Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original article

Effect of Covid-19 on food security: A cross-sectional survey

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SUMMARY

Background: Novel coronavirus (COVID-19) and subsequent quarantine could raise the risk of food inadequacy and nutrition deficiency crises.
Objectives: This study aimed to assess the impacts of COVID-19 on household food security in Jordan, determined the percentage of food security and the levels of food insecurity during the quarantine, determined the associated factor with food insecurity, and determined main food groups associated with FINS during the quarantine.
Design: A cross-sectional study was conducted using a Web-based validated questionnaire. The Food Insecurity Experience Scale was used to measure the food insecurity during the first four weeks of the quarantine, and a modified food consumption score was used to determine the number of times the household consumes each food group. Univariate and multiple logistic regression models were used to describe, explore, and predict risk factors correlated with food insecurity among Jordanians, during the first four weeks of the quarantine.
Results: A total of 3129 Jordanians had responded to the assessment and fully answered the questionnaire. 23.1% of the total participants were severe food insecure, while 36.1% were moderate food insecure, 40.7% were food secure. The regression model demonstrated the monthly income per capita below the poverty line and a number of the family member (1–4 and 5–7) associated significantly with moderate food insecurity (OR: 5.33; 95% CI: 4.44–6.40, OR: 0.64; 95% CI: 0.47–0.86, OR: 0.76; 95% CI: 0.58–0.98, respectively). As well as with the severe food insecurity (OR: 6.87; 95% CI: 5.542–8.512, OR: 0.52; 95% CI: 0.37–0.74, 0.64; 95% CI: 0.48–0.87, respectively). Age 18–30 years old (OR: 1.80; 95% CI: 1.23–2.65) and living in a rented house (OR: 1.30; 95% CI: 1.01–1.69) were associated significantly with severe food insecurity. Carbohydrates and the meat group were significantly related to food insecurity (p-value was <0.001 for both groups).
Conclusion: Covid-19 and its subsequent quarantine have a tangible impact on food security levels for the populations. Awareness and strategies to support individuals at higher risks should be guided not only by the income but also by other risk factors identified in the present study as the number of persons in the family, younger adults (18–30 years old), and those who do not own their houses).

1. Introduction

The Coronavirus (Covid-19) pandemic is a global health crisis caused by a newly discovered coronavirus [1]. Covid-19 is far more than an infectious disease; it is affecting the socioeconomic and food security (FS) worldwide. The impact of the virus on FS is not clear. The United Nation's Framework for the Immediate Socio-economic response reported that the virus would most likely increase poverty, food insecurity (FINS), and inequalities on a global scale. Therefore, achieving Sustainable Development Goals (SDG) is perceived as a top priority [2,3]. Other international organizations have supported this concept, as; The Food and Agriculture Organization of the United Nations (FAO) [4] and the International Food Policy Research Institute (IFPRI) [5].

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FAO defined FS as the situation in which all people have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life all the time [6]. The four domains of FS described widely in the Encyclopedia of FS and Sustainability [7]; Availability, Accessibility, Utilization, and Stability, along with food safety and sanitation concepts considerations. FINS is defined as the limited or uncertain availability of access to adequate and culturally appropriate food for lack of money or other resources [6–8].

Poverty, poor health of household member(s), as well as sub-optimal livelihood and household management strategies could lead to FINS. The severity and classification of FINS depend on the perception of the household member towards food and food-related budget [9]. Consequences and threats of FINS include a negative impact on mental, social, and psycho-emotional status [3,10]. FINS could be mild food insecurity, moderate food insecurity (MFINS), and severe food insecurity (SFINS). The classification depends on the severity of uncertainty, anxiety regarding food access, unbalanced diet, and changes in the quality of the diet [10,11].

Several scales are available to measure FINS. The Food Insecurity Experience Scale (FIES), that designed by FAO, is one of the four experience-based FINS scales: the Household Hunger Scale (HHS); the Household Food Insecurity Access Scale (HFIAS); the Latin American and Caribbean FS Scale (ELCSA) and FIES [12]. It is a dynamic, reciprocal, and time-dependent scale.

Number of recent literature reviews were discussed the effect of Covid-19 lockdown (or quarantine) on the FINS [13–20]. A systematic review of FS and the Coronavirus Disease concluded that the pandamic affected negatively on the food supply and demand, and decreases the purchasing power and the capacity to produce and distribute food [13].

In Jordan, the rate of FINS has kept rising, despite the prevalence of undernutrition was decreased from 8.1% to 4.3% within 15 years (FAO, IFADz, UNICEF 2019). The turmoil that has happened around Jordan over the last decade has proven that FINS can contribute to conflict, especially when it coupled with poverty, low income, ambiguous economic status, and unemployment. Challenges as hosting Syrian refugees [21] and increasing difficulties of agriculture production [22] make the situation even harder and challengeable. The report of World Food Bank (WFB) of The state of FS in Jordan (2013–2014) indicated that FS Households were 93.8% while the insecure Households and Households vulnerable towards FINS were 0.5% and 5.7%, respectively [23]. The distribution of FINS between the governates indicated that Balqa and Zarqa had the highest percentage of FINS10.6% and 7.8%, respectively [23]. Moreover, a recent report from the United Nations International Children's Education Fund (UNICEF) describes the food price in Jordan with high food prices, and there was no prevalence determined for FINS among the overall population [11].

Limited researches were found on FINS in Jordan. A cross-sectional survey among women in northern Jordan indicated that more half the sample (67.6%) was FS households, and only 32.4% were FINS households [24]. Bawadi et al., 2012 concluded that women who have low education levels, low income (less than the poverty line), and rent houses were more likely to have FINS [24]. Under recent circumstances, Jordan announced the incidence of the first case of Covid19 on March 2nd, 2020. The Prime Minister's Office announced the details of quarantining procedure and lockdown operations, which described in detail by the National Defense Law [25]. The quarantine was all the time within the first four weeks. It was predicted that the quarantine would probably affect the household FINS of Jordanians. Thus, the present research aimed to [1] Determine the resultant effects of Covid-19 on FINS in Jordan during the quarantine [2]. Assessing the population prevalence of FS and FINS (levels) in Jordan during the subsequent quarantine of Covid-19 [3]. Identifying risk factors that could associated with FINS [3]. Identifying main food groups associated with FINS during the quarantine [4]. Shed light on the key impact and differential impacts of the pandemic [5]. Suggest recommendations for the future based on the results.

2. Subjects and methods

2.1. Study setting

It is a cross-sectional survey conducted among all Jordanian population (aged more than 18 years) during quarantine caused by Covid-19 and followed by carrying out a prediction model to identify variables associated with FINS. Data were collected from all governates of the Jordan Kingdome. Data collection took place from the first day of the quarantine along four weeks.

2.2. Study participants and sample size

Considering that the total Jordanian population (>18 years) is about 5,742,800.00 in 2019 (46% female and 54% male) [26]. The required sample size based on calculations and the expected response rate would be 1843 respondents. Assuming that confidence interval (CI) 99%, and the Margin of Error is 3% [27,28].

2.3. Study instruments

A web-based questionnaire was used in this study. It includes three parts. The first part included Socioeconomic and socio-demographic details. The second part was FIES, which was used to measure the individual experience of FINS. This scale consists of eight questions capturing a range of FINS severity [29–31]. FIES is a valid and reliable scale [29–31]. FIES categories were classified as Food Secured (FS), Moderate Food Insecure (MFINS), and severe Food Insecure (SFINS) [12,32]. The third part was modified food consumption score (FCS) [23], which included questions regarding the number of times for each household food group consumed during the first four weeks of the quarantine.

The questionnaire was pretested, responses discussed amongst authors, and modified to ensure standardization. The questionnaire was translated from English to Arabic by two bilingual researchers (Arabic, English). To ensure the exactitude of translation, another bilingual researcher retranslated the questionnaire back from Arabic to English. The two English versions (original, translated-back translated) were compared to assure that the meaning of the items in the two versions did not change. Three expert panels reviewed, examined and approved the Arabic version of the questionnaire for content and construct validity.

2.4. Independent variables

Age categories based on Commerce Economics and Statistics Administration [33], Place of living (address) based on the formal administrative divisions in Jordan [34]. Two income categories were generated based on the Jordanian national poverty line cut point [35]. Education, Marital status, Family numbers, Employees within the household, House status (owned or rented), presence of chronic disease(s) within the family, type of health insurance also added.

2.5. Data collection

An online questionnaire was published on the first day (14 March. 2020) of the quarantine to 12 April. 2020). It was accessible to responders only for four weeks, i.e., during the complete lockdown

quarantine in Jordan. The questionnaire was endorsed by the official web sites of the following bodies: The Crown Prince Foundation (CPF), Ministry of Health (MOH), Ministry of Higher Education (MOHE) mainly, Hashemite University, and the University of Petra.

2.6. Statistical analysis

Descriptive statistics, including frequencies, percentages, and univariate analysis (cross-tabulations), were used to measure the distribution of FINS according to the different social and demographic factors. Odds ratios (ORs) and subsequent 95% Confidence intervals were obtained to identify factors responsible for increasing the odds of FINS. Multinomial logistic regressions were used for getting ORs. Chi-square test was conducted to examine the distribution of individuals with different levels of FINS on the weekly consumption of each food-group. The p-value of <0.05 was considered significant. SPSS software for Windows (version 25) (SPSS Inc., Chicago, IL, USA) was used.

3. Ethical approval

Ethical approval for this study was secured through the University of Petra Internal Review Board (IRB); decision number: 2Q/3/2020.

4. Results

4.1. Socio-demographic participants

A total of 3129 Jordanian individuals participated in this national questionnaire within the first four weeks of the quarantine (26% male and 74% females). As shown in Table 1, the majority of the participants were between 18 and 30 years old. More than three-fourths of the participants were from first territories. More than half of the participants were single (58.5%). Approximately 80% of the participants had a Diploma or bachelor's certificates. The monthly income per capita was ≤95.9$ monthly for 69.2% of the participants. Most families (54.1%) consist of 5–7 persons. Employee numbers (within the household) were around half (51.8%) of the study sample. Around one-third of the participants had their own homes (72.2%). Almost half of the participants had chronic diseases within the family (53.1%), and 39.2% had no health insurance.

4.2. The prevalence of food insecurity among the population during the quarantine

The results of FINS in Jordan during the quarantine indicated that 40.7% of the total population were FS while 36.1% were MFINS and 23.1% were SFINS as shown in Fig. 1. Most categories of the sociodemographic characteristics distributed almost in equal proportion within the FS and FINS. For example, 40.7% and 40.8% of females and males respectively were FS as shown in Table 1. Based on the monthly income per capita, the results indicated that more than half of participates who have monthly income more than the poverty line (61.2%) were FS. While 76.7% of the participants who have personal monthly income, less than the poverty line were FINS (45.6% MFINS and 31.1% SFINS) as shown in (Tables 2 and 3).

4.3. Determinants of food insecurity among the population during the quarantine

The chi-squared test indicated that there was a significant difference in FINS categories related to education level, monthly income per capita, and the house status (p-values were 0.05, ≤0.001, and 0.01, respectively). The ORs of being FINS were estimated for each variable. FINS (moderate and severe) were not associated with the governate, gender, social status, education, number of employees per family, chronic diseases within the family, and health insurance. Nevertheless, age, number of family members, income per head, and house status were associated significantly with FINS compared with FS. Age was associated with the FINS status; participants aged 18–30 years were 1.80 (95% CI: 1.23–2.65) times more likely to be in severe FINS status. Monthly income per capita was associated with an increased risk of MFINS and SFINS. Participants with the monthly income of less than the poverty-line were five times more likely to be MFINS and seven times more likely to be SFINS (95% CI: 4.44–6.40) and (95% CI: 5.54–8.51) respectively. Participants who rented houses had 1.30 times higher odds of being severely FINS when compared with those who owned houses (95% CI: 1.0–1.69). Increasing family members was associated with an increased likelihood of both MFINS and SFINS.

4.4. The distribution of the primary food groups consumption based on FS and FINS status during the quarantine

The chi-square goodness-of-fit test indicated that the fruits group, vegetable group, milk and dairy products group, oil group, and sweets group consumption were similarly distributed among the FS, MFINS and SFINS (p-value > 0.05). The carbohydrates group and meat group consumption per week were statistically significantly different (p-value ≤0.001).

5. Discussion

The results of the current study indicated that less than half of the participants were FS during the quarantine obligated by Covid-19. The other participants were distributed within FINS categories: a higher percentage of MFINS. Leading variables associated with FINS were monthly income per capita, house status, age, and the number of family members.

5.1. Sample size

The calculated sample size based on the Jordanian target population was 1843 respondents. Surprisingly, 3129 full responses were received. Many factors may drive the unexpected higher response rate: First is the channels to circulate it, i.e., large governmental bodies (CPF and MOH) and local universities. Second is the timing of the survey, at the time of circulating survey, the internet coverage in Jordan was excellent, and the country was in a complete lockdown state. Finally, the topic of the survey might be perceived as relevant to the population during the Covid-19 pandemic; accordingly, many participants realized the value of their participation.

5.2. Baseline characteristics

The distribution of responders in the present research showed inline results with the overall population. For example, 81.6% of the responders were from the Middle region (which have the capital, Amman and the second largest governate (Zarqa), in addition to many other governorates). Age structure for responders to the survey is in line with the Jordanian population; in the present study, only 11.3% of responders were older than 45 years old. Many baselines result in the current work matched well with the overall Jordanian population; for example, the Jordanian households' average members, single vs. married ratios, and health insurance coverage [36] in addition to education levels [37]. More females (74%) have responded vs 26% males compared with the ratio in the

Table 1
Characteristics of participants based on food security and food insecurity status in Jordan during the quarantine.

Variables	Categories	Total (n = 3129)	FS (n = 1275)	MFIS (n = 1130)	SFIS (n = 724)	P-value
		N (%)	N (%)	N (%)	N (%)	
Governate	North	416 (13.3)	178 (42.8)	139 (33.4)	99 (23.8)	0.74
	Middle	2553 (81.6)	1029 (40.3)	933 (36.5)	591 (23.1)	
	South	160 (5.1)	68 (42.5)	58 (36.3)	34 (21.3)	
Gender	Male	813 (26.0)	332 (40.8)	283 (34.8)	198 (24.4)	0.54
	Female	2316 (74.0)	943 (40.7)	847 (36.6)	526 (22.7)	
Age (years)	18–30	1922 (61.4)	775 (40.3)	685 (35.6)	462 (24.0)	0.56
	31–45	852 (27.2)	353 (41.4)	309 (36.3)	190 (22.3)	
	>45	355 (11.3)	147 (41.4)	136 (38.3)	72 (20.3)	
Marital status	Married	1225 (39.1)	495 (40.4)	447 (36.5)	283 (23.1)	0.92
	Single	1830 (58.5)	748 (40.9)	660 (36.1)	422 (23.1)	
	Divorce/widow	74 (2.4)	32 (43.2)	23 (31.1)	19 (25.7)	
Education level	Secondary school or less	345 (11.0)	127 (36.8)	126 (36.5)	92 (26.7)	**0.05**
	Diploma or bachelors	2489 (79.5)	1023 (41.5)	880 (35.4)	577 (23.2)	
	High education	295 (9.4)	116 (39.3)	124 (42.0)	55 (18.6)	
Monthly income per capita	<poverty line	1687 (53.91))	393 (23.3)	769 (45.6)	525 (31.1)	**≤0.001**
	≥ poverty line	1442 (46.09)	882 (61.2)	361 (25.0)	199 (13.8)	
No. family members	1–4	989 (31.6)	393 (39.7)	357 (36.1)	239 (22.6)	0.80
	5–7	1694 (54.1)	693 (40.9)	619 (36.5)	382 (22.6)	
	≥8	446 (14.3)	189 (42.4)	154 (34.5)	103 (23.1)	
Employment members/Family	0	172 (5.5)	64 (37.2)	65 (37.8)	43 (25.0)	0.21
	1	1622 (51.8)	679 (41.9)	554 (34.2)	389 (24.0)	
	2	884 (28.3)	364 (41.2)	332 (37.6)	188 (21.3)	
	≥3	451 (14.4)	168 (37.3)	179 (39.7)	104 (23.1)	
House status	Rent	870 (27.8)	336 (38.6)	301 (34.6)	233 (26.8)	**0.01**
	Ownership	2259 (72.2)	939 (41.6)	829 (36.7)	491 (21.7)	
Chronic disease	Yes	1468 (46.9)	684 (41.2)	589 (35.5)	388 (23.4)	0.72
	No	1661 (53.1)	591 (40.3)	541 (36.9)	336 (22.9)	
Health insurance	Nothing	1228 (39.2)	500 (40.7)	456 (37.1)	272 (22.1)	0.77
	Military	370 (11.8)	148 (40.0)	136 (36.8)	86 (23.2)	
	Governmental	699 (22.3)	293 (41.9)	249 (35.6)	157 (22.5)	
	Private	832 (26.6)	334 (40.1)	289 (34.7)	209 (25.1)	

Income per head calculated by dividing family income over the family members number. High education included master and PhD. FS: food security; MFIS: moderate food insecurity; SFIS: sever moderate food insecurity.
Bold indicates significant level ≤ 0.05.

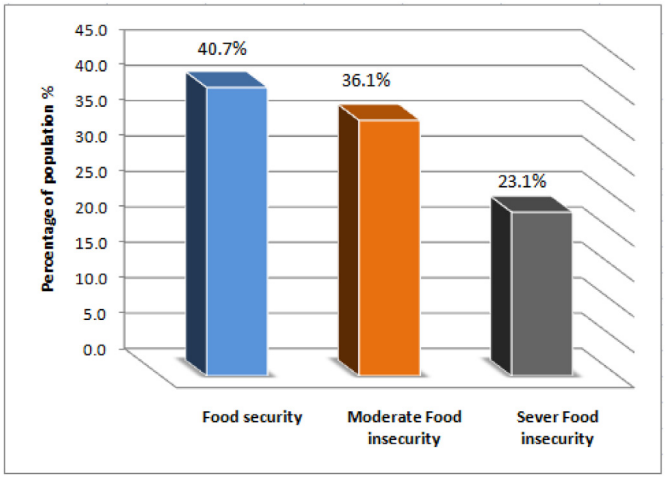

Fig. 1. Food insecurity among the population in Jordan during the quarantine.

population (46% female and 54% male). A higher level of education compared to the general population was also noticed. Nevertheless, the education level in the present study is comparable with the Urban areas in the overall community [38].

5.3. Importance of the current study and Jordan before Covid-19 vs. our results

To our knowledge, this is the first published paper of FINS during the quarantine, alongside the Covid-19 pandemic in Jordan. Accordingly, there was no published data with which to compare the results. These data compare favorably with a report and studies published earlier during the regular, non-pandemic period in Jordan and other countries.

In general review, it was reported that lower- and middle-income countries (including jordan) had a percentage of 31.9% for FINS and 12.5% for SFINS. Upper- and middle-income countries had portions of 26.2% and 9.2%, respectively. It was not unexpected that higher percentages would be reported during the quarantine, as our data indicated. Regards to Jordan classification, the word bank stated that "*On July* 1st, *2016, the World Bank classified Jordan as an upper-middle-income country. Based on new data, on July* 1st, *2017, the World Bank classified Jordan as a lower middle-income country*" [39].

The results of FINS percentage in our research could refer to many reasons; for example; unavailability of the food especially for long time, limitation on migrant workers who work on the food sectors, the lockdowns and movement control during the quarantine were restricting the physical ability of people to access food and is creating food deserts in most areas, reduced wages and loss of income affecting the most vulnerable, the global price of all products increased as well as in Jordan. As mentioned by, Middle East and East Africa is the regions of conflict and crisis that COVID-19 threatened FS and it was increased the obstacles to food access that created by political and military pressures [40].

Compared with previous researches conducted on the normal situations (in Jordan); cross-sectional research in Northern Jordan reported that 67.6% of the women were FS, and (32.4%) were FINS [24]. However, the sample of Bawadi et al. (n = 500) was only females who attended outpatient clinics and FINS assessment was carried out by using the short form of the USFS survey module. Our

Table 2
The association between FS and FIS, and the socio-demographic characteristics of the participants in Jordan during the quarantine.

Variable	MFIS		SFIS	
	B	Odds ratio (95% CI)	B	Odds ratio (95% CI)
Governate				
North	0.08	1.08 (0.70–1.69)		1.31 (0.78–2.18)
Middle	0.19	1.21 (0.82–1.78)		1.27 (0.81–2.01)
South	0[b]	0[b]	0[b]	0[b]
Gender				
Male	−0.10	0.91 (0.74–1.11)	0.08	1.08 (0.86–1.36)
Female	0[b]	0[b].	0[b]	0[b].
Age (years)				
18–30	0.15	1.157 (0.83–1.61)	0.59	**1.80 (1.23–2.65)***
31–45	−0.02	0.981 (0.73–1.33)	0.17	1.18 (0.83–1.69)
>45	0[b]	0[b]	0[b]	0[b]
Social status				
Married	0.02	1.02 (0.56–1.86)	−0.35	0.71 (0.37–1.34)
Single	−0.07	0.93 (0.50–1.75)	−0.60	0.552 (0.28–1.09)
Divorce/widow	0[b]	0[b]	0[b]	0[b]
Education level (year)				
≤12	−0.06	0.94 (0.67–1.33)	−0.24	0.79 (0.54–1.15)
>12	0[b]	0[b]	0[b]	0[b]
Monthly income per capita				
<poverty line	1.67	**5.33 (4.44–6.40)***	1.927	**6.87 (5.542–8.512)***
≥ poverty line	0[b]	0[b]	0[b]	0[b]
No. Family members				
1–4	−0.45	**0.64 (0.47–0.86)***	−0.646	**0.52 (0.37–0.74)***
5–7	−0.28	**0.76 (0.58–0.98)***	−0.442	**0.64 (0.48–0.87)***
≥8	0[b]	0[b]	0[b]	0[b]
No. Employment members/Family				
0	−0.04	0.96 (0.62–1.51)	0.11	1.12 (0.67–1.86)
1	−0.21	0.81 (0.62–1.06)	0.02	1.02 (0.75–1.40)
2	−0.13	0.88 (0.66–1.16)	−0.10	0.90 (0.65–1.26)
≥3	0[b]	0[b]	0[b]	0[b]
House status				
Rented	−0.04	0.96 (0.76–1.22)	0.27	**1.30 (1.01–1.69)***
Owned	0[b]	0[b]	0[b]	0[b]
Chronic disease				
Yes	−0.10	0.904 (0.761–1.074)	−0.037	0.963 (0.792–1.172)
No	0[b]	0[b]	0[b]	0[b]
Health insurance				
Nothing	0.14	1.15 (0.92–1.42)	−0.05	0.95 (0.75–1.22)
Military	0.12	1.13 (0.83–1.52)	−0.02	0.98 (0.70–1.38)
Governmental	0.03	1.03 (0.80–1.32)	−0.11	0.90 (0.68–1.19)
Private	0[b]	0[b]	0[b]	0[b]

Income per head calculated by dividing family income over the family members number. High education included master and PhD. FS: food security; MFIS: moderate food insecurity; SFIS: sever moderate food insecurity.
Bold indicates significant level ≤ 0.05.
Cells including b letter are the reference category in all variables.

results indicated that the broader population during quarantine reported 36.1% as MFINS and 23.1% as SFINS. Both studies, reported higher percentages than that published in the official resources 'The State of FINS in Jordan 2014'. The available recent published report claimed food in FINS is as low as 0.5% of all Jordanian households, and 5.7% of all Jordanian households are vulnerable towards FINS [41]. It is agreed that Epidemics (like HIV/AIDS, Ebola, and the Middle East respiratory syndrome) usually increase risks related to FINS [5]. Moreover, the official Jordanian efforts are more directed to identify and investigate areas of FINS at the district level. Furthermore, its target was both rural and urban areas [23]. Our study did not target Jordanians within the poverty reduction program, and refugees. Such group (n = 90,000) reported higher percentages for FINS; vulnerable to FINS (59%) and FINS (11%) [41]. While Jordan is already struggling with significant poverty, inequality, and considered within the middle-income country, a further economic crisis brought about by the Covid-19 pandemic is likely to be disastrous, resulting in the denial of access to diverse and food supply nutritious diet among the adult population (Roberton et al., 2020). The a accumulative effect of the pandemic combined with existing food supply problem first and then nutrition and health problem problems. Thus, this percentage of FI could weaken the efforts to achieving Sustainable Development Goals (SDGs) 2, which emphasizes ending hunger, achieving FS and improving nutrition, and promoting sustainable agriculture. Whatever the percentage of FIN before the pandamic, most references in low and middle income country indicated that this pandamic increase hunger and reduce the FS [10,14,16,20,42].

5.4. Variables related to outcomes compare with others

Despite differences in the prevalence of FINS populations between the research and the official reports, there has been an agreement that financial status is perceived as the most reliable predictor and a risk factor for FINS. Bawadi et al. (2012) calculated that the odds ratio for people with income less than the poverty line to be 7.7 (95% CI: 4.1–14.5) [24]. Similarly, official reports confirmed that the annual income of 80% of FINS households was less than JD 5000 [38]. Such collective results are in agreement with a recent review, which stated that around 60% of the population in low-income countries suffer from FINS [3]. Similar results had been widely demonstrated by many global researchers [10,32,43–46].

Focusing on the FINS during the quarantine, a surveys published in Nigeriacomparing FS outcomes of households before and after the outbreak of the pandemic concluded that the that lockdowns increase FINS and reduced the probability of participation in non-farm business activities [20].

A second widely agreed factor that kept its influence even during the quarantine was renting a house (compared to owning a house). Our results, during quarantine, are in line with published research, Badawi et al., reported odds ratio for such variable 2.2 (95% CI: 1.1–4.3), other researchers had also documented similar results [3,44,45]. The third variable was the number of family members, which somehow in line with other research results [10,25,47,48].

In the present study, the correlation with FINS for many variables had been attenuated when adjusted with other variables, examples of such variables that used to demonstrate correlations in typical situations, but not during quarantine: Educational level [10,25,43,45–48], and gender [10,25,47,48]. Surprisingly, the age kept its statistically significant relation with FINS despite adjustment. Due to different study designs and methodologies, the age variable did not demonstrate a marked correlation with FINS. However, studies that specifically target the older population have had the age in their final results as a factor related to FINS despite adjustment [43,46,48]. However, this study suggests strength the cooperation between the government sectors by adopting a common strategies to strengthen the food supply system in jordan through appropriate policy measures, to protect the disadvantaged people at all the times, not only during the pandemic crisis in addition to special policy measures during Covid-19 pandamica to limit the increase of hunger, based on the understanding of the gravity of the moment.

5.5. Food group intake during the quarantine in Jordan based on FS and FINS categories

The current results indicated that food groups are not related to FS and FINS except for the carbohydrate and meat group. One of the FS dimensions focuses on diet quality, food safety, and adequate nutrition supply. Most works of literature considered FS is the physical, social, and economic to access to sufficient and safe amount of food. In addition, food should meet the recommended dietary needs and the preference of the consumers [6]. Therefore,

Table 3
Distribution food group intake per week within food security and food insecurity (moderate and sever) among the participants in Jordan during the quarantine. n (%).

Food-group	Times/week	FS	MFIS	SFIS	P-value
Carbohydrates	Never	109 (53.2)	82 (40.0)	14 (6.8)	<**0.001**
	1–2	188 (51.4)	95 (26.0)	83 (22.7)	
	3–4	717 (43.8)	622 (38.0)	297 (18.2)	
	5–7	261 (28.3)	331 (35.9)	330 (35.8)	
Fruits	Never	67 (40.4)	58 (34.9)	41 (24.7)	0.926
	1–2	319 (41.9)	279 (36.6)	164 (21.5)	
	3–4	472 (40.8)	418 (36.1)	268 (23.1)	
	5–7	417 (40.0)	375 (36.0)	251 (24.1)	
Vegetable	Never	–	–	–	0.698
	1–2	644 (40.6)	584 (36.8)	357 (22.5)	
	3–4	503 (41.0)	440 (35.8)	285 (23.2)	
	5–7	128 (40.5)	106 (33.5)	82 (25.9)	
Milk and milk products	Never	40 (44.9)	32 (36.0)	17 (19.1)	0.356
	1–2	265 (43.2)	225 (36.6)	124 (20.2)	
	3–4	442 (41.2)	380 (35.4)	251 (23.4)	
	5–7	528 (39.0)	493 (36.4)	332 (24.5)	
Meat, poultry and fish	Never	4 (1.1)	74 (19.9)	293 (79.0)	<**0.001**
	1–2	445 (46.5)	338 (35.3)	175 (18.3)	
	3–4	510 (41.9)	455 (37.4)	252 (20.7)	
	5–7	316 (54.2)	263 (45.1)	4 (0.7)	
Oil	Never	23 (36.5)	26 (41.3)	14 (22.2)	0.840
	1–2	176 (41.7)	152 (36.0)	94 (22.3)	
	3–4	328 (40.2)	307 (37.7)	180 (22.1)	
	5–7	748 (40.9)	645 (35.3)	436 (23.8)	
Sweets	Never	290 (38.3)	283 (37.4)	184 (24.3)	0.600
	1–2	452 (42.2)	374 (34.9)	246 (22.9)	
	3–4	346 (41.0)	315 (37.3)	183 (21.7)	
	5–7	187 (41.0)	158 (34.6)	111 (24.3)	

FS: food security; MFIS: moderate food insecurity; SFIS: sever moderate food insecurity.
Bold indicates significant level ≤ 0.05.

the term FS advanced to "nutrition security" and "food and nutrition security," which means that the FS is considered as a subset of "food security and nutrition" [48]. In a similar concept, nutrients deficiency and malnutrition are the most serious consequence of FINS which are related to the quality of food, not only the quantity [10]. In the first four weeks of the quarantine, almost all people worried about not having enough amount of the main food items such as the carbohydrates, dairy products (mainly the milk) and meat (mainly poultry in Jordan). Carbohydrates and meat groups are significantly related to FS and FINS status in quarantine time. Higher weekly carbohydrates intake was among SFINS participants. In contrast, higher weekly intake of the meat, poultry, and fish was among FS participants.

There are several explanations for this result. The first point may refer to the variation prices of these food items in the Jordanian market. Carbohydrates, mainly rice and bread are among the highest consumption rates among the Jordanians, and they attributed by a very low price compared with the meat group [8,25,49,50]. In addition, the government co-pays the price of bread in Jordan, which make it available for most individuals [51]. Second, during the first four weeks of the quarantine, the Jordanian government allowed the bakeries to work for 24 h to provide the citizens through delivery only. Moreover, the Jordanian government distributed bread during quarantine by the reasonable price (0.5 USD/kg). Third, large number of the population could make bread at home. Due to its high price compared with all other food groups in the Jordanian market, many participants could replace this group with cheaper food group, but similar nutritional value such as legumes. Further, the absence of meat from nearby grocery stores should be pointed out.

The analytical report of WFB [52,53] reported that the cereals group was the highest intake among all FS and FINS categories, equally, but higher intake of meat group was among the FS group [8]. However, the current study includes all populations during Covid-19 pandemic and quarantine while Bawadi et al. (2012) [24] and WFB (2016) have different aims and study designs. The insignificant relationship between the other food groups (fruits, vegetables, milk and milk products, oils, and sweets) and FS/FINS during the quarantine period means that the study sample experienced the same consumption frequency during and before the quarantine. This is not surprising due to many reasons. First: the Jordanian government prohibited raising the prices of food commodities. Second: during the quarantine period, the Jordanian government allowed shopping from small nearby grocery stores and supermarkets on the condition that the access to shops is by walking not by cars for few limited hours. Therefore, quarantine did not affect the intake of these groups.

6. Strength and limitation

Having a piece of evidence exploring the impact of pandemic (Covid-19) quarantine on FINS in Jordan is the main strength in the concept of the present study. Subsequently, the current findings add to a growing body of literature on both FINS and pandemic impact on the population. Having a large sample size with almost 70% more than the minimum is another strength in conducting the present study. Using the FIES has driven inherited strengths linked to its advantages [12] whereas most published researches were reviews. Despite the ease and reasonable cost of using a self-reporting survey, it has some limitations. It is a subjective measure, and it represents the perception of FINS. Also, the current research didn't include refugees. Due to the quarantine circumstances, the used food consumption score (FCS) focused on the meal's number consumed by household members during quarantine, the source from which the household secured food was beyond the concern in the present study.

7. Conclusion

This research concluded that food security is a critical aspect that affected the social and environmental status in Jordan. Quarantine that adopted as protection was against spreading Covid-19 virus should trigger awareness toward individuals at higher risk for food insecurity. The lockdowns may be the only way to halt the spread of the virus, but where social protection is lacking they may have disastrous economic, social, and nutritional consequences and food chain mainly. In such circumstances, around 40% of the population were considered as secured, one-third of the population was moderate food secured, and less than one quarter was severe food insecure. The risk of the severe food insecure was strongly correlated with many factors as monthly income per capita, the number of family members, individuals younger between 18 and 30 years old, and those who lived in rented houses. Regarding the time number of food categories intake per week, carbohydrates and the meat group were the only groups that have significant relation with food insecurity. Overall, Covid-19 affected many food chain in jordan mainly; food production, trade, commerce, and the supply chain which produce adverse consequences on the food security during the pandamic. This predict negative effect on the dietary pattern and nutrient intake of the adult people on the short and long term. If proper precautionary measures are not assumed to address the issues of food supply by taking into consideration the individual economic status (such as the individual income) and the sociodemographic properties such as (education level), this will effect on th poverty level in jordan, inequality, education, health status, which will threaten the achievement of SDGs in 2030.

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Transparency declaration

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported. The reporting of this work is compliant with STROBE guidelines. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study as planned have been explained.

Authors' contributions

Nour A. Elsahoryi designed the study, collect and analyze the data and writing the manuscript. Hiba Al-Sayyed contributed in designing the study, data collection and writing the manuscript. Mohanad M. Odeh contributed in designing the study, data collection and writing the manuscript. . Andrea McGrattan contributed in writing the manuscript. Fwziah J Hammad designed the study, collect and analyze the data and writing the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

There are no conflicts of interest.

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Abbreviation

Covid-19	Coronavirus
FS	Food Security/Food Secured
FINS	Food Insecurity/Food Insecure
MFINS	Moderate Food Insecure/Moderate Food Insecure
SFINS	Severe Food Insecure/Severe Food Insecure
FAO	The Food and Agriculture Organization of the United Nations
IFPRI	International Food Policy Research Institute
SDG	Sustainable Development Goals
UNICEF	United Nations International Children's Education Fund

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