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# Effect of availability and COVID-19 vaccination on food shopping and consumption behaviors among Jordan universities students

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The COVID-19 pandemic influenced the lives of university students all across the globe. Indeed, the pandemic has impacted many aspects of their daily routine, changing their social and health habits and food-related behaviors. There is now no approved therapy, and vaccination is the only clinical preventative measure that provides the highest protection against the virus. While these vaccines have been beneficial in curbing the pandemic's effect, they may also influence food-related behaviors. Accordingly, this paper aims to investigate the impact of vaccination availability on university students' food shopping and consumption habits, vaccine-related opinions, and back on-campus behaviors in Jordan. The research is based on an online survey conducted in Jordan using a structured questionnaire and distributed through Google Forms between January 1 and March 20, 2022. A total of 624 valid answers were collected. The findings revealed no significant changes in the way students consumed, shopped, and handled food compared to the pre-vaccine period. However, there is a slight post-vaccine trend toward shopping more groceries online and ordering more meals *via* delivery apps and takeout services. Regarding health-related food choices, there was an increase in the consumption of healthy food, water, and fruits and vegetables. Further, following the availability of the vaccination, students' adoption of COVID-19 food-related habits was maintained. Gender, engagement in food preparation activities, and living status (e.g., whether or not living with parents) substantially affected several food-related behaviors. The findings are expected to guide both current emergency preparations and long-term food-related policies

in Jordan. This information may also be helpful to researchers interested in the effects of COVID-19 vaccination on student nutrition and related food behaviors.

#### KEYWORDS

survey, food behavior, consumption habit, nutrition, vaccine, food safety

## Introduction

During the COVID-19 pandemic, the Jordanian government took several strict measures, including the shutdown of higher education institutions, to minimize the virus's spread among university students. This included switching classrooms to virtual learning, shutting dorms, and sending students off-campus (Jordan Times, 2020). After the COVID-19 vaccine became available in December 2020, Jordan started its COVID-19 vaccination campaign on January 13, 2021. The vaccine was initially distributed to persons over 60, those with chronic diseases, and healthcare personnel. Later, with an expanded supply of COVID-19 vaccinations, inoculations were made available to all adult Jordanians, including students (Al Ghad, 2021).

Consequently, starting from the fall of 2021, universities and all other educational institutions across the country reopened, and in-person teaching at campuses was reinstated (MOHE, 2021). Opening universities safely during the COVID-19 pandemic is a challenging task that relies on various safety policies, such as deploying preventative measures and vaccine coverage, to welcome students and university workers back to their campuses (Paltiel and Schwartz, 2021). Indeed, the Jordanian Ministry of Higher Education announced that full COVID-19 vaccination would be mandatory for all students, faculty members, and administrators beginning January 1, 2022, in order to reduce the spread of COVID-19 among university students, as they are at high risk of exposure due to their close contact with classmates and colleagues (Jordan Times, 2022).

The pandemic influenced the lives of university students all across the globe. They were forced to alter their daily routines and food habits when university and college campuses closed in March 2020 (Powell et al., 2021). As a result, they are more likely to be food insecure and eat unhealthily than the overall population (DeBate et al., 2021). Furthermore, stress and anxiety related to adaptation and isolation may also be caused by online learning and a lack of social interaction. Pandemic-related stresses, such as financial instability and disordered eating, might cause students to gain weight and alter their diets and food-related activities (Palmer et al., 2021). Moreover, the pandemic impacted universities' cafeterias and food services. COVID-19 has also been reported to impact students' diet and food-related behaviors in Jordan. Osaili et al. (2021)

highlighted that Jordanian students reduced the frequency of eating with colleagues or in restaurants during the pandemic. Less shopping frequencies, ordering food through fast food delivery or takeaway less often, buying groceries online more often, and reducing the consumption of certain foods due to concern about their safety have also been reported.

Likewise, the pandemic affected the general population's food-related behaviors (Ben Hassen et al., 2020). Panic buying was seen at the beginning of the pandemic, stockpiling food in response to the fear of running out of food or reducing the number of shopping frequencies (Fanelli, 2021). People's dietary choices and habits have also been impacted. They tended to cook more, eat and snack more, and move toward healthy diets (Ben Hassen et al., 2020; Sidor and Rzymiski, 2020). A previous work had evaluated food safety knowledge, attitudes and practices among university students in Jordan and the changes in food-related behaviors during the COVID-19 pandemic before the vaccine rollout (Osaili et al., 2021). However, these behaviors are subjected to change, and the remaining question is whether these behaviors and concerns are still present after the availability of the vaccines or not. It is suggested that people might take this opportunity to determine the habits they want to keep, while others might find maintaining habits challenging. Accordingly, this paper aims to investigate the impact of vaccination availability and receipt on university students' food shopping and consumption habits, vaccine-related opinions, and on campus protective measures and food-related behavior in Jordan.

## Materials and methods

### Study design

The present study is a cross-sectional survey conducted between January 1 and March 20, 2022. The target demographic consisted of Jordanian university students aged 18 and above enrolled in one of the programs during the second semester of the academic year 2021/2022. The optimal sample size was calculated using the Yamane Statistical Formula (Tejada and Punzalan, 2012) based on the number of students enrolled at Jordanian universities the previous year ( $N = 322,349$ ).

## Questionnaire

### Step 1: Questionnaire construction

The research was based on an online questionnaire that was adapted from World Health Organization (WHO), and Centers for Disease Control and Prevention (CDC) reports, as well as previously published studies (Ben Hassen et al., 2020; Cheikh Ismail et al., 2020; WHO, 2020a; CDC, 2022a,b). The questionnaire was initially designed in English; however, the final version was translated into Arabic language (the official language in Jordan). To ensure the quality of the translation, back-translation was carried out by two bilingual native Arabic speakers. The questionnaire included 64 multiple-choice, Likert-scale, and close ended questions separated into four sections: (1) socio-demographics (14 questions); (2) opinions on the COVID-19 vaccine (nine questions); (3) food behavior and consumption habits (29 questions); and (4) back on campus students' behaviors (12 questions).

### Step 2: Content validity

Two food studies experts assessed the questionnaire for content validity based on topic relevancy, clarity, simplicity, and ambiguity. Moreover, they were asked to complete the questionnaire and evaluate the length of the survey, the clarity of the content, and the language and vocabulary used. The questionnaire was then amended based on their feedback with only few corrections reported. The time required for completing the questionnaire was reported to be 5–10 min.

### Step 3: Reliability of the questionnaire

Before the actual data collection, the questionnaire was piloted with 30 students chosen at random from several institutions to check content reliability and ensure that the questions were understandable. A reliability analysis test was performed using Cronbach's alpha to measure the internal consistency. Cronbach's alpha value was 0.834, indicating a high internal consistency level.

## Data collection

The survey was conducted as an anonymous online survey through Google Forms. The link to access the survey and a brief explanation of the study were spread and shared over selected social media platforms, such as Facebook and Twitter. The link was shared by the researchers and by using the snowball approach; participants were also encouraged to invite friends, and colleagues to participate by sharing the online survey link. Before participating in the study, participants had been informed that their participation is entirely voluntary, all of their responses will be kept confidential, and they may opt-out of the survey

at any time. The study and the protocol were approved by Institutional Review Board (IRB) at Jordan University of Science and Technology (ref: 22/146/2021).

## Statistical analysis

The collected data was analyzed using SPSS program version 25.0 (SPSS Inc, USA). Descriptive statistical analysis; frequencies, percentages, means, and standard deviations were used to summarize the continuous and categorical variables. Kolmogorov-Smirnov test was used to test the normality of the data. Non-parametric tests such as the Kruskal-Wallis test and Mann-Whitney *U*-test were used to compare behavior changes between the different independent variables (gender, university, prepare or help in preparing food, and living status). Statistical significance levels were set at  $P < 0.05$ .

## Results

### Socio-demographic characteristics

A total of 624 university students participated in the study. The demographics (Table 1) indicate that 63.8% of the respondents were female, the majority (91.0%) were single, living with their families (87.5%), and were enrolled in bachelor's studies (89.7%). Further, 66.7% were studying at a public university, and 62.0% were from non-health-related majors. Around 75.0% were unemployed and reported helping or preparing food. Only 12.5% have a family member engaged in the health sector. The majority of the students were vaccinated (93.1%). Regarding how comfortable they were about returning to in-person classes on campus (hybrid mode), 30.3% were very comfortable, 42.6% were somewhat comfortable, and 13.5% were not comfortable.

### Students' opinions on the COVID-19 vaccine

Regarding students' opinions about vaccinations, more than a third (38.5%) indicated that the vaccine should not be administered on an empty stomach (Table 2). More than half of the participants (50.5 and 59.1%, respectively) stated that the vaccination had no impact on appetite or taste. Also, 64.6% of the respondents indicated it was unnecessary to eat or drink differently the day or two following vaccination. Nevertheless, 29.8 and 35.7% thought it was vital to drink plenty of water and avoid smoking after vaccination. Moreover, 74.8% of the respondents believed that consuming anti-inflammatory foods would boost their immunity. Further, 50.2% believed that people with common allergies might suffer an adverse reaction to the

TABLE 1 Socio-demographic characteristics of the study participants (n = 624).

Character	Frequency	Percentage
<b>Age</b>		
18	53	8.5%
19	85	13.6%
20	67	10.7%
21	67	10.7%
22	99	16.0%
23	65	10.4%
24	50	8.0%
25	138	22.1%
<b>Gender</b>		
Male	226	36.2%
Female	398	63.8%
<b>Marital status</b>		
Single	568	91.0%
Married	56	9.0%
<b>University type</b>		
Public university	416	66.7%
Private university	208	33.3%
<b>Level of education</b>		
BSc	560	89.7%
MSc/PhD	64	10.3%
<b>Field of study</b>		
Health	237	38.0%
Non-health	387	62.0%
<b>Monthly allowance</b>		
<100 JD	277	44.4%
100–300 JD	267	42.8%
>300 JD	80	12.8%
<b>Occupation</b>		
Unemployed	472	75.6%
Part-time	76	12.2%
Full-time	76	12.2%
<b>Living status</b>		
Alone	42	6.7%
With family	546	87.5%
With roommate	36	5.8%
<b>Preparing/help in preparing food</b>		
Yes	474	76.0%
No	150	24.0%
<b>Vaccinated against COVID-19</b>		
Yes	581	93.1%
No	43	6.9%
<b>Do you have any family members engaged in the health sector?</b>		
Yes	78	12.5%
No	546	87.5%

(Continued)

TABLE 1 (Continued)

Character	Frequency	Percentage
<b>How comfortable would you feel about returning to in-person classes on campus?</b>		
Very comfortable	189	30.3%
Somewhat comfortable	266	42.6%
Not too comfortable	85	13.6%
Not at all comfortable	84	13.5%
<b>When ordering food on campus, are you concerned about your health?</b>		
Yes	354	56.7%
No	270	43.3%

TABLE 2 Jordanian university students' opinions on the COVID-19 vaccine (n = 624).

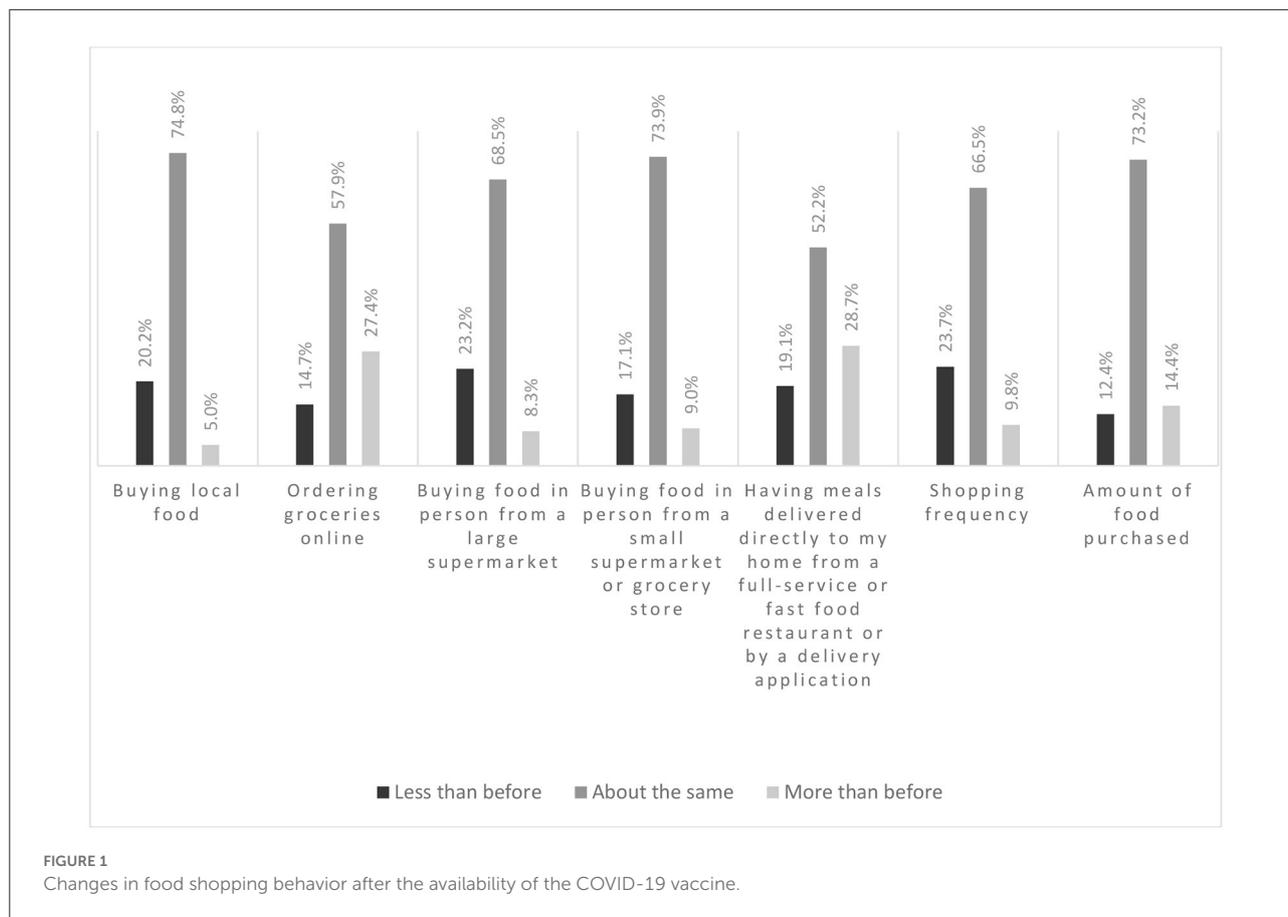
Item	Percentage		
	Yes	No	Not sure
Do you think you should get your vaccine on an empty stomach?	8.0%	38.5%	53.5%
Do you think the COVID-19 vaccine may affect your appetite?	25.5%	50.5%	24.0%
Do you think the COVID-19 vaccine may affect your sense of taste?	20.9%	59.1%	20.0%
Do we need to eat or drink differently the day or two after getting vaccinated?	17.1%	64.6%	18.3%
Do you believe people with food allergies might have an adverse reaction to the COVID-19 vaccine?	50.2%	19.2%	30.6%
Do you think you should drink a lot of water after your vaccination?	29.8%	41.3%	28.8%
Do you think you should avoid tobacco after your vaccination?	35.7%	34.1%	30.1%
Do you believe eating anti-inflammatory foods can boost immunity?	74.8%	13.0%	12.2%
Full vaccination against COVID-19 will prevent you from infection while eating outside the house without following standard safety precautions?	28.5%	59.3%	12.2%

COVID-19 vaccination. More than half (59.3%) of respondents stated that being completely vaccinated is insufficient to protect them if they do not take precautions while eating outdoors (Table 2).

## Food behavior and consumption habits

### Food shopping behaviors

Regarding food shopping, 70% of the participants stated that vaccine availability had not changed the amount of



food purchased, buying local food, and shopping from small supermarkets compared to pre-vaccine time, implying that behaviors during the pandemic remained the same after vaccine availability. More than 25% of students reported ordering groceries online and ordering meals using delivery applications more frequently post-vaccine. On the other hand, around 23% have a reduced level of shopping frequency and shopped less often in large supermarkets (Figure 1).

Kruskal Wallis and Mann Whitney *U*-tests showed that some variables such as gender, university type, engagement in preparing food, and living status significantly affected certain food-related behaviors (Table 3). For example, there is a significant difference between students who prepare or help in preparing food and those who do not in terms of shopping from large markets ( $p = 0.030$ ). Students who prepare food shopped from large supermarkets less than students who do not prepare food.

## Dietary habits

Regarding dietary habits, it was noticed that after the availability of the COVID-19 vaccine, consumption behavior generally had not changed compared to pre-vaccine times (Figure 2). However, 23.6% of the respondents increased their consumption of fruits and vegetables, 25.5 and 16.2%

increased their consumption of healthy food and healthy snacks, respectively, and 27.6% increased their water consumption. On the other hand, some participants reduced their consumption of meat, fast food, unhealthy snacks, packaged frozen food, and canned food (13.1, 25.2, 20.4, 20.2, and 23.6%, respectively).

A Mann-Whitney *U*-test showed a statistically significant difference between students who prepare food or help in preparing it and those who do not in terms of consuming packaged frozen food ( $p < 0.001$ ) and canned food ( $p < 0.001$ ). Students engaged in preparing food reduced their consumption of packaged frozen food and canned food after vaccine availability. There is also a significant difference between female and male students in terms of consuming unhealthy snacks ( $p = 0.025$ ) and healthy food ( $p < 0.05$ ). Female students tended to consume less unhealthy snacks and more healthy food than male students during the time after vaccination. Also, living status significantly affected some behaviors, such as consuming healthy foods ( $p < 0.05$ ), and students living with their families have eaten more healthy food.

## Food-related behaviors

Figure 3 also highlights some changes in food-related behaviors. Less than a third (26.8%) of the participants stated that they were eating with friends, 33.5% were eating out,

TABLE 3 Socio-demographic effects on food behavior and consumption habits after the availability of the COVID-19 vaccine.

	Gender	University	Preparing/help in preparing food	Living status	Field of study	Monthly allowance
	Mann-Whitney <i>U</i>			Kruskal Wallis		
<b>Food shopping behaviors</b>						
Buying local food (produced in your country)	<i>P</i> = 0.426	<i>P</i> = 0.417	<i>P</i> = 0.122	<b><i>P</i> = 0.000*</b>	<i>P</i> = 0.714	<i>P</i> = 0.063
Ordering groceries online	<i>P</i> = 0.862	<b><i>P</i> = 0.046*</b>	<i>P</i> = 0.458	<i>P</i> = 0.716	<i>P</i> = 0.096	<b><i>P</i> = 0.011*</b>
Buying food in person from a large supermarket	<i>P</i> = 0.117	<i>P</i> = 0.223	<b><i>P</i> = 0.030*</b>	<i>P</i> = 0.522	<i>P</i> = 0.991	<i>P</i> = 0.770
Buying food in person from a small supermarket or grocery store	<i>P</i> = 0.086	<b><i>P</i> = 0.029*</b>	<i>P</i> = 0.538	<i>P</i> = 0.050	<i>P</i> = 0.346	<i>P</i> = 0.128
Having meals delivered directly to my home from a full-service or fast food restaurant or by a delivery application	<i>P</i> = 0.287	<i>P</i> = 0.113	<i>P</i> = 0.990	<i>P</i> = 0.650	<i>P</i> = 0.263	<i>P</i> = 0.050
Shopping frequency	<b><i>P</i> = 0.046*</b>	<i>P</i> = 0.794	<i>P</i> = 0.113	<i>P</i> = 0.165	<i>P</i> = 0.802	<i>P</i> = 0.246
Amount of food purchased	<i>P</i> = 0.821	<i>P</i> = 0.381	<i>P</i> = 0.050	<i>P</i> = 0.187	<i>P</i> = 0.993	<i>P</i> = 0.832
<b>Eating habits</b>						
Fruits/vegetables	<i>P</i> = 0.083	<i>P</i> = 0.159	<i>P</i> = 0.062	<b><i>P</i> = 0.002*</b>	<i>P</i> = 0.980	<i>P</i> = 0.569
Meat	<i>P</i> = 0.177	<i>P</i> = 0.710	<i>P</i> = 0.183	<i>P</i> = 0.106	<i>P</i> = 0.379	<i>P</i> = 0.251
Healthy food	<b><i>P</i> = 0.001*</b>	<i>P</i> = 0.489	<i>P</i> = 0.173	<b><i>P</i> = 0.006*</b>	<i>P</i> = 0.866	<i>P</i> = 0.868
Unhealthy food (Fast food)	<i>P</i> = 0.052	<i>P</i> = 0.410	<b><i>P</i> = 0.002*</b>	<i>P</i> = 0.807	<i>P</i> = 0.442	<i>P</i> = 0.286
Water	<i>P</i> = 0.218	<i>P</i> = 0.228	<i>P</i> = 0.143	<i>P</i> = 0.185	<i>P</i> = 0.350	<i>P</i> = 0.770
Candy, cookies, cakes, and pastries	<i>P</i> = 0.945	<i>P</i> = 0.220	<i>P</i> = 0.669	<i>P</i> = 0.614	<i>P</i> = 0.381	<i>P</i> = 0.160
Healthy snacks	<i>P</i> = 0.076	<i>P</i> = 0.370	<i>P</i> = 0.087	<b><i>P</i> = 0.004*</b>	<i>P</i> = 0.638	<i>P</i> = 0.152
Unhealthy snacks	<b><i>P</i> = 0.025*</b>	<b><i>P</i> = 0.040*</b>	<b><i>P</i> = 0.038*</b>	<i>P</i> = 0.245	<b><i>P</i> = 0.023*</b>	<i>P</i> = 0.279
Packaged frozen foods	<i>P</i> = 0.697	<i>P</i> = 0.366	<b><i>P</i> = 0.000*</b>	<i>P</i> = 0.676	<i>P</i> = 0.144	<i>P</i> = 0.595
Canned food	<i>P</i> = 0.177	<i>P</i> = 0.052	<b><i>P</i> = 0.000*</b>	<i>P</i> = 0.505	<i>P</i> = 0.521	<i>P</i> = 0.199
<b>Food-related behaviors</b>						
Eating at home alone	<i>P</i> = 0.333	<b><i>P</i> = 0.039*</b>	<i>P</i> = 0.913	<i>P</i> = 0.154	<i>P</i> = 0.991	<b><i>P</i> = 0.014*</b>
Eating with family members	<i>P</i> = 0.076	<i>P</i> = 0.080	<i>P</i> = 0.413	<b><i>P</i> = 0.005*</b>	<i>P</i> = 0.218	<i>P</i> = 0.667
Eating with friends	<b><i>P</i> = 0.033*</b>	<i>P</i> = 0.184	<i>P</i> = 0.611	<i>P</i> = 0.315	<i>P</i> = 0.578	<i>P</i> = 0.535
Eating out (e.g., restaurants/cafeteria/fast food)	<i>P</i> = 0.060	<i>P</i> = 0.411	<b><i>P</i> = 0.005*</b>	<i>P</i> = 0.736	<i>P</i> = 0.493	<i>P</i> = 0.590
Eating at someone else's place (e.g., family, friends)	<i>P</i> = 0.122	<i>P</i> = 0.190	<i>P</i> = 0.431	<i>P</i> = 0.867	<i>P</i> = 0.735	<i>P</i> = 0.939
Ordering take-away or fast food meals with deliveries	<i>P</i> = 0.394	<b><i>P</i> = 0.014*</b>	<i>P</i> = 0.353	<i>P</i> = 0.967	<i>P</i> = 0.579	<i>P</i> = 0.065
Cooking and preparing food	<b><i>P</i> = 0.007*</b>	<i>P</i> = 0.198	<b><i>P</i> = 0.013*</b>	<b><i>P</i> = 0.001*</b>	<i>P</i> = 0.463	<i>P</i> = 0.767
Spending a lot of time cooking	<i>P</i> = 0.676	<i>P</i> = 0.454	<i>P</i> = 0.686	<i>P</i> = 0.656	<i>P</i> = 0.654	<i>P</i> = 0.834
Making easy meals (e.g., instant foods, frozen foods, etc.)	<i>P</i> = 0.097	<i>P</i> = 0.581	<i>P</i> = 0.253	<i>P</i> = 0.129	<i>P</i> = 0.632	<i>P</i> = 0.415
Eating between meals (e.g., snacks)	<i>P</i> = 0.679	<i>P</i> = 0.286	<i>P</i> = 0.627	<b><i>P</i> = 0.031*</b>	<i>P</i> = 0.599	<i>P</i> = 0.784
Food wastage	<i>P</i> = 0.614	<i>P</i> = 0.850	<i>P</i> = 0.190	<i>P</i> = 0.132	<i>P</i> = 0.719	<i>P</i> = 0.952
Stocking up food and beverages	<i>P</i> = 0.051	<b><i>P</i> = 0.025*</b>	<i>P</i> = 0.419	<b><i>P</i> = 0.011*</b>	<b><i>P</i> = 0.003*</b>	<i>P</i> = 0.418

\*Significance level at  $P < 0.05$ .

and 26.3% were eating at someone's else place with a reduced frequency than before the availability of the vaccine. Conversely, 17.5% stated that they were eating with family more often after the vaccination. Additionally, 21.5% of the respondents

ordered takeaway or delivered fast food meals more than in the pre-vaccine times. Whereas, 18.3 and 11.4% cooked/prepared food more often and were spending a lot of time cooking, respectively. Regarding food wastage and stocking up food

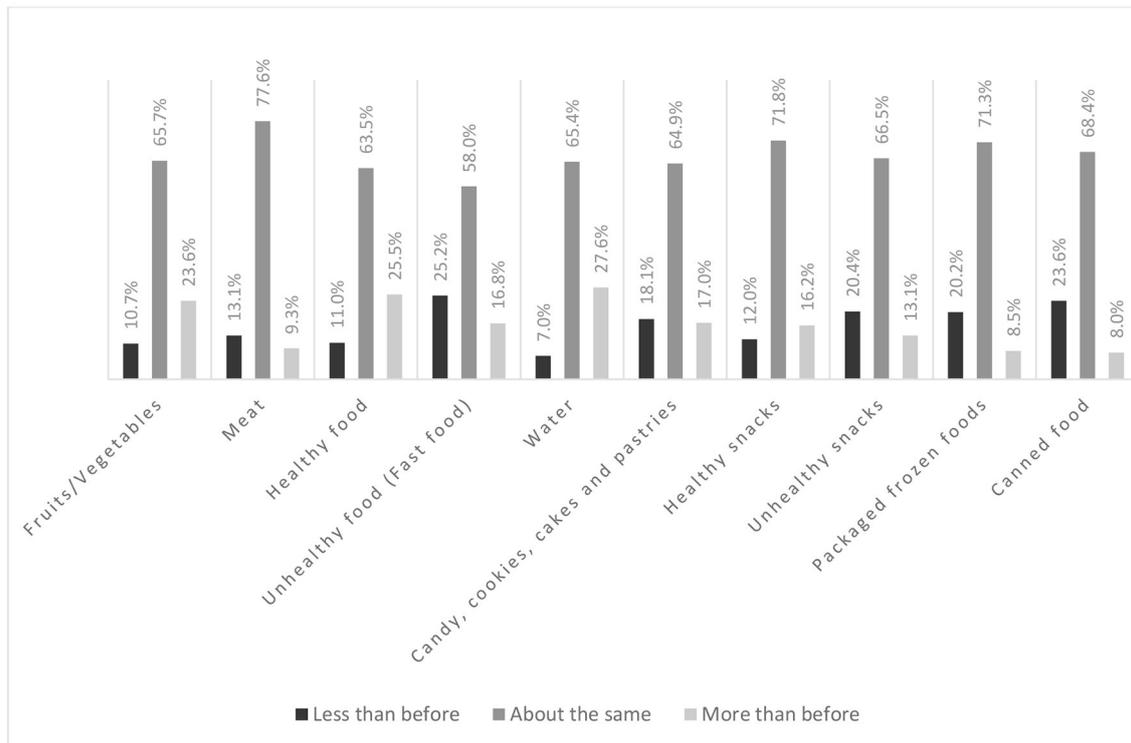


FIGURE 2  
Changes in dietary habits after the availability of the COVID-19 vaccine.

and beverages, 21.3% decreased their food wastage, and 12.0% reduced food stocking.

There is a significant difference between students who prepare food and those who do not in terms of eating out ( $p = 0.005$ ). Those who prepare their food or help in preparing food tended to eat out in restaurants and cafeterias less than students who do not engage in preparing food after the vaccine.

## On campus protective measures and food-related behaviors

Although more than half (56.7%) were concerned about ordering food on campus (as mentioned in Table 1), 58.7% purchased meals from on-campus restaurants, while 42.3% brought food from home. Those who do not dine on campus were asked to indicate the reasons; almost one-third (31.9%) said they did not have enough time, 16.5% were concerned about becoming poisoned, and 13.6% were concerned about becoming infected with COVID-19.

After returning to on-campus learning, students' behaviors were explored using a five-point Likert scale (always, usually, sometimes, rarely, never). About a third (34.5%) of students always carried alcohol-based hand sanitizer, 26.6% always

washed their hands frequently with water and soap, and 59.3 and 25.4% never shared water bottles and cigarettes with friends, respectively. After the vaccine availability, only 18.6% continually followed social distancing and avoided gatherings, and 22.1% all the time wore face masks when sitting with friends. Additionally, 30.8% of respondents always followed the protective measures for using elevators on campus (Table 4).

## Discussion

The results revealed some favorable attitudes, nonetheless, incorrect perceptions regarding the vaccines and their effects after administration were observed among students. Furthermore, some students reported changes in their food shopping and consumption after COVID-19 vaccination, although certain behaviors remained unchanged relative to pre-vaccination times. The finding is consistent with broad literature on the food shopping and consumption behavior during pandemics (Ben Hassen et al., 2020; Cheikh Ismail et al., 2020; Sidor and Rzymiski, 2020; Fanelli, 2021) and extends research into the back on campus behaviors after 2 years closure of universities.

After the first section of the questionnaire which was related to sociodemographic characteristics, the second section of the

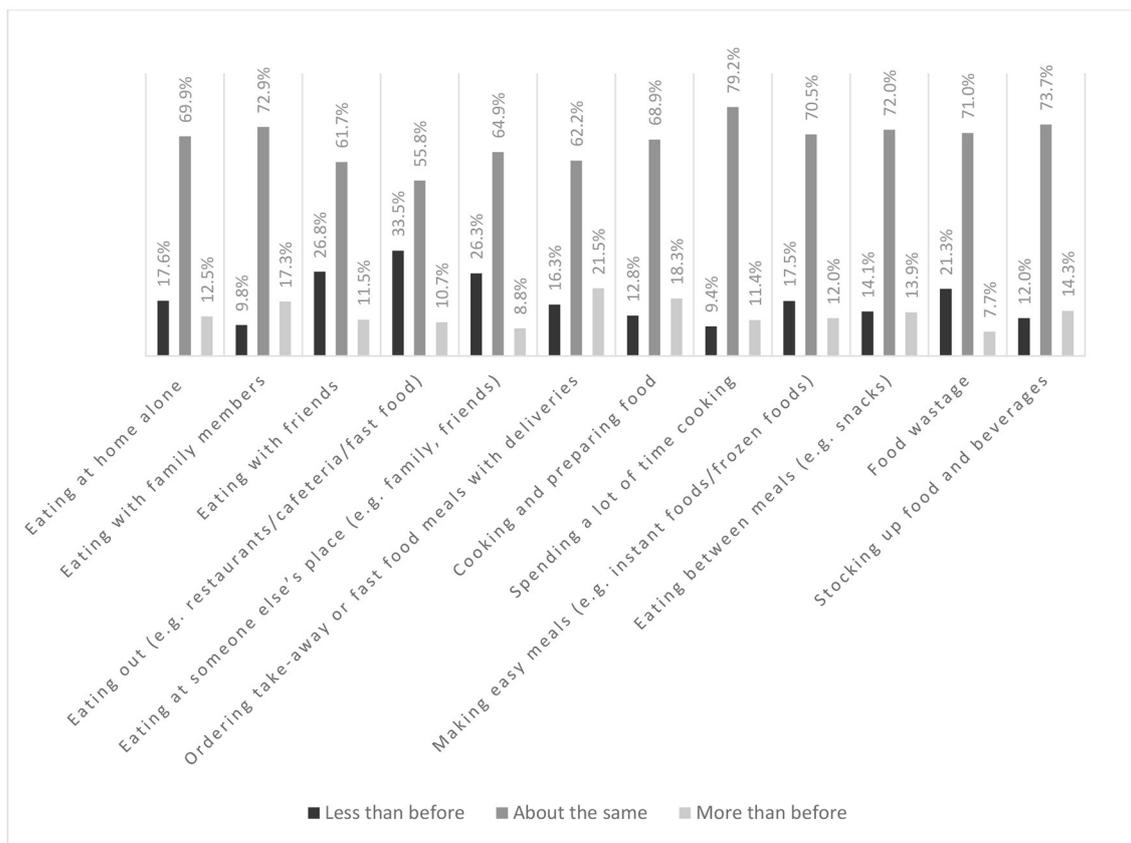


FIGURE 3  
Changes in food-related behaviors after the availability of the COVID-19 vaccine.

questionnaire was concerning measures related to consumption that need to be taken prior to and after the vaccination. One study reported side effects which may affect consumption like loss of taste and decreased appetite after receiving the first dose of the COVID-19 vaccine (1.5 and 9.4%, respectively) (Omeish et al., 2022). In this study, half of the participants believed that COVID-19 vaccines did not affect taste or appetite. Moreover, staying hydrated after getting the vaccine is recommended to avoid the vaccine's stressful side effects (CDC, 2022b). Nevertheless, only 29.8% believed that the individual should drink much water after receiving the vaccine. Some health experts also recommend no smoking after taking the vaccine because exposure to cigarette smoke may impair the ability to form memory cells essential to maintain the vaccine-induced protective immune response (Ferrara et al., 2022). However, only a third of participants believed that they should temporarily stop smoking after vaccine administration. Prior to COVID-19 vaccine administration, an assessment of the individual's past medical history for allergic reactions to any cause and especially to the vaccine's components should be performed since there is a possibility of developing an allergic reaction to

the COVID-19 vaccine among individuals who have common allergies to certain foods, medications, inhalants and latex (Kounis et al., 2021). This evidence was well-believed by half of the participants in the present study. It is important to note that the CDC recommends vaccination even with a history of allergic reactions unrelated to vaccines or injectable medications (CDC, 2022a). Moreover, a high number of participants in this study correctly believed that being fully vaccinated is not enough when eating in public places. They believed that they could still get infected upon viral exposure when socializing/upon contact at food establishments despite being vaccinated. Actions have been taken by the Jordanian government in easing of COVID-19 measures amid high vaccination rates. However, the WHO continues to recommend people to keep following safety precautions, wearing masks, maintaining physical distance, and avoiding crowded places post-vaccination (WHO, 2021).

The third section of the questionnaire was regarding the change in consumption behavior after mass inoculations with the COVID-19 vaccination. Multiple studies indicate that the COVID-19 pandemic was associated with a significant shift in people's attitudes and behavior concerning food and health (Ben

TABLE 4 Back on campus-level of protective behaviors.

Item	Frequency (%)					Mean*	SD
	Never	Rarely	Sometimes	Usually	Always		
Carrying alcohol-based hand sanitizer and use it when cannot wash hands	60 (9.6%)	63 (10.1%)	116 (18.6%)	170 (27.2%)	215 (34.5%)	3.67	1.301
Sharing water bottles with friends	370 (59.3%)	92 (14.7%)	72 (11.5%)	39 (6.3%)	51 (8.2%)	1.89	1.298
Sharing cigarettes with friends ( <i>n</i> = 213)	54 (25.4%)	27 (12.7%)	52 (24.4)	33 (15.5)	47 (22.0%)	2.96	1.479
Following the guidelines for using elevators ( <i>n</i> = 383)	38 (9.9%)	55 (14.4%)	85 (22.2%)	87 (22.7%)	118 (30.8%)	3.50	1.324
Applying social distancing and avoid gatherings	67 (10.7%)	76 (12.2%)	190 (30.5%)	175 (28.0%)	116 (18.6%)	3.32	1.216
Frequently washing hands with water and soap	54 (8.7%)	84 (13.4%)	151 (24.2%)	169 (27.1%)	166 (26.6%)	3.50	1.254
Wearing face mask when sitting with friends	100 (16.0%)	94 (15.1%)	152 (24.4%)	140 (22.4%)	138 (22.1%)	3.20	1.366
I use the toilets and/or public water taps on campus	242 (38.8%)	134 (21.5%)	111 (17.8%)	59 (9.4%)	78 (12.5%)	2.35	1.395
I use vending machines that offer contactless ordering and payment on campus	173 (27.7%)	109 (17.5%)	155 (24.8%)	125 (20.0%)	62 (10.0%)	2.67	1.332
I eat covered ready to eat food (such as packed croissant, cake) rather than uncovered site prepared food (such Falafel or Shawirma sandwich) on campus	100 (16.0%)	96 (15.4%)	163 (26.1%)	148 (23.7%)	117 (18.8%)	3.14	1.329

\*Scale: 5 points-Likert scale.

Hassen et al., 2020; Osaili et al., 2021). It was seen that people increased their consumption of healthy food and reduced their intake of unhealthy food (Ben Hassen et al., 2020). Consumers avoided shopping in person from markets and relied on online grocery shopping, delivery, and pick-up services (Ben Hassen et al., 2020). However, after the availability/inoculations of the vaccine, limited data is available about food-related behaviors. In the current study, most students did not change their food consumption and shopping behaviors pre and post-vaccination. A previously published study found that participants with online grocery shopping experience during the COVID-19 pandemic are more likely to continue post-COVID-19 (Shen et al., 2022). Interestingly in this study, a slight increase in online ordering products for ready-to-eat meals/ raw ingredients was observed after the vaccine availability. This could perhaps be related to the convenience of online food delivery apps and an increased new normal of contactless shopping.

With regards to food choices, a previous study among university students in the United States reported significant and negative changes in food choices during the pandemic, where many students increased their consumption of ice cream and cookies (Powell et al., 2021). In contrast, our results showed a transition toward a healthier diet even post-vaccination. The

participants reduced the consumption of unhealthy food and snacks, packaged frozen food, and canned food. At the same time, they increased their intake of fruits and vegetables, healthy food (rich in fibers and whole grains, unprocessed, low in saturated and trans-fat...) and water consumption. The current findings reflect participant's belief that a healthy diet would couple up the effect of the vaccination. Moreover, the present study results were in line with a previous study, which reported an increased consumption of healthy and fresh food amongst its participants (Powell et al., 2021).

Even though Jordan has a culture of enjoying food sharing and dining out with others, Jordanian universities students reduced eating out to less than before the pandemic and even eat at home with friends or family members (Osaili et al., 2021). After the COVID-19 vaccine became available, precaution measures and restricting practices eased down leading to a slight increase in the frequency of meeting families and friends to jointly eat together, yet, eating in public or restaurants remained limited due to a persistent fear as evidenced by our study.

The last section of the questionnaire was regarding on-campus students' behaviors related to general food safety. Food in cafeterias and vending machines are components of the food environment that influences students' dietary choices (Hasan

et al., 2021). Their use was expected to increase post vaccinations because of their contactless form of delivery. However, this was not the case. This could be because food present in vending machines is considered as “too unhealthy”, as reported by many students in a previous study (Hasan et al., 2021). On the other hand, a comparable number of students had more trust in the food prepared under their sight (where they can see and control the way food is prepared for them).

Furthermore, smoking among university students in Jordan is widespread, with a prevalence rate of 57.1% (Al-Sawalha et al., 2021). Sharing smoking cigarettes among young adults, such as university students, within groups of friends is not uncommon (Liu et al., 2021). Because sharing a cigarette with an infected colleague or friend increases the chance of COVID-19 viral transmission, the WHO advises against sharing any smoking or e-cigarette products during the pandemic (WHO, 2020b). However, many students in the present study (40.7%) continued with this practice.

One of the unintended consequences of vaccination is reducing population adherence to protective behaviors such as mask-wearing, hand-cleansing, and maintaining physical distance. A national survey in the United Kingdom to assist people's adherence to COVID-19 measures after vaccination observed that 50% will keep following the restricted measures even after getting the vaccine, while 11% said they would no longer follow the safety measures (SPI-B, 2020). However, the results of our study showed lower levels of adherence. Less than a third of participants continued wearing face masks when interacting with friends, following hygiene practices, and applying physical distancing inside the university campus. It is worth mentioning that full vaccination for students, faculty members, and administrators is mandatory for entering university campuses in Jordan for the year 2022. Those who have uncertainties regarding the COVID-19 vaccine may be less caring about the practice of preventive measures post-vaccination. On the other hand, overconfidence in the vaccine's effectiveness may decrease the likelihood of vaccinated individuals following suggested precautionary measures due to their belief that the vaccine would provide protection even from COVID-19 exposure (Chandu et al., 2021).

Since the beginning of the pandemic, an increase in the usage of several hand hygiene products, such as soaps, alcohol-based hand sanitizers (ABHS), and disinfectant wipes, was noted (Montero-Vilchez et al., 2022). Zhang et al. (2021) reported that Chinese university students washed their hands an average of 5.76 times per day during the pandemic. However, 17.1% of them were less likely to wash their hands after being vaccinated. Moreover, only 22% of the students wore masks in their classrooms, offices, libraries, canteens, shops, and crowded indoor environments after vaccination. Furthermore, people may get worried about the risk of transmission of infectious diseases, including COVID-19 and other viral or bacterial infections, through washrooms settings using water taps, toilets,

and touching other surfaces (Vardoulakis et al., 2022). This could explain why more than 30% of the surveyed students in the current study never used toilets and water taps on campus even after the availability of the vaccines.

This study has limitations related to the sample bias due to the use of web-based survey, however, it has become a crucial tool during the COVID-19 pandemic and post-vaccination time, since social distance is still needed and face-to-face surveys are complicated and unsafe. Moreover, the responses of the study are based on recall making it prone to bias. Another limitation is that the use of a questionnaire may have led to expression of students' ideas rather than their actual behavior (social desirability bias).

## Conclusion

This study assessed the degree to which the roll-out of the vaccination program affects students' food consumption and shopping behaviors. To the best of our knowledge, this is the first study that contributes to a better understanding of the impact of COVID-19 vaccination availability and campaigns on students' dietary choices, food shopping and their behavior when living on campus. The results support that most respondents did not change their food consumption and shopping behaviors after the vaccine roll-out, but induced positive changes in some students represented by their adoption of healthier diets and reducing ready-to-eat food. Returning to university campuses after the vaccine availability influenced the decision to continue or quit food-related habits adopted during the pandemic. This information may be helpful to researchers interested in the effects of COVID-19 vaccination on student nutrition and related food behaviors.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving human participants were reviewed and approved by Institutional Review Board (IRB) at Jordan University of Science and Technology. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

AT, TO, and AA-N: conceptualization, methodology, and formal analysis. AT, TO, TB, DF-K, AA-N, LC,

and AO: investigation and writing—original draft. TO, TB, and DF-K: review and editing. All authors contributed to manuscript revision, read, and approved the submitted version.

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## Conflict of interest

DF-K was employed by DFK for Safe Food Environment.

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