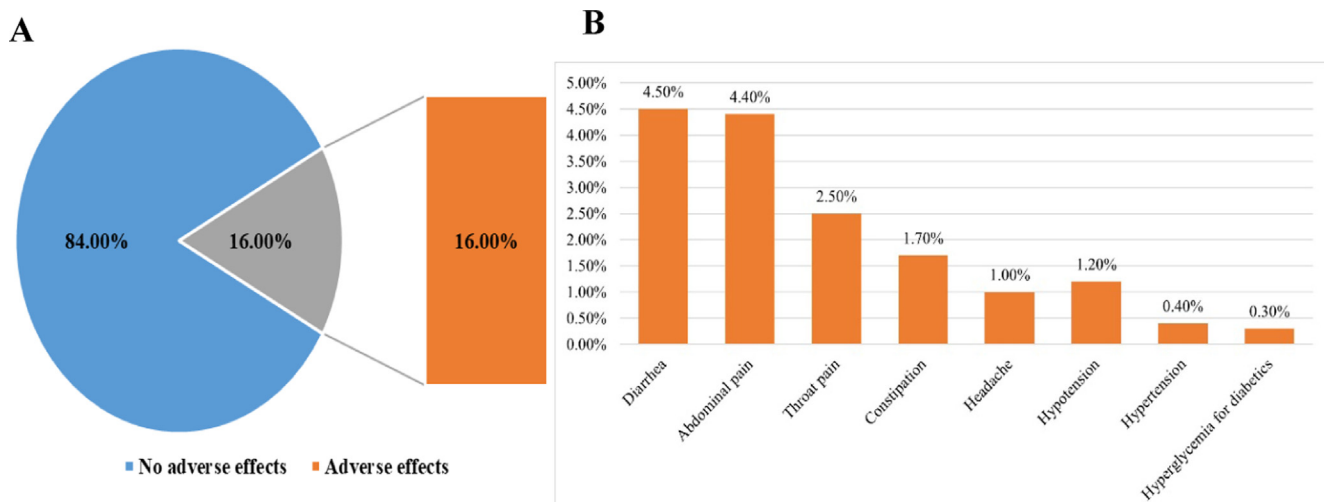
Figure 4 illustrates the participants' associated symptoms with herbs and natural products uses as protective measures during the COVID-19 pandemic.

Table 4  
Frequency of using these herbs and natural products as protective measures during the COVID-19 pandemic

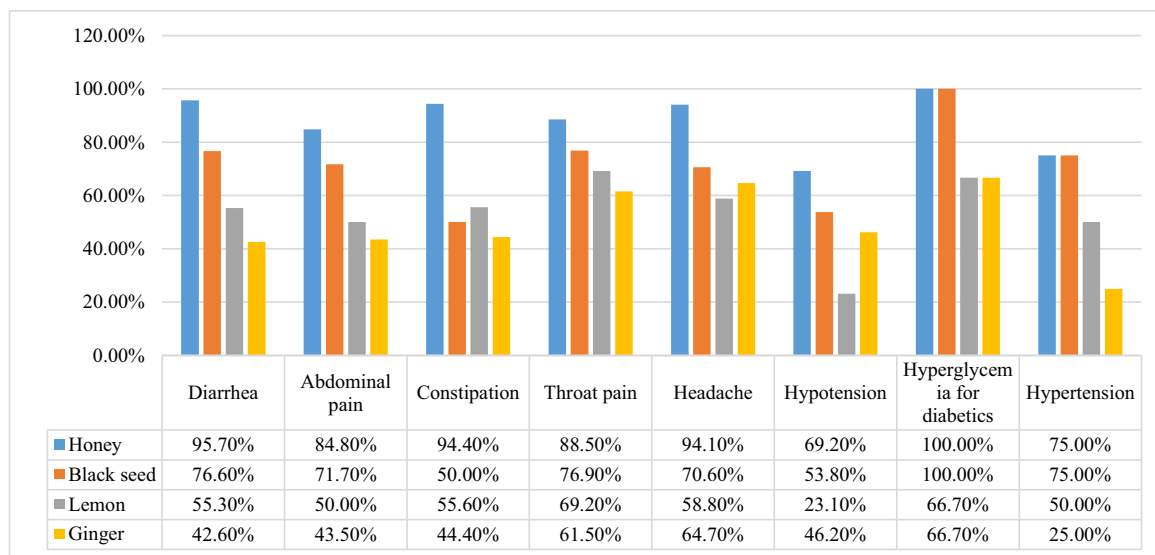
	%
Once daily	44.8%
Once weekly	17.0%
Two times weekly	13.7%
Irregularly	11.2%
Two times daily	8.5%
Three times daily	3.2%
Four times daily	0.7%

Percentages of participants who reported suffering from diarrhoea when they consumed honey, black seeds, and lemons were 95.7%, 76.6%, and 55.3%, respectively. Abdominal pain from consuming honey, black seeds, and lemons was reported in 84.8%, 71.7%, and 50% of participants, respectively. Considering constipation, it was reported by 94.4% of those who consumed honey, compared to 55.6% who consumed lemons, and 50% who consumed black seeds. Headache was reported by 94.1% of those consuming honey, compared to 70.6% of those who consumed black seeds, and 58.8% of those who consumed lemons. Additionally, participants who complained of hypotension when they consumed honey, black seeds, garlic, and ginger were 69.2%, 53.8%, 46%, and 46.2%, respectively. Considering hyperglycaemia in diabetic patients, it was reported among all patients who consumed honey and black seeds. Hypertension was reported in 75% of those who consumed honey and black seeds, compared to 50% who consumed lemons. All these differences were found to be statistically significant ( $P=0.026$ ) (Table 2 in the supplementary data for more details).

Regarding the association between the adverse effects of using herbs and natural products and their frequency of use, current study data showed no statistically significant difference between those who experienced and did not experience adverse effects, or within the group who experienced adverse effects ( $P=0.285$ ) (Table 3 in the supplementary data). However, there was a statistically significant link between the onset of using herbs and natural products and the experience of adverse effects; the  $P$ -value was 0.027 (Table 5). Diarrhoea was reported in 5.3% of those who



**Figure 3.** Potential adverse effects associated with the intake of herbs and natural products during the COVID-19 pandemic from the participants' perspective. A) All participants, B) 16% of participants who had adverse effects.



**Figure 4.** Top four herbs and natural products associated with undesirable effects from the participants' perspective after consuming them as protective measures during the COVID-19 pandemic.

started using them during the pandemic on regular bases, compared to 3.7% and 3.9% of those who used them irregularly during the pandemic and regularly before the pandemic, respectively. Abdominal pain was reported to be more common among 5.2% of those who started using them irregularly during the pandemic, compared to 3.6% of regular consumers during the pandemic, and 3.9% of regular consumers before the pandemic. Considering hypotension, it was reported by 1.2% and 1.4% of those who started using herbs and natural products during the COVID-19 pandemic on regular and irregular bases, respectively, compared to 0% of those who used them before the pandemic.

However, constipation was reported in 2.6% of those who used herbs and natural products before the pandemic compared to 1.6% and 1.7% of those who started using them regularly and irregularly during the pandemic, respectively. Moreover, other adverse effects, such as throat pain, headache, hyperglycaemia for diabetics, and hypertension were reported to be slightly higher in those who used herbs and natural products before the pandemic compared to those who started using them during the pandemic, as presented in Table 5.

### 3.5. Association between socio-demographics and the prevalence of using herbs and natural products as protective measures during the COVID-19 pandemic

Regarding the association of the prevalence of using herbs and natural products as protective measures during the COVID-19 pandemic with current study's variables, such as gender, nationality, and region area, the results show that there is no statistically significant difference between the prevalence of using herbs and natural products and these variables. The P-values were P=0.981 for gender, P=0.963 for nationality, and P=0.803 for region area. The P-value is statistically significant when it is ≤ 0.05 (Tables 4 in the supplementary data).

Moreover, the results of this study show that there is no association between the participants' educational level and the reasons for using herbs and natural products as protective measures during the COVID-19 pandemic. Generally, the most frequently reported reason among both the highly educated (64.5%) and the poorly educated (64.3%) categories was 'to improve immunity but might not protect from the COVID-19 infection'. This was followed by

**Table 5**  
Distribution of used herbs/ products as associated symptoms from participants' perspective during COVID-19 pandemic by participants' onset of use

Symptoms	The onset of using herbs and natural products			P-value
	Before COVID-19 pandemic and regularly %	With COVID-19 pandemic and regularly %	With COVID-19 pandemic but irregularly %	
No symptoms	90.9%	87.0%	89.9%	.027*
Diarrhoea	3.9%	5.3%	3.7%	
Abdominal pain	3.9%	3.6%	5.2%	
Constipation	2.6%	1.6%	1.7%	
Throat pain	3.9%	3.2%	1.4%	
Headache	3.9%	2.6%	0.2%	
Hypotension	0.0%	1.2%	1.4%	
Hyperglycaemia for diabetics	1.3%	0.0%	0.4%	
Hypertension	1.3%	0.6%	0.0%	

P: Exact probability test.

\*P-value is statistically significant when it is ≤ 0.05.

'healthy item generally improves the health' (21.9% vs. 10.7%), and 'to reduce symptoms but not cure the infection' (9.3% vs. 17.9%) with no statistical significance (P=0.430) (Table 5 in the supplementary data).

However, there was a statistically significant difference (P=0.021) between ages and the prevalence of using herbs and natural products. The most frequently consumed product among the old (75.10%) and the middle-aged groups (57%) was black seeds. This was followed by ginger that 51.70% of the old age group reported consuming, compared to 38.50% of the middle-aged group. Garlic and chilli peppers were reported to be consumed by 44.8% and 10.30% of the old age group, respectively, compared to 24.8% and 3.10% of the middle-aged group, respectively. Interestingly, the prevalence of using Murrah and honey was higher in the young age group (12% and 85.2%, respectively) compared to the old age group (3.40% and 82.8%, respectively), as seen in Table 6.

**Table 6**  
Distribution of used herbs and natural products as protective measures during the COVID-19 pandemic by participants' age.

Herbs and natural products	Age in years			P-value
	Young adult (18-40) %	Middle-aged adult (41-59) %	Old adult (60-70) %	
Honey	85.2%	81.2%	82.8%	0.021*
Black seeds	65.1%	57.0%	75.9%	
Lemon	52.1%	56.7%	55.2%	
Ginger	41.8%	38.5%	51.7%	
Garlic	33.4%	24.8%	44.8%	
Turmeric	32.5%	26.8%	31.0%	
Orange	19.3%	19.4%	27.6%	
Green tea	15.0%	17.7%	17.2%	
Vitamin C	15.0%	16.5%	17.2%	
Onion	18.0%	15.7%	13.8%	
Chili pepper	5.0%	3.1%	10.3%	
Others	9.9%	5.1%	10.3%	
Black pepper	2.4%	2.8%	3.4%	
Sesame oil	3.3%	5.4%	3.4%	
Murrah	12.0%	9.1%	3.4%	
Olive oil	5.9%	6.3%	3.4%	
Cloves	8.5%	8.8%	3.4%	
Banana	4.6%	4.8%	0.0%	

P: Exact probability test.

\*P-value is statistically significant when it is ≤ 0.05.

#### 4. Discussion

Globally, majority of people tend to use herbs, natural food products, and dietary supplements as alternative options to enhance their immune system and decrease the probability of contracting an infection (Ang et al., 2020; Alyami et al., 2020; Braciale and Hahn, 2013; Hwang et al., 2020). This study is a first in the Kingdom of Saudi Arabia that covers the broad use of herbs and natural products during the COVID-19 pandemic. Moreover, this study aimed to determine the factors influencing the use of herbs and natural products during the COVID-19 pandemic, patterns and frequency of their use, and to evaluate their potential side effects. Many previous studies have reported that most people in Arab countries still rely on traditional herbs for healthcare (Alghamdi et al., 2018; Almahasheer, 2020; Naja et al., 2015; Alzweiri et al., 2011; Cecilia et al., 2017; Khalaf and Whitford, 2010). In addition, the use of herbs and natural food products has become popular among the Saudi Arabian population as well (Alghamdi et al., 2018; Almahasheer, 2020). Returning to the hypothesis posed at the beginning of this study, the results clearly showed that the use of these herbs and natural products, during the COVID-19 pandemic increased significantly among the Saudi Arabian population.

Honey is one of the most used natural food products among different populations to strengthen their immunity because of its nutritional value (Aljohar et al., 2018; Battino et al., 2020; Pasupuleti et al., 2017). As highlighted in our study, the main finding is the prevalent use of natural food products, especially honey, black seeds, lemons, ginger, garlic, and turmeric. A study by (Naja et al., 2015) reported similar findings, with honey, black seeds, and garlic being the most commonly used natural products by Lebanese adults. A recent Moroccan study (El Alami et al., 2020) reported that the most frequently used natural products were garlic, olives, onions, and ginger. Moreover, According to Hamulka et al. (2020), interest in and consumption of immune-related compounds and foods, such as vitamins C and D, zinc, omega-3, garlic, ginger and turmeric, has increased during the COVID-19 pandemic.

The findings of the current study highlight that most participants used these products to improve their immunity, but not to protect themselves from the COVID-19 infection. Interestingly, none of the participants selected the option that said that natural products are not related to the strength of the immune system. This indicates that most people in Saudi Arabia believe in the role of natural products in improving immunity in general but are aware that these will not protect them from contracting the COVID-19 infection. In agreement with this finding, a recent study that was conducted among the Saudi population reported that the majority of participants used herbs and nutritional supplements during the pandemic period to boost their immunity and reduce the chances of contracting the COVID-19 infection (Alyami et al., 2020).

Several previous studies have reported that honey, black seeds, lemons, ginger, and garlic could help in boosting an individual's immunity and strengthen the immune system in general, not just related to the COVID-19 infection (Daliri et al., 2019; Elmowalid et al., 2019; Sultan et al., 2014; Wang et al., 2018). However, according to the WHO, no studies until now have proven that these products will protect individuals from contracting the COVID-19 infection (WHO, 2020a).

Previous studies have shown that some herbal and natural products might be a safe choice as alternative medicine with low risk of side effects (Barry, 2018; El Khoury et al., 2016). Our study confirmed this, as most participants reported that using these products was safe and did not result in any side effects. However, approximately 16% of participants experienced adverse effects

such as diarrhoea, abdominal pain, constipation, and hyperglycaemia for diabetics, and these effects were reported to be statistically associated with the onset of using natural products. As most of the participants started using them due to the COVID-19 pandemic, they were not accustomed to them before. This might have disturbed their digestive systems. In agreement with the current study's observation, several studies have reported that uncontrolled use or overdose of herbs and natural products results in mild to severe adverse effects (Boullata and Nace, 2000; Ekor, 2014) and a high possibility of a herb-drug interaction (Boullata and Nace, 2000; Parvez and Rishi, 2019). Although these effects are from the participants' perspective and not evaluated by their doctors, they might be serious, especially for chronic disease patients. The current study reported that all diabetic participants suffered from hyperglycaemia, especially those who used honey, black seeds, and ginger. In line with this finding, high blood glucose levels were reported in diabetic patients after consuming natural honey for eight weeks (Bahrami et al., 2009; Zamanian and Azizi-Soleiman, 2020).

The participants' sources of information about the use of herbs and natural products were based on social media posts, family traditions and friends' advice. In contrast to individuals from Saudi Arabia, people from the USA and European countries, such as the UK, Germany, Italy and France obtained knowledge about herbs, food products and supplements during the pandemic from the internet (Günalan et al., 2021). However, the accuracy and reliability of all these sources of information remain unclear; hence, their validity is questionable, which may lead to incorrect practices (Sampson et al., 2018; Kothari and Moolani, 2015). Therefore, potential awareness campaigns about ways to find accurate information from credible sources will help increase people's knowledge about the reliability of medical information sources. Our data confirmed that the distribution of herbs and natural products was not linked to any socio-demographic factors other than age. The current study reported that the most frequently consumed herbs and natural products among the old age group were black seeds, ginger, garlic, and chilli pepper, whereas honey and murrhah were more popular in the young age group. This finding is supported by a recent study in Jordan, which also reported that herbal medicine use was not associated with any demographic factors other than age (El-Dahiyat et al., 2020). This might be due to the extreme difference in the daily life of the two age groups or their different flavour preferences.

To the best of the authors' knowledge, the current study represents the first of its kind in Saudi Arabia to identify the prevalence of different choices of herbs and natural products, associated factors influencing their use, and the associated adverse effects of using them during the COVID-19 pandemic. The most important result indicated a significant increase in the trend of using herbs and natural products among Saudi populations, due to the COVID-19 pandemic. Moreover, the distribution of herbs and natural products was not linked with any socio-demographic factors except age. Finally, based on the self-assessment, the current study highlights the undesirable side effects associated with using herbs and natural products on patients with diabetes. Therefore, the current study recommends the conduct of research to assess the undesirable effects of using herbs in patients with diabetes with a control group. Furthermore, the study recommends raising the awareness of patients with chronic disease and general practitioners to use these herbs and natural products wisely.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Author Contributions

Alotiby, A contributed to the design and implementation of the research. Alotiby, A and Al-Harbi, L contributed equally to the analysis of the results, to the writing of the manuscript, to revise it critically for important intellectual content and gave final approval of the version to be published.

#### Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jsps.2021.04.001>.

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