

Food security status, coping strategies, eating habits, and health conditions of Saudi Adults during COVID-19 curfew

Mahitab A. Hanbazaza¹

¹ Department of Food and Nutrition, Faculty of Human Sciences and Design, King Abdulaziz University
P.O. Box 80200, Jeddah, 21589, Kingdom of Saudi Arabia

Abstract. *Objective:* The COVID-19 pandemic and its related containment actions have impacted food security. This study aimed to assess food security status of adults in Saudi Arabia during the COVID-19 curfew, and describe their coping strategies, eating habits, and health conditions. *Design:* A cross-sectional study was conducted using an online survey, which included questions on sociodemographic characteristics, food security status, coping strategies, eating habits and self-rated health. *Results:* A total of 605 adults living in Saudi Arabia were recruited through an online survey. The overall prevalence of food insecurity was 28.4% (n= 172). Food insecurity was significantly higher among males with lower education and income level, and in participants living in rented properties. Numerous coping strategies were found to be significantly different between four types of food security groups. The total score of coping strategies was negatively associated with food security status (0.94 ± 1.59 , 2.78 ± 2.44 , 6.43 ± 2.76 , 7.34 ± 2.20 , respectively, $p < 0.001$). Food-insecure participants were significantly more likely to report poor/fair physical and mental health, compared to food-secure participants ($p < 0.001$). Food insecurity was significantly associated with changes in usual eating habits during the COVID-19 curfew ($p < 0.001$). *Conclusion:* The results showed that food insecurity can have a potential impact on adults' health and eating habits. Governments need to take crucial actions and adopt comprehensive policies, both locally and globally, to ensure food security among populations.

Key words: COVID-19 curfew, food insecurity, coping strategies, eating habits, self-rated health

Introduction

On March 2020, the World Health Organization (WHO) declared COVID-19 as a pandemic; since then, governments worldwide have been taking actions to stop the spread of the disease that has caused global economic crisis that has been negatively impacting on people's jobs, incomes, and businesses (1,2). Although the COVID-19 pandemic is a health crisis, it has also been threatening the food security status of millions of people globally and reshaping people's lives (3). Many households find their situation worsening, with fewer resources to rely on (2). As a result, many individuals have been experiencing job loss or a decrease in income (4). This has put food-insecure households at a higher

risk of facing food crisis leading to unusual increase in the poverty rate (2,5).

Food insecurity, defined as the "inability to reach nutritionally adequate safe foods and limited ability to acquire acceptable foods in socially acceptable ways," is a worldwide public health problem (6,7). The food insecurity status ranges in terms of severity, from no problem in getting food, decline in the quality of food consumed, to a decrease in the quantity of food consumed, which is the most severe level (8). The Food and Agricultural Organization (FAO) reported that there are currently more than 820 million hungry people worldwide (9). Moreover, the latest data have indicated that due to COVID-19 the number of food-insecure people will dramatically double before the end of the year (3).

Food insecurity can either be long-term or temporary (10–12). Income is the most important predictor of food insecurity (13–15); however, income level does not always reflect the economic status of individuals and their households (14,16). Other factors that could also influence food insecurity include household composition, occupation status, ethnicity, and education level (16).

Food-insecure households may adopt several strategies, temporarily or permanently, to mitigate the effects of lack of income and food (17), including dietary and income restrictions. In fact, previous research has linked food insecurity with poor consumption of nutritious food and quality of diet due to food cost, which have been shown to have negative health consequences (18–20). Moreover, several studies have indicated that food-insecure individuals are more likely to report poor self-rated physical and mental health conditions (19,21,22). In addition, a further study has shown that food-insecure households are at an increased risk of experiencing stress and chronic conditions, such as diabetes, hypertension, and cardiovascular illness (23). The effects of the COVID-19 pandemic are likely to increase the existing problem of food insecurity, by making it more difficult for food insecure individuals who already facing difficulty to procure their basic needs (24).

Till date, only limited research has been conducted in Saudi Arabia with the aim to determine the effects of COVID-19 on its population (25). However, the data lacks information about how food insecure adults are coping during this critical time. Therefore, with the purpose of addressing this existing gap, this study was conducted; wherein, we assessed the status of food security among adults in Saudi Arabia during the COVID-19 related curfew, and described the participants' coping strategies, eating habits, and health conditions.

Methods

This cross-sectional study was conducted between April 25 and June 17, 2020. The data were collected in Arabic, through an online survey conducted through social media applications such as “WhatsApp,” “Twitter,” “Facebook,” and “Snapchat.” The initial

page of the survey contained the consent to participate and a brief introduction of the study objective, duration of the survey, voluntary nature of participation, and declarations of anonymity and confidentiality. The participants included residents of all provinces in Saudi Arabia, aged 20 years or more, and willing to participate in the study.

The Faculty of Medicine Research Ethics Committee at blinded for review approved the study. King Abdul-Aziz University approved the study protocol and procedures (Reference No 218-20).

The minimum sample size required for this study was 385, which was calculated using Raosoft online calculator (26), based on a statistical power of 80%, confidence level of 95%, margin of error of 5%, and the population size of 34.2 million Saudi Arabia residents.

Measures

Sociodemographic characteristics: The demographic data included gender, age, ethnicity, marital status, education level, occupation, number of children, family size, household monthly income, city of residence, housing conditions, accommodation type, and whether the participant received help from any social development organizations.

Economic challenges and difficulties faced during the COVID-19 pandemic: The financial challenges and difficulties faced during the COVID-19 pandemic were assessed using the following questions: 1) “During the COVID-19 pandemic and curfew, did you experience a drop in your income while still on the job?” 2) “During the COVID-19 pandemic and curfew, were you dismissed from work?” 3) “During the COVID-19 pandemic and curfew, did you take out a loan?” 4) “During the COVID-19 pandemic and curfew, did you experience any financial loss?” The response options included yes, no, or refused to answer.

Food security: The food security status during COVID-19 was measured using the validated Arabic version of the Food Insecurity Experience Scale (FIES), obtained from the FAO (27). Many Middle Eastern countries have used and validated the Arabic version of the FIES questionnaire (8,28). This scale consists of eight questions, which aim to match participants with one out of four categories: food-security, mild food-insecurity, moderate food-insecurity, and

severe food-insecurity. Individuals were classified as experiencing mild food insecurity if they had at least one affirmative response, moderate food insecurity if they had 4-6 affirmative response, and severe food insecurity if they had 7-8 affirmative response. The FIES questionnaire was slightly modified by replacing the phrase “during the last 12 months” with “during the COVID-19 pandemic and curfew.”

Coping strategies: The coping strategies were assessed using the adapted version of the Coping Strategies Index which was translated into Arabic (29), and were grouped into two categories: food coping (i.e., eating less expensive and preferred food, limiting food portion size, reducing number of meals during the day, and limiting food consumption of adults to feed children), and income/expenditure coping strategies (i.e., borrowing food or money from friends or family, working more hours or having more than one job, selling any household possessions, giving up services such as (TV, internet, or telephone), deferring bill payments, spending less on food to pay other bills, and receiving help from the Ministry of Labor and Social Development or any emergency services) (30). The response options included yes, no, or refused to answer.

Self-reported physical and mental health: Physical and mental health were assessed using an adopted version of the Canadian Community Health Survey which was translated into Arabic, including self-reported physical and mental health, feelings of sadness, depression, nervousness, stress, or worry (31). Participants were asked whether they were diagnosed with any chronic conditions, including high blood pressure, diabetes, cancer, heart disease, stroke, or any respiratory illness.

Changes in regular eating habits: The changes in regular eating habits during the COVID-19 related curfews was assessed through the following questions: 1) “During the COVID-19 pandemic and curfew, did you notice any changes in your regular eating habits?” The response options included yes, no, or I don’t know. 2) “What were the reasons behind the changes in your regular eating habits during the curfew? (choose all that apply)” The response options included increased number of daily meals/ decreased number of daily meals/ increase in food prices/ not having enough money to buy food/ lack of supermarkets near homes/

don’t have time to go to supermarket/ unavailability of food at home /low food quality in the nearby supermarkets /and food limitations in the nearby supermarkets. 3) “How many meals did you usually eat during the day before the COVID-19 pandemic and curfew?” 4) “How many meals do you usually eat during the day during the COVID-19 pandemic and curfew?” Response options included 1-2 meals, 3-4 meals, 5-6 meals, 7 meals or more.

Statistical analysis

Descriptive analysis was reported either as mean \pm standard deviation for continuous variables, or frequencies and percentages for categorical variables. Chi-square test was used to determine the associations between the two categorical variables. The nonparametric one-way ANOVA on ranks test was used to determine the association between the total coping strategies scores across the four food security categories. For retrospective data, repeated measures ANOVA was used to analyze the differences between the number of meals before and during the curfew, based on the food security status. A p-value < 0.05 was considered to be statistically significant. All data were analyzed using the Statistical Package for the Social Sciences 23 (SPSS 23, SPSS Inc., Chicago, IL).

Results

Characteristics of participants

A total of 605 adult participants were included in the study after excluding those with incomplete data ($n = 33$; 5.17%). The majority of the participants were Saudi ($n = 520$; 86.0%). Among the participants, 84.6% ($n = 512$) were from the Western region of Saudi Arabia (including Jeddah, Makkah, Madinah, Yanbu and Al Taif), 9.10% ($n = 55$) from the Central region (including Riyadh, Al-Qassim, Al Kharj, Buraydah, and Az Zulfi), 4.10% ($n = 25$) from the Eastern region, and 2.00% ($n = 12$) from the Southern and Northern regions. The mean age of the participants was 40.4 ± 10.0 years. The majority of the participants were female ($n = 348$; 57.5%). Moreover, a higher proportion of the participants were married ($n = 484$; 80.0%).

Around 82.6% ($n = 500$) of the participants reported having children, and the average number of children per family was 2.69 ± 1.98 child. The average family size consisted of 5.16 ± 2.32 persons.

Most of the participants lived independently ($n = 483$; 79.8%), and half of them lived in their own house or apartment ($n = 301$; 49.8%). More than half of the participants had a university degree ($n = 368$; 60.8%). About 67.1% ($n = 401$) were employed, and 57.4% ($n = 347$) had a monthly family income of more than SR 10,000 (equivalent to \$3,998/month). Around 4.10% ($n = 25$) reported receiving help from social development organizations (Table 1).

Prevalence of food insecurity

The overall prevalence of food insecurity was 28.4% ($n = 172$), with mild, moderate, and severe food insecurity reaching 16.9% ($n = 102$), 6.40% ($n = 39$), and 5.10% ($n = 31$), respectively. Food insecurity was significantly higher among male participants and those with a lower education level. Similarly, participants with an income under SR 3,000, and who lived in a rented apartment or house showed a higher level of food insecurity. Table 1 shows the sociodemographic characteristics of the participants based on food security status during the COVID-19 related curfews.

Table 1. Sociodemographic characteristics of participants based on food security status during the COVID-19 curfew

	Food Secure ($n = 433$)	Mild Food Insecurity ($n = 102$)	Moderate Food Insecurity ($n = 39$)	Severe Food Insecurity ($n = 31$)	Total ($n = 605$)	<i>p</i>
Age, years, mean \pm SD	40.3 \pm 10.2	41.0 \pm 9.86	39.9 \pm 9.10	39.5 \pm 8.66	40.4 \pm 10.0	0.209
Gender, <i>n</i> (%)						
Female	265 (61.2)	53 (52.0)	20 (51.3)	10 (32.3)	348 (57.5)	0.006*
Male	168 (38.8)	49 (48.0)	19 (48.7)	21 (67.7)	257 (42.5)	
Marital status, <i>n</i> (%)						
Single	56 (12.9)	10 (12.9)	3 (7.70)	3 (9.70)	72 (11.9)	0.732
Married	345 (79.7)	83 (81.4)	32 (82.1)	24 (77.4)	484 (80.0)	
Divorced	25 (5.80)	8 (7.80)	4 (10.3)	4 (12.9)	41 (6.80)	
Widowed	7 (1.60)	1 (1.00)	0 (0.00)	0 (0.00)	8 (1.30)	
Educational level, <i>n</i> (%)						
High school/ or less	79 (18.2)	29 (28.4)	17 (43.6)	16 (51.6)	141(23.3)	<0.001**
University	275 (63.5)	60 (58.8)	20 (51.3)	13 (41.9)	368 (60.8)	
Postgraduate	79 (18.2)	13 (12.7)	2 (5.10)	2 (6.50)	96 (15.9)	
Employment status, <i>n</i> (%)						
Employed	300 (69.8)	62 (60.8)	21 (55.3)	18 (64.3)	401 (67.1)	0.125
Unemployed	130 (30.2)	40 (39.2)	17 (44.7)	10 (35.7)	197 (32.9)	
Family income, SR, <i>n</i> (%)						
0 - <3000	31 (7.20)	24 (23.5)	19 (48.7)	15 (48.4)	89 (14.7)	<0.001**
3000 - <less than 5000	39 (9.00)	13 (12.7)	5 (12.8)	4 (12.9)	61 (10.1)	
5000 - <10,000	74 (17.1)	18 (17.6)	9 (23.1)	7 (22.6)	108 (17.9)	
>10,000	289 (66.7)	47 (46.1)	6 (15.4)	5 (16.1)	347 (57.4)	
Do you have children, <i>n</i> (%)						
Yes	355 (82.0)	84 (82.4)	36 (92.3)	25 (80.6)	500 (82.6)	0.430
No	78 (18.0)	18 (17.6)	3 (7.70)	6 (19.4)	105 (17.4)	

	Food Secure (n = 433)	Mild Food Insecurity (n = 102)	Moderate Food Insecurity (n = 39)	Severe Food Insecurity (n = 31)	Total (n = 605)	p
Number of children, mean ± SD	2.59±1.90	3.05±2.35	3.08±1.76	2.39±1.76	2.69±1.98	0.182
Family size, mean ± SD	5.03±2.29	5.80±2.58	5.26±2.07	4.84±1.93	5.16±2.32	0.927
Housing condition, n (%)						
Independent housing	348 (80.4)	79 (77.5)	32 (82.1)	24 (77.4)	483 (79.8)	0.881
Live with parents/ relatives	85 (19.6)	23 (22.5)	7 (17.9)	7 (22.6)	122 (20.2)	
Accommodation, n (%)						
Rent Apartment/house	189 (43.6)	64 (62.7)	27 (69.2)	24 (77.4)	304 (50.2)	<0.001**
Owned Apartment/ house	244 (56.4)	38 (37.3)	12 (30.8)	7 (22.6)	301 (49.8)	
Receiving help from social development, n (%)						
Yes	18 (4.20)	3 (2.90)	2 (5.10)	2 (6.50)	25 (4.10)	0.829
No	415 (95.8)	99 (97.1)	37 (94.9)	29 (93.5)	580 (95.9)	
Suspended form work, n (%)						
Yes	75 (19.4)	28 (31.1)	19 (54.3)	20 (69.0)	142 (26.2)	<0.001**
No	312 (80.6)	62 (68.9)	16 (45.7)	9 (31.0)	399 (73.8)	
Drop in income while till in the job, n (%)						
Yes	70 (18.2)	31 (35.6)	27 (81.8)	22 (78.6)	150 (28.1)	<0.001**
No	315 (81.8)	56 (64.4)	6 (18.2)	6 (21.4)	383 (71.9)	
Take loan, n (%)						
Yes	3 (0.70)	2 (2.10)	2 (5.70)	2 (8.70)	9 (1.60)	0.004*
No	417 (99.3)	92 (97.9)	33 (94.3)	21 (91.3)	563 (98.4)	
Financial losses, n (%)						
Yes	126 (29.7)	47 (50.5)	28 (73.7)	26 (83.9)	227 (38.7)	<0.001**
No	298 (70.3)	46 (49.5)	10 (26.3)	5 (16.1)	359 (61.3)	

SD, standard deviation; SR, Saudi Riyal (SR 3.75= \$1.00).

* p value < 0.05 was considered statistically significant.

** p value < 0.01 was considered statistically significant.

Economic challenges and difficulties faced during the COVID-19 pandemic

The study found that during COVID-19 related curfews, food insecurity was significantly more common among participants who reported dismissal from work, a drop in their income, financial loss, or had taken a loan ($p < 0.001$) (Table 1).

Coping strategies

Food insecurity was significantly associated with the use of numerous strategies to cope with the crisis ($p < 0.001$). Specifically, food-insecure participants reported using more coping strategies to manage their situation as compared to food-secure participants. The most common coping strategies reported by

participants with moderate and severe food-insecurity were eating less expensive and preferred food (97.4% and 96.8%, respectively), limiting food portions (91.9% and 90.0%, respectively), spending less money on food (83.3% and 87.1%, respectively), deferring bill payments (81.1% and 86.7%, respectively), borrowing food or money from relatives and friends (85.3% and 79.3%, respectively), reducing the number of meals (76.3%, 80%, respectively), restricting food consumption of adults to feed children (64.9% and 86.2%, respectively), giving up services such as TV, internet or telephone (54.3% and 50.0%, respectively), and selling household items (45.7% and 48.3%, respectively).

Conversely, the least reported coping strategies by moderate and severely food-insecure participants were working more hours (12.9% and 29.2%, respectively) and receiving help from the Ministry of Labor and Social Development (11.1% and 24.1%, respectively). For participants in the food-secure category, the most used coping strategies were eating less expensive and preferred food (23.9%), spending less money on food (19.8%), limiting food portions (15.9%), deferring bill payments (15.4%), and reducing the number of meals (13.5%). The total score of coping strategies was negatively associated with food security status ($p < 0.001$; see Table 2).

Table 2. Strategies used to cope with food insecurity among participants based on food security status during the COVID-19 curfew

	Food Secure	Mild Food Insecurity	Moderate Food Insecurity	Severe Food Insecurity	Total	<i>p</i>
Eat less expensive and less preferred food (<i>n</i> = 587)						
Yes	101 (23.9)	60 (63.2)	38 (97.4)	30 (96.8)	229 (39.0)	<0.001*
No	321 (76.1)	35 (36.8)	1 (2.60)	1 (3.20)	358 (61.0)	
Limiting food portion (<i>n</i> = 580)						
Yes	67 (15.9)	37 (40.2)	34 (91.9)	27 (90.0)	165 (28.4)	<0.001*
No	354 (84.1)	55 (59.8)	3 (8.10)	3 (10.0)	415 (71.6)	
Reduce number of meals (<i>n</i> = 580)						
Yes	56 (13.5)	31 (32.0)	29 (76.3)	24 (80.0)	140 (24.1)	<0.001*
No	359 (86.5)	66 (68.0)	9 (23.7)	6 (20.0)	440 (75.9)	
Restrict food consumption to feed children (<i>n</i> = 572)						
Yes	27 (6.5)	22 (24.2)	24 (64.9)	25 (86.2)	98 (17.1)	<0.001*
No	388 (93.5)	69 (75.8)	13 (35.1)	4 (13.8)	474 (82.9)	
Spend less money on food (<i>n</i> = 575)						
Yes	82 (19.8)	42 (54.8)	30 (83.3)	27 (87.1)	181 (31.5)	<0.001*
No	333 (80.2)	51 (45.2)	6 (16.7)	4 (12.9)	394 (68.5)	
Borrowing food or money from relatives or friends (<i>n</i> = 585)						
Yes	21 (5.0)	23 (23.7)	21 (58.3)	23 (79.3)	88 (15.0)	<0.001*
No	402 (95.0)	74 (76.3)	15 (41.7)	6 (20.7)	497 (85.0)	
Work more hours (<i>n</i> = 558)						
Yes	10 (2.4)	10 (11.1)	4 (12.9)	7 (29.2)	31 (5.6)	<0.001*
No	403 (97.6)	80 (88.9)	27 (87.1)	17 (70.8)	527 (94.4)	
Receive help from ministry of labor and social development (<i>n</i> = 588)						
Yes	2 (0.50)	13 (13.4)	4 (11.1)	7 (24.1)	26 (4.40)	<0.001*
No	424 (99.5)	84 (86.6)	32 (88.9)	22 (75.9)	562 (95.6)	

	Food Secure	Mild Food Insecurity	Moderate Food Insecurity	Severe Food Insecurity	Total	<i>p</i>
Give up services (<i>n</i> = 586)						
Yes	10 (2.40)	17 (17.7)	19 (54.3)	15 (50.0)	61 (10.4)	<0.001*
No	415 (97.6)	79 (82.3)	16 (45.7)	15 (50.0)	525 (89.6)	
Deferring bill payment (<i>n</i> = 586)						
Yes	65 (15.4)	40 (40.8)	30 (81.1)	26 (86.7)	161 (27.5)	<0.001*
No	356 (84.6)	58 (59.2)	7 (18.9)	4 (13.3)	425 (72.5)	
Selling household items (<i>n</i> = 592)						
Yes	5 (1.20)	6 (6.10)	16 (45.7)	14 (48.3)	41 (6.90)	<0.001*
No	425 (98.8)	92 (93.9)	19 (54.3)	15 (51.7)	551 (93.1)	
Total score of coping strategies						
	0.94±1.59	2.78±2.44	6.43±2.76	7.34 ± 2.20	1.76±2.54	<0.001*

* *p* value < 0.001 was considered statistically significant.

Note: participants reported refused, coded as missing data

Physical and mental health

Food insecurity was associated with lower physical and mental health (at least $p < 0.05$; see Table 3). Food-insecure participants were significantly more likely to report poor/fair physical and mental health when compared to food-secure participants ($p < 0.001$). In addition, unlike food-secure participants, severe food-insecure participants were significantly more likely to report positive responses to all mental health related questions, including feeling extremely stressed (64.3%), sad or depressed (86.2%), nervous or worried (90.3%), and uncomfortable or unable to carry on with the day (92.6%) (Table 3).

Changes in regular eating habits

Moreover, food insecurity was significantly associated with changes in regular eating habits during COVID-19 related curfews ($p < 0.001$, Table 4). About

35.3% ($n = 207$) of participants reported changes in their regular eating habits during the curfews. Among moderate and severe food-insecure participants, 78.4% ($n = 29$) and 83.9% ($n = 26$) respectively, reported changes in their regular eating habits compared to only 24.3% of food-secure participants. The reasons for these changes were increase in food prices ($p < 0.001$), not having enough money to buy food ($p < 0.001$), the lack of supermarkets near the participants' homes ($p < 0.001$), unavailability of food at home ($p < 0.001$), low food quality in the nearby supermarkets ($p = 0.002$), and food limitations in the nearby supermarkets ($p = 0.005$) (Table 4).

The change in the number of meals consumed before and during the COVID-19 related curfews were analyzed using General Linear Model pairwise comparison. Only food-secure participants reported a significant increase in the number of meals consumed daily, since the beginning of the curfew period (MD ± SE 0.21±0.06, $p < 0.001$; Table 5). There were no

Table 3. Self-reported physical and mental health of participants based on food security status during the COVID-19 curfew

	Food Secure	Mild Food Insecurity	Moderate Food Insecurity	Severe Food Insecurity	Total	<i>p</i>
Physical health (n = 597)						
Excellent/Very good/Good	406 (94.4)	88 (88.9)	29 (78.4)	24 (77.4)	547 (91.6)	<0.001***
Fare/Poor	24 (5.60)	11 (11.1)	8 (21.6)	7 (22.6)	50 (8.40)	
Chronic conditions (n = 605)						
Yes	71 (16.4)	22 (21.6)	8 (20.5)	11 (35.5)	112 (18.5)	0.047*
No	362 (83.6)	80 (78.4)	31 (79.5)	20 (64.5)	493 (81.5)	
Mental health (n = 598)						
Excellent/Very good/Good	368 (85.6)	66 (66.0)	17 (43.6)	14 (48.3)	465 (77.8)	<0.001***
Fare/Poor	62 (14.4)	34 (34.0)	22 (56.4)	15 (51.7)	133 (22.2)	
Level of stress (n = 562)						
Not stressed at all	68 (16.9)	8 (8.4)	1 (2.8)	1 (3.6)	78 (13.9)	<0.001***
A bit stressed	304 (75.4)	65 (68.4)	20 (55.6)	9 (32.1)	398 (70.8)	
Extremely stressed	31 (7.7)	22 (23.2)	15 (41.7)	18 (64.3)	86 (15.3)	
Felt sad or depressed (n = 561)						
Yes	243 (60.8)	71 (74.7)	26 (70.3)	25 (86.2)	365 (65.1)	0.004**
No	157 (39.3)	24 (25.3)	11 (29.7)	4 (13.8)	196 (34.9)	
Felt nervous or worried (n = 589)						
Yes	299 (71.4)	88 (87.1)	31 (81.6)	28 (90.3)	446 (75.7)	<0.001***
No	120 (28.6)	13 (12.9)	7 (18.4)	3 (9.70)	143(24.3)	
Felt uncomfortable or unable to carry on with the day (n = 567)						
Yes	154 (37.7)	69 (73.4)	26 (70.3)	25 (92.6)	274 (48.3)	<0.001***
No	255 (62.3)	25 (26.6)	11 (29.7)	2 (7.40)	293 (51.7)°	

* *p* value < 0.05 was considered statistically significant.

** *p* value < 0.01 was considered statistically significant.

*** *p* value < 0.001 was considered statistically significant.

Note: participants reported I don't know or refused, coded as missing data.

Table 4. Changes in regular eating habits among participants based on food security status during the COVID-19 curfew

	Food Security	Mild Food Insecurity	Moderate Food Insecurity	Severe Food Insecurity	Total	<i>p</i>
Changing in regular eating habits during the COVID-19 curfew (n = 586)						
Yes	102 (24.3)	50 (51.0)	29 (78.4)	26 (83.9)	207 (35.3)	<0.001*
No	318 (75.7)	48 (49.0)	8 (21.6)	5 (16.1)	379 (64.7)	
Reasons for changing regular eating habits during the COVID-19 curfew						
Increased number of daily meals	61 (14.1)	20 (19.6)	5 (12.8)	7 (22.6)	93 (15.4)	0.335
Decreased number of daily meals	17 (3.90)	3 (2.90)	4 (10.3)	2 (6.50)	26 (4.30)	0.229

	Food Security	Mild Food Insecurity	Moderate Food Insecurity	Severe Food Insecurity	Total	<i>p</i>
Increase in food prices	46 (10.6)	32 (31.4)	20 (51.3)	21 (67.7)	119 (19.7)	<0.001**
Not having enough money	7 (1.60)	17 (16.7)	19 (48.7)	19 (61.3)	62 (10.2)	<0.001**
Lack of supermarkets near homes	26 (6.00)	14 (13.7)	8 (20.5)	8 (25.8)	56 (9.30)	<0.001**
Don't have time to go to supermarket	29 (6.70)	8 (7.80)	9 (23.1)	8 (25.8)	54 (8.90)	<0.001**
Unavailability of food at home	7 (1.60)	4 (3.90)	5 (12.8)	6 (19.4)	22 (3.60)	<0.001**
Low food quality in the nearby supermarkets	15 (3.50)	6 (5.90)	5 (12.8)	5 (16.1)	31 (5.10)	0.002*
Food limitations in the nearby supermarkets	43 (9.90)	19 (18.6)	8 (20.5)	8 (25.8)	78 (12.9)	0.005*

* *p* value < 0.01 was considered statistically significant.

** *p* value < 0.001 was considered statistically significant.

Note: 3.1% (*n*=19) reported I don't know

Table 5. Changes in numbers of meals reported by participants based on food security status during the COVID-19 curfew

	MD ± SE	df	F	<i>p</i>	95% Confidence Interval
Food Secure	0.21±0.06	1	12.6	<0.001*	0.09 to 0.32
Mild food insecurity	0.15±0.12	1	1.44	0.232	-0.10 to 0.39
Moderate food insecurity	-0.13±0.25	1	0.25	0.617	-0.64 to 0.39
Severe food insecurity	0.00±0.25	1	0.00	1.000	-0.50 to 0.50

df, degree of freedom; *MD*, mean difference; *SE*, standard error.

* *p* value < 0.001 was considered statistically significant.

P value acquired using pairwise comparison of numbers of meals before and after COVID-19 curfew.

significant changes in the number of daily meals reported by participants with food insecurity (Table 5).

Discussion

The study found that during the COVID-19 related curfews, about one third of the population were experiencing food insecurity. In particular, the food-insecure participants were significantly more likely to report financial challenges, several strategies to cope with food insecurity, poorer physical and mental health, and changes in their regular eating habits. However, no significant changes were reported in the number of daily meals.

Lockdowns and government restrictions on movement strongly affected individuals' income, especially low-income and self-employed, by contributing to the loss of source of income and the inability to access the markets (2,4). According to the latest International Labor Organization (ILO) data, the economic slowdown caused by the pandemic has had a devastating effect on jobs, incomes, and businesses, which in turn has impacted people's ability to buy food, especially those with a low income (4). The current study found that during COVID-19 related curfews, food-insecure participants were significantly more likely to report dismissal from work, a drop in their income, financial loss, and the possibility of taking a loan. Previous study has also found an association between job

loss and food insecurity indicating that an increase in the number of people experiencing job loss will give rise to the prevalence of food insecurity (32).

To deal with the current crisis, the government of Saudi Arabia has taken several precautionary measures to provide the financial help necessary to prevent and limit the adverse effects of the pandemic (33). More specifically, it has provided funds to support the private sector, small businesses, economic activities, as well as assistance to those most affected by this pandemic (33). In addition, various charitable organizations under the Ministry of Human Resources and Social Development have provided free food baskets to families in need (34).

The present study shows that food-insecure participants reported using several coping strategies to mitigate the effects of food insecurity, including compromising food quality and quantity and income/expenditure coping strategies. The most used coping strategies among food insecure adults were eating less expensive and preferred food, limiting food portion, spending less money on food, deferring bill payments, borrowing food or money from relatives and friends, reducing the number of meals, restricting food consumption to feed their children, giving up services, and selling household items. It was reported that, as the level of food insecurity increased, more severe coping strategies were used (17). These results were similar to the findings obtained by a study conducted in Vermont state, in New England during the COVID-19 as they found that newly food insecure households were significantly more likely to report eating less, buying cheaper foods, receiving food from family and friends, and using government assistance programs or food pantries (35). It is important to emphasize that compromising on food quality and quantity for a long term can seriously impact an individual's health (19).

Food-insecure participants were significantly more likely to report poor physical and mental health. Similarly, previous research has shown that food insecurity was negatively associated with several short and long-term health outcomes, including poor mental health (22) and poorer overall health (36). Moreover, it is anticipated that the prevalence of severe mental health disorders will increase during the current pandemic as curfew measures have noticeably changed

the daily routine of people, and contributed to higher levels of stress, anxiety, and depression (37,38). WHO has recommended some ways to help people cope with stress and support adult mental and psychosocial health during the pandemic (39).

The Saudi government has formulated several strategies to ensure food security among its population, including monitoring food prices and preventing price gouging, in order to support low income and vulnerable people. In addition, it has ensured uninterrupted access to affordable staple food, free food deliveries, and the provision of ready meals and groceries through e-applications (2). However, despite governmental efforts, adults experiencing food insecurity reported changes in their regular eating habits during the COVID-19 related curfews for several reasons, including not having enough money to buy food, unavailability of food, increased price of food, lack of supermarkets near their homes, low food quality, and limited food in the supermarkets. A recent study conducted in Saudi Arabia during the COVID-19 pandemic indicated that food-insecure participants reported changes in their eating habits during the curfew mainly due to anxiety and food unavailability (25). The loss of purchasing power caused by limited income, can also alter eating habits, leading to poor diet and in the long run, malnutrition (40). In addition, participants in the current study reported increased food prices, low quality, and limited food available in the supermarkets near their homes, as challenges in maintaining their regular eating habits. A previous study found that living location could also influence food access and the type of food consumed, which could impact healthy eating patterns (41). Especially with limited access to supermarket during COVID-19 curfew, people were more likely to purchase all their food supplies from convenience stores. Convenience stores and small stores, compared to supermarkets, may have higher food prices, lower food quality, and limited food variety (41).

Food-secure participants reported an increase on the number of meals after the curfew, compared to food-insecure participants. It is possible that food-secure individuals had large food stock available and more time to cook at home during the curfew, which led to higher numbers of meals consumed during the pandemic (25).

Limitations

To the best of our knowledge, this study was among the first few to examine food security status, eating habits, coping strategies, and health of the general public in Saudi Arabia during COVID-19. However, this study has some limitations. First, the study was conducted using an online survey, which means only people with internet access and familiarity with online surveys were able to participate; nonetheless, this was the most convenient approach to collect data during the pandemic. Lastly, all data were self-reported; thus, it may be subject to biases.

Conclusion

Food insecurity during COVID-19 curfew has negatively influenced food insecure adults' health and eating habits. This study revealed that food-insecure participants reported using several strategies to help mitigate the negative effect of low income and lack of food supply. The pandemic is worsening, and it is difficult to predict when it will end; this means that the rate of food insecurity is generally expected to increase. Therefore, the governments need to take crucial actions, both locally and globally, to ensure food security for their population. As the COVID-19 pandemic is ongoing, future research will be needed to assess its long-term impact on food security and nutritional status, as well as the consequences to adults' health, especially among the vulnerable population living in Saudi Arabia.

Conflict of Interest

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

References

- World Health Organization. Rolling updates on coronavirus disease (COVID-19). 2020. Available from: <https://www.globalpandemicnetwork.org/covid-19/international-business-and-global-virtual-teams/rolling-updates-on-coronavirus-disease-covid-19/>. Accessed July 5, 2020.
- ESCWA. Mitigating the impact of COVID-19 Poverty and food insecurity in the Arab region. 2020. ESCWA
- World Food Program. COVID-19 will double number of people facing food crises unless swift action is taken. 2020. Available from: <https://www.wfp.org/news/covid-19-will-double-number-people-facing-food-crises-unless-swift-action-taken>. Accessed July 5, 2020.
- International Labour Organization ILO: As job losses escalate, nearly half of global workforce at risk of losing livelihoods. Int Labour Organ. 2020. Available from: https://www.ilo.org/global/about-the-ilo/newsroom/news/WCMS_743036/lang-en/index.htm. Accessed July 7, 2020.
- International Monetary Fund. World Economic Outlook, April 2020: The Great Lockdown. 2020. World Economic Outlook.
- Murthy VH. Food insecurity: A public health issue. *Public Health Rep* 2016; 131(5): 655–657.
- Bickel G, Nord M, Price C, Hamilton W, and Cook J. *Guide to Measuring Household Food Security (Revised 2000)*. Washington, DC: US Department of Agriculture, Food and Nutrition Service. 2000.
- Ballard T, Kepple A, Cafiero C. *The food insecurity experience scale: development of a global standard for monitoring hunger worldwide*. Rome: FAO. 2013
- FAO, IFAD, UNICEF, WFP and WHO. The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns. Rome: FAO. 2019.
- Jones AD, Ngure FM, Pelto G, Young SL. What Are We Assessing When We Measure Food Security? A Compendium and Review of Current Metrics. *Adv Nutr* 2013; 1(4): 481–505. <https://doi.org/10.3945/an.113.004119>
- FAO. *An Introduction to Basic Concepts of Food Security*. Rome: FAO. In: Soc. Indic. Res. 2008.
- Nord M, Andrews M, Winicki J. Frequency and duration of food insecurity and hunger in US households. *J Nutr Educ Behav* 2002; 34(4): 194–200. [https://doi.org/10.1016/S1499-4046\(06\)60093-6](https://doi.org/10.1016/S1499-4046(06)60093-6)
- Leroux J, Morrison K, Rosenberg M. Prevalence and predictors of food insecurity among older people in Canada. *Int J Environ Res Public Health* 2018; 15(11): 2511. <https://doi.org/10.3390/ijerph15112511>
- Kleve S, Booth S, Davidson ZE and Palermo C. Walking the food security tightrope—Exploring the experiences of low-to-middle income Melbourne households. *Int J Environ Res Public Health* 2018;15(10): 2206. <https://doi.org/10.3390/ijerph15102206>
- Coleman-Jensen A, Rabbitt MP, Gregory C, Singh A. *Household food security in the United States in 2014*. Economic Research Report. 2015.
- Nord M. *Characteristics of Low-Income Households With Very Low Food Security: An Analysis of the USDA GPR Food Security Indicator*. 2007. *Economic Information Bulletin no. EIB-25*. Washington, DC: USDA, Economic Research Service.

17. Maxwell D, Watkins B, Wheeler R and Collins G. *The Coping Strategies Index : A tool for rapidly measuring food security and the impact of food aid programmes in emergencies*. Food Security Complex Emergencies. 2003.
18. Hanson KL, Connor LM. Food insecurity and dietary quality in US adults and children: A systematic review. *Am J Clin Nutr* 2014; 100 (2): 684–692. <https://doi.org/10.3945/ajcn.114.084525>
19. Laraia BA. Food Insecurity and Chronic Disease. *Adv Nutr* 2013; 4(2): 203–212. <https://doi.org/10.3945/an.112.003277>
20. Gundersen C, Ziliak JP. Food insecurity and health outcomes. *Health Aff* 2015; 34 (11). <https://doi.org/10.1377/hlthaff.2015.0645>
21. Vozoris NT, Tarasuk VS. Household Food Insufficiency Is Associated with Poorer Health. *J Nutr* 2003;133(1): 120–126. <https://doi.org/10.1093/jn/133.1.120>
22. Bruening M, Dinour LM, Chavez JBR. Food insecurity and emotional health in the USA: A systematic narrative review of longitudinal research. *Public Health Nutr* 2017; 20(17): 3200–3208. <https://doi.org/10.1017/S1368980017002221>.
23. Seligman HK, Laraia BA, Kushel MB. Food Insecurity Is Associated with Chronic Disease among Low-Income NHANES Participants. *J Nutr* 2010; 140(2):304–310. <https://doi.org/10.3945/jn.109.112573>
24. Wolfson JA, Leung CW. Food insecurity and COVID-19: Disparities in early effects for us adults. *Nutrients* 2020; 12(6):1648. <https://doi.org/10.3390/nu12061648>
25. Mumena WA. Impact of COVID-19 Curfew on Eating Habits, Food Intake, and Weight According to Food Security Status in Saudi Arabia: A Retrospective Study. *Prog Nutr* 2020;22(4). <https://doi.org/10.23751/pn.v22i4.9883>.
26. Raosoft. Sample size calculator. 2004. Available from: <http://www.raosoft.com/samplesize.html>. Accessed June 15, 2020.
27. Food and Agriculture Organization of the United Nations. Voices of the Hungry Applying the FIES. In: Food Agric. Organ. United Nations. 2020. Available from: <http://www.fao.org/in-action/voices-of-the-hungry/using-fies/en/>. Accessed Jun 27, 2020.
28. Naja F, Hwalla N, Fossian T, Zebian D, Nasreddine L. Validity and reliability of the Arabic version of the Household Food Insecurity Access Scale in rural Lebanon. *Public Health Nutr* 2015;18(2), 251–258. <https://doi.org/10.1017/S1368980014000317>
29. Maxwell, D. , and Caldwell R. *The Coping Strategies Index : Field Methods Manual - Second Edition*. USA Coop Assist Reli Everywhere Inc. 2008.
30. Shariff ZM, Khor GL. Household food insecurity and coping strategies in a poor rural community in Malaysia. *Nutr Res Pract* 2008; 2(1): 26–34. <https://doi.org/10.4162/nrp.2008.2.1.26>
31. Statistics Canada. *Canadian Community Health Survey – Annual Component (CCHS) 2019*. Stat Canada. 2019. https://doi.org/10.4319/lo.2006.51.1_part_2.0671
32. Nord M, Coleman-Jensen A, Gregory C. *Prevalence of US Food Insecurity Is Related to Changes in Unemployment, Inflation, and the Price of Food*. *Economic Research Report no. ERR-167*. Washington, DC: US Department of Agriculture, Economic Research Service. 2014.
33. Saudi Press Agency. Economic / Government of the Kingdom takes a number of urgent measures to mitigate the effects of the effects of the Corona virus on economic activities and the private sector. 2020a. Available from: <https://www.spa.gov.sa/2049651>. Accessed July 18, 2020.
34. Saudi Press Agency. Social / “Almawada” association participates in providing 5000 food baskets to families affected by the Corona pandemic in Makkah Al-Mukarramah region. 2020b. Available from: <https://www.spa.gov.sa/2076058>. Accessed July 18, 2020.
35. Niles MT, Bertmann F, Belarmino EH, Wentworth T. The Early Food Insecurity Impacts of COVID-19. *Nutrients* 2020;12(7): 2096. <https://doi.org/10.1101/2020.05.09.20096412>
36. Lee JS, Gundersen C, Cook J, Laraia B, Johnson, MA. Food Insecurity and Health across the Lifespan. *Adv Nutr* 2012; 3(5): 744–745. <https://doi.org/10.3945/an.112.002543>
37. Galea S, Merchant RM, Lurie N. The Mental Health Consequences of COVID-19 and Physical Distancing: The Need for Prevention and Early Intervention. *JAMA Intern Med* 2020; 180(6):817–818. <https://doi.org/10.1001/jamainternmed.2020.1562>
38. Giallonardo V, Sampogna G, Del Vecchio V, et al. The Impact of Quarantine and Physical Distancing Following COVID-19 on Mental Health: Study Protocol of a Multicentric Italian Population Trial. *Front Psychiatry* 2020; 11: 533. <https://doi.org/10.3389/fpsy.2020.00533>
39. World Health Organization. Mental health and psychosocial considerations during COVID-19 outbreak (18 March 2020 version). World Heal Organ. 2020. Available from: <https://apps.who.int/iris/handle/10665/331490>. License: CC BY-NC-SA 3.0 IGO. Accessed August 24,2020.
40. Beltrami S. How to minimize the impact of Coronavirus on food security. World Food Program. 2020. Available from: <https://insight.wfp.org/how-to-minimize-the-impact-of-coronavirus-on-food-security-be2fa7885d7e>. Accessed July 20, 2020.
41. Beulac J, Kristjansson E, Cummins S. A systematic review of food deserts, 1966–2007. *Prev Chronic Dis* 2009; 6(3): A 105.

Correspondence:

Dr. Mahitab A. Hanbazaza, Department of Food and Nutrition, Faculty of Human Sciences and Design, King AbdulAziz University, P.O. Box 80200, Jeddah, 21589, Kingdom of Saudi Arabia. Tel: +966554315656, E-mail: mhanbazaza@kau.edu.sa