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OBESITY AND FOOD DELIVERY APPLICATIONS: LESSONS LEARNED FROM COVID-19 IN SAUDI ARABIA

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ABSTRACT

Introduction: Obesity is a global pandemic and has been associated with poor dietary habits and decreased physical activity. It has been linked to various chronic diseases, such as diabetes and hypertension. Food delivery applications have seen a surge in the last ten years, their usage becoming more common throughout the COVID-19 pandemic. While these applications have many advantages and disadvantages, they are expected to contribute to the increasing obesity rates in Saudi Arabia in the upcoming years. The purpose of the study is to assess the use of food delivery applications in Saudi Arabia. **Methods:** This study is a cross-sectional study using a convenience sampling technique. Due to COVID-19 safety protocols, social media platforms were used to distribute the survey from August 21, 2021, until September 19, 2021. A repeated logistic regression model was used to compare food delivery factors before and during the COVID-19 pandemic. All analyses were performed using SAS 9.4 with a two-sided p-value (α =0.05). **Results:** A total of 954 respondents completed the survey. The respondents predominantly reported using online applications for delivery (86.97%), for accessibility convenience and speed (80.08%), and favorably for dinner meals (61.11%). Almost half of the respondents reported an inability to control food cravings (45.49%). Furthermore, 42.14% of the respondents reported an increase in weight of up to five kg during the COVID-19 pandemic. There was a significant difference pre and during the pandemic among the use of the food delivery applications per number of use weekly, amount spent, and food choices. **Conclusion:** Our findings indicate that food delivery applications are commonly used in Saudi Arabia, specifically with a high prevalence of use among young Saudi residents. Yet, no interventions are proposed to reduce the purchase of highly processed food on these applications. Public health officials and healthcare providers are highly encouraged to increase awareness on obesity and healthy dietary choices to limit the ongoing obesity pandemic.

Keywords: COVID-19, Food delivery applications, Diet, Obesity, Saudi Arabia.

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INTRODUCTION

In December 2019, Wuhan City (China) first reported cases of pneumonia of unknown origin [1]. A global outbreak of severe acute respiratory syndrome (SARS) was confirmed due to infection by a novel coronavirus termed SARS-CoV-2 (COVID-19) [2]. Governments enforced precautions and social distancing measures worldwide to ensure safety for all individuals. In Saudi Arabia, the government enforced restrictions, curfew and quarantine measures to ensure proper social distancing in the country in April 2020, which led to the closure of stores, malls, coffee shops, and restaurants [3]. Anxiety and boredom have been associated with higher food intake with compromised quality during the COVID-19 lockdown. Poor dietary habits can increase obesity without awareness of healthy food choices and proper nutrition [4]. Obesity is a major pandemic and a global health threat. In 2020, the prevalence of obesity was 24.7% in Saudi Arabia; females had higher rates of obesity than males (25.5% and 17.9%, respectively) [5]. The high risk of obesity, along with the risk of developing other chronic medical conditions, burdens the health system [6].

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Obesity has been associated with unhealthy lifestyle factors such as lack of physical activity and poor dietary habits [7]. Furthermore, high rates of obesity have had a negative impact on the economy of a country [8]. In the past decade, there has been a surge in the use of online food applications [9]. A food delivery application is an online mobile service that provides a platform in which a customer can conveniently order food and goods to be delivered [10]. In Saudi Arabia, there are several food delivery applications that operate 24/7, making ordering food very convenient. The annual revenue from food delivery applications in Saudi Arabia is expected to reach 8,472 SR, which is equivalent to 2,259 US dollars in 2024 [11]. These numbers were collected before the COVID-19 pandemic, and it is expected to grow exponentially, leading to a significant increase in weight [3]. The Saudi Food and Drug Administration created a policy mandating all coffee shops and restaurants to put caloric labels on their menus in January 2019. However, this policy is yet to include food delivery applications. Including nutrition information in food delivery applications could improve awareness and reduce caloric intake by the consumer, which can help to control obesity rates in Saudi Arabia [12]. The COVID-19 pandemic has adversely influenced lifestyle and eating habits around the world, including Saudi Arabia [13]. Recent studies observed an increase in food consumption during lockdown and a shift to unhealthy eating behaviors [14]. Unexpected changes during the COVID-19 outbreak have induced stress and fear of germs. Therefore, people overstocked long shelf life, typically low in nutrients and high in calories, due to food insecurity [15, 16]. Conducting this study is of great importance since COVID-19 has been a major aspect of daily life. The purpose of the study is to measure the prevalence and use of food delivery applications before and during COVID-19 to understand the factors behind its use. Furthermore, to evaluate the association between food delivery applications and obesity levels and to know who commonly uses these applications in Saudi Arabia. A secondary objective of the study is to understand the perspective of the Saudi community about including the caloric content of food in delivery applications.

MATERIALS & METHODS:

The current study is a cross-sectional study using a convenience sampling technique to collect responses from participants. Our target population is adults aged 18 or older residing in Saudi Arabia at the time of the data collection period. Due to COVID-19 safety protocols, social media platforms were used to distribute the survey. We used various social media to obtain heterogeneous respondents such as WhatsApp, LinkedIn, Facebook, and Twitter to collect the data from August 21, 2021, until September 19, 2021. We used a previously conducted survey with slight modifications in questions related to our study population, geographical location, and language of the respondents [17]. The survey was available in Arabic and English versions. Face validity was achieved by an official word-by-word English to Arabic translation. Content validity was achieved by two experts in the field. We pre-tested the survey with ten participants to validate our survey version with the included modifications. The survey contains three main sections. The first section included questions related to food delivery applications, and its use. The second section contained questions about height, weight, and chronic medical conditions. The last component included demographic questions (age, gender, marital status, employment status, income, area of residence, and nationality). We used Arabic and English languages for the survey. No identifying information such as names or emails were collected. Access to the data was restricted to the authors only. Participation was voluntary and we obtained the consent of the participants to be part of the study. We used Google forms to conduct the survey. We took approval from the Institutional Review Board at King Abdullah International Medical Research Center (KAIMRC) number IRBC/1643/21 to conduct this study. We first examined descriptive statistics to compare the demographics of the participants. We used a univariate analysis to compare the characteristics of the participants. Bivariate associations were assessed using Chi-square $\chi 2$. The study aimed to assess the prevalence of food delivery factors pre and during the COVID-19 pandemic. We used a repeated logistic regression model to compare food delivery factors pre and during the COVID-19 pandemic. For the second objective, we used ordinal logistic regression models to compare the association between obesity and the frequency of use of food delivery applications. Cronbach's Alpha was used to assess the reliability of the answers (internal consistency). All analyses were performed using SAS 9.4 with a two-sided p-value ($\alpha = 0.05$).

RESULTS:

A total of 954 respondents completed the survey. The demographic distribution patterns of the respondents are shown in **Table 1**.

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Table.1 Characteristics of participants of food delivery survey

	N (%) [1]
	954
Age	
18-29	635 (66.56)
30-44	219 (22.96)
>45	100 (10.48)
Gender	
Male	363 (38.05)
Female	591 (61.95)
Marital Status	
Single	637 (66.77)
Married	286 (29.98)
Divorced	25 (2.62)
Widowed	6 (0.63)
Education attainment	
High school diploma or less	537 (56.29)
Bachelor's degree	327 (34.28)
Graduate degree	90 (9.43)
Body Mass Index (BMI)	
Normal	535 (56.08)
Obese /Overweight	419 (43.92)
Nationality	
Saudi	678 (71.07)
Non-Saudi	276 (28.93)
Employment status	
Yes	275 (28.83)
No	679 (71.17)
Monthly income	
9,999 or less	170 (17.82)
10,000 to 19,000	107 (11.22)
20,000 or more	73 (7.65)
I don't have monthly income	410 (42.98)
I prefer not to say	194 (20.34)
Province you live at	
Eastern Province	264 (27.67)
Riyadh 545 (57.13)	
Western/North/south	145 (15.20)
Do you have any chronic medical conditions such as diabetes, hypertension, or cardiac disease?	
Yes	57 (5.97)
No	897 (94.03)
How often do you exercise or engage in a physical activity (30+ min), such as walking, jogging, swimming, soccer, volleyball, basketball, CrossFit, dance, yoga	
1-2 times per week	321 (33.65)
3-4 times per week	194 (20.34)
More than 5 times per week	118 (12.37)
I do not exercise	321 (33.65)

[1] Sample size (N) and percentage (%)

A large proportion of the respondents were females (61.95%), aged 18 to 29 (66.56%), single (66.77%), unemployed (71.17%), Saudi citizens (71.07%), living in Riyadh province (57.13%), and attained a high school diploma or less (56.29%). Nearly half of the respondents were overweight or obese (43.92%), while (66.35%) reported exercising 1 to 5 times per week. Table 2 summarizes the food delivery behaviors. The respondents predominantly reported using online applications for delivery (86.97%), for accessibility convenience and speed (80.08%), and favorably for dinner meals (61.11%). Almost half of the respondents reported an inability to control food cravings (45.49%). Respondents had similar consideration in buying low calories food with or without the information provided about calories on the menu since equal disruption of answers were reported for buying lower calories food (34.17%), not buying low calories food (26.1%), or maybe they will buy low calories food (33.86%). Furthermore, 42.14% of the respondents reported an increase in weight of up to five kg during the COVID-19 pandemic.

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Table.2 Overall food delivery patterns and behaviors

	N (%) [1]
Total	954
Do you use online applications to order delivery?	
Yes	828 (86.79)
No	126 (13.21)
Why do you use food delivery applications?	
Accessibility Convenience Speediness	764 (80.08)
COVID-19	28 (2.94)
Speediness Value	57 (5.97)
I do not use delivery applications	105 (11.01)
What is your favorite meal to order through online delivery applications?	
Breakfast	15 (1.57)
Lunch	209 (21.91)
Dinner	583 (61.11)
Snacks/Sweets	40 (4.19)
I do not use delivery applications	107 (11.22)
How would you describe your food cravings and self-control when ordering food through delivery applications?	
I can control myself	434 (45.49)
I cannot control myself	64 (6.71)
I do not use food delivery applications	108 (11.32)
I have moderate control of myself	348 (36.48)
If the food delivery application provided you with information about calories on the menu, would you consider buying lower calorie foods?	
Yes	326 (34.17)
No	249 (26.10)
Maybe	323 (33.86)
I don't know	56 (5.87)
Did your weight change in the COVID-19 pandemic?	
Increased up to 5 kg	402 (42.14)
Decreased up to 5 kg	245 (25.68)
No change	307 (32.18)

[1] Sample size (N) and percentage (%)

In table 3, we used repeated measure logistic regression model to compare between food delivery factors pre and during COVID-19. There was a significant difference pre and during the pandemic among the use of the food delivery applications 2-3 and 4-5 times per week compared to those using the food delivery application one time or less per week, *p*-value 0.05, and 0.01, respectively. In terms of spending, the results showed a significant difference in respondents who reported spending 200-300 SR and more than 300 SR on food delivery applications per week before and during the pandemic compared to respondents who reported spending 100-199 SR per week (*p*-value 0.01, 0.007, respectively). Similarly, a significant difference pre and during the pandemic among respondents who reported preferences in the type of food they usually order through delivery applications, where the beverages/ groceries, healthy food, sweets/pastry groups showed significant differences compared to fast food group (*p*-value <.0001, 0.0004, 0.031, respectively).

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Table.3 Prevalence of food delivery factors pre and during COVID19 pandemic

	Pre the pandemic	During the pandemic	*p-value* [1]
	N (%) [2]	N (%)	
Total	917 (49.01)	954 (50.91)	
How many times per week did you use food delivery applications?			<.0001
1 or less than 1	449 (48.96)	431 (45.18)	(Ref)
2-3	225 (24.54)	275 (28.83)	0.05
4-5	51 (5.56)	75 (7.86)	0.01
More than 5	45 (4.91)	42 (4.4)	0.62
I did not use delivery applications	147 (16.03)	131 (13.73)	0.83
How much did you spend using delivery applications per week?			<.0001
100-199 SR	268 (29.23)	270 (28.3)	(Ref)
200-300 SR	99 (10.8)	144 (15.09)	0.01
More than 300 SR	75 (8.18)	119 (12.47)	0.007
Less than 100 SR	336 (36.64)	295 (30.92)	0.27
I did not use delivery applications	139 (15.16)	126 (13.21)	0.66
What type of food did you usually order through delivery applications?			
Beverages/ Groceries	7 (0.11)	23 (1.05)	<.0001
Fast food	766 (83.53)	727 (76.21)	(ref)
Healthy food	26 (2.84)	50 (5.24)	0.0004
Sweets/pastry	24 (2.62)	6 (2.83)	0.031
I did not use delivery applications	94 (10.25)	118 (12.37)	<.0001

[1] repeated measure logistic regression; [2] sample size (N) and percentage (%)

On the contrary, there was no significant association between the frequency of food delivery and BMI, as shown in Table 4.

Table.4 Association between obesity and food delivery application

		p-value		*p-value* [1]
	OR 95% CI Obese/overweight **vs** non-obese/overweight		**OR 95% CI** [2] Obese/overweight **vs** non-obese/overweight	
	Pre the pandemic		**Post the pandemic**	
How many times per week did you use food delivery applications?		0.86		0.21
1 or less 1	0.69 (0.44, 1.08)		1.51 (0.92, 2.45)	
2-3	0.93 (0.61, 1.42)		0.92 (0.61, 1.39)	
4-5	0.632 (0.35, 1.12)		0.71 (0.38, 1.35)	
More than 5	0.62 (0.31, 1.29)		0.77 (0.4, 1.5)	
I did not use delivery applications	(ref)		(ref) 3	

[1] logistic regression analysis; [2] Odds ratio and confidence interval (OR 95% CI); [3] reference (ref)

DISCUSSION

This study investigates the prevalence rate of the use of online food applications before and during the COVID-19 pandemic, identifying factors and their relationship with obesity rates in Saudi Arabia. Our findings revealed that 86.97% of participants used online food delivery applications, and the highest prevalence in participants was between 18 and 29 years of age, which could be attributed to their comfort level with using a mobile application. A study among American adults (n=6,697) confirms our findings, as it suggests that the digital divide separates privileged individuals and younger age groups from others in the use of mobile application technologies [18]. This pattern of results is also consistent with another cross-sectional study conducted in Kuwait, located in the Gulf region, (n=1,045) in which 532 participants aged 20 to 30 years reported the use of food delivery applications [17]. The prevalence of online food applications in Kuwait was as high as 87.6%, and women make up a greater percentage of consumers [17]. This could be due to the cultural similarities between Saudi Arabia and Kuwait and the familiarity of young adults with new technologies and applications.

This study reports that 42.14% of the participants indicated an undesired weight gain of up to 5 kg in 2020 since the mandatory lockdown. These results are consistent with a cross-sectional study conducted in Zimbabwe (n=507) in which 44.5% of the participants reported an increase in BMI during COVID-19 [19]. A cross-sectional study conducted in Hong Kong (n=631) reported that during the COVID-19 pandemic, fewer people met the recommended guidelines for physical activity, sleep, or a generally healthy lifestyle [20]. The results showed a significant shift to a sedentary lifestyle and unhealthy eating habits at the beginning of the

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pandemic and during lockdown [20]. These findings may have important public health implications and provide evidence for future intervention studies.

A cross-sectional study in Jakarta (n=253) showed that the use of food delivery applications had increased enormously since the pandemic due to the perceived advantage it provides, such as convenience, hygienic handling and less human contact [21]. Similar results were also observed in Brazil; a cross-sectional study indicated that the food delivery industry is growing rapidly in light of the pandemic [22]. A qualitative study revealed that users preferred the online food delivery service of luxury restaurants, as they appreciated factors such as hygiene handling, safety measures and clean food delivery with high sanitation standards [23]. A study conducted in Bangkok, Thailand (n=402) has similarly concluded that perceived safety and timeliness, among others, had a significant influence (p-value<0.01) on the use of food delivery applications during the COVID-19 pandemic [10]. However, 80.08% of the participants in our study chose accessibility and convenience as factors influencing their use of food delivery applications, while only 2.94% chose safety against COVID-19 as a factor. This could be due to several factors first, as COVID-19 was better controlled in Saudi Arabia compared to other countries mentioned above, hence there was less associated fear of infection. Second, users of food delivery applications are probably returning customers from even before the pandemic, and their main reasons for using such applications were accessibility and convenience.

A recent cross-sectional study in Saudi Arabia (n=1946) indicated a considerable increase in snack intake between meals during the pandemic, as well as a noticeable reduction in the desire to maintain a healthy and balanced diet [4]. This study showed that approximately half of Saudi consumers were unable to control food cravings (45.49%). This could be attributed to elevated levels of stress and anxiety due to the pandemic, and social isolation can contribute to an increased risk of eating disorders [24]. Furthermore, almost only one-third of food delivery service customers reported considering low-caloric labeled food. However, a previous study conducted in Saudi Arabia (n=47,763) aimed to measure the impact of the calorie labeling policy on food consumption and showed a slight decrease in total calories per order [12].

Multiple longitudinal studies, specifically in the United States, have found that delivery applications provide consumers with a wide variety of options [9]. Despite that, reports from the most utilized delivery applications have shown that American consumers mostly ordered unhealthy food options such as cheese burger, fries, and pizza [9]. Another cross-sectional study conducted in China among university students studied the importance of limiting takeout food, as it was linked to greater consumption of a high-fat diet, and consequently a higher rate of obesity [25]. These studies are consistent with our findings, as the most commonly ordered type of food (83.53%) was fast food. Almansour et al. conducted a cross-sectional study among Kuwaitis (n=1045) and concluded that unhealthy eating patterns could be highly associated with the increased usage and accessibility of food delivery applications [17]. All of which contribute to the exponential increase in obesity rates in the Gulf region. However, it should be noted that, surprisingly, there was no significant association between the frequency of food delivery and BMI in our study. One explanation might be the overall high rate of obesity in Saudi Arabia (approximate 25% of the population) among users and non-users of food delivery applications

Although this study aims to investigate the association between the use of food delivery applications before and after the COVID-19 pandemic and its association with obesity, it is important to tackle multiple solutions to eradicate obesity and reduce its rates in general. As suggested by a recently published systematic review, creating a negative energy balance by decreasing caloric consumption and increasing physical activity is a common strategy used to prevent obesity. Results have shown that interventions that include both diet and exercise tend to be more effective in weight loss over a 6-month period than changes in diet alone. Since our study is based in the Kingdom of Saudi Arabia, the government is highly encouraged to implement multiple alterations to promote healthy lifestyles. These might include reducing prices of healthy eating options, including calorie-content in the food delivery applications, and enhancing physical activity [26, 27]. Future studies are needed on a larger scale among the Saudi population to better understand the impact of food delivery applications.

CONCLUSION

Our findings indicate that food delivery applications are commonly used in Saudi Arabia, specifically a high prevalence among young Saudi residents. However, no interventions are proposed to reduce the purchase of highly processed food in these applications. Public health officials and healthcare providers are highly encouraged to increase awareness of obesity and healthy diet choices to limit the obesity pandemic, especially during the COVID-19 pandemic.

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Limitations of the study: The cross-sectional nature of the study limits any causal inference. The online nature of the study limits the generalizability to the elderly population and those who do not have smartphones and internet access. **Conflict of interests & Funding:** The authors declare no conflict of interest. No funds were received for this study. **Ethical Considerations:** This study was approved by the Institutional Review Board at King Abdullah International Medical Research Center (KAIMRC) number IRBC/1643/21.

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