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Original article

Impact of COVID-19 Curfew on Eating Habits, Food Intake, and Weight According to Food Security Status in Saudi Arabia: A Retrospective Study

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Abstract

Background/Aim: Nutritional and lifestyle changes resulting from the implementation of the coronavirus disease (COVID-19) curfew could have detrimental effects on individuals' nutritional health. This study aimed to investigate the impact of COVID-19 curfew on eating habits, food intake, and weight according to food security status in Saudi Arabia.

Material and Methods: This retrospective study included 879 participants who were recruited via an online questionnaire. Data on demographics, food security status (via the Food Insecurity Experience Scale), and changes in eating habits, food intake, and weight before and during the curfew were collected.

Results: Changes in eating habits (mealtime and daily number of meals) during the curfew were more common among severely food-insecure participants. Having more time to cook was the reason for changes in eating habits in food-secure and mildly food-insecure participants, while anxiety related to food availability caused changes in eating habits in all food-insecure groups. Food unavailability was frequently reported among severely food-insecure participants. Food insecurity did not affect food intake during the curfew. However, food-secure participants had higher intakes of fruits, savory snacks, and sweets/candies (p = 0.000 for all). Weight increased significantly during the curfew in the food-secure and mildly food-insecure groups (0.98 kg, p= 0.004, and 0.56 kg, p= 0.014, respectively).

Conclusions: Intake of food between meals increased among food-secure participants during the COVID-19 curfew. Health organizations should emphasize via social media the importance of avoiding overconsumption of foods, promoting positive eating habits, and increasing physical activity during the curfew to maintain health and prevent weight gain.

Key words: COVID-19 curfew, food insecurity, eating habit, food intake, weight change

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Introduction

In early 2020, many countries have been making efforts to prevent the spread of coronavirus disease (COVID-19) after the World Health Organization (WHO) declared it as a pandemic (1). In Saudi Arabia, the first COVID-19 case was reported on March 2, 2020 (2). As a result, a partial curfew was initiated a week after in many cities across the country. Growing concerns of the virus spreading resulted in a gradual

closing of shops, malls, and restaurants. A 24-hour curfew then began on April 2 in some cities around the country, including Makkah and Madinah, followed by the capital of Riyadh and Jeddah and many other cities on April 6 (3,4). The 24-hour curfew was decided based on the number of reported cases in each city. Many other countries have also taken similar measures by promoting social distancing and quarantine regulations to ensure the safety of populations at large (5,6). Thus, most nonessential businesses around the globe were closed, and many individuals lost their source of income.

The implementation of COVID-19 curfew has raised concerns on how it would affect the food security and nutritional health of individuals. Interrupted work routine and lifestyle and income changes as a result of the curfew have caused boredom, anxiety, stress, and depression in many individuals (7). Boredom and anxiety have been associated with negative eating behaviors and consequently higher food intake (8,9). In addition, food cravings, specifically carbohydrate cravings, could be triggered by mood swings, and the consumption of carbohydrate induces the production of serotonin, providing an antidepressant effect (10). Hence, individuals with depressive disorders (e.g., seasonal affective disorder) tend to consume high quantities of carbohydrate-rich foods, including savory snacks (e.g., potato chips and pastries) to improve their mood (10). Food-insecure individuals are also known to have high intake of carbohydrates and fats and poor intake of fruits and vegetables (11,12). These changes in eating habits due to boredom, anxiety, stress, depression, or food insecurity could increase the risk of developing obesity and comorbidities, such as cardiovascular disease and type 2 diabetes, which could have more detrimental effects than COVID-19 (13–15).

The increased intake of macronutrients during the COVID-19 pandemic may result in the replacement of important micronutrients needed to maintain a good health (16). Micronutrient deficiencies among individuals with obesity can affect the cell-mediated immune response and increase susceptibility to viral infections, such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the causative agent of COVID-19 (17). Thus, the WHO published dietary recommendations to reduce the risk of nutritional-related health issues during the COVID-19 pandemic (18). The end date of the COVID-19 curfew and self-quarantine are unknown, and some countries are expecting the situation to last till the end of 2020. To prevent populations from compromising their nutritional status due to poor dietary habits during self-isolation, it is therefore urgent to understand the impact of COVID-19 curfew on nutritional health. This study aimed to specifically assess the impact of COVID-19 curfew on eating habits, food intake, and weight according to food security status in Saudi Arabia.

Material and Methods

Subjects

In this retrospective study, data about demographics, changes in eating habits, current food security status, food intake, height, and weight before and during the implementation of the COVID-19 curfew were collected from 1034 individuals aged >20 years who reside in Saudi Arabia. A sample size of 780 participants at minimum was required for this study, estimated by Epi Info™ (Epi Info 7.2.4.0, CDC, Atlanta) (19) with 95% confidence level, 24% of expected prevalence of food insecurity, and 3% of margin of error. Data were collected via an online questionnaire survey conducted between April 13 and 22, 2020—22 days after the partial curfew was started in the country (i.e., March, 23, 2020). Several social media activists and academic and medical personalities who were socially active and were residents of Saudi Arabia were contacted to assess the distribution of the questionnaire through WhatsApp and Twitter. This study was approved by the Ethics Committee of the College of Applied Medical Sciences, Taibah University, Madinah. The name and contact information of the principal investigator were included in the online questionnaire. All participants provided informed consent through a consent statement on the questionnaire.

Sociodemographic Characteristics and Food Security Status

Demographic data included educational level, employment status, family income, income stabil-

ity, family size, number of rooms in the household (to calculate household crowding), and ownership of household. Food security status was evaluated using the Arabic version of the Food Insecurity Experience Scale (FIES) developed by the Food and Agriculture Organization of the United Nations (20). The Arabic version of the FIES questionnaire has been validated in many Middle Eastern countries (21,22). The questionnaire has eight items divided into three sections. The first section includes three items assessing feelings of uncertainty and worry about food as well as inadequate food quality. Individuals were defined as experiencing a mild level of food insecurity if they answered at least one affirmative answer. The second section includes three items assessing the insufficiency of food quantities; individuals were defined as experiencing a moderate level of food insecurity if they answered at least one affirmative answer. The last section includes two items also regarding the insufficiency of food quantities but in a more severe form (stayed hungry or did not eat for the whole day) (23). For this section, individuals were defined as experiencing a severe level of food insecurity if they answered at least one affirmative answer. The FIES questionnaire was slightly modified by replacing instances of the phrase "during the last 12 months" with "during the curfew."

Changes in Eating Habits, Food Intake, and Weight During the COVID-19 Curfew

Changes in eating habits during the curfew were assessed by the following questions: 1) Is there any change in the number of meals consumed during the COVID-19 curfew? 2) Is there any change in the timing of meals consumed during the COVID-19 curfew? and 3) What are the reasons of changing the usual eating habits during the COVID-19 curfew, if applicable?

Daily food intake was assessed using a food frequency questionnaire adapted to include the main food groups from the Saudi Dietary Guideline "The Healthy Food Palm" (i.e., cereal and bread, vegetables, fruits, milk and dairy products, meat and eggs) (24). Additional food groups were added to categorize snacks and drinks (i.e., savory snacks, sweets and candies, and sugary drinks and juices). For each food category, participants were asked to report the frequency of consumption per week or day before and during the curfew.

Anthropometric data including height in centimeters and weight in kilograms before and after the curfew were also collected. Body mass index was calculated to determine the weight status of each participant, based on the WHO cutoffs (25).

Statistical Analysis

Data are presented as means with standard deviations and frequencies with percentages. The chi-squared test was used to compare between two categorical variables. The Kruskal-Wallis test was used to determine differences of asymmetric continues variables across the four food security categories (i.e., food security, mild food insecurity, moderate food insecurity, and severe food insecurity), while repeated measures analysis of variance (ANOVA) was used to examine differences between food intake and weight changes before and during the curfew, after adjusting for food security status. Two-tailed tests were employed, and a p-value of .05 was considered statistically significant. The Bonferroni adjustment for multiple comparisons was used to determine the significance of the results of the chi-squared test used in analyzing eating habits and the results of the repeated measures ANOVA. The Statistical Package for the Social Sciences 20 (SPSS 20, SPSS Inc., Chicago, IL) was used to analyze the data in this study.

Results

Characteristics of the Study Population

A total of 879 adults who live in Saudi Arabia were included in the final analysis after excluding participants with missing data (n= 155, 14.9%). Most of the participants were Saudis (91.2%), of whom 72.5% were from the Western region of Saudi Arabia (including Madinah, Jeddah, and Makkah), while 18.2% were from the Central region (including Riyadh and Al-Qassim). The mean age was 35.8 ± 12.1 years, 65.5% (n= 576) of participants were female, and 41.5% (n= 365) reported being single. About 63%

(n= 550) of participants were employed, while 76.9% (n= 676) reported having a stable monthly income for the family. Moreover, 58.0% (n= 510) of participants live independently, and 56.9% (n= 500) live in an owned household (apartment or house). Diagnosed chronic diseases were reported in 17.2% (n= 155) of the study sample.

The prevalence of mild, moderate, and severe food insecurity was 19.8% (n= 174), 10.5% (n= 92), and 7.39% (n= 65), respectively. Thus, the overall prevalence of food insecurity was 37.7% (n= 331), with 17.0% (n= 157) of participants experiencing moderate and severe food insecurity. The sociodemographic characteristics of participants stratified by food security status are described in **Table 1**. Food insecurity was significantly higher among male, single, and unemployed participants and those with a lower education level and income.

Table 1. Sociodemographic characteristics of participants stratified by food security status during the COVID-19 curfew in Saudi Arabia.

	Food Security (n=548)	**Mild Food Insecurity (n=174)**	**Moderate Food Insecurity (n=92)**	**Severe Food Insecurity (n=65)**	**Total (n=879)**	***p***
Age, years, mean ± SD	35.7 ± 12.0	37.1 ± 11.1	32.8 ± 11.3	36.9 ± 13.9	35.8 ± 12.1	.124
Sex, n (%)						
Female	373 (68.1)	114 (65.5)	58 (63.0)	31 (47.7)	576 (65.5)	.012*
Male	175 (31.9)	60 (34.5)	34 (37.0)	34 (52.3)	303 (34.5)	
Marital status, n (%)						
Single	233 (42.5)	57 (32.8)	40 (43.5)	35 (53.8)	365 (41.5)	.019*
Married	315 (57.5)	117 (67.2)	52 (56.5)	30 (46.2)	514 (58.5)	
Educational level, n (%)						
High school/diploma or less	74 (13.5)	29 (16.7)	25 (27.2)	37 (56.9)	165 (18.8)	< .001*
University	370 (67.5)	113 (64.9)	48 (52.2)	27 (41.5)	558 (63.5)	
Postgraduate	104 (19.0)	32 (18.4)	19 (20.7)	1 (1.50)	156 (17.7)	
Employment status, n (%)						
Employed	347 (63.3)	118 (67.8)	54 (58.7)	31 (47.7)	550 (62.6)	.031*
Unemployed	201 (36.7)	56 (32.2)	38 (41.3)	34 (52.3)	329 (37.4)	
Income stability, n (%)						
Stable	452 (82.5)	133 (76.4)	61 (66.3)	30 (36.2)	676 (76.9)	< .001*
Not stable	88 (16.3)	41 (23.6)	31 (33.7)	34 (53.1)	194 (22.3)	
Family income, SR, n (%)						
<3000	24 (4.40)	9 (5.20)	13 (14.1)	11 (16.9)	57 (6.50)	< .001*
3000-5999	45 (8.20)	23 (13.2)	15 (16.3)	14 (21.5)	97 (11.0)	
6000-10 000	110 (20.1)	36 (20.7)	21 (22.8)	8 (12.3)	175 (19.9)	
>10 000	357 (65.1)	96 (55.2)	37 (40.2)	11 (16.9)	501 (57.0)	
Family size, mean ± SD	5.73 ± 2.33	5.23 ± 2.28	6.11 ± 2.56	5.78 ± 2.86	5.70 ± 2.40	.020*
Household crowding, mean ± SD	1.00 ± 0.43	1.02 ± 0.47	1.23 ± 0.57	1.45 ± 0.77	1.07 ± 0.51	< .001*

COVID-19, coronavirus disease; SD, standard deviation; SR, Saudi Riyal (SR 3.75= $1.00).
* Difference is significant at the .05 level.

Changes in Eating Habits

Participants reported changes in eating habits during the curfew as follows: 66.1% (n= 581) reported changes in the mealtime, and 57.5% (n= 505) reported changes in the number of meals consumed daily. Changes in mealtime and number of meals per day during the COVID-19 curfew were reported more frequently by participants with severe food insecurity. The reasons for these changes were "boredom" and "having more time to cook." Meanwhile, anxiety related to food unavailability was reported among all food-insecure groups, while unavailability of food was more reported among those with severe food insecurity. Having more time to cook was more commonly reported by those with food security and mild food insecurity. Detailed data describing the changes in eating habits during the COVID-19 curfew and the reasons for these changes, as reported by participants stratified by food security status, are described in **Table 2**.

Changes in the Frequency of Food Intake

In the repeated measures ANOVA with a Greenhouse-Geisser correction, the mean food intake of fruits, savory snacks, and sweets and candies during the curfew increased significantly ($p< .001$) (**Table 3**), and the intake of these foods increased significantly only among participants with food security ($p< .001$ for all). The intakes of cereal and bread, vegetables, milk and dairy products, meat and eggs, and fruit juices and drinks did not change from before the curfew to during the curfew, even after adjusting for food security status.

Changes in Weight

Our findings showed that 6.30% of participants were underweight, while 32.9% and 26.9% were overweight and had obesity, respectively. The repeated measures ANOVA with a Greenhouse-Geisser correction indicated that the mean weight was significantly higher during the curfew than before the curfew [$F(1.00, 1019)=14.6$, $p< .001$]. Post hoc tests using the Bonferroni correction revealed that weight increased by an average of 0.75 kg ($p< .001$). After adjusting for food security status, the mean increase in weight during the curfew reported by participants with food security and those with mild food insecurity was 0.98 kg ($p= .004$) and 0.56 kg ($p= .014$), respectively.

Table 2. Changes in eating habits among participants stratified by food security status during the COVID-19 curfew in Saudi Arabia.

	Food Security (n=548)	Mild Food Insecurity (n=174)	Moderate Food Insecurity (n=92)	Severe Food Insecurity (n=65)	Total (n=879)	*p*
Individuals reporting changes in mealtime during the COVID-19 curfew						
	340 (62.0)	126 (72.4)	63 (68.5)	52 (80.0)	581 (66.1)	.025*
Individuals reporting changes in the daily number of meals consumed during the COVID-19 curfew						
	297 (54.2)	97 (55.7)	62 (67.4)	49 (75.4)	505 (57.5)	.002*
Reasons for changing eating habits during the COVID-19 curfew						
Boredom	205 (37.4)	79 (45.4)	43 (46.7)	18 (27.7)	345 (39.2)	.025
Anxiety related to food availability	53 (9.70)	44 (25.3)	19 (20.7)	16 (24.6)	132 (15)	< .001**
Unavailability of food at home	6 (1.10)	0 (0.00)	16 (17.4)	26 (40.0)	48 (5.50)	< .001**
Availability of food at home	87 (15.9)	21 (12.1)	10 (10.9)	4 (6.20)	122 (13.9)	.100
Having more time to cook	233 (42.5)	72 (41.4)	30 (32.6)	12 (18.5)	347 (39.5)	.001**
Long working hours	39 (7.10)	16 (9.20)	7 (7.60)	3 (4.60)	65 (7.40)	.654

COVID-19, coronavirus disease.
The chi-squared test was used to analyze the data in this table.
* Difference is significant at the .05 level.
** Difference is significant at the .008 level after a Bonferroni adjustment.

Table 3. Changes in the frequency of food intake during the COVID-19 curfew in Saudi Arabia.

	Mean ± SD	df	F	MD ± SE	*p*	95% Confidence Interval
Cereal and bread						
Before curfew	1.33 ± 0.85	1	0.03	0.01 ± 0.02	.870	-0.04 to 0.05
During curfew	1.35 ± 0.88					
Vegetables						
Before curfew	1.09 ± 0.81	1	0.44	0.02 ± 0.02	.507	-0.03 to 0.06
During curfew	1.11 ± 0.80					
Fruits						
Before curfew	0.83 ± 0.76	1	16.2	0.09 ± 0.02	< .001*	0.05 to -0.14
During curfew	0.94 ± 0.82					
Milk and dairy products						
Before curfew	1.10 ± 0.76	1	0.66	-0.02 ± 0.02	.416	-0.05 to 0.02
During curfew	1.10 ± 0.73					
Meat and eggs						
Before curfew	1.11 ± 0.73	1	1.82	-0.03 ± 0.02	.178	-0.06 to 0.01
During curfew	1.10 ± 0.72					
Savory snacks						
Before curfew	0.72 ± 0.74	1	30.6	0.15 ± 0.03	< .001*	0.09 to 0.20
During curfew	0.88 ± 0.88					
Sweets and candies						
Before curfew	0.72 ± 0.74	1	24.3	0.13 ± 0.03	< .001*	0.08 to 0.18
During curfew	0.86 ± 0.84					
Fruit drinks and juices						
Before curfew	1.12 ± 1.03	1	0.41	-0.02 ± 0.03	.520	-0.08 to 0.04
During curfew	1.11 ± 1.05					

COVID-19, coronavirus disease; SD, standard deviation; df, degree of freedom; MD, mean difference; SE, standard error.
Repeated measures analysis of variance was used to analyze the data in this table. All models were adjusted for food security status.
* Difference is significant at the .006 level after a Bonferroni adjustment.

Discussion

Concerns have been raised regarding the impact of the COVID-19 curfew on food accessibility, especially in individuals with food insecurity. In this study, increased food intake and rapid weight gain as a result of the curfew were reported by participants with food security, whereas the curfew had no impact on food intake among food-insecure individuals. These findings might be different from those in other countries; however, the situation could be quite similar among high-income countries and countries with a high level of food security.

The World Bank has warned about a potential rise in food insecurity among vulnerable groups amid the COVID-19 pandemic (26). Therefore, many countries have taken important measures to improve the food security status of their populations through supporting agriculture and the food market. In addition, numerous financial plans were implemented to cope with the COVID-19 curfew. The government of Saudi Arabia, through the Ministry of Finance, has provided funds to support the private sector and individuals who lost their income during the crisis (27). Canada and some other countries have also provided similar financial support to businesses and individuals who were negatively affected (28,29). Despite these efforts, increased prevalence of food insecurity due to COVID-19 pandemic lockdowns was reported among disadvantaged individuals (30).

The government of Saudi Arabia has also been making a significant effort to ensure that food is accessible to

all residents minimize the effects of the pandemic. The Ministry of Commerce has worked hard to control food prices and support food stores in delivering food to customers during the curfew (31–33). Public and private initiatives were also developed to deliver food baskets free of charge to families in need (34–36). Effort was also made by businesses and the government to provide safe food delivery services through many government-supported online applications (33). Most grocery stores were offering delivery services, which increased food accessibility to many individuals, including single mothers, seniors, and people with disabilities who are living alone. In this study, the food intake of food-insecure individuals was not negatively affected by the curfew. In all food-insecure groups, the frequency of food intake was not significantly different before and during the curfew. It is possible that food security status was not affected by the curfew, i.e., individuals who experienced food insecurity before the curfew still reported being food insecure during the curfew.

Our findings also showed that food-secure participants had increased intakes of fruits, savory snacks, and sweets and candies, while there were no changes in the intakes of cereals and bread, vegetables, milk and dairy products, and meat and eggs among all groups. It is not expected to find changes in the intakes of inelastic food items, such as cereals and bread, and meat and eggs, as these foods are consumed mostly during the main meals of the day. No changes in the intakes of vegetables and milk and dairy products were expected too as these foods are not frequently consumed by many populations worldwide, including the Saudi population (37,38).

Food-secure and mildly food-insecure participants reported changes in their eating habits because of having more time to cook. Among these participants, 52% were employed and might not have adequate free time to cook usually. After countless businesses were closed during the curfew, individuals might have been having more time to cook and prepare food at home, especially food-secure and mildly food-insecure individuals, who are more likely to have more food stocks at home during the curfew. As there were no changes in foods served during the main meals, participants might have been more likely to have more time to prepare snacks, such as cakes, cookies, pies, and pastries. These findings were observed despite guidance by the WHO to limit the intake of sweets and high-calorie foods during the COVID-19 curfew (18).

Participants in the food-secure group reported a rapid increase in weight (1.00 kg in <1 month), while those experiencing mild food insecurity reported a weight gain of about half a kilogram since the curfew started. Participants with mild level insecurity did not report increased food intake, but they reported increased weight. The reason could be that participants in this group gained weight due to non-dietary factors, such as physical inactivity. In addition, mildly food-insecure individuals might have been more likely to underestimate their current intake as they expressed anxiety related to food availability during the curfew. Despite the changes in the frequency of food intake, the reported rapid increase in weight among food-secure and mildly food-insecure individuals may place them in a very high risk of developing obesity comorbidities and complications in the long-term. Adopting negative eating behaviors and attitudes during the curfew may result in overeating and place individuals at higher risk of obesity, micronutrient deficiencies, and viral infections (13,16,17). Furthermore, it would be very challenging to change negative eating habits and behaviors once they have been adopted (39–41).

The Ministry of Health in Saudi Arabia and health authorities in the rest of the world have been working extensively to deal with the soaring number of COVID-19 cases. Health organizations have been working on various approaches and precautionary measures to prevent the disease from spreading. Social media may be a convenient approach to communicate with the public and raise awareness about healthy eating during the curfew, but there is limited attention to this aspect. Having a healthy dietary intake and staying physical active are also very important to meeting the recommended micronutrient levels (especially antioxidants) and maintaining a good overall nutritional health during the curfew. Moreover, using online nutrition education interventions aimed at behavioral change could also be very effective during this critical time; however, factors unique to these online interventions should be carefully considered (42).

Limitations

The study conducted an online questionnaire survey, which is a very convenient way to collect data during crises such as the COVID-19 pandemic. However, the use of an online questionnaire might have caused underestimation of weight and food intake in this study. This study is also limited because physical activity was not assessed and was therefore not adjusted for, although physical activity is expected to be limited during the curfew among average individuals living in Saudi Arabia. Nevertheless, this study focused on assessing changes in food intake and weight rather than just describing the dietary intake or weight status of the participants; thus, any systematic error that might be caused by self-reported data is not an issue.

Conclusion

This study revealed that changes in eating habits were commonly reported among severely food-insecure participants and that increased intake of snacks by food-secure participants resulted in increased weight. By sending simplified messages to the public via the social media, national and international health organizations must put more emphasis on the importance of reducing the intake of unhealthy snacks, promoting positive dietary behaviors and attitudes, and increasing physical activity to maintain a good health and prevent weight gain. Future research may focus on the long-term impact of the COVID-19 curfew on the eating habits and overall nutritional health of individuals living in Saudi Arabia and internationally.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported by the authors.

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