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Diets and dietary supplements used during the COVID-19 pandemic in the United Arab Emirates: A cross-sectional survey



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ABSTRACT

Introduction: Since the beginning of the Coronavirus disease 2019 (COVID-19) pandemic, there has been a marked increase in the use of diets and dietary supplements (DDS) for the prevention and treatment of this emerging disease. While DDS are generally regarded as harmless, little evidence exists on the safety and efficacy of their use for COVID-19.

Objectives: To investigate the pattern and determinants of DDS use among the United Arab Emirates (UAE) population for the prevention and treatment of COVID-19.

Design: Cross-sectional web-based survey.

Setting: Adults residing in the UAE.

Participants: Participants (n = 2,060) residing in the UAE were recruited from databases of the Supreme Council for Family Affairs - Sharjah networks in the various Emirates.

Primary and Secondary Outcomes: Prevalence and determinants for the use of different DDS for the prevention and treatment of COVID-19 in the UAE, and sources of information for DDS use.

Results: The majority of participants reported using a form of the DDS understudy, with special foods being the most common (95.5%), followed by intake of citrus fruits (62.1%), supplements use (56.6%), increased water intake (50%), and herbal teas (38.4%). Only 20% of participants reported the main source of information on DDS to be health care practitioners, with the majority relying on either social media (40.4%) or family and friends (28.7%). After adjustment, female gender, older age (>40 years), and Asian ethnicities were characteristics associated with higher odds of using most of the DDS modalities and were also correlates of reporting health care practitioners as the main source of information for their DDS use.

Conclusions: The findings showed widespread use of DDS for the prevention and treatment of COVID-19. The use of DDS in this study was mainly guided by social media with a marginal role of health care practitioners. These findings call for a more integrative approach towards DDS to ensure its proper and safe use.

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1. Introduction

The Coronavirus Disease 2019 (COVID-19) has caused an unprecedented global public health crisis that has affected >200 countries, challenging the capacity of healthcare systems, governments, and societies worldwide to respond and contain this pandemic (WHO, 2020). According to the World Health Organization (WHO), >175,850,000 confirmed infections and >3.8 million deaths have been recorded due to coronavirus up until June 2020 (WHO, 2020). The pressure to mitigate the COVID-19 morbidity and mortality has pushed the scientific community to develop, test, and approve multiple vaccines against COVID-19 at record speed. However, the fast production of the vaccines, as well as the surge of misinformation and conspiracy theories propagated by the media related to the vaccines' origins, side effects, and development process, have caused concerns among the public around the safety and effectiveness of these vaccines (Kerr et al., 2021). Amid the fear of the vaccine, its low supply in many parts of the world, and the persisting risk of COVID-19, interest in alternative remedies, such as diets and dietary supplements (DDS), that may enhance the immune function and reduce the risk of inflammation, remains high (NIH, 2021). DDS include all functional foods, vitamins, minerals, herbal products, essential oils, and other dietary supplements that are consumed orally to supplement the usual diet (NIHa, 2020).

The influences of dietary intake and nutritional status on immune health are well-documented in the literature (Childs et al., 2019; Moscatelli et al., 2021). Several vitamins and minerals, such as zinc, and vitamins C and D, are needed for the proper functioning of the immune system (Calder et al., 2020). Moreover, recent studies have highlighted the positive effects of certain dietary supplements in patients with COVID-19. In a study conducted on COVID-19 patients of older age, the supplementation of a combination of magnesium, vitamin D, and vitamin B12 was associated with significant reductions in patients' clinical deterioration, need for oxygen support, intensive care support, and need for both (Tan et al., 2020). Self-reported omega-3 supplementation >3 times per week for a minimum of 3 months was also associated with a lower risk of COVID-19 infections in the United Kingdom, United States, and Sweden (Louca et al., 2021). The potential effects of supplementing vitamin C, zinc, vitamin D, and probiotics on COVID-19 outcomes have also been explored with mixed results, and several studies are also still underway (NIH, 2021). While such nutritional strategies may prove effective to prevent or treat COVID-19, the quality and quantity of the currently available evidence are insufficient to support recommendations for or against the use of DDS in COVID-19 (NIH, 2021). An analysis of 13 guidelines on nutrition during the pandemic showed that in eleven documents, the role of DDS in COVID-19 prevention was not addressed, while in the remaining two, the authors noted that dietary supplements use was acceptable but only to meet the nutrients' recommendations (de Faria Coelho-Ravagnani et al., 2021). Moreover, to date, the Food and Drug Administration (FDA) did not authorize the use of any dietary supplement for the prevention or management of COVID-19 and recommends not exceeding the Recommended Daily Allowances (RDAs) (FDA, 2021).

Despite the inadequate evidence, a soar in the sales of dietary supplements has been reported in many parts of the world. In the United States, the sales of zinc and elderberry supplements rose by as much as 255% and 415% respectively in a period of one week during the month of March 2020 (Grebow, 2020). Pharmacies in the United Arab Emirates (UAE) have similarly witnessed a dramatic spike in the demand for immune-related supplements, which has reached 200% for some (Kumar, 2021). A Google Trends analysis study that analyzed google searches worldwide highlighted an increased interest in immune-related supplements and

foods such as zinc, garlic, ginger, turmeric, and vitamins C and D (Hamulka et al., 2021). The higher consumption of these compounds was also noted in two cross-sectional studies in Poland, and improving immunity was found to be the main reason for supplementation (Hamulka et al., 2021). Even though DDS may be generally regarded as safe, some of these substances may have a wide range of possible actions, and their uncontrolled use may lead to potentially hazardous interactions with commonly used medications, particularly among the elderly (Abdulla et al., 2019a). For example, garlic and ginger can increase the risk of bleeding when administered with anticoagulants (Moyad, 2010). In the context of COVID-19, irrational supplementation may jeopardize people's health and safety by providing them with a wrongful sense of immunity and distracting them from effective preventative measures (Wiesener et al., 2018). During such a time of the pandemic, the misuse of DDS might be a parallel and covertly occurring epidemic that remains unaddressed (Eboime et al., 2020).

The use of alternative remedies like DDS for the management of diseases in the United Arab Emirates (UAE) as in the Middle East is a widespread practice that has historical, traditional, and religious roots (Ahmed et al., 2015; al Marshedi et al., 2017; AlBraik et al., 2008; DHA, 2011; Ibrahim et al., 2019; Muttappallymyalil et al., 2013; Sridhar et al., 2017). Before the COVID-19 pandemic, studies have estimated the prevalence of DDS use to be between 35% and 39% in the UAE (Abdulla et al., 2019b; Alhomoud et al., 2016; Radwan et al., 2019). The UAE is an ethnically diverse country where the practice and consumption of DDS may vary widely among its population groups. While research is currently focused on examining the clinical effectiveness of DDS for the prevention and management of COVID-19, there exists no evidence on the current use pattern among the UAE population during this pandemic. Therefore, the aim of this study is to investigate the pattern and determinants of the use of DDS among residents of the UAE during the COVID-19 pandemic.

2. Methods

2.1. Study design and participants

In order to investigate the DDS practices among UAE residents for COVID-19 prevention or treatment, a cross-sectional survey was designed and administered to adults aged ≥ 18 years, who are able to read and comprehend either Arabic or English and who were residing in the UAE at the time of conducting the survey. The survey was conducted during May 2020 in the form of a web-based questionnaire that was developed using Google forms. The questionnaire's link was sent to a list of email addresses and phone numbers registered at the database of the Health Promotion Department in the Supreme Council for Family Affairs (SCFA), Sharjah-UAE, and their network in the various Emirates of the UAE ($n = 13,500$). SCFA is an institute that consists of different departments that serve the UAE community. Those departments are engaged in various social, cultural, and health promotion activities and programs that are targeted towards improving the well-being of families in the UAE (Al-Bawaba, 2021). The study purpose, procedure, and time needed to complete the questionnaire were indicated before its start. The informed consent, anonymity, and the voluntary nature of participation were also clearly stated in simple and understandable terms. Once the participants agree on the informed consent, he/she can start filling the questionnaire available in English or Arabic. The study protocol as well as the English and Arabic versions of the consent form and questionnaire were reviewed and approved by the Research and Ethics Committee at the University of Sharjah (REC-20-05-05-01).

2.2. Questionnaire used in data collection

For the purpose of this study, DDS were defined as all functional foods, vitamins, minerals, essential oils, herbal products, and dietary habits/supplements that are consumed specifically in order to prevent and or treat COVID 19. The list of questions that were included in the survey was compiled using multiple approaches. The dietary supplements used to prevent or treat COVID-19 were first identified through a literature search as well as a mapping of the common supplements prevalent on social media platforms. As a result, three main DDS groups were identified: special foods, herbal teas, and vitamins/minerals supplements. Second, these DDS groups were vetted by a multidisciplinary expert panel including a nutritionist, a public health worker, and a community activist, who examined the context specificity of these supplements and proposed two additional DDS groups that were deemed relevant to the UAE context: water and citrus fruit consumption. Specific questions were proposed to cover the consumption of these supplements which were worded in English. Lastly, the draft questionnaire was translated to Arabic by a bilingual native Arabic speaker expert and then translated back to English by a bilingual native English speaker expert. The translated English version was contrasted with the original version in order to ensure the parallel form reliability of the questionnaire. Pilot-testing of both versions of the questionnaire was conducted on a convenient sample of 15 adults in order to check for the clarity, simplicity, and logical flow of the questions. As a result, the final versions of the questionnaires (English and Arabic) were created after rewording certain questions and removing redundant ones.

The final version of the questionnaire consisted of 19 questions and required about 5–7 min to complete. The two main sections of the questionnaire were related to: (1) sociodemographic characteristics and (2) DDS groups consumed for the prevention or treatment of COVID-19. In the sociodemographic characteristics section of the questionnaire (8 questions), participants were asked about their age, sex, marital status, educational level, nationality, place of residence, type of residence (in a house with a garden or yard or an apartment/house with no garden or yard) and employment status. For the DDS use section (9 questions), participants were asked about their use or increased intake of any special foods (excluding citrus fruits), citrus fruits, water, vitamins/minerals supplements, or herbal teas during the COVID-19 pandemic as means to prevent or treat COVID-19. The consumption of citrus fruits was kept as a separate category given the widespread claims on its efficacy to prevent and treat infections. A list of choices for each of these modalities (except for water) was given to participants who were asked to check one or more of these choices they have used. In addition to this list of items for each type of dietary supplement, participants were also given the option to specify any other items, if not included in the list of choices. It is important to note that the DDS use in this section referred to the intentional use of these foods and supplements to prevent or treat COVID 19. Participants were also asked about their source of information for using any of the aforementioned supplements and were given the following options: social media, TV and radio, family and friends, and healthcare practitioners (such as doctors, nurses, dieticians and other members of the healthcare team). A copy of the questionnaire is found in [Appendix A](#).

2.3. Statistical analysis

Data analysis was conducted using IBM SPSS statistics software version 25 for Windows. Descriptive characteristics were presented as frequency and percentage. Simple and multiple logistic regressions were conducted to describe the associations between sociodemographic characteristics and practices related to special

food and dietary supplements use to prevent/treat COVID-19. For these regression analyses, the use (or lack) of any DDS was considered the dependent variable, while the sociodemographic characteristics were considered as independent variables. In order to examine the determinants of indicating a health practitioner as the main source for the use of DDS, simple and multiple logistic regression analyses were conducted. In the adjusted models, in addition to age and sex, variables with a significant p-value (<0.05) at the univariate level were entered in the models. Results of the logistic regression models were expressed as Odds Ratios (OR) with 95% Confidence Intervals (CI). P-values<0.05 were considered statistically significant.

3. Results

3.1. Participants' characteristics

A flow chart describing recruitment is presented in [Fig. 1](#). Out of 13,500 sent links, 2,135 responses were received. Of those, 2,060 were returned with complete answers, resulting in a response rate of 15.8%.

[Table 1](#) describes the sociodemographic characteristics of the study population. One-fourth (24.9%) of the study participants were males, 31.7% were between 18 and 30 years old, 38.4% were between 31 and 40 years old, and 29.9% were older than 40 years. The mean age (\pm SD) of the study population was 36.2 years (\pm 10.05). The majority reported being married or ever married (69%), having a university degree (76%), currently working (74.5%), and living in a house with a garden or yard (60.7%). Over half of the participants (50.7%) were Emiratis, the others were distributed between Arabs (33.4%), Asians (12.4%), Westerns (2.4%), and others (1.1%). The most common place of residence was the emirate of Sharjah (68%), followed by Dubai (11.8%), Ajman (8.8%), Abu Dhabi (5.8%), Ras Al Khaima (RAK) (2.6%), Umm Al Quwain (UAQ) (1.6%), and Fujairah (1.4%) ([Table 1](#)).

3.2. DDS practices

The main DDS practices that were considered in this study and were used to prevent or treat COVID-19 by UAE residents are

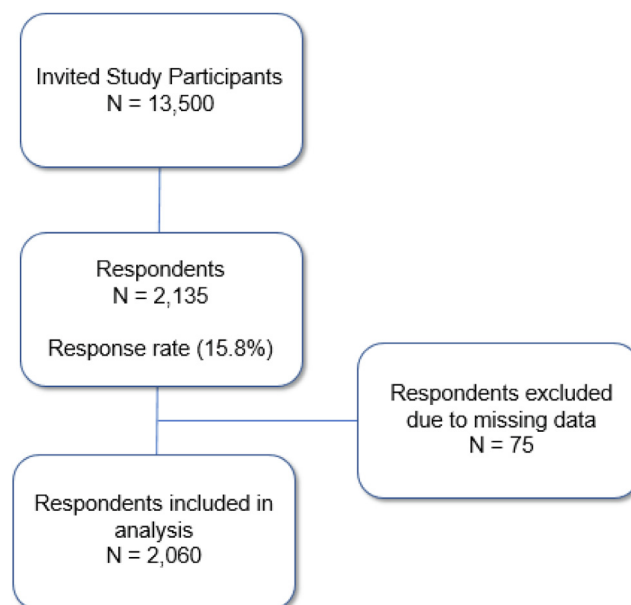


Fig. 1. Recruitment of participants.

Table 1
Sociodemographic characteristics of the study population (n = 2060).

		n	%
Sex	Male	512	24.9
	Female	1548	75.1
Age (years)	18–30	654	31.7
	31–40	791	38.4
	>40	615	29.9
Marital status	Single	639	31.0
	Married/Ever married	1421	69.0
Education	Up to high school & technical diploma	494	24.0
	University	1566	76.0
Nationality	Emirati	1044	50.7
	Arabic	688	33.4
	Asian	256	12.4
	Western	49	2.4
Residence	Other	22	1.1
	Sharjah	1401	68.0
	Dubai	243	11.8
	Ajman	182	8.8
	Abu Dhabi	119	5.8
	Ras Al Khaima (RAK)	54	2.6
	Fujairah	29	1.4
	Umm Al Quwain (UAQ)	32	1.6
Type of living	A house with a garden or yard	1250	60.7
	An apartment/A house with no garden or yard	810	39.3
Working status	Not working	525	25.5
	working	1535	74.5

described in Table 2 and Fig. 2. The majority of the study participants (95.5%) reported increasing their intake of at least one special food to prevent or treat COVID-19, which was the most common DDS practice. The most common special foods reported were dates (88.3%), ginger (87%), onions (81.3%), and garlic (78.9%). Other reported special foods included turmeric (57.9%), black seeds (54.6%), cinnamon (43.6%), and honey (42.2%). The increased intake of citrus fruits in particular was the second most common practice (62.1%). Among those who increased their citrus fruit intake, more than half reported increasing their intake of oranges (57%) and lemons (52.7%), and 8.8% reported increasing their intake of grapefruits. The use of dietary supplements to prevent or treat COVID-19 was reported by 56.6%, and the majorly reported supplements were vitamin C (84.5%), vitamin D (31.6%), and multivitamins (17%). Other supplements used were omega 3 (11.7%), calcium (9.9%), B complex (9.4%), zinc (8%), protein supplements (5.6%), probiotics (4.4%), iron (6.4%), and folic acid (2%). In addition to the intake of special foods, citrus fruits, and dietary supplements, increased water intake to prevent or treat COVID-19 was reported by 50% of the study’s population. Another practice that was noted among the participants is the use of herbal teas as reported by 38.4%. The most commonly used herbal teas were green tea (84.7%), ginger t (56.4%), and thyme (27.4%), (Table 2 and Fig. 2).

3.3. Source of information on DDS

When asked about their source of information for using at least one of the aforementioned DDS practices, only 21% of participants answered “health practitioner”, while the most common answer was “social media” (40%). One-third of the participants (28.7%) reported that their source of information was “family and friends”, and 10% reported getting their information from “TV and radio”. It is however important to note that 45.4% of the study participants did not specify the source of information (Fig. 3).

Table 2
Description of DDS practices to prevent/treat COVID-19 among UAE residents (n = 2060).

		n	%	
Increased special foods to prevent/treat COVID	Yes	1968	95.5	
	No	92	4.5	
Type of special foods (n = 2021)	Date	1737	88.3	
	Ginger	1715	87.1	
	Onion	1599	81.3	
	Garlic	1553	78.9	
	Turmeric	1139	57.9	
	Black Seeds	1075	54.6	
	Cinnamon	859	43.6	
	Honey	830	42.2	
	Walnuts, almonds, and seeds	494	25.1	
	Carrots	375	19.1	
	Chicken Soup	297	15.1	
	Thyme	295	15.0	
	Pomegranate	273	13.9	
Increased citrus fruit intake to prevent/treat COVID-19	Yes	1280	62.1	
	No	780	37.9	
Type of citrus fruits (n = 1280)	Oranges	730	57.0	
	Lemon	674	52.7	
	Grapefruits	112	8.8	
	Others	367	28.7	
	Yes	1031	50.0	
	No	1029	50.0	
Increased water intake to prevent/treat COVID-19	Yes	1165	56.6	
	No	895	43.4	
Supplements used to prevent/treat COVID-19	Type of supplements (n = 1165)			
	Vitamin C	985	84.5	
	Vitamin D	368	31.6	
	Multivitamin	198	17.0	
	Omega 3	136	11.7	
	Calcium	115	9.9	
	B complex	110	9.4	
	Zinc	93	8.0	
	Protein supplements	65	5.6	
	Probiotic	51	4.4	
	Iron	74	6.4	
	Folic Acid	23	2.0	
	Herbal teas use to prevent/treat COVID-19	Yes	791	38.4
		No	1269	61.6
		Type of herbal teas used (n = 791)		
		Green tea	670	84.7
Ginger		446	56.4	
Thyme		217	27.4	
Chamomile		205	25.9	
Cinnamon		153	19.3	
Mixed Herbal	135	17.1		
Others	66	8.3		

3.4. Determinants of DDS use

The sociodemographic determinants of DDS practices used to prevent or treat COVID-19 were examined using simple and multiple logistic regressions and the results are summarized in Tables 3 and 4. Increased intake of special foods was more common amongst Arabic and Asian participants (vs Emirati). Although significant at the crude level, residency and type of living did not reach statistical significance in the adjusted model. After adjustment, factors associated with increased citrus fruit intake were older age (31–40 or >40 years old vs 18–30 years old), being married or ever married (vs single), and being Arabic or Asian (vs Emirati). After adjustment, increased water intake was significantly more likely among older participants, Asians (vs Emirati), those residing in Sharjah (vs Dubai), and those living in an apartment or house with no garden or yard (vs in a house with a garden or yard). Adjusting for potential confounders, females and older adults (>40 years old vs 18–30) were 1.36 and 1.67 times more likely to use vitamins/minerals supplements, respectively. In addition,

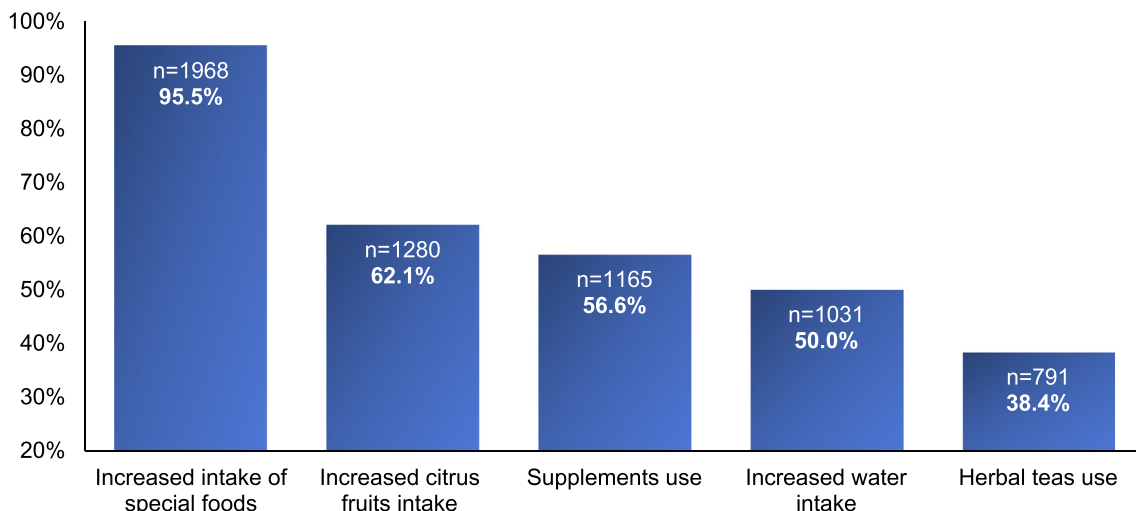


Fig. 2. Practices related to food and dietary supplements used to prevent/treat COVID-19 among UAE residents (n = 2060).

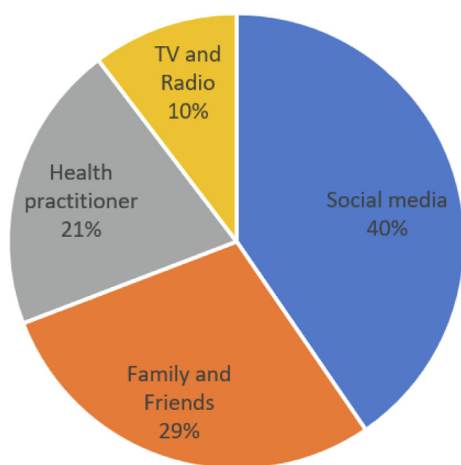


Fig. 3. Source of information of practices related to food and dietary supplements use to prevent/treat COVID-19*. *Percentage among the pool of answers excluding those who did not specify.

tion, results have shown that currently working participants and those living in an apartment or house with no garden or yard were 1.28 and 1.47 times more likely to use supplements, respectively. Increased herbal tea use was more likely among females, older adults, Asian participants, and participants residing in Sharjah, RAK, UAQ, and Ajman (vs Dubai) (Table 4).

Table 5 summarizes the logistic regression analyses examining the associations between sociodemographic characteristics and the odds of indicating a health practitioner as source of information with regards to the aforementioned DDS practices used to prevent or treat COVID-19. Results have shown that after adjusting for potential confounders, females, older adults (>40 years old vs 18–30), married, and Asian participants (vs Emirati) were more likely to indicate a health practitioner as a source of information. (Table 5).

4. Discussion

This study is the first to investigate the prevalence and determinants of DDS use among the UAE population during the COVID-19 pandemic. Our findings indicated that a sizable proportion of the UAE population use at least one type of food or supplement to pre-

vent or treat COVID-19. Despite the limited literature on DDS use during the COVID-19, our findings are consistent with the DDS use patterns observed in other countries during this pandemic and highlight a significant increase in the demand for dietary supplements compared to pre-pandemic figures. In Saudi Arabia, a recent survey revealed that 93% of the population used natural or herbal products to improve their immunity during the COVID-19 pandemic, noting a remarkable increase in the percentage of people who use natural or herbal products regularly, from 7.3% before the pandemic to near 46% (Abdullah Alotiby and Naif Al-Harbi, 2021). Reports from Poland have also highlighted a dramatic increase in the proportion of people who started using DDS during the pandemic (Hamulka et al., 2021). A population-based cross-sectional survey has also shown a prevalent use of dietary supplements, natural remedies, vitamins, and minerals during the first three months of the pandemic among the majority of the populations in the Netherlands (59.4%), Sweden (50%), and Norway (72.8%) (Nordberg, 2021). The increased dependence on DDS during the COVID-19 pandemic could be a reflection of people's frustration and increased urgency to take charge of protecting their health. Furthermore, DDS are generally widely available and easily accessible in the UAE and can be bought over the counter in many outlets across the country, or over the internet without any supervision (AlBraik et al., 2008).

Among the investigated DDS practices in this study, the intake of special foods (dates, ginger, onions, and garlic) was the most prevalent (95.5%), followed by the increased intake of citrus foods (62.1%), supplements (56.6%), water (50%), and herbal teas (38.4%). The intake of special foods for the treatment of diseases is an ancient practice that has historical, cultural, and religious origins in the MENA region (Khalil et al., 2013). For example, dates have long been considered as an effective natural remedy for a wide range of diseases due to their antioxidant, anti-inflammatory, and anti-carcinogenic properties, in addition to their spiritual significance in the Islamic religion. In addition to that, dates are a main commercial crop and a commonly consumed fruit in the UAE and other countries of the Arabian Peninsula (Ismail et al., 2006). As such, given its popularity and acknowledged health value, the observed increased consumption of dates during this pandemic is not surprising, though evidence linking its consumption to positive outcomes in COVID-19 or similar respiratory diseases is lacking. Similarly, the use of garlic as a remedy is an old practice and a considerable body of evidence supports a medicinal value for garlic's unique nutritional and chemical properties

Table 3
Regression analysis of the association between sociodemographic characteristics and DDS practices (increased intake of special foods, citrus fruits, and water) used to prevent/treat COVID-19 (n = 2060).

	Increased intake of special foods				Increased intake of citrus fruit				Increase intake of water			
	OR	95% CI	Adj OR	95% CI	OR	95% CI	Adj OR	95% CI	OR	95% CI	Adj OR	95% CI
Sex (ref: Male)												
Female	0.83	(0.5–1.38)	1.09	(0.64–1.84)	0.85	(0.69–1.04)	1.15	(0.92–1.44)	0.98	(0.8–1.2)	1.17	(0.95–1.45)
Age (ref: 18–30)												
31–40	1.18	(0.72–1.94)	1.17	(0.71–1.95)	1.86	(1.5–2.3)	1.69	(1.33–2.16)	1.68	(1.36–2.07)	1.56	(1.23–1.97)
>40	1.12	(0.66–1.89)	1.07	(0.63–1.83)	2.17	(1.73–2.73)	1.89	(1.45–2.48)	1.86	(1.49–2.33)	1.8	(1.39–2.33)
Marital status (ref: Single)												
Married/Ever Married	0.97	(0.62–1.53)			1.78	(1.48–2.16)	1.35	(1.07–1.7)	1.45	(1.2–1.75)	1.13	(0.91–1.42)
Education (ref: Up to high school)												
University	0.76	(0.45–1.29)			0.87	(0.71–1.08)			0.82	(0.67–1)		
Nationality (ref: Emirati)												
Arabic	2.38	(1.41–4)	2.07	(1.07–4.04)	2.08	(1.7–2.55)	1.86	(1.42–2.44)	1.07	(0.88–1.3)	0.92	(0.71–1.2)
Western	1.03	(0.31–3.42)	0.9	(0.25–3.27)	0.92	(0.52–1.63)	0.75	(0.41–1.38)	0.79	(0.44–1.42)	0.68	(0.37–1.25)
Asian	17.21	(2.38–124.58)	13.75	(1.78–106.18)	3.56	(2.56–4.94)	3.06	(2.07–4.54)	2.82	(2.1–3.8)	2.31	(1.61–3.31)
Others	0.43	(0.12–1.48)	0.39	(0.11–1.4)	1.28	(0.54–3.01)	1.28	(0.53–3.1)	1.15	(0.49–2.67)	1.06	(0.45–2.52)
Residence (ref: Dubai)												
Sharjah	0.84	(0.41–1.72)	0.87	(0.42–1.8)	1.25	(0.95–1.65)	1.32	(0.99–1.77)	1.53	(1.16–2.02)	1.57	(1.18–2.09)
Abu Dhabi	0.38	(0.15–0.94)	0.43	(0.17–1.09)	1.19	(0.76–1.86)	1.36	(0.85–2.16)	1.04	(0.67–1.62)	1.18	(0.75–1.85)
Ras Al Khaima (RAK)	0.48	(0.14–1.62)	0.59	(0.17–2.03)	1.27	(0.69–2.34)	1.63	(0.87–3.04)	1.38	(0.77–2.5)	1.6	(0.87–2.93)
Fujairah	1.08	(0.13–8.82)	1.38	(0.16–11.81)	0.7	(0.32–1.51)	0.82	(0.36–1.85)	1.12	(0.52–2.44)	1.3	(0.59–2.9)
Umm Al Quwain (UAQ)	0.58	(0.12–2.8)	0.65	(0.13–3.18)	1.25	(0.58–2.66)	1.7	(0.78–3.75)	0.72	(0.33–1.57)	0.94	(0.43–2.06)
Ajman	1.71	(0.52–5.65)	1.5	(0.45–5.05)	1.6	(1.07–2.39)	1.45	(0.95–2.22)	1.38	(0.94–2.03)	1.4	(0.93–2.09)
Type of living (ref: House with a garden or yard)												
Apartment/House with no garden or yard	2.41	(1.46–3.99)	1.22	(0.63–2.39)	2.12	(1.75–2.56)	1.27	(0.97–1.66)	1.51	(1.27–1.81)	1.32	(1.02–1.7)
Working status (ref: Not working)												
Working	0.75	(0.45–1.26)			1.06	(0.86–1.3)			1.08	(0.89–1.32)		

Abbreviations: OR: Odds Ratio, adj OR: Adjusted Odds Ratio, CI: Confidence interval. The adjusted models include, in addition to age and sex, all the variables that were significant (p-value < 0.05) at the crude level. Numbers in bold are statistically significant (p-value < 0.05).

Table 4
Regression analysis of the association between sociodemographic characteristics and DDS practices (supplements and herbal teas) used to prevent/treat COVID-19 (n = 2060).

	Supplements use				Herbal teas use			
	OR	95% CI	Adj OR	95% CI	OR	95% CI	Adj OR	95% CI
Sex (ref: Male)								
Female	1.14	(0.93–1.4)	1.36	(1.1–1.68)	1.48	(1.2–1.83)	1.64	(1.31–2.05)
Age (ref: 18–30)								
31–40	1.31	(1.06–1.61)	1.22	(0.97–1.55)	1.35	(1.08–1.67)	1.34	(1.07–1.67)
>40	1.73	(1.38–2.17)	1.67	(1.29–2.16)	1.32	(1.05–1.66)	1.44	(1.14–1.83)
Marital status (ref: Single)								
Married/Ever married	1.24	(1.03–1.5)	1.01	(0.81–1.26)	1.13	(0.93–1.37)		
Education (ref: Up to high school)								
University	0.86	(0.7–1.06)			0.76	(0.61–0.93)	0.87	(0.7–1.07)
Nationality (ref: Emirati)								
Arabic	1.17	(0.96–1.42)			0.8	(0.66–0.98)	0.88	(0.71–1.08)
Western	1.02	(0.57–1.82)			0.81	(0.44–1.48)	0.92	(0.49–1.7)
Asian	1.24	(0.94–1.63)			2.32	(1.75–3.06)	2.5	(1.88–3.34)
Other	1.2	(0.51–2.83)			1.39	(0.59–3.24)	1.37	(0.58–3.27)
Residence (ref: Dubai)								
Sharjah	0.97	(0.74–1.28)			1.44	(1.07–1.92)	1.5	(1.11–2.03)
Abu Dhabi	0.69	(0.44–1.07)			1.07	(0.67–1.71)	1.24	(0.77–2)
Ras Al Khaima (RAK)	0.78	(0.43–1.41)			1.89	(1.04–3.45)	2.15	(1.16–3.97)
Fujairah	0.78	(0.36–1.68)			1.34	(0.6–2.98)	1.53	(0.68–3.47)
Umm Al Quwain (UAQ)	1.38	(0.64–2.99)			2.2	(1.04–4.62)	2.64	(1.24–5.61)
Ajman	0.86	(0.59–1.27)			1.37	(0.92–2.06)	1.58	(1.04–2.4)
Type of living (ref: House with a garden or yard)								
Apartment/House with no garden or yard	1.23	(1.03–1.47)	1.28	(1.07–1.54)	1.19	(0.99–1.42)		
Working status (ref: Not working)								
Working	1.45	(1.19–1.77)	1.47	(1.2–1.83)	0.96	(0.79–1.18)		

Abbreviations: OR: Odds Ratio, adj OR: Adjusted Odds Ratio, CI: Confidence interval.
The adjusted models include, in addition to age and sex, all the variables that were significant (p-value < 0.05) at the crude level.
Numbers in bold are statistically significant (p-value < 0.05).

Table 5
Regression analysis of the association between sociodemographic characteristics and indicating a health practitioner as source of information with regards to the DDS practices to prevent/treat COVID-19.

	OR	95% CI	Adj OR	95% CI
Sex (ref: males)				
Female	1.34	(0.99–1.8)	1.47	(1.07–2.02)
Age (ref 18–30)				
31–40	0.98	(0.73–1.31)	1.27	(0.9–1.78)
>40	1.11	(0.82–1.51)	1.6	(1.11–2.3)
Marital status (ref: Single)				
Married/Ever married	0.67	(0.52–0.86)	0.56	(0.42–0.76)
Education (ref: up to high school)				
University	1.07	(0.8–1.43)		
Nationality (ref: Emirati)				
Arabic	1.38	(1.04–1.84)	1.4	(0.97–2.03)
Western	1.79	(0.85–3.79)	1.78	(0.81–3.93)
Asian	3.66	(2.64–5.07)	3.67	(2.4–5.62)
Other	0.82	(0.19–3.55)	0.83	(0.19–3.65)
Residence (ref: Dubai)				
Sharjah	1.00	(0.68–1.46)		
Abu Dhabi	1.16	(0.64–2.1)		
Ras Al Khaima (RAK)	0.69	(0.28–1.74)		
Fujairah	0.63	(0.18–2.18)		
Umm Al Quwain (UAQ)	1.09	(0.39–3.02)		
Ajman	0.96	(0.56–1.64)		
Type of living (ref: house with a garden or yard)				
An apartment/A house with no garden or yard	1.65	(1.29–2.1)	1.08	(0.77–1.52)
Working Status (ref: Not working)				
Working	0.74	(0.57–0.96)	0.84	(0.63–1.12)

Abbreviations: OR: Odds Ratio, adj OR: Adjusted Odds Ratio, CI: Confidence interval.
The adjusted models include, in addition to age and sex, all the variables that were significant (p-value < 0.05) at the crude level.
Numbers in bold are statistically significant (p-value < 0.05).

(Petrovska and Cekovska, 2010). Due to its rich content in sulfur-producing compounds (e.g. allicin, alliin), garlic is thought to exert anti-biotic, anti-carcinogenic, anti-hypertensive, antioxidant, and anti-lipaemic actions (Rana et al., 2011; Tedeschi et al., 2007). The use of garlic as a natural remedy has also been noted during

previous epidemics like dysentery, cholera, and influenza (Petrovska and Cekovska, 2010). However, a meta-analysis of systematic reviews addressing the role of garlic in respiratory diseases and common cold deemed the evidence to be insufficient and of poor quality (Lissiman et al., 2014). The COVID-19 pandemic has

also caused a high demand for ginger globally (Ayipey, 2020), which is reflected in our study's findings as >80% of participants reported increasing their ginger intake during this pandemic. A considerable body of evidence supports ginger's therapeutic values in pulmonary and inflammatory conditions such as pneumonia, pulmonary fibrosis, and sepsis, which are all pertinent to COVID-19, though a direct link has not been established yet (Panyod et al., 2020; Rodrigues et al., 2018; Shariatpanahi et al., 2010; Thota et al., 2020). The evidence also supports a therapeutic value for other natural products and foods such as turmeric, curcumin, cinnamon, lemon, basil, and pepper, which were also being increasingly consumed by our study's population (Thota et al., 2020). These spices and foods are known to be natural immunity boosters due to their anti-viral, antinociceptive, anti-inflammatory, antipyretic, and anti-fatigue properties, and have therefore been proposed to be effective in the treatment of COVID-19 (Singh et al., 2021). While most of these foods are generally highly tolerated and have no side effects (Thota et al., 2020), it is important to note that their effectiveness in the prevention or management of COVID-19 requires further investigation due to the paucity of data.

This study's findings showed that almost two-thirds of the UAE population had increased their intake of citrus fruits, namely oranges, and around 85% had been taking vitamin C supplements to prevent or treat COVID-19. Both citrus fruits and vitamin C supplements are frequently consumed in common colds and flu-like infections due to the common belief in their immunity-boosting properties (Carr and Maggini, 2017). Similar to ginger, the orange juice market has witnessed a surge in sales during this pandemic, and reports from the United States have indicated a rise of 50.7% in orange juice sales during the period between March and April 2020 compared to the same period of the year before (Heng et al., 2020). In a consumer survey study by Heng et al (2020), 23% of respondents reported that they had increased their purchases of orange juice due to its rich content in vitamin C and other nutrients that support a healthy immune system (Heng et al., 2020). Indeed, the anti-oxidant and anti-viral effects of vitamin C have been well-documented in the literature (Ang et al., 2018; Bellavite and Donzelli, 2020; Carr and Maggini, 2017; Hemilä, 2017; Kim et al., 2013). The evidence on its efficacy in the treatment of respiratory conditions is however equivocal. While some studies show little or no impact, evidence from two Cochrane systematic reviews suggest that a daily vitamin C dose of 1–2 g is safe, inexpensive, and consistently reduces the duration and severity of the common cold in people exposed to increased stress, intense physical exercise, and cold environment, yet has no impact on colds' incidence, duration or severity in the general population (Douglas et al., 2007; Hemilä and Chalker, 2013). In the COVID-19 context, the efficacy and safety of high-doses of vitamin C supplementation are currently under investigation and have not been proven yet (Bellavite and Donzelli, 2020; Carr, 2020; Feyaerts and Luyten, 2020).

Our study has also examined the sociodemographic determinants of DDS use for COVID-19 prevention or treatment in the UAE. The results indicated that females, older adults (>40 years), and expatriates of Asian and Arabic ethnicities were more likely to report using DDS to prevent or treat COVID-19. The positive association between older age and the use of DDS aligns with findings in the literature from the UAE (Rosalia et al., 2017) and elsewhere (Bogale et al., 2018; Kofod et al., 2015). Previous studies have similarly noted sex disparities in DDS use in the UAE (Alomar et al., 2019), and elsewhere (Alqrache et al., 2021; Kofod et al., 2015; Pouchieu et al., 2013), whereby women were shown to use DDS more than men, though some other studies reported contradictory findings (Abdullah Alotiby and Naif Al-Harbi, 2021; Radwan et al., 2019). In this study, individuals of

Asian nationalities were more likely to report using DDS which could be related to the significance of such practices in different Asian cultures and traditions, and to the social and cultural acceptance of DDS as effective treatment modalities in that part of the world (Shim, 2016; Shim and Kim, 2018).

The increased intake of DDS in this study was also associated with the type of living residence suggesting an association between DDS use and lower socioeconomic status. The evidence from the literature on the relationship between the use of DDS and socioeconomic status is inconclusive (Rosalia et al., 2017). However, previous studies from the UAE and from other high-income countries associated the use of alternative remedies including DDS with higher income (Alomar et al., 2019; Clarke et al., 2015; Frass et al., 2012; Kim et al., 2013; Reid et al., 2016). One reason that could explain the divergent results of this study is that the study's survey only included relatively cheap food-based remedies that are affordable for the general population and did not include expensive supplements or other complementary and alternative medicine (CAM) practices like massages and acupuncture, which tend to be more expensive treatments and thus may be unaffordable for individuals of moderate to low income.

Our findings indicated that 40% of the study population depended on social media as the main source of information on DDS use for COVID-19, around 30% depend on information from family members and friends, and only 21% rely on information from healthcare practitioners. Since the beginning of this crisis, social media has played an essential role in the dissemination of health information and recommendations by public health authorities in a cost-effective and timely manner (Jayaseelan et al., 2020). On the other hand, social media platforms have also become channels for the fast propagation of fake news, providing direct and unmediated access to information, which can amplify the spread of rumors and unfounded claims, especially in the lack of certitude and timely, consensus-oriented information from credible sources. For instance, an analysis of Twitter content showed that around 25% of tweets related to COVID-19 contained misinformation (Kouzy et al., 2020). Misinformation could be shared accidentally or fabricated and promoted deliberately for political, profit, or other ulterior motives, creating a state of panic and confusion (Jayaseelan et al., 2020). Therefore, the control of the COVID-19 pandemic is largely dependent on the public's awareness and compliance with the recommended preventative measures as well as their responsible use of social media.

The role of healthcare practitioners is also crucial in the dissemination of COVID-related knowledge and the elimination of public anxiety and confusion as credible sources of health information. In the United States, healthcare practitioners have been reported to be the most trusted source of information on COVID-19 even though less than half of the population relied on them for information and more people reported relying on friends instead (Ali et al., 2020; Teske et al., 2020). Such reports are in line with our findings which showed that only one-fifth of the population (21%) in the UAE are relying on healthcare practitioners for information on food and dietary supplements use to prevent or treat COVID-19, and more people are relying on their family members and friends instead. The limited interaction with practitioners during periods of lockdown and curfew as well as the perceived harmlessness and non-invasive nature of DDS could be possible reasons for not disclosing DDS use to healthcare practitioners. Females, older adults, and Asians were found to be more likely to indicate healthcare practitioners as their main source of information about their DDS consumption behaviors which suggests that these sociodemographic subgroups may be more concerned with their health and well-being. Older adults are undoubtedly more likely to have chronic diseases compared to younger adults and thus may visit

healthcare practitioners more often, which could increase the chance of them disclosing their dietary supplement use. Evidence on the effect of gender on the decision to consult healthcare practitioners about the use of complementary and alternative remedies including DDS is scarce and inconsistent (Alidu and Grunfeld, 2017; Kelak et al., 2018; Thomson et al., 2012).

4.1. Strengths and limitations

To the best of the authors' knowledge, this is the first study to examine the prevalence and determinants of DDS use in the UAE during the COVID-19 pandemic. Therefore, the results of this study fill a major knowledge gap on the prevalence and drivers of DDS use during this pandemic, which is essential to planning educational strategies and developing recommendations for the safe and effective use of dietary supplements during the current public health crisis. Among the strengths of the online survey, we mention the ability to reach the population residing in different Emirates and geographical areas in addition to the speed of data collection.

The findings of this study are ought to be considered in light of a few limitations. The data was collected through a self-completed questionnaire. Although this data collection method eliminates a potential interviewer bias and social desirability bias, the possibility that subjects may have misread or misunderstood certain questions could not be ruled out. Furthermore, a self-selection bias could have taken place, and subjects interested in DDS were more likely to participate in the survey. In addition, the cross-sectional nature of the study design does not generally allow the inference of causation, however, in the context of this study, reverse causation is unlikely. Moreover, it is important to note that the study population is younger and consists of a larger proportion of women as compared to the general population of the UAE; which may limit the generalizability of the study's findings. Such a limitation, however, is a general concern with online surveys which might exclude a non-negligible part of the population who don't use the internet or are less keen on using it. Lastly, although the questionnaire used in this study was examined for its content validity and cultural adaptability, future studies are encouraged to use available validated questionnaires designed specifically to examine the DDS.

5. Conclusion

This study provided key insights on the prevalence and determinants of DDS use in the UAE during the COVID-19 emerging pandemic. Our findings showed widespread use of DDS for the prevention and treatment of COVID-19, with the most common practice being the intake of special foods, followed by the intake of citrus fruits, then supplements, water, and herbal teas. Older age, female gender, and Asian ethnicities were consistently associated with higher use of DDS. The majority of DDS users were guided by social media platform or by family and friends, and only 21% consulted healthcare practitioners about their DDS use. The pattern of DDS use observed in this study may have been deemed safe for diseases with better documented knowledge on etiology, susceptibility, and outcomes. However, given the unpredictability of the COVID-19 scenario and given the lack of evidence, uncontrolled and irrational supplementation could lead to potentially hazardous outcomes and side effects, and should therefore remain under caution. The control of this pandemic has been and continues to be largely dependent on the public's awareness and adherence to the recommended preventative measures, as well as their responsible behaviors with regards to using dietary supplements and sharing information. The role of healthcare practitioners in

awareness raising efforts should be promoted. This study indicates that the use of DDS for the prevention and management of COVID-19 is a prevalent practice in the UAE and provides evidence to elicit a more integrative approach towards DDS to ensure their proper and safe use. Given the novelty of this disease, higher quality studies should be conducted in order to confirm the benefits of DDS in the current pandemic and before making recommendations for or against their use in the prevention or management of COVID-19.

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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Contributors

HR, ERS and MAK conceived the initial research questions. HR, ERS, MAK and HH coordinated the data collection. HH and NA had full access to the study's data and take responsibility for the integrity and accuracy of the data analysis. FN, HR and NA completed the statistical analysis. FN supervised the conduct of the research. HR, FN and ZJ drafted the initial paper. HR, HH, ZJ and FN critically reviewed the write up of the manuscript. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Patient and Public Involvement statement

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination plans of our research.

Appendix A. Survey to assess the use of DDS during COVID-19 in the UAE

Information About You

- 1- Age *
- 2- Gender *

- Male
- Female

- 3-Marital status *

- Married
- Single
- Divorced
- Widowed

4- What is your nationality ?

- Emirati
- Arabic
- Western
- Asian
- Other:_____

5- Education *

- High school diploma or less
- University

6- Residence at----- *

- Abu Dhabi
- Sharjah
- Dubai
- Ajman
- UAQ
- RAK
- Fujairah

7- Are you living in: *

- An apartment/house with no garden
- A house with a garden or yard

8- Are you working? *

- Yes
- No

9- If yes, are you working from home?

- Yes
- No

Nutrition Intake

10- Did you increase your citrus intake during the corona outbreak to specifically prevent or treat Covid-19? *

- Yes
- No

11- If yes, which of the following citrus fruits did you consume the most?

- Lemon
- Orange
- Grapefruit
- Others

12- Did you increase your intake of any food /food groups (other than citrus) during the corona outbreak to specifically prevent or treat Covid-19? *

- Yes
- No

13- If yes, which of the following foods/food group did you consume to specifically prevent or treat Covid-19 ? (You can choose more than one).*

- Onion
- Date

- Ginger
- Garlic
- Turmeric
- Black Seeds
- Cinnamon
- Honey
- Walnuts, almonds and seeds
- Carrots
- Chicken Soup
- Thyme
- Pomegranate
- Beets
- Others

14-Did you use any dietary supplement during the corona outbreak to specifically prevent or treat Covid-19? *

- Yes
- No

15-If yes, which of the following supplements you used to specifically prevent or treat Covid-19 ? (You can choose more than one) *

- Vitamin C
- Vitamin D
- Multivitamin
- Omega 3
- Calcium
- B complex
- Zinc
- Protein supplements
- Probiotic
- Iron
- Folic Acid

16-Did you increase your water intake during the corona outbreak to specifically prevent or treat Covid-19?

- Yes
- No

17- Did you drink any herbal teas during the COVID-19 Pandemic to specifically prevent or treat Covid-19? *

- Yes
- No

18- If yes, which of the following herbal teas did you drink to specifically prevent or treat Covid-19? *

- Green tea
- Ginger
- Thyme
- Chamomile
- Cinnamon
- Mixed Herbal
- Others

19-In case you have increased your intake of any specific food including citrus, water, herbal teas or have taken any a form of supplement to prevent or treat COVID-19, what was your source of information ? *

- Social media
- TV and Radio

- Healthcare practitioner (such as doctors, nurses, dieticians and other members of the healthcare team)
- Family and friends
- Did not consult anybody

References

- Abdulla, N.M., Aziz, F., Blair, I., Grivna, M., Adam, B., Loney, T., 2019a. Prevalence of, and factors associated with health supplement use in Dubai, United Arab Emirates: a population-based cross-sectional study. *BMC Complem. Alternative Med.* 19, 172. <https://doi.org/10.1186/s12906-019-2593-6>.
- Abdulla, N.M., Aziz, F., Blair, I., Grivna, M., Adam, B., Loney, T., 2019b. Prevalence of, and factors associated with health supplement use in Dubai, United Arab Emirates: A population-based cross-sectional study. *BMC Complem. Alternative Med.* 19 (1). <https://doi.org/10.1186/s12906-019-2593-6>.
- Abdullah Alotiby, A., Naif Al-Harbi, L., 2021. 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. *Saudi Pharmaceut. J.* 29 (5), 410–417. <https://doi.org/10.1016/j.jsps.2021.04.001>.
- Ahmed, S., Shaikh, F., Lawal, S., Ogugua, F., Al-Hafeiti, K., Al-Hafri, S., Shaikh, R., 2015. Factors influencing the use of complementary and alternative medicine for musculoskeletal disorders in the United Arab Emirates. *Hamdan Med. J.* 8, 137. <https://doi.org/10.7707/hmj.371>.
- al Marshedi, S., al Samahi, E., Mohammed, M.A., Darwish, E., al Fahim, M., 2017. Citation: Shaikhah Al Marshedi et al. Knowledge, Attitudes, and Practice of Complementary and Alternative Medicine in the Abu Dhabi Region. *World Family Medicine/Middle East J. Family Med.* 15, 8–16. <https://doi.org/10.5742/MEWFM.2019.93663>.
- Al-Bawaba, 2021. Supreme Council for Family Affairs | Al Bawaba [WWW Document]. URL <https://www.albawaba.com/company/supreme-council-family-affairs-1070080> (accessed 4.4.21).
- AlBraik, F.A., Rutter, P.M., Brown, D., 2008. A cross-sectional survey of herbal remedy taking by United Arab Emirate (UAE) citizens in Abu Dhabi. *Pharmacoeconom. Drug Saf.* 17 (7), 725–732. <https://doi.org/10.1002/pds.1591>.
- Alhomoud, F.K., Basil, M., Bondarev, A., 2016. Knowledge, attitudes and practices (KAP) relating to dietary supplements among health sciences and non-health sciences students in one of the universities of United Arab Emirates (UAE). *J. Clin. Diagnostic Res.* 10. <https://doi.org/10.7860/CDR/2016/19300.8439>.
- Ali, S.H., Foreman, J., Tozan, Y., Capasso, A., Jones, A.M., DiClemente, R.J., 2020. Trends and predictors of COVID-19 information sources and their relationship with knowledge and beliefs related to the pandemic: Nationwide cross-sectional study. *JMIR Public Health Surveillance* 6. <https://doi.org/10.2196/21071>.
- Alidu, L., Grunfeld, E.A., 2017. Gender differences in beliefs about health: A comparative qualitative study with Ghanaian and Indian migrants living in the United Kingdom. *BMC Psychol.* 5, 8. <https://doi.org/10.1186/s40359-017-0178-z>.
- Alomar, M.J., Bloukh, S., Eid, D.A., 2019. Dietary supplement use, adverse events and related health effects among population of UAE: A cross-sectional study. *Res. J. Pharmacy Technol.* 12, 5627–5632. <https://doi.org/10.5958/0974-360X.2019.00974.0>.
- Alqrache, A., Mostafa, M., Ghabrah, O., Ghabrah, Z., Kamal, N., Ghabrah, T., Atta, H., 2021. Knowledge and Patterns of Dietary Supplement Use among Students Attending King Abdulaziz University in Saudi Arabia: A Cross-Sectional Study 004695802110208 INQUIRY: J. Health Care Organization, Provision, Financing 58. <https://doi.org/10.1177/00469580211020882>.
- Ang, A., Pullar, J.M., Currie, M.J., Vissers, M.C.M., 2018. Vitamin C and immune cell function in inflammation and cancer. *Biochem. Soc. Trans.* 46 (5), 1147–1159. <https://doi.org/10.1042/BST20180169>.
- Ayipey, P., 2020. Impact of Covid-19 on Ginger Export, a Root Crop as Traditional Remedy for Covid-19. *J. Basic Appl. Res. Biomed.* 6, 25–31. <https://doi.org/10.51152/jbarbiomed.v6i1.5>.
- Bellavite, P., Donzelli, A., 2020. Hesperidin and SARS-CoV-2: New light on the healthy function of citrus fruits. *Antioxidants*. <https://doi.org/10.3390/antiox9080742>.
- Bogale, A., MacKay, D., Mitmesser, S.H., 2018. Determinants of Dietary Supplement Use and Compliance by US Adults 640.25–640.25 FASEB J. 31. https://doi.org/10.1096/FASEBJ.31.1_SUPPLEMENT.640.25.
- Calder, P., Carr, A., Gombart, A., Eggersdorfer, M., 2020. Optimal nutritional status for a well-functioning immune system is an important factor to protect against viral infections. *Nutrients* 12 (4), 1181. <https://doi.org/10.3390/nu12041181>.
- Carr, A.C., 2020. A new clinical trial to test high-dose vitamin C in patients with COVID-19. *Crit. Care* 24 (1). <https://doi.org/10.1186/s13054-020-02851-4>.
- Carr, A., Maggini, S., 2017. Vitamin C and immune function. *Nutrients* 9 (11), 1211. <https://doi.org/10.3390/nu9111211>.
- Childs, C.E., Calder, P.C., Miles, E.A., 2019. Diet and immune function. *Nutrients*. <https://doi.org/10.3390/nu11081933>.
- Clarke, T.C., Black, L.L., Stussman, B.J., Barnes, P.M., Nahin, R.L., 2015. Trends in the use of complementary health approaches among adults: United States, 2002–2012. *National Health Statistics Reports* 1.
- de Faria Coelho-Ravagnani, C., Corgosinho, F.C., Sanches, F.L.F.Z., Prado, C.M.M., Laviano, A., Mota, J.F., 2021. Dietary recommendations during the COVID-19 pandemic. *Nutr. Rev.* 79, 382–393. <https://doi.org/10.1093/nutrit/naaa067>.
- DHA, 2011. Traditional, Complementary and Alternative Medicine Scope of Practice. Douglas, R.M., Hemilä, H., Chalker, E., Treacy, B., 2007. Vitamin C for preventing and treating the common cold. *Cochrane Database Syst. Rev.* <https://doi.org/10.1002/14651858.CD000980.pub3>.
- Eboreime, E.A., Iwu, C.J., Banke-Thomas, A., 2020. Any and every cure for covid-19: An imminent epidemic of alternative remedies amidst the pandemic? *Pan Afr. Medical J.* 35, 1–4. <https://doi.org/10.11604/pamj.supp.2020.35.108.24728>.
- FDA, 2021. Fraudulent Coronavirus Disease 2019 (COVID-19) Products | FDA [WWW Document]. URL <https://www.fda.gov/consumers/health-fraud-scams/fraudulent-coronavirus-disease-2019-covid-19-products> (accessed 6.16.21).
- Feyaerts, A.F., Luyten, W., 2020. Vitamin C as prophylaxis and adjunctive medical treatment for COVID-19? *Nutrition* 79–80, 110948. <https://doi.org/10.1016/j.nut.2020.110948>.
- Frass, M., Strassl, R.P., Friehs, H., Müllner, M., Kundi, M., Kaye, A., 2012. Use and acceptance of complementary and alternative medicine among the general population and medical personnel: a systematic review - PubMed [WWW Document]. URL <https://pubmed.ncbi.nlm.nih.gov/22438782/> (accessed 4.4.21).
- Grebow, J., 2020. Dietary supplement sales skyrocket during coronavirus pandemic [WWW Document]. *Nutritional Outlook*. URL <https://www.nutritionaloutlook.com/view/dietary-supplement-sales-skyrocket-during-coronavirus-pandemic> (accessed 6.16.21).
- Hamulka, J., Jeruszka-Bielak, M., Górnicka, M., Drywień, M.E., Zielinska-Pukos, M.A., 2021. Dietary supplements during covid-19 outbreak. Results of google trends analysis supported by plifecovid-19 online studies. *Nutrients* 13, 1–17. <https://doi.org/10.3390/nu13010054>.
- Hemilä, H., 2017. Vitamin C and infections. *Nutrients* 9 (4), 339. <https://doi.org/10.3390/nu9040339>.
- Hemilä, H., Chalker, E., 2013. Vitamin C for preventing and treating the common cold. *Cochrane Database System. Rev.* <https://doi.org/10.1002/14651858.CD000980.pub4>.
- Heng, Y., Zansler, M., House, L., 2020. Orange Juice Consumers' Response to the COVID-19 Pandemic 1.
- Ibrahim, O., Rashrash, M., Soliman, S., 2019. Perception and utilization of complementary and alternative medicine (CAM) among University of Sharjah (UOS) students. *Bull. Faculty Pharmacy, Cairo University* 57 (1), 82–87.
- Ismail, B., Henry, J., Haffar, I., Baalbak, R., 2006. Date consumption and dietary significance in the United Arab Emirates. *J. Sci. Food Agric.* 86 (8), 1196–1201. <https://doi.org/10.1002/jsfa.2467>.
- Jayaseelan, R., Brindha, D., Kades, W., 2020. Social Media Reigned by Information or Misinformation About COVID-19: A Phenomenological Study. *SSRN Electronic J.* <https://doi.org/10.2139/ssrn.3596058>.
- Kelak, J.A., Cheah, W.L., Safi, R., 2018. Patient's Decision to Disclose the Use of Traditional and Complementary Medicine to Medical Doctor: A Descriptive Phenomenology Study. *Evidence-Based Complem. Alternative Med.* 2018, 1–11. <https://doi.org/10.1155/2018/4735234>.
- Kerr, J.R., Freeman, A.L.J., Marteau, T.M., van der Linden, S., 2021. Effect of information about COVID-19 vaccine effectiveness and side effects on behavioural intentions: Two online experiments. *Vaccines* 9, 379. <https://doi.org/10.3390/vaccines9040379>.
- Khalil, S.H.A., Zaki, A., Ibrahim, A.M., El-Moughazi, A.M., Khater, A.M., Youssef, A.M., El-Sa'ed, A.T., Rashed, E.M., 2013. Pattern of use of complementary and alternative medicine among type 2 diabetes mellitus patients in Alexandria, Egypt. *J. Egypt. Public Health Assoc.* 88 (3), 137–142. <https://doi.org/10.1097/01.EPX.0000440994.89503.45>.
- Kim, Y., Kim, H., Bae, S., Choi, J., Lim, S.Y., Lee, N., Kong, J.M., Hwang, Y.-i., Kang, J.S., Lee, W.J., 2013. Vitamin C Is an Essential Factor on the Anti-viral Immune Responses through the Production of Interferon- α/β at the Initial Stage of Influenza A Virus (H3N2) Infection. *Immune Network* 13 (2), 70. <https://doi.org/10.4110/in.2013.13.2.70>.
- Kofoed, C.L.F., Christensen, J., Dragsted, L.O., Tjønneland, A., Roswall, N., 2015. Determinants of dietary supplement use - Healthy individuals use dietary supplements. *Br. J. Nutr.* 113 (12), 1993–2000. <https://doi.org/10.1017/S0007114515001440>.
- Kouzy, R., Abi Jaoude, J., Kraitem, A., el Alam, M.B., Karam, B., Adib, E., Zarka, J., Traboulsi, C., Akl, E., Baddour, K., 2020. Coronavirus Goes Viral: Quantifying the COVID-19 Misinformation Epidemic on Twitter. *Cureus* 12. <https://doi.org/10.7759/cureus.7255>.
- Kumar, A., 2021. Covid-19: 200% rise in demand for supplements in UAE pharmacies - News | Khaleej Times [WWW Document]. URL <https://www.khaleejtimes.com/coronavirus-pandemic/covid-19-200-rise-in-demand-for-supplements-in-uae-pharmacies> (accessed 6.16.21).
- Lissiman, E., Bhasale, A.L., Cohen, M., 2014. Garlic for the common cold. *Cochrane Database Systematic Rev.* <https://doi.org/10.1002/14651858.CD006206.pub4>.
- Louca, P., Murray, B., Klaser, K., Graham, M.S., Mazidi, M., Leeming, E.R., Thompson, E., Bowyer, R., Drew, D.A., Nguyen, L.H., Merino, J., Gomez, M., Mompeo, O., Costeira, R., Sudre, C.H., Gibson, R., Steves, C.J., Wolf, J., Franks, P.W., Ourselin, S., Chan, A.T., Berry, S.E., Valdes, A.M., Calder, P.C., Spector, T.D., Menni, C., 2021. Modest effects of dietary supplements during the COVID-19 pandemic: Insights from 445 850 users of the COVID-19 Symptom Study app. *BMJ Nutrition, Prevention Health* 4 (1), 149–157. <https://doi.org/10.1136/bmjnp-2021-000250>.
- Moscattelli, F., Sessa, F., Valenzano, A., Polito, R., Monda, V., Cibelli, G., Villano, I., Pisanelli, D., Perrella, M., Daniele, A., Monda, M., Messina, G., Messina, A., 2021. Covid-19: Role of nutrition and supplementation. *Nutrients* 13 (3), 976. <https://doi.org/10.3390/nu13030976>.

- Moyad, M., 2010. Under-hyped and over-hyped drug-dietary supplement interactions and issues - PubMed [WWW Document]. URL <https://pubmed.ncbi.nlm.nih.gov/20359149/> (accessed 6.16.21).
- Muttappallymyalil, J., Sreedharan, J., John, L.J., John, J., Mehboob, M., Mathew, A., Mathew, E., 2013. Self-reported use of complementary and alternative medicine among the health care consumers at a tertiary care center in Ajman, United Arab Emirates. *Annals Med. Health Sci. Res.* 3 (2), 215. <https://doi.org/10.4103/2141-9248.113665>.
- NIH, 2021. Dietary Supplements in the Time of COVID-19 - Health Professional Fact Sheet [WWW Document]. URL <https://ods.od.nih.gov/factsheets/COVID19-HealthProfessional/#en8> (accessed 6.10.21).
- NIH, 2020. Background Information: Dietary Supplements - Consumer [WWW Document]. URL <https://ods.od.nih.gov/factsheets/DietarySupplements-Consumer/> (accessed 6.16.21).
- Kristoffersen, A.E., van der Werf, E.T., Stub, T., Musial, F., Wider, B., Jong, M.C., Wode, K., Danell, J.B., Busch, M., Hoenders, H., & Nordberg, J.H. (2021). Consultations with health care providers and use of self-management strategies for prevention and treatment of COVID-19 related symptoms. A population based cross-sectional study in Norway, Sweden and the Netherlands. *Complementary therapies in medicine*, 64, 102792. Advance online publication. <https://doi.org/10.1016/j.ctim.2021.102792>.
- Panyod, S., Ho, C.-T., Sheen, L.-Y., 2020. Dietary therapy and herbal medicine for COVID-19 prevention: A review and perspective. *J. Traditional Complem. Med.* 10 (4), 420–427. <https://doi.org/10.1016/j.jtcm.2020.05.004>.
- Petrovska, B., Cekovska, S., 2010. Extracts from the history and medical properties of garlic. *Pharmacogn. Rev.* 4 (7), 106. <https://doi.org/10.4103/0973-7847.65321>.
- Pouchieu, C., Andreeva, V.A., Péneau, S., Kesse-Guyot, E., Lassale, C., Hercberg, S., Touvier, M., 2013. Sociodemographic, lifestyle and dietary correlates of dietary supplement use in a large sample of French adults: Results from the NutriNet-Santé cohort study. *Br. J. Nutr.* 110 (8), 1480–1491. <https://doi.org/10.1017/S0007114513000615>.
- Radwan, H., Hasan, H.A., Ghanem, L., Alnajjar, G., Shabir, A., Alshamsi, A., Alketbi, F., 2019. Prevalence of Dietary Supplement Use and Associated Factors Among College Students in the United Arab Emirates. *J. Community Health* 44 (6), 1135–1140. <https://doi.org/10.1007/s10900-019-00700-2>.
- Rana, S.V., Pal, R., Vaiphei, K., Sharma, S.K., Ola, R.P., 2011. Garlic in health and disease. *Nutr. Res. Rev.* 24 (1), 60–71. <https://doi.org/10.1017/S0954422410000338>.
- Reid, R., Steel, A., Wardle, J., Trubody, A., Adams, J., 2016. Complementary medicine use by the Australian population: A critical mixed studies systematic review of utilisation, perceptions and factors associated with use. *BMC Complem. Alternative Med.* 16, 176. <https://doi.org/10.1186/s12906-016-1143-8>.
- Rodrigues, F.A.d.P., Santos, A.D.d.C., de Medeiros, P.H.Q.S., Prata, M.d.M.G., Santos, T. C.d.S., da Silva, J.A., Brito, G.A.d.C., dos Santos, A.A., Silveira, E.R., Lima, A.Â.M., Havt, A., 2018. Gingerol suppresses sepsis-induced acute kidney injury by modulating methylsulfonylmethane and dimethylamine production. *Sci. Rep.* 8 (1). <https://doi.org/10.1038/s41598-018-30522-6>.
- Rosalia, R., Panjwani, S., Ali, A.A., Hameed, M.M., Hayali, A., Alahmad, A.M., Shirwaikar, A., Shirwaikar, A., 2017. A Cross Sectional Survey on the Knowledge and Attitude towards the Use of Multivitamin Products among the Students of a Medical University in the U.A.E ARTICLE INFO ABSTRACT. *J. Appl. Pharmaceut. Sci.* 7, 201–208. <https://doi.org/10.7324/JAPS.2017.70827>.
- Shim, J.M., 2016. The relationship between the use of complementary and alternative medicine and the use of biomedical services: evidence from East Asian medical systems. *Asia Pacific. Journal of Public Health.* 28 (1), 51–60.2.
- Shim, J.M., Kim, J., 2018. Cross-national differences in the holistic use of traditional East Asian medicine in East Asia. *Health promotion international.* 33 (3), 536–544.
- Shariatpanahi, Z.V., Taleban, F.A., Mokhtari, M., Shahbazi, S., 2010. Ginger extract reduces delayed gastric emptying and nosocomial pneumonia in adult respiratory distress syndrome patients hospitalized in an intensive care unit. *J. Crit. Care* 25 (4), 647–650. <https://doi.org/10.1016/j.jccrc.2009.12.008>.
- Singh, N.A., Kumar, P., Jyoti, Kumar, N., 2021. Spices and herbs: Potential antiviral preventives and immunity boosters during COVID-19. *Phytotherapy Res.* 35, 2745–2757. <https://doi.org/10.1002/ptr.7019>.
- Sridhar, S., Shariff, A., Al Halabi, N., Sarmini, R., Harb, L., 2017. Assessment of perception, experience, and information-seeking behavior of the public of Ras Al-Khaimah, United Arab Emirates, toward usage and safety of complementary and alternative medicine. *J. Pharmacy Bioallied Sci.* 9 (1), 48. https://doi.org/10.4103/jpbbs.JPBS_337_16.
- Tan, C.W., Ho, L.P., Kalimuddin, S., Cherng, B.P.Z., Teh, Y.E., Thien, S.Y., Wong, H.M., Tern, P.J.W., Chandran, M., Chay, J.W.M., Nagarajan, C., Sultana, R., Low, J.G.H., Ng, H.J., 2020. A cohort study to evaluate the effect of combination Vitamin D, Magnesium and Vitamin B12 (DMB) on progression to severe outcome in older COVID-19 patients. medRxiv 2020.06.01.20112334. <https://doi.org/10.1101/2020.06.01.20112334>.
- Tedeschi, P., Maietti, A., Boggian, M., Vecchiati, G., Brandolini, V., 2007. Fungitoxicity of lyophilized and spray-dried garlic extracts. *J. Environ. Sci. Health, Part B* 42 (7), 795–799. <https://doi.org/10.1080/03601230701551459>.
- Teske, K., Tsirigotis, J., Riba, M., Platt, J., Udow-Phillips, M., 2020. Health professionals are the most trusted source of information on COVID-19.
- Thomson, P., Jones, J., Evans, J.M., Leslie, S.L., 2012. Factors influencing the use of complementary and alternative medicine and whether patients inform their primary care physician. *Complem. Therapies Med.* 20 (1–2), 45–53. <https://doi.org/10.1016/j.ctim.2011.10.001>.
- Thota, S.M., Balan, V., Sivaramkrishnan, V., 2020. Natural products as home-based prophylactic and symptom management agents in the setting of COVID-19. *Phytother. Res.* <https://doi.org/10.1002/ptr.6794>.
- WHO, 2020. Coronavirus disease (COVID-19) [WWW Document]. URL https://www.who.int/emergencies/diseases/novel-coronavirus-2019?gclid=CjwKCAjwx6WDBhBQEiwA_dP8rXHMaZhnqelBGF8pzJm7eQJUnSsxIORE4rt8lWhL7dR0iqeUiyELOBoCw4EQAvD_BwE (accessed 4.4.21).
- Wiesener, S., Salamonsen, A., Fønnebo, V., 2018. Which risk understandings can be derived from the current disharmonized regulation of complementary and alternative medicine in Europe? *BMC Complem. Alternative Med.* 18, 11. <https://doi.org/10.1186/s12906-017-2073-9>.