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Cross-sectional Study

Psychological impact of the COVID-19 pandemic on waitlisted pre-bariatric surgery patients in Saudi Arabia: A cross-sectional study

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ABSTRACT

Background: During the COVID-19 pandemic, the number of bariatric surgeries was decreased to ensure patient safety. This study aimed to evaluate the effect of such delays on the psychological status and weight management behaviors of waitlisted pre-bariatric surgery patients in Jeddah, Saudi Arabia.

Materials and methods: A web-based cross-sectional survey was conducted. Results were then evaluated with simple descriptive statistics and inferential analyses through the Chi-square test, one-way ANOVA, and the general linear regression model.

Results: Of 437 patients, 208 successfully completed the survey. Approximately half of the participants reported weight change (46.6%, n = 97), while other weight management behaviors remained unchanged. The mean Patient Health Questionnaire-9 (PHQ-9) total score of the respondents was 8.29 ± 6.3, indicating mild depression. Higher PHQ-9 scores were associated with being a student, unhealthy dietary habits, physical inactivity, worsened psychological status, and weight gain. Among these factors, being a student was the strongest predictor of the total PHQ-9 score.

Conclusion: The COVID-19 pandemic significantly affected the psychological status of patients with obesity on the bariatric surgery waitlist. Since delays in bariatric surgeries could worsen patients' psychological status, as substantiated in this study, the provision of virtual care through telemedicine and the development of policies for reintroducing bariatric surgeries for future lockdowns are highly recommended.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has negatively affected general hospital services worldwide. Reducing the number of elective surgeries was among the measures taken to ensure patient safety as well as to control in-hospital virus transmission. This resulted in a backlog of patients and a delay in the conduction of urgent procedures, raising the risk of morbidity and mortality [1].

A recent meta-analysis by Liu et al. [2] revealed that postponement of in-person clinical care affected the management of patients with chronic diseases, such as the postponement of bariatric surgeries for chronic obesity [3]. A worldwide survey of bariatric surgeons revealed that 84.6% had postponed primary or redo bariatric procedures under COVID-19 restrictions [4]. In the researcher's center in Saudi Arabia, bariatric surgeries were not routinely performed until August 2021.

Obesity is a major community health problem in Saudi Arabia. A nationwide cross-sectional study in 2020 reported that obesity was prevalent among 24.7% of individuals [5]. Existing literature also substantiated the supposition that patients with obesity are at a higher risk of complications after COVID-19 [6–8].

Associations between psychological status and obesity have also been demonstrated in several studies [9–15], where increased anxiety

Abbreviations: BMI, body mass index; COVID-19, coronavirus disease 2019; ICU, intensive care unit; PHQ-9, Patient Health Questionnaire-9; SD, standard deviation; SR, Saudi Riyals.

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and psychological distress were the commonly reported effects of delayed bariatric surgeries [9,15]. While several Western studies have examined the psychological impact of the COVID-19 pandemic on both pre- and post-bariatric surgery patients, no study has yet explored the impact of the pandemic on the weight management behaviors of waitlisted pre-bariatric surgery patients in Jeddah, Saudi Arabia, which has different lifestyle behaviors and COVID-19 protocols. Moreover, the novelty of this study is its inclusion of waitlisted pre-bariatric surgery patients instead of the general population as described in previous studies.

Specifically, this study primarily aimed (1) to identify the association between the respondents' weight-management behaviors (including dietary habits, physical activity and psychological status of patients on the bariatric surgery waiting list at the investigators' center in Jeddah) during the pandemic and demographic characteristics, comorbidities and perceptions of obesity as a COVID-19 risk factor; (2) to evaluate the psychological status of respondents during the COVID-19 pandemic using the Arabic version of the Patient Health Questionnaire-9 (PHQ-9); (3) to determine which of the aforementioned factors significantly affected PHQ-9 scores; and (4) to determine the strongest predictor of PHQ-9 scores among the significant factors identified in (3).

2. Methods

2.1. Study area/setting

A web-based survey was conducted with pre-bariatric surgery patients visiting the bariatric surgery clinic at the researchers' institution (Jeddah, Saudi Arabia). The clinic regularly followed up with patients undergoing bariatric surgery preoperatively and postoperatively. The National Institutes of Health established the eligibility conditions for bariatric surgery in 1992, and all patients referred to the said clinic were required to meet these conditions. The inclusion criteria for bariatric surgery included the following: body mass index (BMI) of 40 or higher or a BMI of 35–40 with obesity-associated comorbidities, such as hypertension, diabetes, heart disease, or severe sleep apnea. All patients who met the bariatric surgery inclusion criteria were included in the bariatric-surgery waiting list.

Prior to the COVID-19 pandemic, the annual number of bariatric surgeries performed in the center ranged from 100 to 150. During the pandemic, bariatric-surgery patients had regular follow-up appointments with the bariatric clinic and were informed of the surgery being postponed as an infection control measure to decrease the spread of COVID-19. During the clinic visit, patients received weight-loss counseling, including consultations on lifestyle behavioral changes, medical and surgical options, and dietician referrals.

2.2. Study subjects

Patients aged ≥18 years and on the bariatric surgery waiting list were included in the study. Patients who refused to participate, did not complete the survey, underwent bariatric surgery outside the researchers' center, and no longer wanted to undergo bariatric surgery were excluded.

2.3. Study design

This study employed a cross-sectional and quantitative design in accordance with the STROCSS 2021 guidelines [16]. Data were collected via an online survey and were subjected to both descriptive and inferential analyses. The English version of the survey is available in Supplementary File 1.

2.4. Sample size and sampling technique

A computer-generated simple random sampling method was used to enroll participants. The sample size (n) was calculated to be 205 patients, with the use of the Raosoft Sample Size Software and the following parameters: population size of 437 patients on the bariatric-surgery waiting list at our center, 50% response distribution, 95% confidence interval, and 5% margin of error.

2.5. Data collection and measurement

The study utilized an Arabic web-based survey designed by the research team. The survey was composed of four sections: (1) demographic profile; (2) COVID-19-related items; (3) weight management behaviors; and (4) psychological status assessment. A score of 10 or more on the PHQ-9 was used to define depression; cut-off values for mild, moderate, moderately severe, and severe depression were set at 5, 10, 15, and 20, respectively [10].

Using Google forms, data collection was performed between November 22, 2021, and January 31, 2022. The survey was disseminated to participants via WhatsApp and their phone numbers registered on the record system of the center. The pre-pilot testing phase of the study involved 10 participants. Subsequently, the questionnaire was deployed to 30 patients during the pilot phase. Three consultants with expertise in the fields of obesity and bariatric surgery face-validated the questionnaire. Modifications were made based on their feedback.

2.6. Data analysis

IBM SPSS version 23 (IBM Corp., Armonk, N.Y., USA) was used to analyze the data. Simple descriptive statistics were used, as necessary, to characterize the research variables. The Chi-square test was used to identify the association between weight management behaviors and PHQ-9 scores with demographic characteristics and other predictors. One-way ANOVA was employed to determine whether the predictors showed statistically significant differences with the PHQ-9 scores. The general linear regression model was then used to determine the strongest predictor of the PHQ-9 scores.

3. Results

A total of 437 patients were identified from the bariatric surgery waiting list. Of these, only 208 patients were able to complete the survey. The majority of the respondents were female, married, and had a BMI category of class 3 obesity (Table 1). Most respondents also strongly agreed that obesity was significantly linked to an increased risk of developing severe COVID-19. Notwithstanding this, most respondents did not return a positive test result for COVID-19 (nasopharyngeal or oral swab). Most of those who tested positive only required home isolation to manage their COVID-19 disease (83.3%, n = 55). Since the researchers hypothesized that those who had contracted the infection were more predisposed to depression, this particular item was added to the questionnaire.

A majority of the participants demonstrated no changes in terms of their diet and psychological status (Table 2). Most participants did not exercise even before the COVID-19 pandemic (37%, n = 77). Over 80% of respondents were not diagnosed with mental disorders (86.5%, n = 180), whereas almost 10% were diagnosed with depression (9.6%, n = 20). Almost half of the participants experienced weight change during the pandemic (46.6%, n = 97), with the following reported ranges of weight gain: >10 kg (26.8%, n = 26); 7.1–10 kg (16.5%, n = 16); 5.1–7 kg (24.7%, n = 24); 3.1–5 kg (19.6%, n = 19); and <3 kg (12.4%, n = 12) (Table 2).

Statistically significant associations were established between the demographic profile of respondents and their weight management behaviors through a Chi-square test (Table 3). A change in dietary habits was significantly associated with age (p = 0.010), highest educational attainment (p = 0.018), and employment status (p = 0.030). Although most of the respondents demonstrated no changes in their diets,

Table 1
Respondents' demographic profile, perspective on obesity and COVID-19, and treatment received for COVID-19.

Demographics (Continuous)		Mean	SD
Age		45.32	12.5
Height (cm)		162.74	10.0
Current weight (kg)		117.42	23.4
BMI		44.46	8.8
Demographics (Categorical)		**Count**	%
Total		208	100.0
Sex	Male	80	38.5
	Female	128	61.5
Age	<30 years old	26	12.5
	31–45 years old	84	40.4
	46–60 years old	76	36.5
	>60 years old	22	10.6
Marital status	Single	20	9.6
	Married	157	75.5
	Divorced	16	7.7
	Widow/Widower	15	7.2
Highest educational attainment	Uneducated or illiterate	27	13.0
	Elementary school	30	14.4
	Intermediate school	22	10.6
	High school	67	32.2
	Higher education	62	29.8
Monthly income	5,000 SR or less	100	48.1
	5001–10,000 SR	68	32.7
	10,001–15,000 SR	22	10.6
	More than 15,000 SR	18	8.7
Employment status	Employed	68	32.7
	Unemployed	98	47.1
	Student	9	4.3
	Retired	33	15.9
Comorbidities	None	45	21.6
	One comorbidity	52	25.0
	Two comorbidities	44	21.2
	Three or more comorbidities	67	32.2
BMI categories	Overweight = 25–29.9	4	1.9
	Class 1 Obesity = 30–34.9	15	7.2
	Class 2 Obesity = 35–39.9	51	24.5
	Class 3 Obesity ≥40	138	66.3
How much do you agree with the following statement?		**Count**	**%**
Total		208	100.0
Obesity is associated with increased risks of severe COVID-19 outcomes	Strongly disagree	4	1.9
	Disagree	13	6.3
	Neutral	37	17.8
	Agree	62	29.8
	Strongly agree	92	44.2
Were you tested positive for COVID-19 through nasopharyngeal or oral swab?	Yes	66	31.7
	No	142	68.3
Treatment received for COVID-19		**Count**	**%**
Total		66	100.0
Treatment received for COVID-19 disease	Home isolation	55	83.3
	Hospital admission	9	13.6
	ICU admission	2	3.0

BMI, body mass index; COVID-19, coronavirus disease 2019; ICU, intensive care unit; SD, standard deviation; SR, Saudi Riyals.

Table 2
Respondents' weight-management behaviors during the COVID-19 pandemic.

Variables		Count	%
Dietary change			
Compared to the period prior to the COVID-19 pandemic, how has your diet changed?	Got healthier	34	16.3
	Got unhealthier	31	14.9
	No change	143	68.8
Compared to the period prior to the COVID-19 pandemic, I have been feeling hungry	More often	36	17.3
	Less often	33	15.9
	No change	139	66.8
Compared to the period prior to the COVID-19 pandemic, I have been eating snacks	More often	69	33.2
	Less often	25	12
	No change	114	54.8
Compared to the period prior to the COVID-19 pandemic, I have been ordering food from outside	More often	70	33.7
	Less often	56	26.9
	No change	82	39.4
Physical activity change			
Compared to the period prior to the COVID-19 pandemic, how has your physical activity changed?	Increased	21	10.1
	Decreased	60	28.8
	No change	50	24.0
	I do not exercise	77	37.0
Compared to the period before the COVID-19 pandemic, how has the intensity of your exercise changed?	Increased	16	7.7
	Decreased	50	24
	No change	49	23.6
	I do not exercise	93	44.7
Psychological status			
Compared to the period prior to the COVID-19 pandemic, my psychological status has	Got better	33	15.9
	Got worse	64	30.8
	No change	111	53.4
Have you been diagnosed with a mental health disorder?	None	180	86.5
	Depression	20	9.6
	Generalized Anxiety Disorder	6	2.9
	Panic Attacks	1	0.5
	Schizophrenia	1	0.5
Presence of psychiatric disease	No	180	86.5
	Yes	28	13.5
Weight lost/gained			
Have you lost/gained weight during the pandemic?	Gained	97	46.6
	Lost	48	23.1
	No change	63	30.3
Weight changes in kg	<3 kg	21	10.1
	3–5 kg	30	14.4
	5.1–7 kg	33	15.9
	7.1–10 kg	22	10.6
	>10 kg	39	18.8
	No change	63	

participants who were ≤30 years old (30.8%), uneducated (11.1%), with the highest educational attainment of high school (16.4%) and higher (24.2%), employed (25.0%), and students (22.2%) became less healthy.

Change in physical activity was also associated with comorbidities ($p = 0.038$). Most of those who had decreased physical activity had a single comorbidity (36.5%, n = 19). Meanwhile, psychological status was associated with the perception that obesity was linked with increased risks of developing severe COVID-19 complications ($p = 0.028$). Interestingly, those who strongly disagreed that obesity was a risk factor for COVID-19 demonstrated worse psychological status (75.0%).

Based on the PHQ-9 questionnaire, most of the respondents demonstrated no depression (32.2%), followed by those with mild depression (30.8%). The mean total PHQ-9 score of the participants was 8.29 ± 6.3 (min = 0, max = 27), indicating mild depression (Table 4).

Statistically significant differences among the total PHQ-9 scores of subgroups of participants, stratified by the demographic profile and

Table 3
Association of weight-management behaviors with demographics, comorbidities, and perceptions of obesity as a COVID-19 risk factor.

Variables		Total	Compared to the period prior to the COVID-19 pandemic, how has your diet changed?			p-value
			Got healthier	Got unhealthier	No change	
Total		208	34 (16.3%)	31 (14.9%)	143 (68.8%)	–
Age	≤30 years old	26	1 (3.8%)	8 (30.8%)	17 (65.4%)	0.010[a]
	31–45 years old	84	18 (21.4%)	16 (19.0%)	50 (59.5%)	
	46–60 years old	76	10 (13.2%)	5 (6.6%)	61 (80.3%)	
	>60 years old	22	5 (22.7%)	2 (9.1%)	15 (68.2%)	
Highest educational attainment	Uneducated or illiterate	27	1 (3.7%)	3 (11.1%)	23 (85.2%)	0.018[a]
	Elementary school	30	7 (23.3%)	0 (0.0%)	23 (76.7%)	
	Intermediate school	22	4 (18.2%)	2 (9.1%)	16 (72.7%)	
	High school	67	8 (11.9%)	11 (16.4%)	48 (71.6%)	
	Higher education	62	14 (22.6%)	15 (24.2%)	33 (53.2%)	
Employment status	Employed	68	8 (11.8%)	17 (25.0%)	43 (63.2%)	0.030[a]
	Unemployed	98	20 (20.4%)	12 (12.2%)	66 (67.3%)	
	Student	9	1 (11.1%)	2 (22.2%)	6 (66.7%)	
	Retired	33	5 (15.2%)	0 (0.0%)	28 (84.8%)	
Variables		**Total**	**Compared to the period prior to the COVID-19 pandemic, how did your physical activity change?**			**p-value**
			Increased	**Decreased**	**No change**	
Total		208	21 (10.1%)	60 (28.8%)	50 (24.0%)	–
Comorbidities	None	45	6 (13.3%)	14 (31.1%)	15 (33.3%)	0.038[a]
	One	52	4 (7.7%)	19 (36.5%)	14 (26.9%)	
	Two	44	6 (13.6%)	12 (27.3%)	11 (25.0%)	
	Three or more	67	5 (7.5%)	15 (22.4%)	10 (14.9%)	
Variables		**Total**	**Compared to the period prior to the COVID-19 pandemic, my psychological status had**			**p-value**
			Got better	**Got worse**	**No change**	
Total		208	33 (15.9%)	64 (30.8%)	111 (53.4%)	–
Obesity is associated with increased risks of severe COVID-19 outcomes	Strongly disagree	4	0 (0.0%)	3 (75.0%)	1 (25.0%)	0.028[a]
	Disagree	13	3 (23.1%)	2 (15.4%)	8 (61.5%)	
	Neutral	37	9 (24.3%)	10 (27.0%)	18 (48.6%)	
	Agree	62	13 (21.0%)	12 (19.4%)	37 (59.7%)	
	Strongly agree	92	8 (8.7%)	37 (40.2%)	47 (51.1%)	

[a] statistically significant using the Chi-squared test at $p < 0.05$ level. COVID-19, coronavirus disease 2019.

weight management behaviors, were evaluated with a one-way ANOVA test (Table 5). Significant differences in the total PHQ-9 scores were only observed in subgroups of participants stratified by employment status ($p = 0.031$), diet change ($p = 0.002$), physical activity change ($p = 0.004$), psychological status ($p = 0.001$), and weight change ($p = 0.006$). Across all categories, higher PHQ-9 scores were observed among students (12.56 ± 6.2), those whose dietary habits became less healthy (11.45 ± 6.8), those who did not exercise (9.71 ± 7.1), those whose psychological status worsened (11.56 ± 6.7), and those who gained weight (9.55 ± 6.3).

A univariate analysis with the general linear regression model was used to identify predictors of PHQ-9 scores among the variables which were found to be significantly associated with these scores (Table 6). Of which, being a student was the strongest predictor of the PHQ-9 score ($B = 5.229$, $p = 0.016$) followed by a worsened psychological status ($B = 3.526$, $p = 0.001$), less healthy dietary habits ($B = 2.764$, $p = 0.032$), healthier dietary habits ($B = 2.613$, $p = 0.033$), and unchanged physical activity ($B = -2.359$, $p = 0.028$).

4. Discussion

The frequency of bariatric surgeries was reportedly insufficient even before the COVID-19 pandemic due to the growing incidence of obesity and the demands of bariatric patients globally [17,18]. Many elective surgeries were either canceled or postponed to optimize the availability of intensive care unit facilities for the management of more critical COVID-19 cases. Subsequently, patients on the waiting list for such operations had increased [19–21].

Prior to the pandemic, the global prevalence of depression in the outpatient setting was 27% [22]. In the general population of Saudi Arabia, the prevalence of depression was 20% [23]. Consistent with this report, a systematic review of the risk of depression in Saudi Arabia found a prevalence of 41% [24].

During the COVID-19 pandemic, particularly between March and April 2020, Alyami et al. showed that the prevalence of anxiety and depression in the general population of Saudi Arabia were 9.4% and 7.3%, respectively [25]. Furthermore, this study suggested that the Saudi population was at an increased risk of developing mental illness during the COVID-19 pandemic.

This study represented the first investigation of the prevalence of depression among pre-bariatric surgery patients because of delays in scheduled bariatric procedures. Specifically, the prevalence of depression (defined by a PHQ-9 score of 10 or more) in the present study was 37%. Furthermore, this reported prevalence could result from (1) the impact of obesity as a medical comorbidity and its association with poor mental health [26,27], (2) higher susceptibility to developing poor weight management skills during the pandemic [28], and (3) frustration due to postponement of bariatric surgery [29,30]. As previously reported, bariatric surgery could reduce the prevalence of depression, consequently improving the psychological status among patients [31–33]. Interestingly, a relatively lower prevalence of depression (23.7%) was reported in another study of post-bariatric surgery patients in a tertiary care center in Saudi Arabia [34]. This variation in findings could be attributed to differences in the study population: the sample of the present study were pre-bariatric surgery patients, whereas that of Bineid et al. included post-bariatric surgery patients.

While the prevalence of depression was relatively higher in the current study compared to that in other settings, the mean total PHQ-9 score among the sample population was less severe (8.29 ± 6.3, mild depression). Consistent with this, more than half of the respondents demonstrated almost no change in psychological status compared to the period before the COVID-19 pandemic. A possible reason for this would be the availability of COVID-19 booster shots in Saudi Arabia during data collection (November 2021 to January 2022) [35]. It is

Table 4
Patient Health Questionnaire-9 categories of respondents.

PHQ-9				Count	%
Total				208	100.0
Little interest or pleasure in doing things	Not at all			89	42.8
	Several days			66	31.7
	More than half the days			26	12.5
	Nearly every day			27	13.0
Feeling down, depressed, or hopeless	Not at all			85	40.9
	Several days			69	33.2
	More than half the days			30	14.4
	Nearly every day			24	11.5
Trouble falling or staying asleep, or sleeping too much	Not at all			66	31.7
	Several days			57	27.4
	More than half the days			26	12.5
	Nearly every day			59	28.4
Feeling tired or having little energy	Not at all			38	18.3
	Several days			70	33.7
	More than half the days			28	13.5
	Nearly every day			72	34.6
Poor appetite or overeating	Not at all			80	38.5
	Several days			70	33.7
	More than half the days			29	13.9
	Nearly every day			29	13.9
Feeling bad about yourself or that you are a failure or have let yourself or your family down	Not at all			121	58.2
	Several days			44	21.2
	More than half the days			18	8.7
	Nearly every day			25	12.0
Trouble concentrating on things, such as reading the newspaper or watching television	Not at all			129	62.0
	Several days			36	17.3
	More than half the days			16	7.7
	Nearly every day			27	13.0
Moving or speaking so slowly that other people could have noticed. Or the opposite being so fidgety or restless that you have been moving around a lot more than usual	Not at all			135	64.9
	Several days			39	18.8
	More than half the days			12	5.8
	Nearly every day			22	10.6
Thoughts that you would be better off dead or of hurting yourself	Not at all			178	85.6
	Several days			18	8.7
	More than half the days			6	2.9
	Nearly every day			6	2.9
How difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?	Not at all difficult			97	46.6
	Somehow difficult			71	34.1
	Very difficult			19	9.1
	Extremely difficult			21	10.1
PHQ-9 categories	No depression (0–4)			67	32.2
	Mild depression (5–9)			64	30.8
	Moderate depression (10–14)			40	19.2
	Moderately severe depression (15–19)			25	12.0
	Severe depression (20–27)			12	5.8
	N	**Min**	**Max**	**Mean**	**SD**
PHQ-9 total score	208	0	27	8.29	6.3

PHQ-9, Patient Health Questionnaire-9.

hypothesized that this situation provided more protection and reassurance to respondents, which could have translated into a less severe psychological status.

The present study found a statistically significant difference between changes in physical activity and comorbidities, in which the presence of one comorbidity was associated with decreased physical activity. Similarly, Dutra et al. [36] found that comorbidities were strongly associated with physical inactivity and a sedentary lifestyle. However, this finding contradicted the recommended use of multicomponent perioperative

Table 5
One-way analysis of variance between the Patient Health Questionnaire-9 total score and independent variables.

Variables		Total	PHQ-9 total score	p-value
Sex	Male	80	7.55 ± 7.1	0.203
	Female	128	8.75 ± 5.7	
Age	<30 years old	26	8.92 ± 6.6	0.312
	31–45 years old	84	9.07 ± 6.6	
	46–60 years old	76	7.62 ± 6.3	
	>60 years old	22	6.86 ± 3.6	
Marital status	Single	20	10.50 ± 6.9	0.410
	Married	157	8.03 ± 6.3	
	Divorced	16	8.56 ± 6.3	
	Widow/Widower	15	7.73 ± 4.2	
Highest educational attainment	Uneducated or illiterate	27	8.56 ± 6.1	0.306
	Elementary school	30	7.17 ± 5.4	
	Intermediate school	22	9.91 ± 5.8	
	High school	67	9.03 ± 7.1	
	Higher education	62	7.34 ± 5.9	
Family monthly income	5,000 SR or less	100	9.04 ± 5.9	0.344
	5,001–10,000 SR	68	7.69 ± 6.9	
	10,001–15,000 SR	22	6.77 ± 5.8	
	More than 15,000 SR	18	8.22 ± 5.9	
Employment status	Employed	68	7.85 ± 7.1[AC]	0.031[a]
	Unemployed	98	8.88 ± 5.7[AB]	
	Student	9	12.56 ± 6.2[B]	
	Retired	33	6.27 ± 5.6[C]	
Comorbidities	None	45	7.60 ± 6.0	0.732
	One	52	7.96 ± 6.6	
	Two	44	8.50 ± 6.4	
	Three or more	67	8.87 ± 6.2	
BMI categories	Overweight	4	5.50 ± 2.9	0.526
	Class 1 Obesity	15	6.93 ± 6.3	
	Class 2 Obesity	51	7.86 ± 6.2	
	Class 3 Obesity	138	8.67 ± 6.4	
Obesity is associated with increased risks of severe COVID-19 outcomes	Strongly disagree	4	5.75 ± 7.6	0.118
	Disagree	13	5.92 ± 5.0	
	Neutral	37	7.00 ± 7.6	
	Agree	62	8.00 ± 6.0	
	Strongly agree	92		

(*continued on next page*)

Table 5 (*continued*)

Variables		Total	PHQ-9 total score	p-value
			9.45 ± 5.9	
Were you tested positive for COVID-19?	Yes	66	8.14 ± 6.0	0.812
	No	142	8.36 ± 6.4	
Treatment received for COVID-19 disease	Home isolation	55	8.40 ± 6.3	0.731
	Hospital admission	9	6.78 ± 4.2	
	ICU admission	2	7.00 ± 5.7	
Variables		**Total**	**PHQ-9 total score**	**p-value**
Change in dietary habits	Got healthier	34	9.44 ± 6.9^{AB}	0.002[a]
	Got unhealthier	31	11.45 ± 6.8^{A}	
	No change	143	7.33 ± 5.7^{B}	
Change in physical activity	Increased	21	6.86 ± 6.1^{ABC}	0.004[a]
	Decreased	60	8.97 ± 5.5^{B}	
	No change	50	5.88 ± 5.2^{C}	
	I do not exercise	77	9.71 ± 7.1^{B}	
Change in psychological status	Got better	33	6.15 ± 5.4^{A}	<0.001[a]
	Got worse	64	11.56 ± 6.7^{B}	
	No change	111	7.04 ± 5.5^{A}	
Weight lost/gained	Gained	97	9.55 ± 6.3^{A}	0.006[a]
	Lost	48	8.35 ± 6.6^{AB}	
	Unchanged	63	6.30 ± 5.5^{B}	

[a] statistically significant using one-way ANOVA test at $p < 0.05$ level. Capital letters in superscripts reported the results of all pairwise comparisons among means values of the study groups. BMI, body mass index; COVID-19, coronavirus disease 2019; ICU, intensive care unit; PHQ-9: Patient Health Questionnaire-9; SR, Saudi Riyals.

care for bariatric-surgery patients through increased physical activity as prescribed by The American Society of Metabolic and Bariatric Surgery and the National Institute for Health and Care Excellence [37]. Furthermore, most respondents concurred that obesity was linked to an increased risk of developing severe COVID-19. This finding was supported by another study by Waldziak et al., in 2020 [38], in which 72.25% of the respondents considered obesity a major factor that might impact the course of COVID-19 illness. Since the respondents were aware of such risk, it was expected that they would be more receptive to lifestyle modifications, particularly in terms of physical activity. Furthermore, patient counseling could be performed with relative ease in these cases, unlike those who lack the knowledge of such risks and are more likely to become hesitant toward lifestyle recommendations.

Higher total PHQ-9 scores were significantly associated with being a student, unhealthy dietary habits, a lack of physical activity, unstable psychological status, and weight gain. These findings concur with the results from the study by Liu et al. [39], in which the total PHQ-9 score was associated with a consistent trend of poor weight management behavior accompanied by worsening psychological status during the COVID-19 pandemic. Nasirzadeh et al. [40] also reported that emotional dysregulation induced by the COVID-19 pandemic could increase the

Table 6
Parameter estimates.

Dependent Variable: PHQ-9 total score					
Parameter[a]	B	S.E.	95% Confidence interval		p-value
			Lower bound	Upper bound	
Intercept	5.460	1.290	2.916	8.004	<0.001[b]
Employment status = Employed	0.659	1.244	−1.794	3.113	0.597
Employment status = Unemployed	1.906	1.164	−0.389	4.201	0.103
Employment status = Student	5.229	2.152	0.985	9.473	0.016[b]
Change in dietary habits = Got healthier	2.764	1.277	0.245	5.283	0.032[b]
Change in dietary habits = Got unhealthier	2.613	1.216	0.213	5.012	0.033[b]
Change in physical activity = Increased	−1.855	1.506	−4.826	1.115	0.220
Change in physical activity = Decreased	−1.176	0.994	−3.136	0.783	0.238
Change in physical activity = No change	−2.359	1.068	−4.465	−0.252	0.028[b]
Change in psychological status = Got better	−1.637	1.186	−3.976	0.702	0.169
Change in psychological status = Got worse	3.526	0.919	1.713	5.338	<0.001[b]
Weight lost/gained = Gained	1.523	0.993	−0.436	3.481	0.127
Weight lost/gained = Lost	0.894	1.193	−1.459	3.247	0.455

[b] Statistically significant using univariate analysis with the general linear regression model at $p < 0.05$. PHQ-9: Patient Health Questionnaire-9.
[a] Variables entered: Employment status, change in dietary habits, change in physical activity, change in psychological status, weight lost/gained.

symptoms of overeating before and after bariatric surgery. Ahmed et al., in 2021 [9] also reported that more than two-thirds of bariatric-surgery patients showed weight gain during the lockdown period.

Only employment status was significantly associated with the total PHQ-9 score; that is, students followed by unemployed participants had the highest PHQ-9 scores. Being a student was also the strongest predictor of the PHQ-9 score. Brooks et al. [41] found that students and unemployed individuals are at a higher risk of developing depression, which could be attributed to the uncertainty of academic and professional career growth implicated by the delays in bariatric procedures and unprecedented lockdowns [42].

4.1. Limitations of the study

Only respondents with internet access and active WhatsApp accounts could complete the survey. The response rate was approximately half of the study sample, which could have given rise to selection bias.

Comparison with participants who were not waiting for surgery was also not shown in this study, potentially resulting in an overestimation of results. The study was also conducted at a later stage of the COVID-19 pandemic, potentially leading to an underestimation of its true impact. Furthermore, the results of this study were limited and could not be generalizable since it focused on a single institution in Saudi Arabia.

5. Conclusions

Weight management behaviors that were significantly associated with higher total PHQ-9 scores included being a student, unhealthy dietary habits, physical inactivity, worsened psychological status, and weight gain. Among these factors, being a student was the strongest predictor of the PHQ-9 score. These findings highlight the need for

depression screening and the provision of psychotherapy services to promote healthy coping mechanisms, especially among students.

The evidence of depression in the study could have been due to the delays in scheduled surgeries, consequently affecting the participants' ability to demonstrate effective bariatric weight management during the pandemic. Hence, it is important to prioritize policies for reintroducing bariatric surgeries in future lockdowns, along with the utilization of virtual care through telemedicine to provide individualized assistance and continued access to obesity management programs under lockdown restrictions.

Ethical approval

This study was approved by the International Review of the Board of King Abdullah International Medical Research Center, National Guard-Health Affairs, Riyadh, Saudi Arabia (registration no: H-01-R-005 and reference no. IRBC/2002/21). The study was carried out in agreement with the principles of the Declaration of Helsinki.

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Author contribution

SM was involved in all stages of the study. MS, BA, and HT contributed to data collection and proposal and manuscript writing. HM participated in data collection and manuscript writing. AA and TJ provided scientific feedback in all stages of the study and contributed to manuscript writing. All authors read and approved the final version of the manuscript.

Consent

Electronic informed consent was secured from the participants at the beginning of the survey.

Registration of research studies

1. Name of the registry: Research Registry http://www.researchregistry.com.
2. Unique Identifying number or registration ID: researchregistry8140.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): https://researchregistry.knack.com/research-registry#user-researchregistry/registerresearchdetails/62e3914b9f4d280022af7e9c/

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Provenance and peer review

Not commissioned, externally peer reviewed.

Declaration of competing interest

The authors declare no conflicting interest for this study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104767.

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