POOR SLEEP QUALITY, HIGH BODY MASS INDEX AND FEMALE GENDER MAY AFFECT WEIGHT GAIN IN THE COVID-19 PANDEMIC: A CROSS-SECTIONAL STUDY

COVID-19 Pandemisinde Kötü Uyku Kalitesi, Yüksek Beden Kütle İndeksi ve Kadın Olmak Vücut Ağırlığı Artışında Etkili Olabilir: Kesitsel Bir Çalışma

Mustafa Volkan YILMAZ[1], Özlem ÖZPAK AKKUŞ[2], Esma ASİL[1]

[1]Ankara Üniversitesi,
Sağlık Bilimleri Fakültesi,
Beslenme ve Diyetetik Bölümü,
Ankara,
Türkiye.
[2]Toros Üniversitesi,
Sağlık Bilimleri Fakültesi,
Beslenme ve Diyetetik Bölümü,
Mersin,
Türkiye.

Mustafa Volkan YILMAZ, Dr. Öğr. Ü.
(0000-0002-7411-134X)
Özlem ÖZPAK AKKUŞ, Dr. Öğr. Ü.
(0000-0002-1471-8000)
Esma ASİL, Doç. Dr.
(0000-0003-0809-4008)

İletişim:
Mustafa Volkan YILMAZ
Ankara Üniversitesi, Sağlık Bilimleri Fakültesi Beslenme ve Diyetetik Bölümü, Fatih Cad. no:197/7, 06290 Keçiören/Ankara/Türkiye

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ABSTRACT

Objective: The aim of the study was to understand the effects of demographic factors, changes in food consumption, sleep patterns, and physical activities on body weight in individuals restricted by social isolation during the COVID-19 pandemic in Türkiye.

Material and Methods: A total of 699 healthy adults under partial quarantine conditions in Türkiye participated in the study. This cross-sectional study inquired about the sociodemographic characteristics and anthropometric measurements of the individuals during the pandemic, as well as changes in their dietary habits and physical activities compared to the pre-pandemic period. Participants' sleep quality was measured using the Pittsburgh Sleep Quality Index.

Results: It was found that food consumption increased in 53.8% of the participants (n=376), physical activity decreased in 77.1% (n=539), and body weight increased in 44.5% (n=311). Logistic regression analysis for individuals with increased body weight indicated that poor sleep quality was associated with weight gain (OR=1.469, 95% CI=[1.012-2.133]; P<0.05), as was female gender (OR=2.376, 95% CI=[1.486-3.800]; P<0.001). Similarly, being overweight or obese was related to an increased risk of weight gain (OR=2.413, 95% CI=[1.514-3.847]; P<0.001) and (OR=2.545, 95% CI=[1.311-4.938]; P=0.006), respectively.

Conclusion: Changes in dietary habits, sleep patterns, and physical activities during the social isolation period due to the COVID-19 pandemic were found to significantly affect body weight. There is a need for large-scale, randomized studies to explore the interaction between lifestyle changes, sleep quality, dietary habits, and obesity during pandemic periods.

Keywords: *Covıd-19 Pandemic; Body Weight; Dietary Habits; Obesity; Pittsburgh Sleep Quality Index*

ÖZET

Amaç: Bu çalışmanın amacı, Türkiye'deki COVID-19 pandemisi sırasında sosyal izolasyonla kısıtlanmış bireylerde beslenme alışkanlıklarındaki değişikliklerin, uyku düzeni ve fiziksel aktivitelerin vücut ağırlığı üzerindeki etkilerini anlamaktır.

Gereç ve Yöntemler: Çalışmaya Türkiye'de kısmi karantina koşullarında olan toplam 699 sağlıklı yetişkin katılmıştır. Katılımcıların pandemi dönemindeki sosyodemografik özellikleri, antropometrik ölçümleri ve pandemi öncesi döneme kıyasla beslenme alışkanlıklarındaki değişiklikler ve fiziksel aktiviteleri sorgulanmıştır. Bireylerin uyku kalitesi, Pittsburgh Uyku Kalitesi İndeksi ile ölçülmüştür.

Bulgular: Katılımcıların %53,8'inde (n=376) besin tüketiminin arttığı, %77,1'inde (n=539) fiziksel aktivitenin azaldığı ve %44,5'inde (n=311) vücut ağırlığının arttığı saptanmıştır. Vücut ağırlığı artan bireyler için yapılan lojistik regresyon analizinde, düşük uyku kalitesinin ağırlık kazanımı (OR=1,469, %95 GA=[1,012-2,133]; P<0,05) ve kadın cinsiyetinin (OR=2,376, %95 GA=[1,486-3,800]; P<0,001) ile ilişkili olduğu olduğu belirlenmiştir. Benzer şekilde, fazla kilolu veya obez olmanın ağırlık kazanımı riski ile ilişkili olduğu (OR=2,413, %95 GA=[1,514-3,847]; P<0,001) ve (OR=2,545, %95 GA=[1,311-4,938]; P=0,006) tespit edilmiştir.

Sonuç: COVID-19 pandemisi nedeniyle uygulanan sosyal izolasyon sürecindeki beslenme alışkanlıklarındaki değişiklikler, uyku düzeni ve fiziksel aktivitelerin vücut ağırlığı üzerinde etkili olduğu bulunmuştur. Pandemi dönemlerinde yaşam tarzı değişiklikleri, uyku kalitesi, beslenme alışkanlıkları ve obezite arasındaki etkileşimi anlamak için geniş çaplı randomize çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: *Covid-19 Pandemisi; Vücut Ağırlığı; Beslenme Alışkanlıkları; Obezite; Pittsburgh Uyku Kalite İndeksi*

INTRODUCTION

The COVID-19 pandemic, with its resultant social isolation, has significantly disrupted daily life, leading to challenges such as difficulties in obtaining food, increased time spent at home, changes in income status, and heightened psychological stress. In Türkiye, as part of the response to manage the spread of the virus, stringent measures were implemented. These included a curfew from 21:00 to 05:00 on weekdays and full-day curfews during weekends, with exceptions only for essential activities such as purchasing food and medicine. The response extended to various sectors: many government departments and private institutions transitioned to remote working conditions, and educational institutions, along with public spaces like cafes and cinemas where social distancing was challenging, were closed. Furthermore, intercity transportation was tightly regulated, requiring official permission for travel. These factors collectively pose a risk to individuals' dietary habits, consumer behaviors, physical activities, and sleep patterns, potentially exacerbating health issues (1-4).

Negative moods during periods of psychological stress, such as a pandemic, are assumed to be associated with increased food consumption (5). Previous studies have found that negative mood further increases food consumption compared to a positive mood (6, 7), leading to higher energy and macronutrient consumption and, consequently, weight gain (8).

Obesity, characterized by weight gain, is correlated with poor sleep quality (9). Proinflammatory cytokines released from visceral adipose tissue, which increase in obesity, are claimed to cause deterioration in sleep quality by altering the sleep-wake rhythm (10). It has been reported that individuals with poor sleep quality are more susceptible to obesity due to a positive energy balance, resulting from increased food consumption and decreased physical activity (11, 12).

The aim of this study is to understand the effects of demographic factors, changes in food consumption, sleep patterns, and physical activities on body weight during the period of social isolation in the COVID-19 pandemic.

MATERIAL AND METHODS

This cross-sectional study was conducted with 699 individuals in partial quarantine between June and July 2020 during the COVID-19 pandemic. The data were collected through an online questionnaire (via Google Forms). The questionnaire form was announced on various social media platforms such as Facebook, Instagram, and WhatsApp, and volunteers were allowed to participate during the three weeks between June 23rd and July 13th, 2020. All procedures involving human participants adhered to the ethical standards of the institutional and national research committees, as well as the 1964 Declaration of Helsinki and its subsequent amendments. The study was approved by the Ministry of Health in Türkiye (Approval number: 2020-05-15T16_00_57) and the Clinical Research Ethics Committee at Toros University (Approval number: 35, dated June 17th, 2020). Participants provided written informed consent electronically.

Individuals between 18-65 years of age, without any psychological or chronic diseases, with no medical history of COVID-19, and living under partial quarantine conditions were included in the study. Those exempt from the partial quarantine conditions (for work or school-related reasons, etc.), who gave inconsistent responses to the questionnaire, filled out the questionnaire multiple times, had implausible energy intake, or had inconsistent data were excluded (Figure 1).

The questionnaire inquired about sociodemographics (education, income level, etc.), anthropometric characteristics, dietary habits, and changes in these aspects during the pandemic. The Pittsburgh Sleep Quality Index (PSQI) was used to measure sleep quality. According to the PSQI, sleep quality is evaluated over 21 points, where a score ≥5 indicates poor sleep quality, and a score <5 indicates good sleep quality (13).

Evaluations for height, body weight, regular physical activity, and weight changes were based on self-reports. BMI classification was made according to the WHO classification (14). To calculate energy and macronutrient intakes, a 19-item food frequency questionnaire (FFQ), developed by the researchers, was used, as there is no validated online questionnaire for similar inquiries in Türkiye. This FFQ was prepared to reflect food consumption based on the Türkiye Dietary Guidelines (15). The mean daily consumption was determined for each food group, and the approximate

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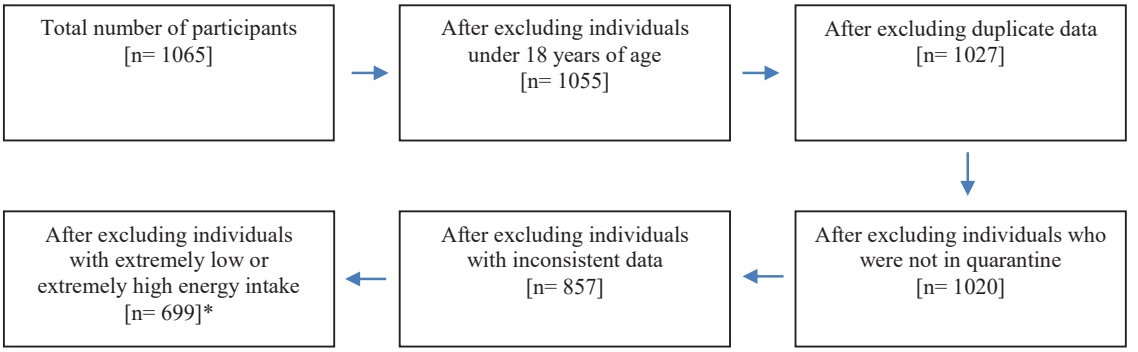
Figure 1. Data Cleaning



**Pittsburgh Sleep Quality Index was evaluated in 576 of the 699 individuals that were included in the study.*

daily energy and macronutrient intake was calculated using these amounts. For the calculation of the average energy and macronutrient value of food groups, the sum of energy and macronutrient content of each food item included in a certain food group was divided by the number of food items in that group (15). The sum of all food group consumptions provided the daily approximate energy and macronutrient intake. An energy intake less than 800 kcal was considered extremely low, and an intake more than 5000 kcal was considered extremely high. Individuals in either of these two groups were evaluated as implausible, and their data were excluded (16). While evaluating the effect of energy intake on body weight gain, quartiles according to energy intake were used (Q1: 800 – 1840 kcal; Q2: 1841-2881 kcal; Q3: 2882-3922 kcal; Q4: 3922-4963 kcal).

All statistical analyses were performed using SPSS v23 (IBM Corp. Released 2015. IBM SPSS Statisticss for Windows, Version 23.0. Armonk, NY: IBM Corp.) The Shapiro-Wilk test was used to examine conformity to normal distribution. Numerical variables with normal distribution are presented as mean and standard deviation. Categorical variables are presented as percentage and frequency. The risk factors affecting weight gain were determined by multiple logistic regression analysis. A univariate logistic regression analysis was performed on the independent variables, including only those with a p-value of up to 0.25 in the multiple logistic regression model as possible risk factors. Other variables were excluded from the analysis. The Backward Elimination Method (Backward: LR) was used to determine statistically significant variables. The Hosmer-Lemeshow test was used to evaluate the goodness of fit of the obtained model. For the final model, the Box-Tidwell method was used to test for linear correlations in numerical variables. The level of statistical significance was accepted as $p<0.05$ for all analyses.

RESULTS

Among the participants of the study (n=699), 78.3% were female, and the mean age of the individuals was 28.7 ± 10.4 years. The majority of the participants were bachelor's degree (74.7%), were unemployed (65.1%), did not do regular physical activity (59.1%), did not smoke (82.4%), did not consume alcohol (91.3%), and had two main meals a day (62.5%). Of the participants, 61.7% had normal body weight, and the mean BMI of the participants was found to be 23.4 ± 4.4 kg/m². Table 1 presents the general information of the participants.

Changes in behaviors and habits during the pandemic were inquired. Accordingly, 44.5% of participants reported weight gain, while 77.1% stated decreased physical activity levels. Those with weight gain gained an average of 3.4±1.9kg, and those with weight loss lost 3.2±1.9kg. Participants reported increased food consumption (53.8%) and cooking frequency (71.2%), while the frequency of ordering food decreased (76.0%) (Table 2).

Some independent variables associated with weight

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Table 1. Selected demographic, anthropometric and lifestyle information of participants

	n	**% / Mean**±SD
Gender		
Female	547	78.3
Male	152	21.7
Age (years)	699	28.7**±10.4**
Education Status		
High School or lower degree	65	9.3
Bachelor's Degree	522	74.7
Masters or PhD	122	16
Working Status		
Working	244	34.9
Not Working	455	65.1
BMI (kg/m^2)	699	23.4**±4.4**
BMI Classification		
Underweight	57	8.2
Normal	432	61.7
Overweight	155	22.2
Obese	55	7.9
Regular Physical Activity		
Doing	286	40.9
Not doing	413	59.1
Smoking Status		
Smoking	123	17.6
Not Smoking	576	82.4
Alcohol Consumption		
Consuming	61	8.7
Non-consuming	638	91.3
Number of Meals [per day]		
1 meal	15	2.1
2 meals	437	62.5
3 meals	247	35.3
Number of Snacks [per day]		
No snack	80	11.4
1 snack	166	23.7
2 snacks	267	38.2
3 snacks	125	17.9
4+ snacks	61	8.7

Numerical data were presented as mean (Standard Deviation), and categorical data were presented as number (%), BMI: Body Mass Index

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Table 2. The changes habits of individuals during the pandemic

	n	%
Weight Change During the Pandemic		
Decreased*	131	18.7
Increased**	311	44.5
Unhanged	257	36.8
Income Change During the Pandemic		
Decreased	208	29.8
Increased	41	5.9
Unchanged	450	64.4
Change in Physical Activity During the Pandemic		
Decreased	539	77.1
Increased	100	14.3
Unchanged	60	8.6
Change in Smoking During the Pandemic		
Decreased	42	28.8
Increased	40	27.4
Unchanged	41	28
Quit Smoking	23	15.8
Change in Alcohol Consumption During the Pandemic		
Decreased	25	37.7
Increased	16	22.9
Unchanged	20	28.6
Stopped Drinking	9	12.9
Change in Food Consumption During the Pandemic		
Decreased	126	18
Increased	376	53.8
Unchanged	197	28.2
Change in the Frequency of Meal+Snack During the Pandemic		
Decreased	166	23.7
Increased	266	38.1
Unchanged	267	38.2
Change in the Frequency of Cooking During the Pandemic		
Decreased	30	4.3
Increased	498	71.2
Unchanged	171	24.5
Change in the Frequency of Ordering Food		
Decreased	531	76
Increased	44	6.3
Unchanged	124	17.7

* Mean Weight Loss: 3.2 ± 1.9 kg; ** Mean Weight Gain: 3.4 ± 1.9 kg

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Table 3. Selected independent variables associated with weight gain

	No Weight Gain	Weight Gain	OR (CI)	p
Energy Intake [kcal]	2124 ± 821	2424 ± 977	1.000 (1.000-1.001)	**0.000**
Gender				
Female	289 (52.8%)	258 (47.2%)	0.600 (0.413-0.871)	**0.007**
Male	99 (65.1%)	53 (34.9%)		
Age [years]	28.3 ± 10.5	28.9 ± 10.5	1.002 (0.988-1.017)	0.768
BMI [kg/m²]	22.7 ± 4.0	24.4 ± 4.8	1.100 (1.060-1.142)	**0.000**
Education				
High School or Lower	32 (49.2%)	33 (50.8%)	0.757 (0.454-1.262)	0.286
University or Higher	356 (56.2%)	278 (43.8%)		
Sleep Quality				
Poor Sleep	220 (54.2%)	186 (45.8%)	1.436 (0.994-2.073)	0.054
Good sleep	107 (62.9%)	63 (37.1%)		
Income				
Decreased	104 (50.0%)	104 (50.0%)	1.372 (0.991-1.900)	0.057
Did not decrease	284 (57.8%)	207 (42.2%)		
Regular physical activity				
Doing	167 (58.4%)	119 (41.6%)	0.820 (0.605-1.112)	0.202
Not doing	221 (53.5%)	192 (46.5%)		
Smoking				
Does not smoke	314 (54.5%)	262 (45.5%)	0.794 (0.534-1.180)	0.253
Smoking	74 (60.2%)	49 (39.8%)		

Numerical data were presented as mean (Standard Deviation), and categorical data were presented as number (%). OR: Odds ratio, CI: Confidence Interval, BMI: Body Mass Index

gain are presented in Table 3.

The logistic regression model evaluated the relationship between dietary energy intake, gender, BMI, sleep quality, and weight gain (Table 4). Low sleep quality was found to increase the risk of weight gain (OR=1.469, 95% CI = [1.012-2.133]; p=0.048). Being overweight or obese also increased weight gain risk (OR=2.413, 95% CI = [1.514-3.847]; p<0.001) and (OR=2.545, 95% CI=[1.311-4.938]; P<0.05), respectively, compared to individuals with normal/low weight. Females had a 2.4 times higher risk of weight gain during the pandemic (OR=2.376 95% CI=[1.486–3.800]; p<0.001). The highest energy intake group (Q4) had a higher risk of weight gain compared to the lowest intake group (Q1) (OR=2.808, 95%CI=[1.245 – 6.334]; p<0.05), but no significant difference was found between Q1 and the Q2 and Q3 groups.

DISCUSSION

This study revealed that 44.5% of the participants experienced a mean weight gain of 3.39±1.93 kg, and this increase was associated with high dietary energy intake, poor sleep quality, high BMI (>25.0 kg/m²), and gender. Quarantines and isolations implemented since the onset of the COVID-19 pandemic have led to changes in physical activity levels, dietary habits, and the types and amounts of food consumed (17, 18). Research conducted during the pandemic indicates a trend towards undesirable increases in body weight, with obese individuals being most affected (19-22). In our study, the mean BMI of participants was 23.4±4.4 kg/m², with 30.1% classified as overweight or obese (Table 1). Furthermore, we found that the risk of weight gain was higher in overweight and obese individuals (p<0.05) (Table 4). Obesity has been shown to increase the risk of severe COVID-19 infection and

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Table 4. Risk factors associated with weight gain

	ß	p	OR (CI)
Low Sleep Quality	-0.029	0.001	1.469 (1.012-2.133)
Energy			
Q1		Ref	Ref
Q2	0.005	0.980	1.005 (0.679-1.488)
Q3	0.517	0.054	1.677 (0.991-2.840)
Q4	1.032	0.013	2.808 (1.245-6.334)
BMI			
Underweight/Normal		Ref	Ref
Overweight	0.881	0.000	2.413 (1.514-3.847)
Obese	0.934	0.006	2.545 (1.311-4.938)
Female	0.866	0.000	2.376 (1.486-3.800)

BMI: Body Mass Index, OR: Odds ratio, CI: Confidence Interval Q1: 800 – 1840 kcal; Q2: 1841-2881 kcal, Q3: 2882-3922 kcal; Q4: 3922-4963 kcal

complications, as it does with many other chronic diseases and high BMI is associated with poor outcomes from COVID-19 (17, 23). A meta-analysis evaluating 14 studies identified a BMI of 28 kg/m² and above as an independent risk factor for COVID-19 mortality (24). Gao et al. reported that individuals with a mean BMI of 27.7 kg/m² experienced more severe COVID-19 symptoms and longer hospitalizations compared to those with a mean BMI of 21.8 kg/m² (25).Additionally, a dose-response relationship was observed between BMI increase and COVID-19 severity, with each 1 unit increase in BMI raising the risk of severe COVID-19 by 1.13 times. Decreased expiratory reserve volume and functional capacity in obese individuals exacerbate the disease by increasing patients' ventilation requirements (26). Therefore, during the pandemic, it is crucial to provide information on healthy nutrition to manage the weight of overweight and obese individuals, increase awareness, and encourage weight loss, especially in obese individuals (27). Studies involving obese individuals in quarantine or social isolation have noted increased snack consumption and difficulties in maintaining dietary compliance and achieving weight loss (22, 28). Almandoz et al. found that 61.2% of participants consumed more food to cope with pandemic-induced stress, and 47.9% reduced their exercise time (28). In our study, 53.8% of participants reported decreased food consumption, while 77.1% noted a reduction in regular exercise (Table 2). Thus, providing nutrition education alone is insufficient during the pandemic; individuals also require psychological and physical support to mitigate the adverse effects of quarantine.

Sleep duration and quality are among the physiological factors affected during the pandemic. Increased stress during this period complicates falling asleep, shortens sleep duration, and impairs sleep quality (27, 29). A study comparing pre- and post-pandemic sleep quality found that 23.4% of participants experienced poorer sleep quality following lockdown (30). In China, 51% of individuals self-isolating and 76.7% of those isolated due to illness or risk of illness reported difficulties in falling asleep (29). In Italy, a study using the PSQI to evaluate the sleep quality of 2291 patients during the pandemic found that 57.1% had poor sleep quality (31). Our study observed that 70.5% of participants, whose sleep quality was assessed, had poor sleep quality (Table 3).

Short sleep duration or poor sleep quality can lead to emotional symptoms, affecting dietary habits and energy intake (27, 29, 32). A prospective study in China showed that short sleep duration increased the risk of weight gain and central obesity by 1.13 times (33). A negative relationship between sleep quality and BMI was also reported and Zachary et al. found that 22% of adults gained weight during the pandemic,

correlating this weight gain with short sleep duration (32,34). In our study, the average sleep duration was 7.87 ± 1.6 hours, and poor sleep quality was found to increase the risk of weight gain (OR= 1.469, 95% CI= [1.012-2.133]; P<0.05) (Table 4). Although the sleep duration in this study falls within the 7-9 hour range recommended by the American National Sleep Foundation for adults, the prevalence of poor sleep quality was notably high (35). Additionally, regular physical activity is known to improve sleep quality (36). In our study, 77.1% of participants reported decreased regular physical activity (Table 2), suggesting that reduced physical activity, coupled with increased stress levels due to the pandemic, may be associated with poor sleep quality. Consequently, these findings highlight the critical interplay between sleep quality, physical activity, and stress management during the pandemic, emphasizing the need for integrated strategies to promote better sleep and overall health, particularly in the context of reduced physical activity and heightened stress.

The risk of weight gain was found to be higher in females than in males (OR= 2.376, 95% CI=[1.486-3.800); p<0.001) (Table 4). Research by the American Psychological Association (APA) observed weight gain in 45% of female participants compared to 39% of male participants during the pandemic (37). Studies have also indicated that women's daily lives were more significantly affected by the pandemic (38). According to a United Nations report, 77.6% of women reported an increase in cleaning chores, while 59.9% noted an increase in cooking and meal preparation. In our study, 71.2% of participants reported more frequent cooking at home during quarantine (Table 2). Additionally, higher levels of stress and anxiety in women during the pandemic, along with changes in mood and increased consumption of sugary, fatty, or salty foods, may contribute to a higher risk of weight gain in women (27,38). Thus, these findings suggests that the pandemic's disproportionate impact on women's daily routines and stress levels, as evidenced by increased domestic responsibilities and altered dietary habits, may significantly contribute to the observed higher risk of weight gain in females compared to males during this period.

The use of an online questionnaire, enabling participation from across the country, was a strength of this study. However, there were limitations. The inability to conduct face-to-face interviews led to a reduced sample size due to incomplete and inconsistent data, and reliance on participants' self-reported body weight and weight changes. Another limitation was the use of a non-validated FFQ due to the absence of a validated online FFQ in Turkish. Additionally, the lack of pre-pandemic data on participants prevented a clear comparison between the two periods. Future studies should aim to collect data through face-to-face interviews using validated questionnaires.

CONCLUSION

The pandemic has had multifaceted effects on health beyond the virus itself. Quarantine and isolation measures implemented to control the pandemic have altered individuals' dietary habits, limited physical activity spaces, and impaired sleep quality. It is also evident that individuals consume more calories and tend to choose "palatable foods" high in sugar, fat, and salt during periods of elevated stress (27). Consequently, quarantine has become an obesogenic environment, particularly for obese individuals who are at greater risk of weight gain during the pandemic (28,39). High body weight is a significant risk factor for COVID-19 as well as many other chronic diseases. Therefore, during the pandemic, greater attention should be paid to individuals' nutrition in quarantine, guiding them in selecting appropriate foods and providing home exercise routines to protect against the disease and prevent an increase in obesity prevalence.

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