



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Assessment of dietary habits and use of nutritional supplements in COVID-19: A cross-sectional study

Cağla Ayer^{a,1,*}, Adviye Gulcin Sagdicoglu Celep^{b,3}

^a Research Assistant, İzmir Kâtip Çelebi University Faculty of Health Sciences Department of Nutrition and Dietetics, İzmir, Turkey

^b Gazi University Faculty of Health Sciences Department of Nutrition and Dietetics, Ankara, Turkey

ARTICLE INFO

Keywords:
 COVID-19
 SARS-Cov-2
 Nutrition
 Nutritional supplement
 Supplementation

ABSTRACT

Objective: Determine nutritional status and use of food supplements during COVID-19.

Methods: Sample of individuals aged 18–65 participated in study voluntarily. Patients with COVID-19 or individuals with contact were not included. Questionnaire form was prepared based on literature on food supplements and included questions adapted to COVID-19 pandemic.

Results: 488 participants completed the study. Participants' mean age was 26.28 ± 7.64 , %82.0 were female, 88.3% were high educated. During COVID-19, 33.6% exercise less than 150 min/day, 55.1% evaluate their eating habits as good/very good, and number of meals did not change compared to before pandemic (41.8%). 34.2% of participants consume 5–7 cups of water daily during pandemic. Consumption of pastry (54.7%) and green leafy vegetables (49.6%) increased. 78.7% of participants did not use any nutritional supplement, and 51.1% stated that they did not need nutritional supplements. Multivitamin and mineral (16.5%), vitamin D (15.3%), and vitamin C (11.4%) are used the most, and 56.7% have been using these products for 1–3 months. Use of nutritional supplements was recommended mostly by doctors (39.4%). 43.1% stated that they used these products to maintain good health, 21.9% because they felt tired, 13.8% because they did not have adequate and balanced nutrition. 51.0% of those using nutritional supplements benefited, 30.8% had no effect.

Conclusions: Participants did not make significant changes in their eating habits compared to before pandemic, the use of nutritional supplements increased to maintain good health.

1. Introduction

COVID-19 is recognized as a global health problem, first appearing in Wuhan, China and rapidly spreading to many countries [1,2]. According to World Health Organization (WHO) data published on August 18, 2022, the number of cases worldwide was reported to be 590.659.276 and the number of deaths was 6.440.163 [3]. The high number of cases and deaths caused the WHO to define COVID-19 as a virus with a high risk of contagiousness [4].

An adequate and balanced diet is effective in preventing and treating infectious diseases such as COVID-19 [5–7]. To maintain a healthy immune system, WHO recommends increasing the consumption of fresh vegetables, fruits, and unprocessed foods, adequate water consumption (8–10 cups), reducing the consumption of saturated fat, trans fat, salt,

and sugar, and reducing eating outside the home [8]. At the same time, it is recommended not to smoke, to do regular physical activity, to provide an adequate sleep pattern, and to reduce the stress level to support a healthy life in this period [9].

Nutritional supplements are substances with one or more components that contain vitamins, minerals, amino acids, or other substances with a nutritional or physiological effect. The use of nutritional supplements has been increasing in the last decade, and 50–75% of the population routinely use nutritional supplements [10]. Although there is no particularly recommended supplement for reducing the risk of infection from COVID-19, it is of great importance to support the immune system [5]. Supplements obtained from herbal products such as turmeric, echinacea, ginger, tea, carob, black pepper and sumac, various spices, fruits, and vegetables taken in addition to an adequate and

* Corresponding author.

E-mail address: cagla.dalbay@gmail.com (C. Ayer).

¹ orcid.org/0000-0001-6124-7339

² PhD Student, Gazi University Institute of Health Sciences Department of Nutrition and Dietetics, Ankara/Turkey

³ orcid.org/0000-0002-4598-5814

balanced diet may have a supportive effect on the immune system when consumed in appropriate amounts and times [11–13]. Nutritional supplements can show prophylactic and therapeutic effects by reducing the pathological effects caused by COVID-19 [11]. During the one week at the beginning of the epidemic, sales of elderberry, zinc, multivitamin, and vitamin D increased by 415%, 255%, 23%, and 22%, respectively [14]. The outbreak has seen a 365% increase in sales of nutritional supplements in online purchases [15].

This study, it was aimed to determine the nutritional status and the use of nutritional supplements during the COVID-19 outbreak.

2. Material and methods

2.1. Study design and participants

The sample of the study consisted of individuals aged 18–65, healthy and/or sick, living in Turkey. Volunteering is fundamental in the study, and individuals were included in the study with their consent. COVID-19 patients or contacts were not included in the study. The questionnaire form was delivered to the individuals online for 2 months (1st of November, 2020–1st of January, 2021). In the research, it was aimed to reach at least 384 people in the 95% confidence interval [16]. The study was completed with the participation of 488 participants.

2.2. Ethical approval

This study, in which participants participated voluntarily, was conducted by all ethical procedures/standards and the Declaration of Helsinki. The study was approved by Gazi University Ethics Commission (Approval number: 2020–565).

2.3. Research instruments

In the questionnaire used in the study, questions were prepared based on the literature on nutritional supplements and adapted to the COVID-19 epidemic period. It consists of four groups:

2.3.1. Sociodemographic information

In the first part of the questionnaire, socio-demographic information such as age, gender, marital status, and education level of the participants was questioned.

2.3.2. Basic health information

In the second part of the form, basic health information such as smoking status, physical activity level, disease information of the participants, and the changes in these conditions during the pandemic process were questioned.

2.3.3. Nutrition information

In the third part of the form, the number of meals, the conditions of skipping meals, the amount of water consumption, and the change in the consumption states of nutrients during the pandemic process were questioned. It was requested to make a comparison between the date of the first COVID-19 case identified in Turkey, before 11 March 2020, and the date of the survey. To analyze changes in food consumption during the pandemic, each food group was assigned a score: much less consumption (–2), less consumption (–1), the same (0), more consumption (1), and much more consumption (2).

2.3.4. Dietary supplements use and about information

In the last part of the form, basic information about nutritional supplements was questioned and the use cases of these supplements were questioned.

Table 1

Sociodemographic characteristics of participants, general and specific to the lockdown period, by gender.

Variables	Total		Females		Males	
	Mean	± SD	Mean	± SD	Mean	± SD
Age (years)	26.28	± 7.64	24.68	± 5.82	33.56	± 10.29
Body weight (kg)	63.94	± 14.23	63.34	± 14.00	66.64	± 15.01
Body Mass Index (kg/m ²)	23.16	± 4.22	22.90	± 4.11	24.32	± 4.53
Variables	n	%	n	%	n	%
Gender	488	100.0	400	82.0	88	18.0
Education Status						
Low	8	1.6	6	1.5	2	2.3
Moderate	52	10.7	41	10.3	11	12.5
High	353	88.3	75	85.2	428	87.7
Marital Status						
Married	119	24.4	68	17.0	51	58.0
Unmarried	369	75.6	332	83.0	37	42.0
Smoking Status						
Smoker	64	13.1	34	8.5	30	34.1
Non-Smoker	424	86.9	366	91.5	58	65.9
Diagnosed disease status						
Yes	100	20.5	88	22.0	12	13.6
No	388	79.5	312	78.0	76	86.4
Health perception status						
Very bad/Bad	7	1.4	7	1.8	0	0
Moderate	105	21.5	91	22.8	14	15.9
Good/Very good	376	77.0	302	75.5	74	84.1
Regular physical activity /exercise during COVID-19 period						
Do not < 150 min/week	243	49.8	198	49.5	45	51.1
> 150 min/week	164	33.6	138	34.5	26	29.5
Daily food consumption status in COVID-19 period						
Very bad/Bad	45	9.2	38	9.5	7	8.0
Moderate	174	35.7	161	40.3	13	14.8
Good/Very good	269	55.1	201	50.2	68	77.3
Changes in the number of daily meals during COVID-19						
Increased	155	31.8	136	34.0	19	21.6
Decreased	129	26.4	110	27.5	19	21.6
Not changed	204	41.8	154	38.5	50	56.8
Change in skipping meals during COVID-19						
Increased	107	21.9	95	23.8	12	13.6
Decreased	160	32.8	138	34.5	22	25.0
Not changed	221	45.3	167	41.8	54	61.4
Water consumption during COVID-19 period (1 water glass=200 mL)						
1–5 water glass	104	21.3	84	21.0	20	22.7
5–8 water glass	167	34.2	137	34.3	30	34.1
8–11 water glass	138	28.3	114	28.5	24	27.3
> 11 water glass	79	16.2	65	16.3	14	15.9

2.4. Statistical analysis

SPSS 25 (Statistical Package for Social Sciences) package program was used in the statistical analysis of the data obtained from the study. Descriptive results are presented as mean and standard deviation values, while categorical data are presented as a number-percentage. Multiple Response Set was created when evaluating more than one answered question. Binary logistic regression was used to explore the association between sociodemographic characteristics, usual lifestyles, and a cluster of changes in dietary supplements during a pandemic. The results were evaluated at the 95% confidence interval and the significance level of $p < 0.05$.

We used exploratory factor analysis on these variables to identify underlying patterns of change in eating habits during the pandemic. To ensure that factor analysis was appropriate, we used Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, with a KMO value greater than 0.60 used to assess the degree of intercorrelations between variables. Factors were also orthogonally

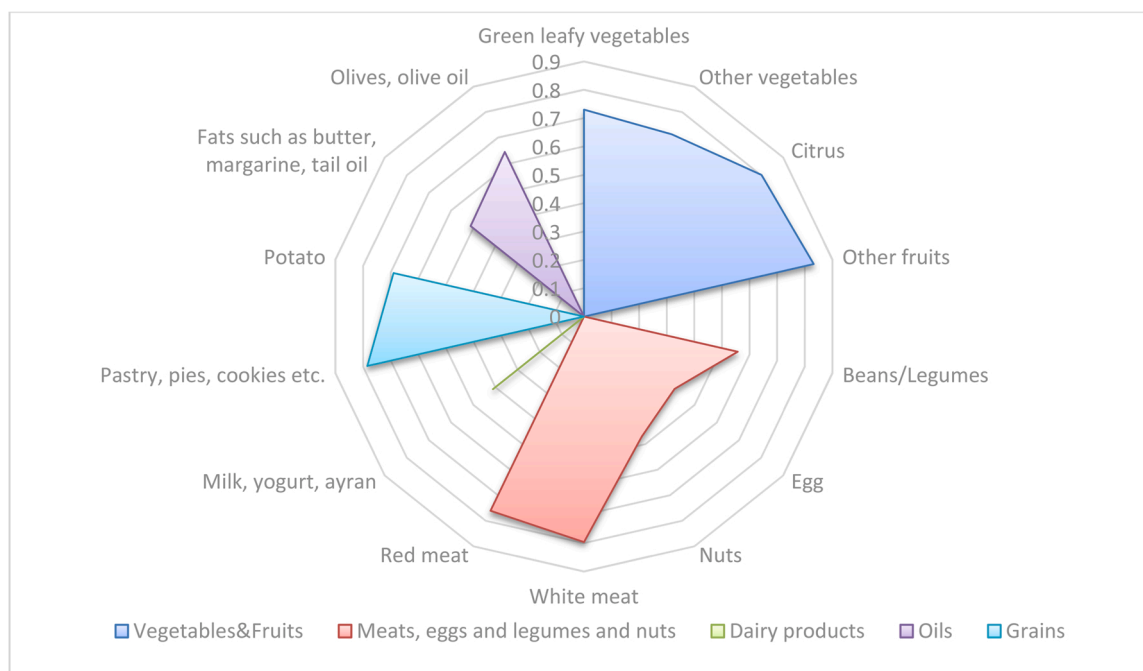


Fig. 1. Changes in the consumption of food groups during the COVID-19 process in Turkey. Factor scores of patterns identified by factor analysis, principal component. Coefficients < 0.30 have been deleted.

rotated (varimax option) to increase the difference in loadings, allowing for easier interpretation. Factors were chosen based on eigenvalues greater than 1.1, the presence of a breakpoint in the scree plot, the proportion of variance explained, and factor interpretability. A rotated factor loading matrix was used to describe the strength and direction of the associations between patterns and food groups. Food groups with factor loadings greater than 0.30 were retained in the identified patterns. The factor score for each pattern was calculated by adding the scores of the component food items and multiplying them by the factor loading. A high factor score for a given pattern indicated a higher change in intake of the foods comprising that food factor, and thus a higher intake; a low score indicated a lower intake of those foods.

3. Results

Table 1 describes the sociodemographic characteristics and usual lifestyles of participants. The mean age of the participants was 26.28 ± 7.64 years, the mean body weight was 63.94 ± 14.23 kg, and the mean body mass index was 23.16 ± 4.22 kg/m². 82.0% of the participants are women, 88.3% are high educated, and 75.6% are unmarried. 79.8% of the participants do not smoke, 79.5% do not have any diagnosed disease and 77.0% find their health status to be good or very good (**Table 1**).

When the participants' regular exercise status was questioned during the COVID-19 process, it was determined that 49.8% did not exercise regularly during this process and 33.6% exercised less than 150 min weekly. During the COVID-19 process, 55.1% of the participants describe their daily food consumption as good or very good, and 35.7% as moderate. It was stated that before the COVID-19 pandemic process, 41.8% of the individuals did not change the number of meals during the pandemic process, while the number of meals increased by 31.8%. 59% of the individuals stated that they skipped meals before the pandemic, while 45.3% of the individuals stated that there was no change in the status of skipping meals and 32.8% stated that the status of skipping meals decreased during the pandemic process. 34.2% of the participants consume 5–7 cups of water daily, and 28.3% consume 8–10 cups of water (**Table 1**). [**Table 1** near here].

Fig. 1 shows factor scores of the matrix of rotating components. The pattern was characterized by shifts toward increased consumption of

green leafy vegetables and bakery products (pastry, pies, cookies, etc.). There was no change in the consumption of milk and dairy products, meat and meat products, legumes, fatty products, and other products compared to the pre-pandemic period (**Fig. 1**). [**Fig. 1** near here].

The nutritional support usage status of individuals during the pandemic process is shown in **Table 2** and **Fig. 2**. 78.7% of the participants do not use nutritional support. The reason for not using nutritional supplements was 51.1% because they did not need it (they don't feel the absence), and 17.2% stated that they did not have any reason (they have no reason to consume or not consume). 56.7% of individuals used nutritional supplements for 1–3 months, and 22.1% have been using these supplements for less than 1 month (**Table 2**). Of the individuals using nutritional support ($n = 104$), 60.2% use vitamin-mineral support, and 39.8% use nutritional support (**Fig. 2A**). Vitamin-mineral supplements, respectively multivitamin and mineral (16.5%), vitamin D (15.3%) and vitamin C (11.4%) (**Fig. 2B**); nutritional support as omega-3 (8.5%), beta-glucan (5.1%), probiotics (4%) and propolis (4%) (**Fig. 2C**) is used. These people were mostly recommended by doctors (39.4%), pharmacists (12.8%), and their relatives or friends (8.5%). These individuals use these supports to maintain good health (43.1%), because they feel tired (21.9%) because they cannot eat well-balanced (13.8%) and to protect themselves from COVID-19 (10.6%). Almost all of the individuals who use nutritional supplements (98.1%) tell their physicians that they use these products. 85.8% of the participants read the label information when purchasing nutritional supplements. Participants are most often informed about nutritional supplements by doctors (19.1%), dietitians (18.9%), and pharmacists (18.1%). 76.7% of the participants buy these supplements products from the pharmacy. Individuals using nutritional supplements stated that 51.0% benefited while using these products, while 30.8% stated that they did not see any effect (**Table 2**). [**Table 2** and **Fig. 2** near here].

Fig. 3 shows the participants' views on whether certain foods and nutrients strengthen the immune system. According to these data, fruits, and vegetables (99.2%), onions and garlic (98.4%), and vitamin C (98.0%) are considered to strengthen the immune system the most. It is believed that L-carnitine (86.5%), honey-molasses (86.7%), and calcium (88.7%) strengthen the immune system the least (**Fig. 3**). [**Fig. 3** near here].

Table 2
Nutritional supplements usage status and related factors.

Variables		Total		Females		Males		
		n	%	n	%	n	%	
Use of nutritional supplement during COVID-19 period	Yes	104	21.3	90	22.5	14	15.9	
	No	384	78.7	310	77.5	74	84.1	
If your answer is "No", the reason for the situation*	Because of the side effects	11	2.5	9	2.5	2	2.2	
	Because they are expensive	27	6.0	19	5.3	8	8.9	
	I don't think they work	44	9.8	29	8.1	15	16.7	
	I don't need it	229	51.1	190	53.1	39	43.3	
	My doctor suggested not to use it	10	2.2	9	2.5	1	1.1	
	I don't think they're safe	42	9.4	37	10.3	5	5.6	
	No reason	77	17.2	58	16.2	19	21.1	
	Another	8	1.8	7	2.0	1	1.1	
	If your answer is "Yes", your nutritional supplement usage period (days)	< 1 month	23	22.1	20	22.2	3	21.4
		1-3 months	59	56.7	52	57.8	7	50.0
3-12 months		16	15.4	13	14.4	3	21.4	
> 12 months		6	5.8	5	5.6	1	7.2	
Person recommending the nutritional supplement	Doctor	37	39.4	34	42.5	3	21.4	
	Dietician	7	7.4	5	6.3	2	14.3	
	Pharmacist	12	12.8	11	13.8	1	7.1	
	Relatives, friends	8	8.5	5	6.3	3	21.4	
	Own decision	27	28.7	23	28.7	4	28.6	
	Social media/media	3	3.2	2	2.5	1	7.1	
Top reasons to use nutritional supplements	To maintain good health	69	43.1	62	45.3	7	31.8	
	For the treatment of my illness	11	6.9	10	7.3	1	4.5	
	For weight loss	5	3.1	3	2.2	2	9.2	
	For feeling tired	35	21.9	30	21.9	5	22.7	
	Because I am not eating enough and balanced	22	13.8	16	11.8	6	27.3	
	Corona to be protected from the virus	17	10.6	16	11.8	1	4.5	
	Another	1	0.6	1	0.7	0	0	
Telling your doctor that you are using nutritional supplements	Yes	102	98.1	92	98.9	10	90.9	
	No	2	1.9	1	0.1	1	9.1	
Status of reading the label on the supplement	Yes	181	85.8	159	90.9	22	61.1	
	No	30	14.2	16	9.1	14	38.9	
Information resource on nutritional supplements	Doctor	88	17.8	80	19.3	8	8.6	
	Pharmacist	111	22.4	99	23.9	13	13.9	
	Dietician	87	17.6	69	16.7	18	19.4	
	Social media	27	5.4	22	5.3	5	5.3	
	Television, radio, newspaper	28	5.6	14	3.4	14	15.1	
	Article, scientific papers	77	15.5	74	17.9	3	3.2	
	Internet	65	13.1	48	11.6	17	18.2	
	I did not get any information	13	2.6	8	1.9	5	5.3	
	Pharmacy	115	76.7	101	77.7	14	70.0	
	Internet	27	18.0	23	17.7	4	20.0	

Table 2 (continued)

Variables		Total		Females		Males	
		n	%	n	%	n	%
Where the dietary supplement is taken	Another	8	5.3	6	4.6	2	10.0
The effect of the nutritional supplement you use	Benefit	53	51.0	45	50.0	8	57.2
	Harm	0	0	0	0	0	0
	Ineffective	32	30.8	29	32.2	3	21.4
	Do not know	19	18.3	16	17.8	3	21.4

Table 3 shows a linear regression analysis of various variables to determine the relationship between the use of dietary supplements and various sociodemographic characteristics and various lifestyle habits. According to this analysis, it was determined that the use of nutritional supplements by men was 2.20 times higher than that of women ($p = 0.040$). The use of nutritional supplements in the 18–34 age group is higher than in the other age groups ($p = 0.002$). It was determined that individuals with a high level of education used nutritional supplements 0.37 times less than individuals with other levels of education ($p = 0.046$). It has been determined that marital status, smoking, diagnosed disease status, and regular physical activity do not affect the use of dietary supplements ($p > 0.05$) (Table 3). [Table 3 near here].

4. Discussion

In this study, different patterns of change in nutrition habits and dietary supplements were identified in adults during COVID-19 in Turkey. 82.0% of the participants are women. The average age of females is 24.68 ± 5.82 , and the average age of males is 33.56 ± 10.29 . The average age was found to be low because young individuals use online platforms more frequently. The mean BMI of females ($22.90 \pm 4.11 \text{ kg/m}^2$) is lower than that of males ($24.32 \pm 4.53 \text{ kg/m}^2$). In a study conducted in Turkey during the pandemic process, the gender distribution of the participants and the body mass index averages by gender were similar [17].

Data showed that the number of people exercising during COVID-19 was decreasing, as was the frequency of outbreaks. Individual inactivity may be explained in this case by a decrease in outdoor exercise. During the COVID-19 pandemic, nearly half of the participants in this study reported not engaging in any physical activity. In the study where Galali (2020) [18] evaluated lifestyle changes during the COVID-19 process, 60% of the participants stated that they did not exercise during the pandemic period. In comparison to other studies, the pictures at the time of the lockdown are remarkably similar [5,17,19–26]. The World Health Organization's Guidelines on Physical Activity and Sedentary Behavior Guide (2020) recommend that adults perform 150–300 min of medium intensity or 75–150 min of high intensity or a combination of medium and high intensity aerobic physical activities weekly [27]. In line with the recommendations developed as a result of COVID-19, especially strengthening, balance and control, stretching exercises are recommended for individuals staying at home [5].

In our study, while 55.1% of the participants defined their food consumption as good/very good during the pandemic process, it was determined that 41.8% of them did not change the number of meals during the pandemic process. Similarly, in another study, 50.3% of the participants think that they do not have unhealthy eating habits [28]. Ozenoglu et al. (2021), it was stated that the number of meals did not change in 56.7% of the participants, and the number of meals in 37% of the participants decreased. [17]. In another study, 53.7% of individuals had 3 main meals before the COVID-19 epidemic, while this rate decreased to 33.7% after the epidemic. However, there has been an increase in the number of snacks [5]. In an Indian study of life changes during the pandemic period, it was discovered that 43.8% of participants did not change their food consumption, while 34.6% increased

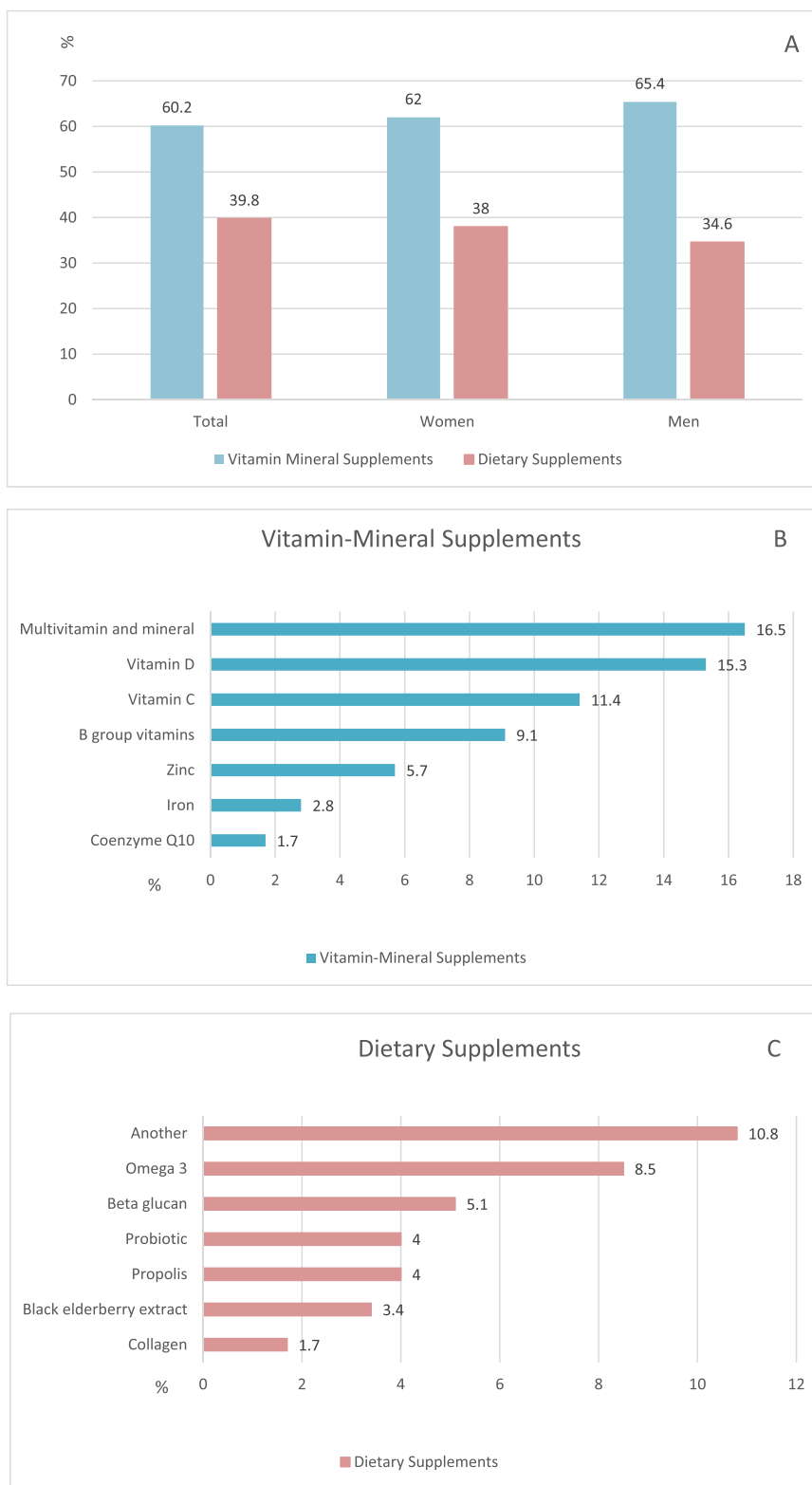


Fig. 2. Most frequently consumed vitamin-mineral and dietary supplements (%) during COVID-19 pandemic in Turkey: (A) Percentage of consumers by gender (%); (B) Most frequently consumed vitamin and mineral supplements; (C) Most frequently consumed dietary supplements (Another: curcumin, acacia gum, ginseng, black cumin oil, etc.).

their food consumption [22].

About half of the participants consume water below the recommendation of the World Health Organization. 34.2% of participants consume 5–8 cups of water daily during the pandemic. In a cross-sectional study conducted in Italy, it was determined that 60.4% of

the participants had 1–2 liters per day during the pandemic process [23]. In a similar study, 82.6% of the participants consume less than 2 liters of water per day during the pandemic process [28]. In other studies, unlike these studies, it was determined that water consumption increased during the pandemic period compared to the pre-pandemic

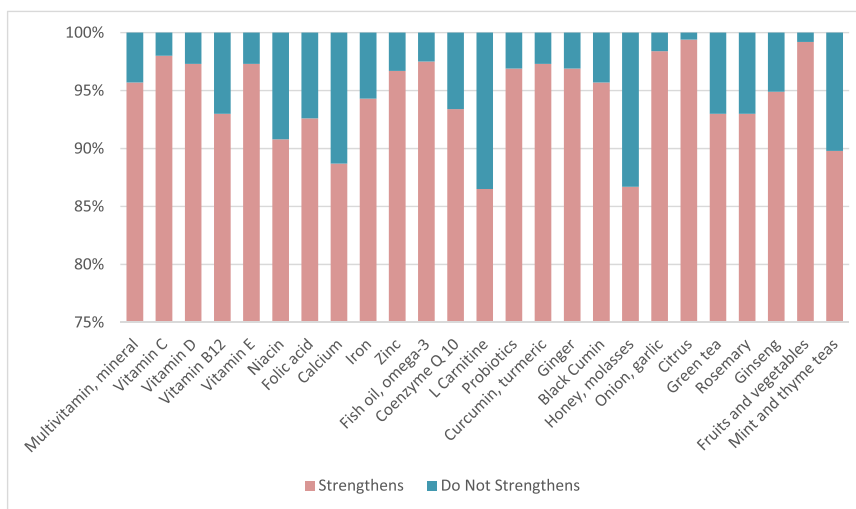


Fig. 3. Opinions of the participants about strengthening the immune system of some foods and nutrients.

Table 3

Association between sociodemographic characteristics, usual lifestyles, and a cluster of changes in dietary supplements during a pandemic.

	B	SE	Beta	%95 CI	p values
Costant	1.10	1.63	2.99		
Gender					
Females					
Males	0.79	0.39	2.20	1.04–4.68	0.040 *
Age Group					
18–34 years					0.002 *
35–54 years	-3.07	1.57	0.05	0.00–1.02	0.051
≥ 55 years	-1.65	1.56	0.19	0.01–4.05	0.289
Education Status					0.105
Low					
Moderate	-0.93	1.15	0.40	0.04–3.78	0.420
High	-0.99	0.50	0.37	0.14–0.98	0.046 *
Marital Status					
Married					
Unmarried	-0.26	0.35	0.77	0.39–1.53	0.455
Smoking Status					
Smoker					
Non-Smoker	-0.02	0.37	0.98	0.48–2.00	0.950
Diagnosed disease status					
Yes					
No	0.16	0.28	1.18	0.69–2.03	0.552
Regular physical activity					0.137
< 150 min/week	-0.31	0.33	0.74	0.39–1.39	0.346
> 150 min/week	0.20	0.33	1.22	0.64–2.34	0.546

Binary logistic regression analysis, R2: 0.050 (Cox-Snell), R2: 0.078 (Nagelkerke). B=Regression Coefficient; %95 CI: %95 Confidence Interval; R2 =Regression Coefficient; SE: Standart Error.

period [21,24,26].

Studies have shown that the consumption of vegetables, fruits, legumes, and cereal products, which are the basis of the Mediterranean diet, increased during the pandemic process, while the consumption of unhealthy snacks such as bakery products (cakes, cookies, chocolate, candy, and pastry foods) and alcoholic beverages increased [5,17,20,21,24,25,28–31]. Opposite to other studies, in another study, it was determined that one-third of the participants did not consume fruit every day [26], and in another study, the consumption of seafood and meat group foods, junk food, and the habit of eating out decreased [22]. According to the results of this research, it was determined that the consumption of green leafy vegetables and pastries increased. Increased consumption of green leafy vegetables as reported in our study suggests that some people tend to follow healthy food habits during the lockdown. The increase in healthy eating habits will reduce complications related to COVID-19. On the other hand, the increase in pastry consumption may be related to the increase in emotional eating and night

eating habits in some individuals due to the increase in the time spent at home. Consumption of green leafy vegetables is recommended to may protect from COVID-19, and the increase in individuals' consumption of green leafy vegetables is in line with the recommendations. However, the consumption of green leafy vegetables and pastries of individuals should be questioned as a portion.

The positive effects of vitamins, minerals, and probiotics on the immune system are known. The British Dietetic Association reported that there is no specific supplement to strengthen the immune system in the prevention of COVID-19 and that a protective effect can be achieved with a diet containing adequate amounts of folate, iron, selenium, zinc minerals, and vitamins A, B₆, B₁₂, C and D [32]. According to Macit's study, it was determined that a significant part of the participants (36.1%) started to use nutritional supplements and that vitamins C and D were consumed the most [5]. In other studies, the most commonly used nutritional supplements in the pandemic are vitamin C, multivitamin, B complex vitamins, vitamin D, iron, and zinc [17,24,28]. Along with these, 10.9% of people consume dietary supplements such as brewer's yeast, fiber, omega-3 fatty acids, and probiotics [29]. In this study, multivitamins, and minerals, vitamins D and C are consumed the most, similar to others. In this case, the known effects of vitamin and mineral supplements on the immune system may have increased the consumption of these supplements.

In a study investigating the consumption of nutritional supplements, it was determined that they consumed these products to strengthen the immune system [33], in another study, prevent fatigue, and against infectious diseases due to being recommended by health professionals stated that you are using [34]. According to similar studies, the reasons for using supplements are to strengthen their immunity, a lack of biochemical findings, and the belief that using nutritional supplements is healthy [28]. Similarly, in this study, the participants use nutritional supplements to provide adequate and balanced nutrition and prevent fatigue the most.

5. Conclusion

Various changes in the eating habits of individuals have occurred during the pandemic process. One of the important points here is that some of the participants increased the consumption of green leafy vegetables, which is the basis of healthy eating habits, while the other part increased the consumption of pastry products, which can be called unhealthy eating habits. In addition, about one-fifth of the participants have already started using the nutritional supplement during the pandemic process. Gaining adequate and balanced nutritional habits of

the participants will reduce the need for nutritional supplements. For this purpose, community-based nutrition education should be expanded. Due to the pandemic, such training will be planned and disseminated online, and access to much wider masses will be provided.

6. Limitations

Among the limitations of this cross-sectional study is that it was conducted in a convenience sample recruited online, which implies a selection bias. Using an online survey was necessary during the pandemic, but it may have biased the sample toward more digitally competent individuals, resulting in disparities in response rates across societal groups. The collection of information online limits the participation of underprivileged sectors and older people, while it probably increases acceptance among people who are more concerned about food, health, and self-care. Another limitation is the fact that changes in diet and lifestyle habits were assessed before and during lockdown using a single questionnaire, which can lead to a certain recall bias. Furthermore, it is recognized that the study sample is not representative of the entire population, so the conclusions cannot be extrapolated. Although the average age of the participants and the higher number of women did not affect the normal distribution of the data, they limited the study in terms of representing the population. One of the most fundamental limitations of the study is the inability to collect food consumption records and anthropometric measurements. The bias due to forgetting in the transmission of the pre-pandemic eating habits of the participants limited the study.

Author contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

Author note

This research was presented as an oral presentation at the "COVID-19 Pandemisinde Araştırma-Yayın ve Eğitim Süreçlerine Bakış Kongresi" congress.

Financial disclosure

The authors declared that this study has received no financial support.

Acknowledgments

The authors would like to express their gratefulness to everyone who agreed to take part in the study. The final version of the manuscript has been approved by all co-authors. This manuscript has not been published before and it is not under consideration for publication anywhere else.

Ethical approval

The study was approved by Gazi University Ethics Commission (Approval number: 2020–565).

Conflict of interest

The authors declare that they have no conflict of interest.

References

- [1] E.F.T. Çölgeçen, Sağlık Okuryazarlığı Işığında COVID-19 Pandemisi İle Beslenme Arasındaki İlişki, *Turkey Health Literacy J.* 1 (2) (2020) 79–89.
- [2] J. Musulin, S. Baressi Šegota, D. Štifić, I. Lorencin, N. Anđelić, T. Šusteršić, A. Blagojević, N. Filipović, T. Čabov, E. Markova-Car, Application of artificial intelligence-based regression methods in the problem of covid-19 spread prediction: a systematic review, *Int. J. Environ. Res. Public Health* 18 (8) (2021) 4287.
- [3] WHO, 2021 WHO Coronavirus Disease (COVID-19) Dashboard.
- [4] WHO, 2020 WHO COVID-19: Case Definitions.
- [5] M.S. Macit, Covid-19 salgını sonrası yetişkin bireylerin beslenme alışkanlıklarındaki değişikliklerin değerlendirilmesi, *Mersin Üniversitesi Sağlık Bilim. Derg.* 13 (3) (2020) 277–288.
- [6] K.W. Lange, Food science and COVID-19, *Food Sci. Hum. Wellness* 10 (1) (2021) 1–5.
- [7] F. Bourbour, S. Mirzaei Dahka, M. Gholamalazadeh, M.E. Akbari, M. Shadnough, M. Haghghi, H. Taghvaye-Masoumi, N. Ashoori, S. Doaei, Nutrients in prevention, treatment, and management of viral infections; special focus on Coronavirus, *Arch. Physiol. Biochem.* (2020) 1–10.
- [8] WHO, 2021 Nutrition advice for adults during the COVID-19 outbreak.
- [9] FAO, 2020 Maintaining a healthy diet during the COVID-19 pandemic.
- [10] J. Hamulka, M. Jeruszka-Bielak, M. Górnicka, M.E. Drywień, M.A. Zielinska-Pukos, Dietary supplements during COVID-19 Outbreak. Results of Google trends analysis supported by PLifeCOVID-19 online studies, *Nutrients* 13 (1) (2021) 54.
- [11] M. Mrityunjaya, V. Pavithra, R. Neelam, P. Janhavi, P. Halami, P. Ravindra, Immune-boosting, antioxidant and anti-inflammatory food supplements targeting pathogenesis of COVID-19, *Front. Immunol.* 11 (2020).
- [12] TÜBA, COVID-19 Küresel Salgın Değerlendirme Raporu, Türkiye Bilim. Akad. Yayın. (2020).
- [13] M. Mrityunjaya, V. Pavithra, R. Neelam, P. Janhavi, P.M. Halami, P.V. Ravindra, Immune-boosting, antioxidant and anti-inflammatory food supplements targeting pathogenesis of COVID-19, *Front. Immunol.* 11 (2337) (2020), <https://doi.org/10.3389/fimmu.2020.570122>.
- [14] J. Grebow, Dietary supplement sales skyrocket during the COVID-19 pandemic, *Nutr. Outlook* 23 (2020) 4.
- [15] Demirdöğmez M., Taş H.Y., Gültekin N. Koronavirüs' ün (Covid-19) E-Ticaret Etkileri. *OPUS Uluslararası Toplum Araştırmaları Dergisi* 16 (29):1–1.
- [16] L. Cohen, L. Manion, K. Morrison, Research methods in education. *Teaching in Higher Education*, fifth ed., Routledge Falmer, London, 2000, p. 21.
- [17] A. Ozenoglu, E. Cevika, H. Colaka, T. Altıntaş, K. Alakusc, Changes in nutrition and lifestyle habits during the COVID-19 pandemic in Turkey and the effects of healthy eating attitudes, *Mediterr. J. Nutr. Metab.* 14 (2021) 325–341.
- [18] Y. Galali, The impact of COVID-19 confinement on the eating habits and lifestyle changes: a cross sectional study, *Food Sci. Nutr.* 9 (4) (2021) 2105–2113.
- [19] M.M.A. Shaun, M.W.R. Nizum, S. Munny, F. Fayeza, S.K. Mali, M.T. Abid, A.-R. Hasan, Eating habits and lifestyle changes among higher studies students post-lockdown in Bangladesh: a web-based cross-sectional study, *Heliyon* 7 (8) (2021), e07843.
- [20] F. Grant, M.L. Scalvedi, U. Scognamiglio, A. Turrini, L. Rossi, Eating habits during the COVID-19 lockdown in Italy: the nutritional and lifestyle side effects of the pandemic, *Nutrients* 13 (7) (2021) 2279.
- [21] Yang G-y, X.-l Lin, A.-p Fang, H.-l Zhu, Eating habits and lifestyles during the initial stage of the COVID-19 lockdown in China: a cross-sectional study, *Nutrients* 13 (3) (2021) 970.
- [22] A. Elangovan, A. Eapen, V. Padmapriya, J. Nagaraj, R. Kannan, M. Ravi, A. Santhakumar, M. Malathi, G. Elavarasu, D.A. Merciline, Impact of lockdown due to Covid-19 on the lifestyle changes of employees in India: a cross-sectional analysis of personnel who work at office versus work from home, *Asian J. Pharm. Res. Health Care* 13 (2) (2021) 177–186.
- [23] L. Di Renzo, P. Gualtieri, F. Pivari, L. Soldati, A. Attinà, G. Cinelli, C. Leggeri, G. Caparelli, L. Barrea, F. Scerbo, Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey, *J. Transl. Med.* 18 (2020) 1–15.
- [24] Küçükçankurtaran S., Özdoğan Y. COVID-19 Pandemisinin Yetişkinlerin Beslenme Durumuna Etkisi. *Düzce Üniversitesi Sağlık Bilimleri Enstitüsü Dergisi*.
- [25] A. Dilber, F. Dilber, Koronavirüs (COVID-19) Salgınunun Bireylerin Beslenme Alışkanlıkları Üzerindeki, *J. Tour. Gastron. Stud.* 8 (3) (2020) 2144–2162.
- [26] L.C. Ismail, T.M. Osaili, M.N. Mohamad, A. Al Marzouqi, A.H. Jarrar, A. Zampelas, C. Habib-Mourad, D.O.A. Jamous, H.I. Ali, H. Al Sabbah, Assessment of eating habits and lifestyle during the coronavirus 2019 pandemic in the Middle East and North Africa region: a cross-sectional study, *Br. J. Nutr.* 126 (5) (2021) 757–766.
- [27] F.C. Bull, S.S. Al-Ansari, S. Biddle, K. Borodulin, M.P. Buman, G. Cardon, C. Carty, J.-P. Chaput, S. Chastin, R. Chou, World Health Organization 2020 guidelines on physical activity and sedentary behaviour, *Br. J. Sports Med.* 54 (24) (2020) 1451–1462.
- [28] G. Garipoğlu, N. Bozar, Covid-19 salgınında sosyal izolasyonda olan bireylerin beslenme alışkanlıklarındaki değişiklikler, *Pearson J. Soc. Sci. Humanit.* 6 (6) (2020) 100–113.
- [29] C. Pérez-Rodrigo, M. Gianzo Citores, G. Hervás Bárbara, F. Ruiz-Litago, L. Casis Sáenz, V. Arija, A.M. López-Sobaler, E. Martínez de Victoria, R.M. Ortega, T. Partearroyo, Patterns of change in dietary habits and physical activity during lockdown in Spain due to the COVID-19 pandemic, *Nutrients* 13 (2) (2021) 300.
- [30] Pietrobello A., Pecoraro L., Ferruzzi A., Heo M., Faith M., Zoller T., Antoniazzi F., Piacentini G., Fearnbach S.N., Heymsfield S.B. (2020) Effects of COVID-19 lockdown on lifestyle behaviors in children with obesity living in Verona, Italy: a longitudinal study. *Obesity* 28 (8):1382–1385.
- [31] A. Jimenez, A. de Hollanda, E. Palou, E. Ortega, A. Andreu, J. Molero, C. Mestre, A. Ibarzabal, A. Obach, L. Flores, Psychosocial, lifestyle, and body weight impact of COVID-19-Related lockdown in a sample of participants with current or past history of obesity in Spain, *Obes. Surg.* 31 (5) (2021) 2115–2124.

- [32] Association B.D. ,2020 COVID-19/coronavirus–advice for the general public. <https://www.bda.uk.com/resource/covid-19-corona-virus-advice-for-the-general-public.html>. Accessed 19.01.2022.
- [33] Kanak E.K., Öztürk S.N., Özdemir Y., Kübra A., Öztürk Yılmaz S. ,2021, Gıda takviyeleri kullanım alışkanlıklarının değerlendirilmesi. Niğde Ömer Halisdemir Üniversitesi Mühendislik Bilimleri Dergisi 10 (1):168–177.
- [34] Başer D.A., Cankurtaran M., Doğan B.G. ,2021. The Practice and Opinions of the Applicants of a University Health Center on Multivitamin/Mineral Use, Ankara-Turkey. Beslenme ve Diyet Dergisi 49 (2):47–55.