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

Cagla Ayer\textsuperscript{a,1,*}, Adviye Gulcin Sagdicoglu Celep\textsuperscript{b,3}

\textsuperscript{a} Research Assistant, Izmir Kâtip Çelebi University Faculty of Health Sciences Department of Nutrition and Dietetics, Izmir, Turkey
\textsuperscript{b} Gazi University Faculty of Health Sciences Department of Nutrition and Dietetics, Ankara, Turkey

\textbf{ARTICLE INFO}

\textbf{Keywords:}
COVID-19
SARS-Cov-2
Nutrition
Nutritional supplement
Supplementation

\textbf{ABSTRACT}

\textbf{Objective:} Determine nutritional status and use of food supplements during COVID-19.

\textbf{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.

\textbf{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.

\textbf{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.

\section{Introduction}

COVID-19 is recognized as a global health problem, first appearing in Wuhan, China and rapidly spreading to many countries \cite{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 \cite{3}. The high number of cases and deaths caused the WHO to define COVID-19 as a virus with a high risk of contagiousness \cite{4}.

An adequate and balanced diet is effective in preventing and treating infectious diseases such as COVID-19 \cite{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 \cite{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 \cite{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 \cite{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 \cite{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...
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.

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
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).

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). 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).

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).

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).
Nutritional supplements usage status and related factors.

| Variables                                      | Total  | Females n | Males n | Females % | Males % |
|------------------------------------------------|--------|-----------|---------|-----------|---------|
| Use of nutritional supplement during COVID-19 period | Yes    | 104       | 90      | 22.5      | 14      |
| <br> No                                          | 384    | 78.7      | 310     | 77.5      | 74      |
| If your answer is "No", the reason for the situation* | Because of the side effects | 27 | 6.0 | 19 | 9.5 | 3 | 8.9 |
| <br> Because they are expensive | 44 | 9.8 | 29 | 8.1 | 15 | 16.7 |
| <br> I don’t think they work | 229 | 51.1 | 190 | 53.1 | 39 | 43.3 |
| <br> I don’t need it | 10 | 2.2 | 9 | 2.5 | 1 | 1.1 |
| <br> My doctor suggested not to use it | 42 | 9.4 | 37 | 10.3 | 5 | 5.6 |
| No reason | 77 | 17.2 | 58 | 16.2 | 19 | 21.1 |
| <br> 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

| Variables | Total | Females n | Males n | Females % | Males % |
|-----------|-------|-----------|---------|-----------|---------|
| Doctor    | 37    | 39.4      | 34      | 42.5      | 3      |
| Dietician | 7     | 7.4       | 5       | 6.3       | 2      |
| Pharmacist| 12    | 12.8      | 11      | 13.8      | 1      |
| Relatives | 8     | 8.5       | 5       | 6.3       | 3      |
| Friends   | 27    | 28.7      | 23      | 28.7      | 4      |
| Social media/media | 3    | 3.2       | 2       | 2.5       | 1      |

Top reasons to use nutritional supplements

| Variables | Total | Females n | Males n | Females % | Males % |
|-----------|-------|-----------|---------|-----------|---------|
| 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 |
| Yes | 102 | 98.1 | 92 | 98.9 | 10 | 90.9 |
| No | 2 | 1.9 | 1 | 0.1 | 1 | 9.1 |

Telling your doctor that you are using nutritional supplements

| Variables | Total | Females n | Males n | Females % | Males % |
|-----------|-------|-----------|---------|-----------|---------|
| Yes       | 181   | 85.8      | 159     | 90.9      | 22      |
| No        | 30    | 14.2      | 16      | 9.1       | 14      |

Information resource on nutritional supplements

| Variables | Total | Females n | Males n | Females % | Males % |
|-----------|-------|-----------|---------|-----------|---------|
| Doctor    | 88    | 17.8      | 80      | 19.3      | 8       |
| Pharmacist | 111  | 22.4      | 99      | 23.9      | 13      |
| Dietician | 87    | 17.6      | 69      | 16.7      | 18      |
| Social media | 27 | 5.4       | 22      | 5.3       | 5       |
| 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      |
| I did not get any information | 13 | 2.6 | 8 | 1.9 | 5 | 5.3 |
| Pharmacy | 115   | 76.7      | 101     | 77.7      | 14      |
| Internet | 27    | 18.0      | 23      | 17.7      | 4       |

Table 2 (continued)

| Variables | Total | Females n | Males n | Females % | Males % |
|-----------|-------|-----------|---------|-----------|---------|
| Where the dietary supplement is taken | Another | 8 | 5.3 | 6 | 4.6 | 2 | 10.0 |
| The effect of the nutritional supplement | Benefit | 53 | 51.0 | 45 | 50.0 | 8 | 57.2 |
| Harm | 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 ± 4.53 kg/m²) is lower than that of males (24.32 ± 4.53 kg/m²). 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...
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
related to COVID-19. On the other hand, the increase in pastry consumption decreased. The increase in healthy eating habits will reduce complications. Gains adequate and balanced nutritional habits of diet, increased during the pandemic process, while the 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. 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. In other studies, the most commonly used nutritional supplements in the pandemic are vitamin C, multivitamin, B complex vitamins, vitamin D, iron, and zinc. Along with these, 10.9% of people consume dietary supplements such as brewer’s yeast, fiber, omega-3 fatty acids, and probiotics. 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, another study, prevent fatigue, and against infectious diseases due to being recommended by health professionals stated that you are using. 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. 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

Table 3

| Variable                        | B   | SE  | Beta | %95 CI     | p    |
|---------------------------------|-----|-----|------|------------|------|
| Constant                        |     |     |      |            |      |
| Gender                          | Females | 1.10 | 1.63 | 2.99       |      |
| Age Group                       | Males | 0.79 | 0.39 | 2.20       | 1.04-4.68 | 0.040 *  |
| Education Status                | Low  | -1.65 | 1.50 | 0.19       | 0.01-4.05 | 0.289 |
| Smoking Status                  | Low  | -0.93 | 1.15 | 0.40       | 0.04-3.78 | 0.420 |
| Marital Status                  | Married | -0.99 | 0.50 | 0.37       | 0.14-0.98 | 0.046 *  |
| Diagnosed Disease Status        | Yes  | 0.16  | 0.28 | 1.18       | 0.69-2.03 | 0.552 |
| Regular physical activity /exercise | No | 0.20  | 0.33 | 1.22       | 0.64-2.34 | 0.546 |
| during COVID-19 period          | <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.

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

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The authors declare that they have no conflict of interest.

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.

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The authors declare that they have no conflict of interest.

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