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New Epidemics Are At The Door: Leveraging Unanticipated Lessons from COVID-19 on Nutrition

Yeni Salgınlar Kapıda: Beslenme Konusunda COVID-19'un Beklenmedik Derslerinden Yararlanmak

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ABSTRACT

The number of new cases of COVID-19 variants increasing globally in recent weeks. There is a need to learn lessons from COVID-19 experiences and take new measures to better respond to new epidemics and the devastating effects of the disease. This cross-sectional study aimed to investigate the changes in nutritional habits of individuals with COVID-19 diagnosis in the Kayseri sample in Turkey. This study was conducted with 479 participants aged 18-65 years who had positive COVID-19 PCR tests. The data were collected online using the sociodemographic data form. Changes in nutritional characteristics of participants compared to the pre-pandemic period were recorded. The results showed that the rate of participants who increased paying attention to a healthy diet during the pandemic was 83.1%. They changed their food choices towards a healthier pattern supporting immunity. Eating regularly, using nutritional and herbal supplements, and eating at home increased compared to the pre-pandemic period ($p<0.001$). No difference was found in the rate of paying more attention to healthy eating between individuals who gain and lose weight. We think that to navigate emerging new epidemics, this time we are more experienced to implicate healty nutritional habits to our live with the upside-down effect of COVID-19.

Keywords: COVID-19, Immunity, Dietary habits, SARS-CoV-2.

ÖZ

Son zamanlarda yeni COVID-19 varyantı vakalarının sayısı dünya çapında artış göstermektedir. Bu durumda beklenen yeni salgınlara ve hastalığın yıkıcı etkilerine daha iyi yanıt verebilmek için COVID-19 deneyimlerinden yararlanmaya ve yeni önlemler almaya ihtiyaç oluşmaktadır. Kesitsel tipteki bu çalışma, Türkiye'de Kayseri örneğinde COVID-19 tanısı alan bireylerin beslenme alışkanlıklarındaki değişimleri araştırmayı amaçlamıştır. Çalışma, COVID-19 PCR testi pozitif olan 18-65 yaş arası 479 katılımcı ile yürütülmüştür. Veriler sosyodemografik veri formu kullanılarak çevrimiçi olarak toplanmıştır. Pandemi öncesi döneme göre katılımcıların beslenme özelliklerinde değişiklikler kaydedilmiştir. Sonuçlar, pandemi döneminde sağlıklı beslenmeye dikkat etmeyi arttıran katılımcı oranının %83,1 olduğunu göstermiştir. Yiyecek seçimleri bağışıklığı destekleyecek şekilde daha sağlıklı bir beslenme düzenine doğru değişmiştir. Pandemi öncesi döneme göre düzenli beslenme, bitkisel takviyeler kullanma ve evde yemek yeme sıklığı artmıştır ($p<0,001$). Ağırlık artışı ve ağırlık kaybı olan bireyler arasında sağlıklı beslenmeye daha fazla dikkat etme oranında fark bulunmamıştır. Ortaya çıkabilecek yeni salgınlara karşı önlem almak için, bu sefer COVID-19'un beklenmedik ters etkisi ile sağlıklı beslenme alışkanlıklarını hayatımıza dahil etme konusunda daha tecrübeli olduğumuzu düşünmekteyiz.

Anahtar kelimeler: Bağışıklık, Beslenme alışkanlıkları, COVID-19, SARS-CoV-2.

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INTRODUCTION

World Health Organisation (WHO) reported globally, the number of new cases of COVID-19 increased by 52% during the 28 days period of 20 November to 17 December 2023, with over 850 000 new cases reported.[1] From December 2023 to January 2024, there was an overall increase in new hospitalizations and intensive care unit admissions due to COVID-19 of 40% and 13%, respectively. As of December 2023, the sub-lineage of the omicron variant has been reported to have a rapid increase in prevalence in recent weeks. WHO recommends an update on hospitalizations and intensive care unit admissions and an update on the SARS-CoV-2 variants under monitoring.[2]

Although the COVID-19 epidemic has become a public health problem governing life all over the world as of March 2020, it is again worrying globally with its new variants. When we open a window to the effects of COVID-19 on our lives, we can say the following: nutritional habits, consumer behaviors, physical activity habits, sleep patterns, and daily living activities of individuals have been affected by the pandemic. Lifestyle has changed due to restriction measures, resulting in the risk of sedentary behavior and changes in eating and sleeping habits. Staying at home due to quarantine and hearing or reading about COVID-19 from the media can be quite stressful. Stress leads individuals toward overeating.[3,4] Additionally, emotional and psychological responses to COVID-19 may increase the risk of occurring dysfunctional eating behaviors.[5]

On the opposite side, based on the recommendations of supporting the immune system in the COVID-19 pandemic, a healthy lifestyle choosing foods rich in fruits and vegetables, exercising, maintaining weight, and getting enough sleep, some people tend to have healthy eating habits to support immune systems, and they took care to add antioxidant nutrients to their diets. In addition, during quarantine periods, individuals find more time for themselves and the decrease in confidence in meals cooked outside the home has led to an increase in individuals' interest in preparing meals at home.[6] The main dietary change during the pandemic was shown in the consumption of packaged foods and the consumption of vegetables and fruits. Some studies have reported individuals eating fewer fruits and vegetables,[7,8] some studies have indicated that fruit and vegetable consumption didn't change,[3,9] others have found that individuals increased fruit and vegetable consumption mainly to cope with the COVID-19.[10-12] During the COVID-19 pandemic, both an increased desire for healthy eating to defend against disease and, increased unhealthy eating occurred due to stress and faulty coping strategies. Eating habits and lifestyle modification could strongly affect and threaten our health. Maintaining an adequate nutritional status is crucial, especially during a specific period when the immune system may need to defense.[3]

In addition to the general effects of the COVID-19 pandemic and the social isolation on people's lifestyles and eating habits, being diagnosed with COVID-19 has been shown to have some additional effects on the dietary habits of people. The symptoms such as fever, fatigue, loss of appetite, insufficient food intake, and loss of taste and smell, also affect patients' nutritional status. While overeating, unhealthy food consumption, and overweight/obesity may occur due to stress and social isolation in people without being diagnosed with COVID-19, changes in diet composition and a tendency to care for healthy eating to support the immune system may occur in COVID-19 patients to cope with the symptoms of the disease.[10] The hypothesis of this study was the nutritional habits changed both positively and negatively during the COVID-19 pandemic. This study aimed to investigate the changes in nutritional habits of individuals with COVID-19 diagnosis in the Kayseri sample in Turkey during the COVID-19 pandemic period.

MATERIALS AND METHODS

Study design and participants

This cross-sectional study was conducted between February and May 2021 with participants aged 18-65 years and who registered in governmental family health centers with positive COVID-19 PCR tests in Kayseri Province Central Districts (Melikgazi, Kocasinan ve Talas) during the COVID-19 pandemic. The sample size was calculated (G-Power Version 3.1.9.4 Universität Düsseldorf, Germany) power of 80% with 0.05 significance, using a reference to a previous study (13) and generating a sample of 356 participants. Considering the dropout rate, 500 participants were aimed to reach, and 479 participants were included after removing the missing data. Individuals with COVID-19 diagnosis were included in order to more clearly observe the changes in the group that may experience the effects of the disease on nutrition most intensely. No pilot study was conducted before the study.

Data collection

The data were collected by using an online questionnaire consisting of 63 questions on sociodemographic characteristics, nutritional habits, physical activity, self-reported height and weight values, and changes in weight during the pandemic. The survey was created by the authors and its validity and reliability is not available. Nutritional characteristics and changes in the food consumption of participants compared to the pre-pandemic period were recorded. Food consumption and changes in habits were recorded according to individuals' self report, and the frequency of consumption of some foods was questioned, without including the porsions. BMI(Body mass index) was calculated and their BMI values were classified as underweight (<18.5 kg/m2), normal weight (18.5-24.9 kg/m2), overweight (25-29.9 kg/m2), and obese (≥30 kg/m2) (14). Regular physical activity was questioned as 1 hour at least 3 times a week. Participants, aged <18 or >65 years, who do not use a smartphone, who filled in the questionnaire insufficiently, and who were treated in a hospital with the diagnosis of COVID-19 were excluded from the study.

Ethical Aspect

Ethics committee approval (Ethics Committee Approval No: 1/713) was obtained from the Ethics Committee at Nuh Naci Yazgan University. Participants were informed about the study via the online platform, and their consent was obtained through an informed consent form.

Statistical Analysis

The data were analyzed using the Statistical Package Program for Social Sciences (SPSS 22.0) statistical program. Continuous variables were expressed as the mean and standard deviation. The regularity of the distribution of parameters was evaluated using the Shapiro–Wilk normality analysis. The differences between the categorical variables were examined with Chi-square analysis. Bonferroni test was used for multiple comparison between groups. The variables were presented by number (n) and percent (%). The significance level in the study was assumed as $p<0.05$.

Limitations

Since the study was conducted at the COVID-19 outbreak the data were collected by using an online questionnaire. Due to the limitations in online data collection, conditions that affect appetite and metabolism such as medication use that affects appetite, the presence of an eating disorder, and were on a special diet could not be excluded, and we think that this may have a confounding effect on the research results as a limitation. Biochemical and clinical data could also have provided a better evaluating disease severity and better interpretation of the changes in eating habits. In addition, our results may have been affected by restrictions and partial quarantine measures such as restrictions on eating out. Another limitation is that body weight measurement results are based on individuals' declarations and cannot be obtained with a standard weight scale. The data used to evaluate eating habits were obtained relatively based on the statements of the participants and without portion information is also a limitation of the study.

Although this study was conducted from almost all social classes in the Central Districts of Kayseri Province, the study findings may still not represent the entire population, making it difficult to generalize the findings.

RESULTS AND DISCUSSION

A total of 479 participants aged 18-65 years were included in the study with a mean age of 33.9±12.8. Most of them (57.4%) were 18-35 age group and 42.8% of them were female. 81.2% of participants had no chronic disease and 71.8% of them were not smoking. The mean BMI of participants was 25.6±4.7, 34.2% of them were overweight and 17.5% of them were obese (Table 1). The rate of participants who reported that they lost weight was 26.5%, gained weight was 27.3%, and no weight change was 46.2 % during the pandemic. The mean weight gain score was 5.6±3.2 kg and the mean weight loss score was 5.1±3.3 kg (Table 2).

The most common symptoms during COVID positive state were weakness (79.5%), loss of smell (58.9%), loss of taste (54.1%) and loss of appetite (56.4%). 70.8% of the participants reported decreased physical activity levels during the pandemic (Table 1).

The rate of participants with increased paying attention to a healthy diet during the pandemic compared to the pre-pandemic period was 83.1%. The rate of those who had a decreased appetite was 38.2% and an increased appetite was 23.2% during the pandemic in general (Table 2).

Table 1. Sociodemographic characteristics of the participants

Characteristics	n	%
Gender		
Female	205	42.8
Male	274	57.2
Age (x̄±SS) (min-max)	33.9 ±12.8	18.0-63.0
Age category		
18-35 year	275	57.4
36-50 year	137	28.6
51-65 year	67	14.0
Marital status		
Married	260	54.3
Single	219	45.7
Working status		
No work	32	6.7
Home working	13	2.7
Rotational working	195	40.7
Regular working	239	49.9
Income		
Having income lower than expenses	249	52.0
Having income equivalent to expenses	219	45.7
Having income higher than expenses	11	2.3
Chronic disease		
Yes	90	18.8
No	389	81.2
Smoking		
Yes	87	18.2
No	392	71.8
Symptoms during COVID-19 positive stage		
Nausea-vomiting	85	17.7
Diarrhea	148	30.9
Fatigue	381	79.5
Loss of taste	259	54.1
Loss of smell	282	58.9
Loss of appetite	270	56.4
Physical activity		
Yes	140	29.2
No	339	70.8
BMI classification		
Underweight	23	4.8
Normal weight	208	43.4
Overweight	164	34.2
Obese	84	17.5
BMI (kg/m2) (x̄ ± SS) (min-max)	25.6±4.7	15.7– 40.8

Abbreviations
BMI, Body mass index

Table 2: Changes in some characteristics of the participants during pandemic in general

Changes during pandemic	n	%
Sleep time		
Increase	142	29.6
Decrease	162	33.8
No change	175	36.6
Physical activity		
Increase	12	8.6
Decrease	99	70.7
No change	29	20.7
Increased paying attention to a healthy diet		
Yes	398	83.1
No	81	16.9
Food preference		
Consume more frozen-canned foods	12	2.5
Consume more fresh food	168	35.1
No change eating habits	299	62.4
Appetite		
Increased	111	23.2
Decreased	183	38.2
No change	185	38.6
Body weight		
Increased	131	27.3
Decreased	127	26.5
No change	221	46.2
Weight gain (kg) ($\bar{x}$ ± SS)	131	5.6±3.2
Weight loss (kg) ($\bar{x}$ ± SS)	127	5.1±3.3

During the pandemic, the rate of participants who have 3 or more meals/per day was lower (41.1% vs 46.1%) (p< 0.001); and those who have 3 or more snacks/per day (12.3% vs 7.1%) (p= 0.016), who used nutritional supplements (57.0% vs 24.4%) (p< 0.001), who used herbal supplements (35.3% vs 15.7%), who do not eat out the home (46.3% vs 9.8%) (p< 0.001), who orders food online less than 1-2 times/month (60.5% vs 46.6%) were higher than before the pandemic (Table 3).

Table 3. Nutritional characteristics of individuals before and during the pandemic

		Before the Pandemic		During the Pandemic			
Characteristics		**n**	**%**	**n**	**%**	**x²**	**p***
Meal	1 time/day	8	1.7[a]	30	6.3[b]	21.4	**<0.001**
	2 time/day	250	52.2	252	52.6		
	≥3 time/day	221	46.1	197	41.1		
Snack	None	134	28.0	125	26.1	15.63	**0.016**
	1 time/day	157	32.8	139	29.0		
	2 times /day	154	32.2	156	32.6		
	≥3 times/day	34	7.1[a]	59	12.3[b]		
Nutritional Suplement use	Yes	117	24.4[a]	273	57.0[b]	75.00	**<0.001**
	No	362	75.6[a]	206	43.0[b]		
Herbal Suplement use	Yes	75	15.7[a]	169	35.3[b]	143.57	**<0.001**
	No	404	84.3[a]	310	64.7[b]		
Eating out of home	None	47	9.8[a]	222	46.3[b]	69.02	**<0.001**
	1 time/month	172	35.9	164	34.2		
	1 times /week	149	31.1[a]	51	10.6[b]		
	≥2-3 times/week	111	23.2[a]	42	8.8[b]		

Table 3. Nutritional characteristics of individuals before and during the pandemic (continued)

Ordering food online	<1-2 times/month	223	46.6[a]	290	60.5[b]	44.36	
	1-2 times/ month	160	33.4	126	26.3		
	≥ 2-3 times/ week	96	20.0[a]	63	13.2[b]		**<0.001**
Drinking Water	1-5 glass	215	44.9[a]	163	34.0[b]	50.68	
	6-10 glass	207	43.2	222	46.3		**<0.001**
	≥11 glass	57	11.9[a]	94	19.6[b]		
Tea and herbal tea drinking	None	37	7.7	44	9.2	9.31	
	1-2 cup	198	41.3	188	39.2		0.157
	3-4 cup	116	24.2	122	25.5		
	≥5 cup	128	26.7	125	26.1		

* chi-square test, p<0.05
[ab] Statistically significant difference between groups

The rate of participants who have increased consumption of fruit and vegetables was 45.5%, high protein-containing foods (meat, poultry, egg, fish, and legume) was 29.6%, packaged products were 34.9%, salt was 85.2%, and onion/garlic was 38.2% during the pandemic (Table 4).

Table 4. Changes in the food consumption of individuals compared to the pre-pandemic period

Food/Food Group	Increased consumption	Decreased consumption
	n (%)	n (%)
Fruit and vegetable	218 (45.5)	19 (4.0)
High protein-containing foods (meat, poultry, egg, fish, legume)	142 (29.6)	21 (4.4)
Sugar	71 (14.8)	59 (12.3)
Salt	408 (85.2)	37 (7.7)
Packaged products	167 (34.9)	82 (17.1)
Onion/Garlic	183 (38.2)	9 (1.9)
Desert	101 (21.1)	81 (16.9)
Offal (head, trotter, etc.)	73 (15.2)	72 (15.1)
Cereals (rice, pasta, bread)	60 (12.5)	61 (12.7)

The rate of participants who reported an increase in appetite (respectively; 55.0% vs 4.5%), and increased consumption of sugar (respectively; 40.8% vs 16.9%), packaged products (respectively; 38.3% vs 17.4%), and cereals (rice, pasta, and white bread) (respectively; 40.0% vs 21.7%) in participants with weight gain was higher than those who stated that they lost weight (p<0.05) (Table 5). The rate of most common foods that participants stated that they started to consume more after the pandemic was fruit and vegetable (70.1%), meat and poultry (6.8%), and drink was herbal tea (69.3%), vinegar-added water (14.7%), and kefir (6.7%) (Data not shown in table).

Table 5: Nutritional characteristics of individuals according to weight change during the pandemic

During the Pandemic	Weight gain	Weight loss	No weight change	p*
	n(%)	n(%)	n(%)	
Increased paying attention to a healthy diet				
Yes	101 (25.4)	110 (27.6)	187 (47.0)	0.089
No	30 (30.7)	17 (21.0)	34 (42.0)	
Change in appetite				
Increased	61 (55.0)[a]	5 (4.5)[b]	45 (40.5)[a]	**<0.001**
Decreased	31 (16.9)[a]	82 (44.8)[b]	70 (38.3)[b]	
No Changed	39 (21.1)[a]	40 (21.6)[a]	106 (57.3)[b]	
Regular Physical Activity				
Yes	32 (22.9)	46(32.9)	62 (44.3)	0.100
No	99 (29.2)	81 (23.9)	159 (46.9)	
Ordering food online				
Yes	43(24.3)	46(26.0)	88(49.7)	0.413
No	88(29.1)	81(26.8)	133(44.0)	
Sugar consumption				
Increased	29(40.8)[a]	12(16.9)[b]	30(42.3)[a]	**0.020**
Decreased	90(25.8)[a]	93(26.6)[a]	166(47.6)[b]	
No Changed	12(20.3)	22(37.3)	25(42.4)	
Cereals (rice, pasta, bread) consumption				
Increased	24(40.0)[a]	13(21.7)[b]	23(38.3)[a]	**0.034**
Decreased	91(25.4)[a]	91(25.4)[a]	176(49.2)[b]	
No Changed	16(26.2)	23(37.7)	22(36.1)	
Packaged products consumption				
Increased	64(38.3)[a]	29(17.4)[b]	74(44.3)[a]	**<0.001**
Decreased	51(22.2)[a]	62(27.0)[a]	117(50.9)[b]	
No Changed	16(19.5)	36(43.9)	30(36.6)	
High protein-containing foods consumption (meat, poultry, egg, fish, legume)				**0.011**
Increased	48 (33.8)	43 (30.3)	51 (35.9)	
Decreased	8 (38.1)	7 (33.3)	6 (28.6)	
No Changed	75 (23.7)[a]	77 (24.4)[a]	164 (51.9)[b]	
Fruit and vegetable consumption				
Increased	60(27.5)	61(28.0)	97(44.5)	0.914
Decreased	67(27.7)	61(25.2)	114(47.1)	
No Changed	4(21.1)	5(26.3)	10(52.6)	

* chi-square test, $p<0.05$

[ab] Bonferroni test, Statistically significant difference between groups

This study showed that the rate of participants who increased paying attention to a healthy diet during the pandemic compared to the pre-pandemic period was 83.1%. Most of the participants who changed their food choices moved towards a healthier diet. During the pandemic, changes were observed in the lifestyles and habits of individuals around the world.[3,15] Studies have noticed the dramatic impact of isolation on health and eating behaviors. It has been reported that COVID-19 caused both positive and negative changes in eating behaviors.[16]

The effects of the pandemic on food choice and consumption were wide-ranging and multifactorial. Restrictions and health-related concerns have been reported to cause psychological effects on food consumption. COVID-19-related stress, depressive symptoms, mental fatigue, and anxiety have been demonstrated during the pandemic.[3] Acute stress typically reduces appetite; chronic stress increases appetite, and the consumption of high energy-density foods by acting on the adrenal glands to secrete cortisol.[17] Di Renzo et al. found that 32% of the participants indicated increased food consumption, and 14% indicated decreased food consumption during the pandemic.[3] Zachary et al showed that during quarantine of the participants, 59% ate more often with friends and family, 52% increased eating as a response to stress, 73% increased eating in bored time, and 65% increased snacking after dinner.[4] Elmacıoğlu found that 22.1 % of the participants increased their food consumption and portion size.[18] In this study, when the change in appetite, which generally affected eating habits throughout the pandemic period, was questioned, the rate of those who stated that there was an increase in appetite was found to be 38.2%, and the rate of those who stated that there was a decrease in appetite was 23.8%. However, when the loss of appetite was questioned only during the COVID positive stage, it was seen that the rate was higher (56.4%) compared to the general pandemic period. Appetite and food intake are also affected by the symptoms of COVID-19 infection. COVID-19 has been associated with clinical symptoms and changes in smell and taste.[19] Several studies showed alterations in smell and taste and other symptoms such as nausea and vomiting.[17, 20] It is thought that the higher rate of participants reporting loss of appetite while being COVID positive may be due to the fact that the loss of taste affects the loss of appetite, the loss of appetite is more pronounced during infection disease, and they remember the devastating effects of the disease better in this stage. In the current study, it was found that 54.1% of the participants had a loss of taste, 58.9% of them had a loss of smell 79.5% of them had tiredness during the COVID-19-positive stage. The appetite and food intake of participants were also affected by these changes. Although information based on individuals' statements regarding nausea, vomiting and GI symptoms were asked; including biochemical and clinical data could have provided a better interpretation of the changes in eating habits. Future studies may better interpret causative factors by adding biochemical findings.

All the devastating effects of COVID-19 have led individuals to make changes in their diet to increase immunity. Changes in food intake, a tendency to care for healthy eating to support the immune system, higher consumption of foods with high energy density related to stress and social isolation, and changes in food preferences have been shown in studies.[4,10] Changes in food choices have mostly gone towards a healthier eating pattern. This finding was also reported in several studies.[3,21,22] performed in different countries during the COVID-19 pandemic. Staying more hours at home may increase cooking at home and encourage better adaptation to healthier eating standards. Although there are different results in the literature regarding changes in eating habits during the pandemic period, most of these are positive changes.[17,23,24] In a study, 58% of participants reported changes in nutritional habits during the pandemic.[25] Jaeger et al. showed that 44% of the participants self-reported increased importance to healthy foods. Researchers stated that COVID-19 has caused changes towards healthier nutrition, and increased importance given to

consumption of foods recommended in nutritional guides.[23] Enriquez-Martinez et al. found that 38.4% of the participants reported they changed their eating patterns, 22.7% of the participants reported they ate healthier and 15.7% reported they ate less healthily during the pandemic.[24] A study by Kocak et al. conducted with individuals with and without COVID-19 diagnosis, found that approximately 1/3 of of the individuals stated that they ate healthier, and 1/5 of them stated that they ate unhealthier during the pandemic.[17] In the current study, it is thought that the rate of those who take care of healthy nutrition during the pandemic (83.1%) is higher than the other studies examining the general population with or without COVID-19 diagnosis, this may be due to the participants with COVID-19 diagnosis has a more attentive effect on healthy nutrition in individuals. It can be concluded that participants paid more attention to healthy nutrition habits after they were diagnosed with COVID-19. In addition, they have a higher consumption of fruit and vegetables and higher use of nutritional supplements and herbal supplements during the pandemic compared to before the pandemic.

Studies show that regular eating of whole food plant-based diets may improve the intestinal microbiota and support the immune system.[20,26] To support healthy food intake during the pandemic, the WHO published a report recommending that legumes, fresh fruits, and vegetables should be prioritized.[27] In the food consumption patterns of consumers during the pandemic, it was shown that participants mostly consumed fruits and vegetables, animal-based products,[28] and foods with high antioxidant content mostly due to fear of viral infection.[3,20] Ben Hassen et al. showed that 32.4% of the participants increased fruit and vegetable consumption.[29] Puścion-Jakubik showed a significant increase in the consumption of fruit and vegetables with a rate of 22% during the pandemic.[20] In line with the other studies' results which showed increased consumption of fruit and vegetables, in the current study, the rate of participants who have increased consumption of fruit and vegetables was found 45.5%. We thought that the relatively higher rate of individuals who say that they increase their consumption of fruit and vegetables in our study compared to other studies, may be due to those only individuals diagnosed with COVID-19 were included in our study and that they may be more susceptible to increase their consumption of more fruits and vegetables to contribute to the treatment of the disease and strengthen immunity. It is also known that some types of foods are of interest during the pandemic due to the anti-inflammatory and antiviral properties that come from elements found in especially vegetables, garlic, ginger, onions, curcuma, and berries.[30] Among increased animal-based products Yılmaz et al. found that 32.1% of the participants increased their consumption of meat, chicken, and fish.[31] Puścion-Jakubik showed of the participants 11.1% increased their consumption of meat and meat products and 16.7% of them increased their consumption of fish and processed fish during the pandemic.[20] Cancello et al. reported increased consumption of bread, pasta, and flour by 66% of participants and legumes by 24% of participants during the pandemic period.[11] We found the rate of participants who had increased consumption of high protein-containing foods (meat, poultry, egg, fish, and legume) was 29.6%, grains were 12.5%, and onion/garlic was 38.2% during the pandemic.

Mainly depending on the lockdown, staying at home for more hours, and stress several studies indicated an increased consumption of processed foods, junk foods, and snacks during the pandemic.[25,32] In a study, it was reported that 21.2% of the participants increased their carbohydrate consumption, 14.3% their sweet consumption, 8.6% their sugar consumption, and 19.5% their junk food consumption.[25] Although most participants who changed their food preferences stated shifting to healthier diets, consistent with the results of studies indicating increased consumption of processed foods, sugar, and salt, we also found increased rates of packaged products (34.9%), sweet foods-deserts (21.1%), and salt (85.2%). There are also studies that show

the opposite results. In a study by Molina-Montes et al., within the COVIDiet cross-national study, including data from 16 European countries, it was reported that the majority of participants (>90%) stated they maintained or decreased fast food and fried food consumption, and cooked more often during the pandemic and 2/3 of the participants stated they reduced the consumption of fast-food dishes.[32] Some studies also reported a decrease in ready-to-eat meal consumption during the pandemic.[33,34] Our results are also in line with these positive nutritional changes. We found that during the pandemic, the rate of participants who used herbal supplements, who had no eating out of the home, and who ordered food online less, were higher than before the pandemic. Although nutritional supplements, herbal supplements and herbal teas cannot be directly considered within the scope of healthy nutrition recommendations and their intake must be controlled, they are among the frequently preferred practices to increase immunity during the pandemic period. Although there are studies indicating an increased consumption of processed foods, breakfast cereals, and snacks, containing high in fats, sugars, and salt;[25,32] a large number of studies reported additional positive changes in the eating habits of individuals during the pandemic besides increasing fruit and vegetable, high antioxidant-containing foods and animal-based product consumption to support immunity.[20,30,33,34]

All these multifactorial changes in eating habits also led to changes in body weight, which are also important for body resistance. During the pandemic, concerning changes in food intake and activity levels, changes in the body weight of individuals have occurred. Although studies reported both weight gain and weight loss during the pandemic,[4,24] a general tendency towards an increase in weight was reported in the majority of studies. In a meta-analysis, it was reported that in several studies, more than 30% of the total study population reported weight gain.[15] Enriquez-Martinez found that 48.6% of the participants stated weight gain and 23.1% of them reported weight loss.[24] In a study by Pu´scion-Jakubik et al, it was found that 39% of participants stated that they had an increase in weight 3-5 kg during the pandemic, whereas 47.2% of participants stated no change.[20] The results of another study showed that 35% of the individuals have increased body weight, 20% of them lost weight and 36% of them have had no changes in their weight since the isolation began.[18] In this study, the rate of participants who reported that they gained weight was 27.3%, lost weight was 26.5%, and no weight change was 46.2% during the pandemic. The majority of individuals in the study worked rational (40.7%) or regular (49.9%), and most (70.8%) did not have regular physical activity. Factors such as restrictions during the pandemic, working from home, and inactivity may affect nutritional behaviors such as food preparation, online ordering, and eating out, and this may lead to changes in body weight.

Studies also investigated the changing eating patterns and weight status. The link between changing food patterns, snacking, and weight gain is well supported in several studies.[35,36] In a study by Daniel et al., the predictors of weight gain were reported as increased food intake, fast food, snacking, and canned products. They stated the rate of participants who increased food intake, who increased snacking, and who increased evening snacking was higher in those who stated weight gain than in those who stated that they had no weight gain during the pandemic ($p<0.001$).[35] In a study from Malesia, it was reported that the rate of participants who increased food consumption and who increased snacking was higher in those who stated weight gain than in those who stated that they had no weight gain ($p<0.001$).[36] In the current study, it was found that the rate of those who reported an increase in appetite and increased consumption of sugar, packaged products, and cereals in participants with weight gain was higher than those who stated that they lost weight. Although our study population mostly increased attention to healthy nutrition during the pandemic, the results were similar in the rate of those who pay more attention to

healthy eating between those who gain and lose weight.

When we interpret all these effects shown in the literature that COVID-19 has caused on our lives and nutrition, we can briefly say that, although COVID-19 has some devastating effects due to the disease and negative effects such as weight gain and lack of movement due to the lack-down, it has had an important impact to guide individuals to healthy eating habits to protect themselves from infectious diseases and increase immunity.

CONCLUSION AND RECOMMENDATIONS

In conclusion, this study has shown that, in addition to the many negativities caused by COVID-19 in our lives, it also brings positive experiences about strengthening immunity and turning to healthy eating habits. The impact of being diagnosed with COVID-19 on nutritional habits will guide individual immunity against new epidemics that are likely to be expected in the near future.

It is thought that to navigate emerging new epidemics, this time we are more experienced to implicate healty nutritional habits to our live. For future studies, a recommendation is to focus on the changes in individuals' attitudes toward nutrition and their awareness about nutrition as a precaution against possible future epidemics.

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