



Research article

Digital food behaviours, motivations, and delivery application usage among saudis during COVID-19: A mixed-methods study

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ABSTRACT

Food delivery apps (FDAs) and smartphones in Saudi Arabia have become ubiquitous and increasingly popular methods for food ordering and consumption. Such app use during the COVID-19 pandemic has become a convenient and popular response to pandemic restrictions. However, the motivations and preferences behind FDA use are complex, as are the perceptions of FDA users regarding nutrition and healthy foods. To explore FDA usage, motivations, perceptions, and food behaviours in the unique cultural context of Saudi Arabia at the intersection of two epidemics, COVID-19 and obesity, a convergent parallel mixed-methods study design was used with 566 Saudis in the quantitative phase and 17 continuing to the qualitative phase. Of the respondents, 71.9 % reported using FDA typically once a week. Frequent FDA usage was reported by 33.3 % of the participants aged 30–40 years ($P = .049$). Nearly two-thirds of the sample (62 %) reported that time and convenience were the driving factors in using FDAs. Qualitatively, six main themes were identified: 'Perceived benefits and drawbacks', 'Effects of Promotions and Food Preferences', 'Nutritional information and dietary guidelines', 'Concepts of healthy food', 'Obstacles to healthy food consumption', and 'Maintaining Customs and Traditions'. Although convenience and taste were the primary drivers of FDA usage, the roles of tradition and culture in Saudi Arabia were also important FDA usage factors. Overall, understanding the determinants of how Saudis engage with FDAs, in concert with a deeper understanding of food preferences, perceptions, and nutritional knowledge, should help guide future efforts in nutrition education, app development, and public health policy.

1. Introduction

Notably, the rise of food delivery apps (FDAs) and the proliferation of the digital food environment, or the 'cloud kitchen' [1], have occurred most prominently in the context and crucible of two concurrent epidemics in the Kingdom of Saudi Arabia: COVID-19 and obesity. According to the 2020 report published by the Saudi Ministry of Health [2] 58 % of the Saudi adult population is overweight or obese. In fact, Saudi Arabia is 'now among the nations with the highest obesity and overweight prevalence rates due to a number of factors' [3] However, the obesity epidemic is just one of three significant factors—the other two being the COVID-19 pandemic and the exponential rise of FDAs—that triangulate the current unique public health picture and challenge. The influences and consequences of these three intertwining and inter-influential phenomena represent the context of this study.

As with online grocery stores and the digital food environment, FDAs are tools that can promote positive or detrimental eating

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behaviours and food options. What cannot be denied, however, is the growing power and presence of FDAs as part of the food culture within Saudi Arabia. A qualitative study of the Lebanese, Saudi Arabian, and Emirati markets noted that during the Covid-19 pandemic 'the food and beverage sector witnessed a significant rise in online food ordering and delivery companies' [4]. The exponential rise in FDAs within Saudi Arabia has been recognised and reported by the Communications, Space & Technology Commission [5] It stated that 'The number of delivery applications operating in the Kingdom has risen by over 460 % in just two years, from 3 in the fourth quarter of 2019 [to 17 in 2021]'. Not only has the FDA market and presence grown in Saudi Arabia, but FDAs are anticipated to continue to occupy an increasing market space and presence in the food ecosystem. Indeed, Hakami and Al-Aama [6] noted that 'the Online Food Ordering and Delivery Market in Saudi Arabia will continue to grow steadily' and 'is expected to increase at a 10.05 % compound annual growth rate between 2021 and 2026'. Another recent study surveyed 590 Saudis and found that 43 % of the applications on their smartphones were FDAs [7].

The concurrent phenomena of COVID-19, FDA usage, and obesity have influenced one another in observable and often detrimental ways. A study by Hakami and Al-Aama [6] noted that 'turnout for food delivery applications significantly increased during the epidemic of the novel coronavirus'. While another recent study in Saudi Arabia concluded that the 'eating frequency of food between meals increased among food-secure participants during the COVID-19 curfew' [7]. These results echo those of several other studies that found an increase in snacking episodes and other culinary behavioural changes during the pandemic [8,9]. The third noteworthy point of this triangulation is obesity. Another recent study in Saudi Arabia, Alhousseini et al. [10] revealed that '42.14 % of study participants reported an increase in weight of up to five kg during the COVID-19 pandemic'. While these studies point to individual changes within each of the three concurring phenomena, our understanding of this trifecta working in concert in Saudi Arabia—obesity, COVID-19, and the rise of FDAs—is weak and, as a topic, not sufficiently studied. While Alhousseini and Alqahtani [11] also acknowledged the positives and negatives of FDAs, they warned that FDAs are 'expected to contribute to the increasing obesity rates in Saudi Arabia in the coming years'.

Overall, research on the motivating factors behind FDA use and its impact on eating, food culture, and human health is only in its early phases. Ultimately, as little is known about Saudi experiences with FDAs in general, the aim of this study is to gain a deeper understanding of Saudi perspectives and experiences of FDA usage, shed light on food choices, preferences, and nutritional knowledge of FDA users, and contribute to the dialogue that offers a social-cultural contextual understanding of FDA usage. Thus, in the context of obesity and the COVID-19 epidemic, this study addresses the rise in influencing factors, motivations, perceptions, and food behaviours around FDA usage in Saudi Arabia.

2. Methods

2.1. Study design

To gather diverse and complementary information and provide a more in-depth understanding of FDA usage in Saudi Arabia, a

convergent parallel mixed-methods study was designed and implemented. Convergent parallel mixed-methods involve the collection and analysis of quantitative and qualitative data, which are gathered simultaneously in separate ways, and analysed independently. Data from both qualitative and quantitative studies are then merged to compare and combine the results [12].

Between October and December 2021, a quantitative online survey was conducted in accordance with the consensus-based checklist for reporting survey studies (CROSS) [13]. To pursue and further investigate survey findings, along with a qualitative study involving focus group discussions (FGDs) with a subset of participants. Ethical approval was obtained from the King Saud University Institutional Review Board; (Ref No: KSU-HE-21-636).

2.2. Study population and recruitment

Participant recruitment was done through online channels, including social media apps, such as WhatsApp and Telegram. Social networks have been shown to be an effective and efficient recruitment method, capable of rapidly collecting diverse and valid data, particularly during the challenges of COVID-19 [14,15] Interested participants were directed to the first part of the online survey, which acted as an eligibility screener. If the participants met the criteria (Saudi adults ≥ 18), their informed consent was also gained during this screening.

The study's minimum sample size was calculated as 377 participants using Geiger's equation. Next, the questionnaire was distributed through social networks and 581 responses were received and recorded. For the subsequent qualitative phase of the study, the questionnaire gave participants the opportunity to provide contact information if they were interested in participating in follow-up

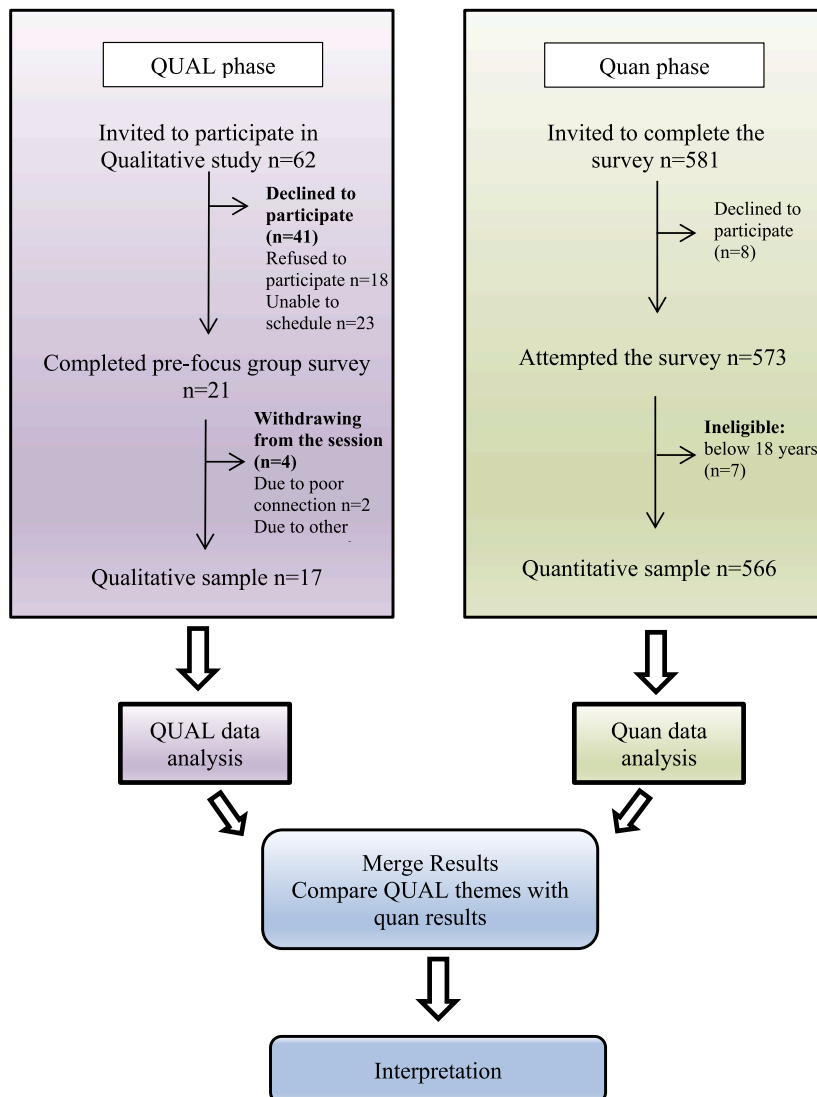


Fig. 1. Flow diagram of participants in the convergent mixed-methods study.

FGDs on Zoom (during the COVID-19 pandemic) to share additional information through qualitative dialogue [16].

Sixty-two of the questionnaire respondents agreed to participate in the FGDs. Invitations were sent via WhatsApp messages with a Google form link to collect demographic data and assist in scheduling. Reminders were sent to potential participants to confirm participation. Twenty-one participants responded to the invitation, leaving a total of 17 after two participants withdrew from the session owing to time conflicts. Two other participants withdrew due to connectivity issues. Fig. 1 illustrates the participant flow diagram.

2.3. Instrument development

2.3.1. Questionnaire development for quantitative study

To investigate the use of FDAs in Saudi Arabia, a set of questions was developed based on a review of the literature [17–20]. Within the questionnaire, the questions were randomly ordered and included questions such as, ‘In a typical week, how many times do you order from food delivery apps?’ [21].

The questionnaire consisted of three sections (see Supplementary Material-Appendix. A) The first section contained demographic data, the second contained questions related to FDA user practices, and the third invited participants to the qualitative portion of the study.

To determine questionnaire content validity through expert judgment, an assessment template was provided to a panel of experts. All modifications by the panel members were accepted and included [22]. The survey was then distributed to a pilot test group representative of the target audience. A total of 23 pilot surveys were completed. The survey was modified and revised in response to the input of the pilot participants. The final questionnaire reflected the valuable contributions of both the expert panel and the participants in the pilot study. The reliability of the questionnaire was deemed acceptable, with a Cronbach alpha of 0.73.

2.3.2. Topic guide development for qualitative study

An inductive semi-structured topic guide script was developed to direct the discussions on FDA experiences, ordering habits, food choices, and perceptions of healthy foods related to diet, FDAs, cooking, and home-based meals. The script started with an icebreaker question, ‘What is your favourite FDA?’ to build a strong and open rapport between the research team and the participants [23].

In preparation for the FGDs, a series of mock discussions were carried out. FGDs were conducted by the authors of this paper who were trained in qualitative methods at the postgraduate level.

In response to pandemic restrictions and considerations, Zoom, as used in this study, has been successfully applied in many qualitative studies [24–28]. Prior to the sessions, participants received an invitation link and appointment reminders. The discussions were conducted by one researcher, while another supervised, took notes, and provided general assistance.

2.4. Data analysis

2.4.1. Quantitative statistical analysis

After extraction, the data were revised, coded, and fed into IBM SPSS version 22 (SPSS, Inc. Chicago, IL). All the statistical analyses were performed using two-tailed tests. *P* values less than 0.05 were considered statistically significant. Descriptive analysis based on frequency and percentage distribution was performed for all variables, including personal data, body mass index, FDAs used, frequency of use, types of food ordered, cost per order, motivations for food ordering, menu items, and food choice factors, as well as the meals ordered the most and menu items. Cross-tabulation was used to assess the demographic distribution of the participants’ frequency of app use. Relationships were tested using the Pearson chi-square test and exact probability tests for small frequency distributions.

2.4.2. Qualitative data analyses

The sessions were recorded, transcribed verbatim, and reviewed for accuracy and clarity. Subsequently, manual corrections were applied. To familiarise themselves with the data, researchers read through the transcriptions and initiated data analysis by identifying salient themes. To ensure analytical consistency, quality, transparency, and reflexivity, each researcher conducted thematic analysis individually for the first transcript and then jointly for the other three transcripts. When the thematic analysis was complete and salient themes were identified, relevant and noteworthy quotes were identified, excerpted, and translated into English.

2.4.3. Mixed methods data analysis

The data from the qualitative and quantitative phases were merged for analysis and interpretation. The FGD themes were compared with the survey results to determine whether the overarching dimensions converged or diverged [29].

3. Results

3.1. Participation and demographics in the quantitative phase

A total of 566 respondents completed the questionnaires. Participants’ ages ranged from 18 to 66 with a mean age of 34.8 ± 13.5 years. Most participants were attending or had graduated from a university (409, 72.3 %).

Less than half of the participants (232, 41 %) reported receiving a monthly income of less than 2000 Saudi Riyals (SR), and

approximately one-third reported receiving a monthly income exceeding 10,000 SR.

More than half of the participants (323, 57.1 %) were classified as overweight or obese based on BMI calculations using their reported height and weight (Table 1).

3.2. Pattern of FDA usage

The majority of participants (407, 71.9 %) reported using FDAs once a week, and more than half of the participants (313, 55.3 %) reported using the 'Hungerstation' delivery app specifically (Table 2). Most participants (361, 63.8 %) reported that they were 'totally satisfied' with their FDA usage and noted that they preferred to order with a significant other (partner, sibling, etc.) (390, 68.9 %).

Lunch was the meal ordered the most (459, 81.1 %). Fast food was the most popular choice (393, 69.4 %) and approximately half of the participants (290, 51.2 %) spent less than 50 SRs per order. A quarter of the sample (143, 25.3 %) reported that the main factor driving FDA usage was lack of time.

The demographic breakdown of frequent FDA users is presented in Table 3. There was a notable relationship between age and frequent FDA usage. In particular, frequent FDA usage was reported among 33.3 % of the participants aged 30–40 years ($P = .049$). There was no significant difference ($P > .05$) in the frequency of FDA use between male and female participants.

3.3. Participation and demographics in the qualitative phase

To generate qualitative and anecdotal data, four small FGDs ($n = 17$; mean group size: four participants) were conducted following the online survey portion of the study (Table 4). The FGDs were held on Zoom; the longest session lasted for an hour and 40 min, and the shortest session lasted approximately 1 h.

3.3.1. Salient themes

The main discussion topics were categorised into six themes: 'Perceived benefits and drawbacks'; 'Effects of promotions and food preferences'; 'Nutritional information and dietary guidelines'; 'Concepts of healthy food'; 'Obstacles to healthy food consumption'; and 'Maintaining customs and traditions'.

3.3.1.1. Perceived benefits and drawbacks. Participants recognised several benefits and drawbacks to using FDAs; however, the perceived advantages outweighed the drawbacks. Examples of the advantages and drawbacks of FDA use, as noted by the participants, are detailed in Table 5.

Many participants indicated that speed and convenience were their primary reasons for using FDAs. The participants also pointed out that the time and effort needed to travel to a restaurant, find a parking space, and wait to be served were compelling reasons for using the FDA. Other factors that influenced FDA usage were busyness and preoccupation with other activities, such as work, study, family responsibilities, and/or house guests. Where lack of transportation was an issue, some indicated the necessity of using the FDA.

In response to the icebreaker question (*Which food delivery app do you prefer?*), the majority of the participants preferred the Hungerstation app for the following reasons: 'Hungerstation has more restaurant options. Although it is more expensive, they have good customer service; They take care of clients; If your order is delayed for some reason, Hungerstation will always

Table 1
Demographics of the quantitative study survey respondents.

Socio-demographic data	No	%
Age in years		
<20	70	12.4
20–29	187	33.0
30–40	117	20.7
>40	192	33.9
Gender		
Male	117	20.7
Female	449	79.3
Educational level		
Below secondary	68	12.0
Secondary	89	15.7
Attending or Graduated from University	409	72.3
Monthly income		
<2000 SR	232	41.0
2000–5000 SR	74	13.1
5001–7000 SR	37	6.5
7001–10000 SR	62	11.0
>10,000 SR	161	28.4
Body mass index		
Normal	243	42.9
Overweight	177	31.3
Obese	146	25.8

Table 2
Patterns of food delivery application usage.

Pattern of using applications	No	%		
What app do you use the most to order food?	Hungerstation	313	55.3	
	Jahez	112	19.8	
	Other	89	15.7	
	To you	37	6.5	
	Tmmt	10	1.8	
	The Chefz	5	0.9	
In a typical week, how many times do you order from food delivery apps?	One time	407	71.9	
	Two times	107	18.9	
	3–4	47	8.3	
	5+	5	0.9	
How satisfied are you with food delivery apps?	Totally dissatisfied	10	1.8	
	Dissatisfied	41	7.2	
	Neutral	154	27.2	
	Satisfied	265	46.8	
	Totally satisfied	96	17.0	
How many people do you usually order food for from food delivery apps?	Only me	77	13.6	
	With significant other	390	68.9	
	With household/family	86	15.2	
	Work colleges	13	2.3	
How much do you spend on food delivery per order?	<50 SR	290	51.2	
	50-100 SR	165	29.2	
	101-150 SR	80	14.1	
	>150 SR	31	5.5	
What is the main factor that drives you to use food delivery apps?	No time to cook/convenience	143	25.3	
	Speed of delivery	110	19.4	
	Ease of app usage	100	17.7	
	Cooking is not available option	73	12.9	
	Promotions	35	6.2	
	Other	105	18.6	
What meal do you order the most from other food apps?	Breakfast	16	2.8	
	Dinner	55	9.7	
	Lunch	459	81.1	
	Snacks	36	6.4	
What do you usually order from food apps?	Fast food (hamburgers, fried chicken, etc.).	393	69.4	
	Italian food (Pizza, Pasta, etc ...)	45	8.0	
	Bakery and sweets	30	5.3	
	Other	30	5.3	
	Local foods (Rice, Jarish, etc ...)	29	5.1	
	Lebanese food (Manakish, Falafel etc ...)	22	3.9	
	Asian cuisine (Indian food, Chinese food, Japanese food)	9	1.6	
	Drinks (Coffee, Juice)	8	1.4	
Would caloric and nutritional information about the foods available for delivery be helpful?	Yes	346	61.1	
	Maybe	161	28.4	
	No	59	10.4	

compensate you for it, either through replacing your meal or giving your money back' (P 1 FGD 4; P 2 FGD 3). A few participants preferred to use the restaurant's specific delivery application because 'the delivery and meal pricing is lower' (P 1 FGD 3).

The participants indicated their preferred application based on the following perceived benefits: availability of restaurants, proximity of restaurants (to ensure that the food arrived quickly and maintained its desired temperature), quality of the app's customer service, speed of delivery, and price of delivery.

3.3.1.2. Effects of promotions and food preferences. When the participants were asked what kinds of food they usually order on the FDAs, and the overwhelming response was fast food, such as hamburgers and pizzas. Some participants stated that they only ordered non-traditional Saudi foods from FDAs, as traditional foods were easy to make at home; and they preferred them homemade. A few participants said that they preferred to order specific foods, such as steaks, in person in a restaurant to ensure the correct food temperature and quality. When using an FDA to share a meal with another, pizza was the most often ordered item.

Many participants mentioned that they decided to order food from FDAs or switch from one restaurant to another when they received promotional offers. This was especially true when promotions came from a favourite restaurant. One participant noted 'I always look at the offers first. When I enter the app, I check if my favourite restaurants have any offers available and usually choose them first' (P 3 FGD 2). Some participants mentioned that promotions can be practical, but often, they are aimed only at large groups. 'If I see an attractive offer, for example, two pizzas for the price of one, then I will suggest this as a shareable meal for my family (P 4 FGD 4). To take advantage of free delivery, some noted that they might order more food than they would normally order.

If the participants had a certain food desire or taste in mind before ordering, they claimed that the promotions did not influence

Table 3
Prevalence of frequency of FDA usage by demographics.

Demographic data	Frequency of ordering from FDA/week		P value
	Frequent/total	%	
Age in years			.049
<20	12/70	17.1	
20–29	59/187	31.6	
30–40	39/117	33.3	
>40	49/92	25.5	
Gender			.469
Male	36/117	30.8	
Female	123/449	27.4	
Educational level			.209
Below secondary	25/68	36.8	
Secondary	22/89	24.7	
University/above	112/409	27.4	
Monthly income			.467
<2000 SR	58/232	25.0	
2000–5000 SR	18/74	24.3	
5001–7000 SR	12/37	32.4	
7001–10000 SR	19/62	30.6	
>10,000 SR	52/161	32.3	
Body mass index			.914
Normal	67/243	27.6	
Overweight	49/177	27.7	
Obese	43/146	29.5	

Table 4
Socio-demographic data of FDA users in Saudi Arabia (Focus group participants).

Participant	Age	Gender	Income	BMI
Focus group 1				
No 1	26	Female	<2000	26
No 2	24	Female	2000–5000	20
No 3	23	Male	2000–5000	24
No 4	28	Male	10,000 <	27.5
Focus group 2				
No 1	29	Female	<2000	19.8
No 2	27	Female	<2000	20
No 3	24	Female	<2000	24
No 4	23	Female	<2000	19
Focus group 3				
No 1	23	Female	<2000	19
No 2	20	Female	<2000	22
No 3	18	Female	<2000	17
No 4	21	Female	2000–5000	20
No 5	24	Female	5001–7000	25.7
Focus group 4				
No 1	39	Female	5001–7000	28
No 2	40	Female	2000–5000	24
No 3	28	Female	<2000	26.7
No 4	18	Female	<2000	22.2

Table 5
Benefits and drawbacks of FDAs.

Perceived benefit	Perceived drawbacks
Saving time and effort.	Exaggeration in delivery prices.
Ease of completing the order and ability to see the available customisable menu options.	Higher prices for meals presented on the application in comparison with ordering directly at the restaurant.
The speed of food delivery.	Lower food quality and temperature of the food on arrival may have changed.
Excellent customer service.	Food safety concerns.
Ease of use.	Potential for technical errors on the app when placing an order.
Convenient, time saving, no need to leave location to order food.	Lack of professionalism of the delivery person.

their FDA usage. One participant shared, for example, 'I choose to order grilled chicken burgers because they are more healthy. It doesn't matter to me if there is a promotion on another type of food' (P 2 FGD 2).

Because they did not enjoy reheating food or eating leftovers, other participants noted that over-ordering to satisfy the requirements of the promotion was not worth it. Finally, one participant shared that she never orders food based on promotions, because she only uses FDAs when there is no food to eat at home.

3.3.1.3. Nutritional information and dietary guidelines. The majority of the participants indicated that they had no knowledge of the Saudi Arabia dietary guidelines. One participant commented, 'Frankly, this is the first time I have ever heard of the Saudi Guidelines' (P 4 FGD 1). Those who had seen the dietary guidelines either did not recall specifics from the dietary guidelines or chose not to follow them: 'I feel that each person knows what is right for himself'. There is no need to follow guidelines, as the expression says, "you are your own doctor"' (P 1 FGD 3).

When the participants were asked if they would like to see caloric information for food items in FDAs, overwhelmingly, they agreed that having access to caloric information would not change their desires or ordering behaviour. As one participant reported, 'Calories won't ever change what I plan to order, because I crave it. I imagine the information could be useful for some people, but not me' (FGD 2). Notably, various participants responded with comments that suggested that it was more important for them to have food allergen information on the app: 'I don't count calories and I don't care, but allergens are very important' (P 2 FGD 2).

3.3.1.4. Concepts of healthy food. Responses varied when participants were asked, 'What is healthy food?' Interestingly, many participants defined healthy foods as those without spices. One participant commented, 'Healthy food is without spice and unattractive' (P 3 FGD 3); while another participant shared that 'Healthy food means it contains vitamins, iron, and zinc, no spices and no oil' (P 6 FGD 3).

Other misconceptions about healthy food included that all high-protein foods could be classified as healthy. 'Unhealthy foods are anything that contains oil. I see it as healthy if food contains protein, even if it is fried. As long as it contains a percentage of protein ...' (P 4 FGD 1).

Other participants reported that healthy food was natural, not processed or genetically modified: 'Healthy food is how God made it, without humans inserting genetically modified things into it ...' (P 1 FGD 1). One participant stated that as long as healthy items were added to a meal, the meal was healthy: "I add avocado and broccoli to every meal to make them healthy" (P 2 FGD 3). 'Healthy food is salad' (P1 FGD 4), one participant commented. In general, it was agreed that food prepared in the home was the healthiest: 'Homemade dishes are healthy food' (P3 FGD 4).

When participants were asked if they ordered healthy food from the FDAs, the resounding response was no. Participants responded overwhelmingly that they used FDAs for various reasons, but healthy food consumption was not one of them. Other participants stated that they did not believe that any restaurant was healthy and that the FDAs did not deliver any healthy items, even if they were labelled as healthy. Meanwhile, some participants said that they had seen healthy options for FDAs but did not find such offerings appealing. 'I don't want healthy. I want tastiness', one woman said (P 1, FGD 2).

Other participants said that they did not choose healthy items for one or more reasons: there was no guarantee that the menu items were healthy, prices were often higher, and the taste or enjoyment of their food could be compromised. One participant observed, for example, 'I tried to order healthy food. The price was higher and the serving size was much smaller than average. Also, it was not as described' (P 3 FGD 4).

3.3.1.5. Obstacles to healthy food consumption. When participants were asked if and what kind of obstacles they faced in eating healthy food, they expressed that a fast-paced lifestyle was the biggest challenge. As one participant said, 'I will try to be healthy, but the *pace* of life now will make me eat fast food or canned food' (P 1 FGD 2). Another participant concurred and offered, 'There is no comparison - either I spend an hour cooking to prepare dinner or in just one click of a button and I have food' (P 5 FGD 3).

Time pressures and lifestyle demands were not the only obstacles. Social influence and the mores of Saudi food culture and family gatherings were also potential obstacles. For example, one participant's family did not like healthy deserts, such as fruits. Some participants spoke of the tradition of always bringing a dessert to regular family gatherings: 'I really want to take healthy options when going to visit other people, but people don't want that. Our society will not accept healthy options' (P 1 FGD 4).

Some participants discussed the influence that children have on meals, food choices, shopping, and food ordering: 'I am a mother, I am under pressure from my kids to order from a restaurant. Even if I try to resist them, they will say "There is a promotion. Let's order!" With one click of a button, I can resolve the issue of food with my children and not have to argue with them' (P 2 FGD 4).

Obstacles also presented themselves in the form of acculturated customs, habits, and expectations about food, such as food habits from early childhood through adulthood. One participant commented that a healthy food lifestyle was not an easy option for those who did not grow up eating healthy and for whom the desire to eat the same foods as adults was strong. He stated that 'I would have to force myself to change. It's not easy to change my desires' (P 4 FGD 1). Another participant commented that she eats a very healthy diet regularly but that 'It's not what I'm keen on. It's something I'm accustomed to. I mean, I was raised that way' (P 4 FGD 2).

Table 6
Integration and comparison of quantitative and qualitative results.

Dimension	Quantitative findings	Qualitative findings	Mixed method interpretation
Preferred FDA by participants	55 % reported Hungerstation was the most used app	<p>1. <i>'Hungerstation has more restaurant options. Although it is more expensive, they have good customer service; They take care of clients; If your order is delayed for some reason, Hungerstation will always compensate you for it, either through replacing your meal or giving your money back'</i> (P 1 FGD 4; P 2 FGD 3).</p> <p>1a. <i>'I like Mrsool app the best because I can order from several stores at a time and have all the items delivered together'</i> (P 4 FGD 3).</p> <p>1b. <i>'I prefer to order directly from the restaurant that I want food from because the delivery and meal pricing is lower'</i> (P 1 FGD 3).</p>	<p>Confirmation</p> <p>Most participants described Hungerstation as the app that was most frequently used and expanded on qualities they found practical in the application. Other participants expressed preference for either Mrsool or ordering directly from restaurants, using their in-house delivery options.</p>
Driving factors for using FDAs.	62 % of participants reported time and convenience as the driving factors for using FDAs.	<p>1. <i>'There is no comparison - either I spend an hour cooking to prepare dinner or in just one click of a button and I have food'</i> (P 5 FGD 3).</p> <p>1a. <i>'It takes a long time to cook, and I don't usually like my own cooking'</i> (P 1 FGD 1).</p> <p>1b. <i>'I will try to be healthy, but the pace of life now will make me eat fast food or canned food'</i> (P 1 FGD 2).</p>	<p>Expansion</p> <p>Participants in the FGD expanded on their main reasons for using FDAs. Some participants mentioned that they possessed the ability to cook and do so when they have time, while others mentioned that they do not know how to cook. Additionally, participants spoke of the impact of culture and gender norms influencing their FDA use.</p>
Effects of promotions on FDA orders	Only 6 % reported that promotions may drive them to use food delivery apps.	<p>3. <i>'I always look at the offers first. When I enter the app, I check if my favourite restaurants have any offers available and usually choose them first'</i> (P 3 FGD 2).</p> <p>3a. <i>'If I see an attractive offer, for example, 2 for the price of 1 on pizza, then I will suggest it to my family for sharing'</i> (P 4 FGD 4).</p> <p>3b. <i>'When I open the app, it is because I have a certain food desire in mind. I don't change my mind based on promotions'</i> (P 2 FGD 1).</p>	<p>Divergence</p> <p>Participants in the quantitative study reported that promotions drove only a small percentage of their FDA orders. In the qualitative study, a majority of the participants said that while the promotion may not have driven the impulse to purchase food from an FDA (driving factors could be related to lack of time, etc) that they were regularly influenced by promotions they saw once they opened the app.</p>
Behaviours and concepts around healthy eating and FDA orders.	69 % reported they usually use FDAs to order fast food	<p>4. <i>'I don't want healthy. I want tasty'</i> (P 1 FGD 2).</p> <p>4.a <i>'I tried to order healthy food. The price was higher for it, and the serving size was much smaller than average. Also, it was not as described'</i> (P 3 FGD 4).</p> <p>4.b <i>'I will try to be healthy, but the pace of life now will make me eat fast food or canned food'</i> (P 1 FGD 2).</p>	<p>Convergence</p> <p>Participants in the FGD responded similarly to the responses on the survey. Fast food was the type of food ordered most.</p>
Nutritional information and dietary guidelines	61 % reported caloric and nutritional information about the foods available for delivery would be helpful.	<p>5. <i>'Frankly, this is the first time I have ever heard of the Saudi Guidelines'</i> (P 4 FGD).</p> <p>5a. <i>'I feel that each person knows what is right for themselves. There is no need to follow guidelines, as the expression says, "you are your own doctor"'</i> (P 1 FGD 3).</p> <p>5b. <i>'Calories won't ever change what I plan to order because I crave it. I imagine the information could be useful for some people, but not me'</i> (P3 FGD 2).</p> <p>5c. <i>'I don't count calories and I don't care, but allergens are very important'</i> (P 2 FGD 2).</p>	<p>Divergence</p> <p>FGD participants expressed little to no interest in seeing caloric and nutritional information on their food orders, while in the quantitative phase, a majority of the participants reported that nutritional information would be very helpful for them.</p>
Maintaining Saudi food customs and traditions.	Only 5 % reported ordering traditional Saudi foods on FDAs. Additionally, 86 % reported that they usually order food from FDAs when they are sharing it with at least one other person. Only 14 % stated they usually make orders alone.	<p>6. <i>'I don't order traditional Saudi food from FDAs because I can make those without a lot of effort at home'</i> (P 2 FGD 1)</p> <p>6a. <i>'I prefer to eat traditional foods if they are cooked by my mother, not from a restaurant'</i> (P2 FGD 3).</p> <p>6 b. One man explained why cooking was not an available option. His mother told him: <i>'Men don't need to cook. I am cooking</i></p>	<p>Convergence</p> <p>The majority of participants confirmed they prefer to order non-traditional foods (Italian, Chinese, etc) from FDAs. Additionally, many participants stated that they continue to follow Saudi traditions of eating together with others even when making FDA orders.</p>

(continued on next page)

Table 6 (continued)

Dimension	Quantitative findings	Qualitative findings	Mixed method interpretation
Frequency of using food delivery apps	61 % reported ordering from FDAs one time a week.	<p><i>for you, and God willing, you will get married, and your wife will cook for you'</i> (P 4 FGD 1).</p> <p>6c. <i>'If I am alone, I won't order from an FDA. For me food is meant for sharing. I would rather go hungry than order food alone from an FDA.'</i> (P 3 FGD 1)</p> <p>7. <i>'I have to study so cooking is difficult for me. I order in at least 3 times a week'.</i></p> <p>7a. <i>'I order once a week with my whole family, we all order from different restaurants because we have different preferences, but we eat it all together'.</i></p> <p>7 b. <i>'Two months have passed since I made my last order'.</i></p>	<p>Convergence</p> <p>Participants reported various patterns in their FDA ordering habits. Some reported ordering less than once a week, while the majority spoke of ordering at least once or more times each week.</p>

3.3.2. Maintaining Saudi food customs and traditions

When participants were asked about the role that Saudi food customs and traditions played in FDA usage and in making healthy food choices, many participants reported being pushed toward FDA usage because of the rapid and growing social-cultural changes in the Saudi Arabia, particularly in relation to food hospitality. For example, many restaurants and coffee shops no longer provide music-free environments or separate areas for families to eat privately, which are ingrained practices in Islamic culture. One participant described the situation by sharing, 'I don't go to restaurants anymore. They don't respect my privacy as a customer or provide a calm atmosphere without music' (P 2 FGD 4).

Not only is the ubiquitously changing face of food hospitality in Saudi Arabia a driving factor in FDA usage, but long-held traditional beliefs about gender and cooking are also factors. For example, a male participant noted that he regularly used FDAs because he was unable to cook for himself. He reported that his mother refused to teach him how to cook by sharing a paraphrasing of her justification: 'Men don't need to cook. I am cooking for you, and God willing, you will get married, and your wife will cook for you' (P 4, FGD 1).

If FDA usage is caught up in and part of a food culture clash in the Saudi Arabia, FDA usage, specifically FDA users' menu choices, may symbolise deeper beliefs about food, culture, and eating. The participants reported a general trend of ordering non-traditional Saudi foods. One participant explained this by stating, 'I don't order traditional Saudi food items on an app. It is better when it is homemade. I use apps for making things that I cannot make at home like burgers and pizza' (P 2 FGD 3). Another participant echoed this sentiment by offering, 'I can't figure out what they [the restaurants] put in their [non-local] food to make it so delicious' (P 5 FGD 2).

3.4. Mixed-methods result

The results of the qualitative and quantitative studies were complementary in providing a broader picture of FDA usage and preferences. The combined results were analysed to determine if they confirmed, expanded upon, or differed from each other (see Table 6).

4. Discussion

The popularity of FDAs has increased significantly in recent years, driven, in part, by lockdowns and restaurant closures associated with the COVID-19 pandemic [30,31]. This study took place during the COVID-19 pandemic when the availability and interest in FDAs in Saudi Arabia were even more pronounced [10]. Within this context, the present findings emerged from a mixed-methods investigation of FDA usage trends in Saudi Arabia, including FDA menu choices, preferences, and motivating factors, as well as participant knowledge of nutrient content, healthy food, healthy food practices, and dietary guidelines.

In addition to the unique context of the COVID pandemic, another novel aspect of the research is that it was conducted in Saudi Arabia where societal expectations and cultural values differ significantly from those in the West, and at a time when the traditions and beliefs of the former are being more impacted by Western influences and the rise of technology [32]. Guided by the dietary laws and food rituals written in the Quran, Islam has defined the culinary culture and food heritage for Muslims, a food culture and legacy that departs significantly from Western traditions [33]. Given the comparative context of the two disparate food cultures and culinary traditions, the sudden and exponential rise of FDAs presents unique and significant challenges for practising Muslims in Saudi Arabia and beyond.

Globalisation and the importing of food and food cultures have led to the notable introduction of Western-based food, coffee chains, and other food cultures in Saudi Arabia, a precipitous shift that has served as a stress test for food traditions and rituals in the Kingdom [11,34–37]. Most recently, the introduction and rapid embrace of FDAs has served to challenge, and interestingly, uphold some beliefs and practices of Muslims in the Gulf countries. This phenomenon is expected to continue to influence the food and hospitality sector. In

the specific setting of Saudi Arabia, between 2022 and 2027, online food delivery is expected to grow annually at 10.98 %. Specifically, in 2022, revenue was forecasted to rise \$4.71 billion (USD), and user penetration was expected to reach around 31.7 % of the population [38].

Further evidence of the dramatically shifting socio-cultural environment in Saudi Arabia revealed itself in this study. When participants were asked about their food ordering habits on FDAs, for example, only 15 % of FDA users reported sharing food with family. In Arabic culture, traditional family food gatherings are an integral part of life. Thus, this shift is noteworthy and demonstrates that there is a strong individualistic tendency toward food consumption, especially with lunch (81.1 %). Yousif [32] points out that this development may have begun with the arrival of fast-food restaurants in the Gulf and therefore predates FDAs. He further observes that in fast-food restaurants, the menus offer meals designed for an individual, and he notes that the eating habits of young Saudis reflect “an individualist manner rather than [a] collectivist manner as before” [32].

While FDAs may be the latest manifestation of a larger individualistic trend that defies the foundational food culture and heritage of Saudi Arabia, the phenomenon paradoxically reinforces some traditional ideals and rituals related to food. In this study, for example, participants reported that they preferred to order food from FDAs rather than visit restaurants, as many restaurants no longer had curtains or partitions to allow families to eat separately from single male diners, a common practice in Muslim culture. Furthermore, one participant identified that FDA usage allowed her to avoid frequenting restaurants that played music, a practice expressly forbidden in Islam. Curiously, FDA usage in Saudi Arabia may also support delineating ideas about gender, food preferences and behaviours, and food culture. For example, one male participant, an FDA user, noted that his mother refused to teach him to cook because she sees food preparation as the role and domain of women.

Other perceptions and behaviours around home cooking and FDAs also surfaced in the FGDs. For many participants, home food preparation was challenging and prohibitive for a myriad of reasons, including ‘lack of time’, inability to cook’, and ‘pressure from children to eat out or order in’. In contrast, the participants identified FDAs as easy, convenient, and accessible. These results reflect what Macdiarmid et al. [39] found in their study regarding both the obstacles to home cooking and participant misconceptions about healthy food.

In fact, in the current study when participants were asked to describe and detail what a healthy meal in the home consisted of, they shared perspectives that included such views as ‘healthy food does not contain spices’, or that if ‘an avocado or broccoli was added to a meal that made it healthy’, or if ‘a meal was cooked at home, it is necessarily healthy’. Other participants expressed the idea that ‘any food that is healthy is never delicious’.

There appeared to be little, if no, association between healthy food consumption and the use of FDAs. The results of a qualitative study conducted in the UK [40] parallel and echo those in this study. Overwhelmingly, participants ordering food through an app expected the food to be unhealthy. Consequently, when using FDAs, participants did not search for healthy menu items. Moreover, one common participant view shared in both studies was that if healthy food was the goal, participants would cook at home and not use an FDA.

However, with some FDA users, there was an awareness of and curiosity about understanding the specific aspects of FDA menu items better. These participants expressed an interest in knowing the type of fat in FDA menu items (hydrogenated, trans, or saturated fats) and food allergens. When presented with the question of whether they would like to see the caloric information of FDA menu items, most FGD participants indicated that they did not find this information important. This result was consistent with the findings of Keeble et al. [40] in the UK.

A strength of this study was the ability to capture the participants’ perspectives on FDA menu offerings and nutrient information, for example, using a mixed-methods approach. This design allowed qualitative and quantitative methods to be applied for a more thorough and integrated understanding of the use and experience of FDAs in the Saudi Arabia. However, some limitations of this study should be acknowledged. First, the study was conducted during the COVID-19 pandemic when in-person data collection was discouraged. However, during the pandemic, participant familiarity with online conferencing tools grew, as did their comfort with online conferencing [16]. Therefore, online surveys and online FGDs were conducted. Yet, this approach may have limited or prohibited the participation of those who had little to no internet access, as well as those who were uncomfortable using the Internet. Furthermore, this research relied on self-reported data, which are potentially susceptible to social desirability bias. Moreover, the typical gender imbalance among respondents, with an overrepresentation of females, can introduce bias and limit the generalisability of the findings. Therefore, owing to these limitations and biases, the findings may not be generalisable. Nonetheless, this study contributes to an emerging but limited field of research on digital food behaviours and FDAs, particularly in Arabic countries. It also explores and expands our understanding of digital food behaviours and digital food literacy.

5. Conclusion

Although convenience and taste were primary drivers in FDA usage, the roles of tradition and culture in Saudi Arabia were also important factors. Overall, understanding the determinants of how Saudis engage with FDAs, in concert with a deeper understanding of food preferences, perceptions, and nutritional knowledge, may help guide future efforts in nutrition education, app development, and public health policy. This study contributes to the argument that future public health research and interventions may need to take a new, adaptive, and technologically attuned approach from a baseline understanding of the influence of FDAs on food consumption and behaviours, and may need to consider efforts that countervail the impact of FDA usage.

Ethics approval and consent to participate

This study was approved by the King Saud University Institutional Review Board; (Ref No: KSU-HE-21-636). Informed consent was obtained from all participants.

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Data availability statement

Data will be made available on request.

CRediT authorship contribution statement

Aroub Alnasser: Writing – review & editing, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **Alreem Abaalkhail:** Writing – original draft, Visualization, Validation, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e24903>.

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