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

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Original article

Eating behaviors and weight outcomes in bariatric surgery patients amidst COVID-19

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Abstract

Background: Recent studies suggest that eating habits are an area particularly affected by the lockdown imposed by many countries to curb the COVID-19 epidemic. Individuals that received bariatric surgery may represent a particularly susceptible population to the adverse effects of lockdown for its potential impact on eating, psychological, and weight loss outcomes.

Objectives: This study seeks to investigate the incremental impact of COVID-19 lockdown on treatment outcomes of postbariatric patients in the risk period for weight regain.

Setting: Main hospital center.

Methods: This work uses data from an ongoing longitudinal study of bariatric patients assessed before surgery (T_0), 1.5 years after sugery (T_1), and 3 years after surgery (T_2). Two independent groups were compared: the COVID-19_Group (n = 35) where T_0 and T_1 assessments were conducted before the pandemic started and T_2 assessment was conducted at the end of the mandatory COVID-19 lockdown; and the NonCOVID-19_Group (n = 66), covering patients who completed T_0, T_1, and T_2 assessments before the epidemic began. Assessment included self-report measures for disordered eating, negative urgency, depression, anxiety, stress, and weight outcomes.

Results: General linear models for repeated measures showed that the COVID-19_Group presented significantly higher weight concern ($F = 8.403$, $P = .005$, $\eta^2_p = .094$), grazing behavior ($F = 7.166$, $P = .009$, $\eta^2_p = .076$), and negative urgency ($F = 4.522$, $P = .036$, $\eta^2_p = .05$) than the NonCOVID-19_Group. The COVID-19_Group also showed less total weight loss ($F = 4.029$, $P = .05$, $\eta^2_p = .04$) and larger weight regain at T_2, with more COVID-19_Group participants experiencing excessive weight regain (20% versus 4.5%).

Conclusion: These results show evidence for the impact of the coronavirus outbreak on eating-related psychopathology and weight outcomes in postbariatric surgery patients. (Surg Obes Relat Dis 2021;17:1165–1174.)

Key words: COVID-19 pandemic; Bariatric surgery; Disordered eating psychopathology; Grazing behavior; Weight outcomes

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The World Health Organization (WHO) declared COVID-19 a global pandemic on the March 11, 2020 [1]. To stop the spread of the virus, several governments implemented enforced lockdown. Although these control measures helped to break chains of transmission, this new condition had an unprecedented impact on the general population's lives. Recent studies suggest that eating habits are one of the areas particularly affected by stay-at-home orders [2]. Indeed, emerging evidence shows that, during the COVID-19 lockdown, individuals reported increasing the consumption of unhealthy food, engaging in more snacking between meals, an overall higher number of main meals, and eating with loss of control [3]. Some authors have suggested that the limited access to daily grocery shopping may lead to reduced consumption of fresh food in favor of stockpiling convenience food [4,5]. Finally, the emotional instability resulting from this pandemic may increase the risk of developing dysfunctional eating patterns [5]. Among individuals with obesity, emerging research suggests significant difficulties in achieving weight loss goals, and less physical exercise time and intensity during lockdown [4,6]. Stress eating [4], eating out of boredom [6], along with increased food consumption and more opportunities to eat, have also been pointed as obstacles by individuals engaging in self-managed weight loss during COVID-19 lockdown [6].

Individuals that received bariatric surgery for weight loss may represent a particularly susceptible population to the adverse effects of the mandatory COVID-19 lockdown [7]. While bariatric surgery is the most effective treatment for severe obesity, there is a concerning variability in the long-term weight loss outcomes [8]. Following an initially successful weight loss, postbariatric patients seem to be at increased risk for weight regain after the 24 months of follow-up mark [9,10]. Several modifiable psychobehavioral factors have been identified as strong predictors of weight outcomes and are recommended as a target for specialized interventions among patients at risk [11]. Specifically, disordered eating [11], the tendency to act rashly under negative emotions (negative urgency) [12], and depression/anxiety [13,14] are common in bariatric populations and associated with poor quality of life (QoL) or long-term weight recidivism.

In tandem with weight trajectories, these behavioral/psychological aspects tend to decrease immediately after surgery [13–15]. However, particularly after the second year after surgery, post-bariatric patients seem to be at increased risk for engaging in problematic eating behaviors, increased negative urgency, and depression [14,15]. These modifiable aspects appear to be in close association with each other. Specifically, problematic eating behaviors are associated with the tendency to engage in impulsive actions under negative emotions (negative urgency) which is augmented under more depressive negative states [12].

In the context of mandatory lockdown, it is plausible that the psychological distress experienced during home confinement serves as an additional trigger for the arising or reemergence of problematic eating patterns [16], resulting in undesirable weight variations. Besides, it is also possible that the hindered access and diminished contact with healthcare teams can exacerbate fears of weight regain, increasing concerns about health and fitness as was suggested with other populations [5]. However, research on the psychological impact of mandatory lockdown during the COVID-19 outbreak in bariatric patients is very limited. A recent study showed that bariatric surgery patients (both pre- and postsurgery) perceived increased hunger, frequency of snacking, more impulse to eat, and increased difficulties in following a recommended diet during the COVID-19 pandemic [17].

Considering the established link between eating psychopathology and poorer weight loss/weight regain after bariatric surgery, it is imperative to investigate the incremental impact of COVID-19 lockdown on bariatric surgery outcomes. This longitudinal study seeks to compare 2 groups: (1) postbariatric surgery patients in the risk period for weight regain during the COVID-19 mandatory lockdown (COVID-19_Group); and (2) patients reaching the same follow-up time before the pandemic began (NonCOVID-19_Group). We hypothesized that the COVID-19_Group would experience exacerbated eating-related psychopathology and psychological distress, and poor weight outcomes compared with the NonCOVID-19_Group.

Methods

Participants and procedure

The present investigation uses data collected from an ongoing longitudinal study [18], conducted in a central public hospital in the north of Portugal that assesses adult patients with severe obesity seeking bariatric surgery for weight loss before and on consecutive times after surgery. Exclusion criteria included: severe cognitive compromise that limited patients' autonomy; pregnancy after surgery; not being able to understand written and spoken Portuguese.

For the purpose of this study, 2 independent groups of bariatric patients from the parent longitudinal study (COVID-19_Group, and NonCOVID-19_Group) were compared during 3 defined periods: T_0, before surgery; T_1, 1.5 years after surgery—a time when weight loss is usually stabilized [6]; and T_2, 3 years after surgery—a time of increased susceptibility for weight regain [7,8]. All patients from the 2 groups had their T_0, T_1, and T_2 assessment. The NonCOVID-19_Group completed T_0, T_1, and T_2 assessment before the epidemic began. For the COVID-19_Group, T_0 and T_1 were conducted before the pandemic started, but T_2 assessment was carried out at the end of the mandatory 46-day COVID-19 lockdown in Portugal.

During this state of emergency period in which mandatory lockdown was imposed, schools and public services/commercial establishments were closed, public gatherings prohibited, telework was mandatory whenever possible, and home confinement enforced. The official data point of national percentage of individuals in absolute home confinement ranged from 46% to 79% during the state of emergency (https://www.pse.pt/evolucao-confinamento-mobilidade/).

A total of 138 bariatric surgery patients from the parent longitudinal study had their 3-year assessment during the COVID-19 lockdown. The patients were contacted by phone for their regular assessment and asked to answer an additional question related to their degree of social confinement. Fifty-one patients did not answer phone contact during the short timeframe for data collection at the end of the lockdown period, and 37 did not complete the assessment during the lockdown period. These patients are still participating in the parent longitudinal study. Only 15 patients (17.24% of those actually contacted by the research team) denied the invitation claiming no interest in further participation in the study, resulting in a final sample of 35 bariatric surgery patients (COVID-19_Group). No significant differences were found between patients included and excluded from this group on the variables being studied (see Supplementary material Tables S1 and S2). The COVID-19_Group data collection was conducted exclusively online using Google Forms.

Sixty-six bariatric patients from the longitudinal parent study had completed T_0, T_1, and T_2 before the pandemic started and were included in the NonCOVID-19_Group. Data from the NonCOVID-19_Group were collected in a paper-pencil format in the hospital after their medical appointment with the multidisciplinary team (see [18] for further details).

Participants were informed of the confidentiality of the data collected and the right to quit the study at any time. All participants provided their informed consent before the assessment. The study was approved by the ethical review committees of the university University of Minho, Centro Hospitalar Universitário de São, João, Porto (SECVS 034/2015) and the hospital [blinded name of institution] (CES 108-15) involved.

Measures

Sociodemographic and clinical information. Participants answered questions about sociodemographic information such as age, sex, marital status, educational level, professional status, the degree of lockdown, number of days since the beginning of the state of emergency, and number of individuals cohabiting during the lockdown. Regarding the degree of lockdown, participants were categorized by the following options: (1) following lockdown governmental orders leaving home only for healthcare and food shopping; (2) following lockdown governmental orders but leaving home sporadically for work or other affairs; (3) following lockdown governmental orders but leaving home regularly for work or other affairs. Clinical data such as height, weight, and type of surgery performed were retrieved from hospital medical records. For the COVID-19_Group, weight at T_2 was self-reported.

Eating Disorder Examination-Questionnaire (EDE-Q) [19,20]. This 28-item self-report measure used to assess eating disorder psychopathology and associated features generated 4 subscale scores (restraint eating, shape, weight, and food concern) and a total score. Questions are answered from 0 (“Never”) to 6 (“Every day”) and higher scores are indicative of greater eating disorder psychopathology (McDonald’s ω T_0 = .99, T_1 = .99, and T_2 = .99).

Repetitive Eating Questionnaire (Rep[eat])-Q) [21]. This 12-item measure answered from 0 (“Never”) to 6 (“Every day”) assesses a grazing-type pattern. It comprises 2 subscales—compulsive grazing and repetitive eating. Higher scores reveal more grazing and/or eating patterns (McDonald’s ω T_0 = .98, T_1 = .99, and T_2 = .99).

Urgency, Premeditation, Perseverance, and Sensation Seeking Scales–Negative Urgency (UPPS) [22,23]. The Negative Urgency Scale, composed of 12 items rated from 1 (“Completely agree”) to 4 (“Completely disagree”), evaluates the tendency to act impulsively under negative emotions. Higher scores are indicative of greater negative urgency (McDonald’s ω T_0 = .99, T_1 = .99, and T_2 = .98).

Depression, Anxiety, and Stress Scales (DASS) [24,25]. This 21-item self-report measure is composed of 3 scales—depression, anxiety, and stress. Responses ranged from 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”), and higher scores express greater distress (McDonald’s ω T_0 = .97, T_1 = .99, and T_2 = .99).

Statistics

Computation of weight variables. Recent research [10] suggests that the continuous weight regain measure that performs better for associations with relevant clinical aspects within the bariatric population is computed as [(weight_at_given_assessment − nadir weight) / (weight_pre_surgery − nadir weight)] × 100. The authors proposing this measure [10] termed it the Percentage of Maximum Weight Loss. In the context of our work, we feel that this term focuses exclusively on weight loss rather than on weight regain, which could be misleading in the interpretation of our results. Therefore, for the purpose of this study, we will adopt the term Percentage of Weight Loss Regained (%WLRegained) as we believe it fully captures the mathematical formula. Weight loss metrics are computed as:

To define Excessive Weight Regain at the 3-year postsurgery assessment, the z score of 1.5 (1.5 standard deviations [SD] above the mean) criterion was applied to select the

Table 1
Sociodemographic and clinical information of participants in the COVID-19_ Group and NonCOVID-19_Group

	COVID-19_ Group (n = 35)	NonCOVID-19 _Group (n = 66)	t/χ^2
Age, yr	50.80 (12.40)	50.06 (10.68)	.27, P = .79
Sex, n (%)			2.45, P = .12
Male	2 (5.7)	11 (16.7)	
Female	33 (94.3)	55 (83.3)	
Marital status, n (%)			4.25, P = .24
Single	6 (17.1)	9 (13.6)	
Married/live together	18 (51.4)	45 (68.2)	
Separated/divorced	7 (20.0)	10 (15.2)	
Widower	4 (11.4)	2 (3.0)	
Educational level, n (%)			1.95, P = .38
≤6 yr	15 (42.9)	21 (31.8)	
9–12 yr	12 (34.3)	32 (48.5)	
College degree	8 (22.9)	13 (19.7)	
Professional status, n (%)			3.34, P = .34
Student	1 (2.9)	1 (1.5)	
Employed	22 (62.9)	38 (57.6)	
Unemployed	4 (11.4)	17 (25.8)	
Retired	8 (22.9)	10 (15.2)	
Presurgery BMI, kg/m^2	42.93 (4.85)	42.67 (5.49)	.24, P = .82
Lowest BMI, kg/m^2	28.51 (4.38)	27.31 (4.97)	1.19, P = .24
Type of surgery, n (%)			.26, P = .61
Gastric bypass	21 (60.0)	43 (65.2)	
Gastric sleeve	14 (40.0)	23 (34.8)	

BMI = body mass index.
Values are presented as mean (SD) unless otherwise indicated.

participants with excessive weight regained at the 3-year assessment [26]. The cutoff value corresponding to a 1.5 z score of the %WLRegained of the total sample was estimated at 37.13%: Mean %WLRegained at T_2 (16.37) + 1.5 Standard Deviation (13.84) = 16.37 + 20.76 = 37.13%. The participant's %WLRegained closest to the cutoff value of 37.13% was 39.75% (≈40%). Thus, we defined a %WLRegained equal or superior to ≈40% as the criterion to identify participants with excessive weight regain at the 3 years after surgery assessment in this paper.

Statistical analyses

Data were analyzed using IBM SPSS statistics V26 software. Both t and χ^2 tests (for continuous or ordinal/dichotomous variables, respectively) were used to compare the COVID-19_Group and the NonCOVID-19_Group on sociodemographic and clinical variables. McDonald's ω was computed as a measure of scale reliability for the self-report measures using JASP version .12.2 (JASP Team University of Amsterdam, Amsterdam, Netherlands).

A binary logistic regression analysis was performed using the baseline characteristics in Table 1 (sex, age, education, marital status, number of children, employment status) to calculate a propensity score. Propensity score adjustment was used as a covariate in the following analyses comparing the 2 groups. By using baseline characteristics to determine the probability of each person belonging to a given group, we control for pretreatment differences between the 2 nonrandomized groups. Propensity scores were included in all models, but only rendered statistical significance for the compulsive grazing model. According to the parsimony principle [27], when the propensity score would result in a nonsignificant variable worsening the model tested, this variable would be removed from the final model.

General linear models for longitudinal designs compared the 2 groups testing main effects for the variables of interest (self-report measures) and time since surgery, and interaction effects between the variables of interest and time, with a 2 × 3 design (2 independent groups: COVID-19_Group and NonCOVID-19_Group × 3 different assessment times T_0, T_1, and T_2). Post hoc analyses were performed using pairwise comparisons with Bonferroni adjustment for multiple comparisons. The same approach was used to compare participants from the COVID-19_Group to those who were eligible but did not complete their 3-year assessment during the COVID-19 lockdown (Data available as supplementary material). There were no missing data.

Statistical significance was considered at $P < .05$. Effect size is expressed as partial eta squared (η^2_p). Post hoc power analyses were conducted with G*Power 3 [28] considering the lowest η^2_p achieved in our analyses (η^2_p = .03, corresponding to an effect size F = .175), α = .05, and correlation among repeated measures = .5, resulting in a minimum achieved power of .90.

Results

Characterization of the sample

Table 1 shows the detailed participants' characterization for the groups under study. There were no statistically significant differences in sociodemographic and clinical variables under study between the COVID-19_Group and the NonCOVID-19_Group.

During the imposed COVID-19 lockdown in Portugal, 27 (77.1%) participants from the COVID-19_Group reported obeying the stay-at-home recommendations, and 5 (14.3%) and 3 (8.6%) of the participants maintained sporadic or regular visits to work, respectively. The mean number of individuals cohabiting with the participants was 2.14 (SD = 1.75; min = 0; max = 10). Only 1 participant was unemployed due to the pandemic.

Differences between the groups across the different assessment times

The COVID-19_Group and the NonCOVID-19_Group were compared on eating-related psychopathology, psychological variables, and weight outcomes across the different assessment times. Table 2 shows the statistics resulting from each model tested. Fig. 1 depicts the scores on the

Table 2
Comparison between COVID-19_Group versus Non_COVID-19_Group on psychopathological assessments

	COVID-19 Group (n = 35)			Non_COVID-19_Group (n = 66)			F (effect of time)	η^2_p	F (between groups)	η^2_p	F (interaction effect TIME*GROUP)	η^2_p
	T_0	T_1	T_2	T_0	T_1	T_2						
Eating-related variables												
Weight concern (EDE_Q)	3.30 (1.41)	2.10 (1.58)	3.04 (1.48)	3.49 (1.41)	1.95 (1.48)	1.98 (1.70)	24.697, $P < .001$	.23	1.760, $P = .188$	-	5.388, $P = .005$	.062
Shape concern (EDE_Q)	3.43 (1.28)	2.23 (1.43)	3.02 (1.30)	3.53 (1.57)	1.95 (1.55)	2.42 (1.83)	26.441, $P < .001$	.246	.942, $P = .335$	-	1.665, $P = .192$	-
Food concern (EDE_Q)	.94 (.95)	.48 (.62)	.71 (.98)	1.28 (1.41)	.61 (.90)	.80 (.98)	8.886, $P < .001$	.095	1.387, $P = .242$	-	.507, $P = .603$	-
Restriction (EDE_Q)	1.55 (1.18)	1.55 (1.33)	1.38 (1.27)	1.73 (1.46)	1.40 (1.29)	1.48 (1.39)	.681, $P = .507$	-	.062, $P = .804$	-	.403, $P = .669$	-
Repetitive eating (Rep (eat))	1.17 (1.19)	.54 (1.01)	1.32 (1.69)	1.65 (1.49)	.61 (.87)	.75 (.90)	12.007, $P < .001$	.121	.001, $P = .976$	-	4.783, $P = .010$	.052
Compulsive grazing (Rep (eat))*	1.29 (1.39)	.52 (.92)	1.40 (1.67)	1.48 (1.49)	.55 (.83)	.69 (.84)	2.057, $P = .131$	-	1.349, $P = .249$	-	6.205, $P = .002$	.067
Other psychological variables												
Negative urgency (UPPS)	28.79 (7.11)	25.97 (7.44)	29.55 (7.91)	28.84 (7.71)	25.78 (7.20)	25.96 (7.49)	6.281, $P = .002$	.068	.867, $P = .354$	.010	2.929, $P = .056$	.033
Anxiety (DASS)	5.64 (5.07)	3.97 (3.72)	4.64 (4.52)	4.53 (4.08)	3.56 (4.21)	4.44 (4.63)	3.403, $P = .035$	.037	.572, $P = .452$	.006	.444, $P = .642$	.005
Depression (DASS)	5.27 (5.42)	3.85 (5.33)	4.85 (5.13)	4.32 (4.98)	3.26 (4.65)	3.63 (3.75)	2.883, $P = .059$	-	1.135, $P = .290$	-	.189, $P = .828$	-
Stress (DASS)	7.79 (5.22)	5.97 (4.48)	7.03 (5.39)	6.93 (5.60)	6.12 (5.53)	6.77 (5.16)	2.271, $P = .106$	.025	.126, $P = .724$	-	.331, $P = .719$	.004
Weight outcomes												
%WLRegained	-	4.44 (7.99)	21.71 (16.36)	-	4.12 (6.15)	14.07 (11.76)	91.227, $P < .001$	.485	4.843, $P = .005$	.49	7.077, $P < .01$	.066

EDE-Q = Eating Disorder Examination Questionnaire; Rep(eat) = Repetitive Eating questionnaire; UPPS = Urgency, Premeditation, Perseverance, and Sensation Seeking Scales – Negative Urgency scale; DASS = Depression, Anxiety, and Stress scale; %WLRegained = percentage of weight loss regained; η^2_p = partial eta squared.

Values are presented as mean (SD) unless otherwise indicated.

* F (interaction effect TIME*Propensity score) = 3.497, $P = .035$, $\eta^2_p = .076$.

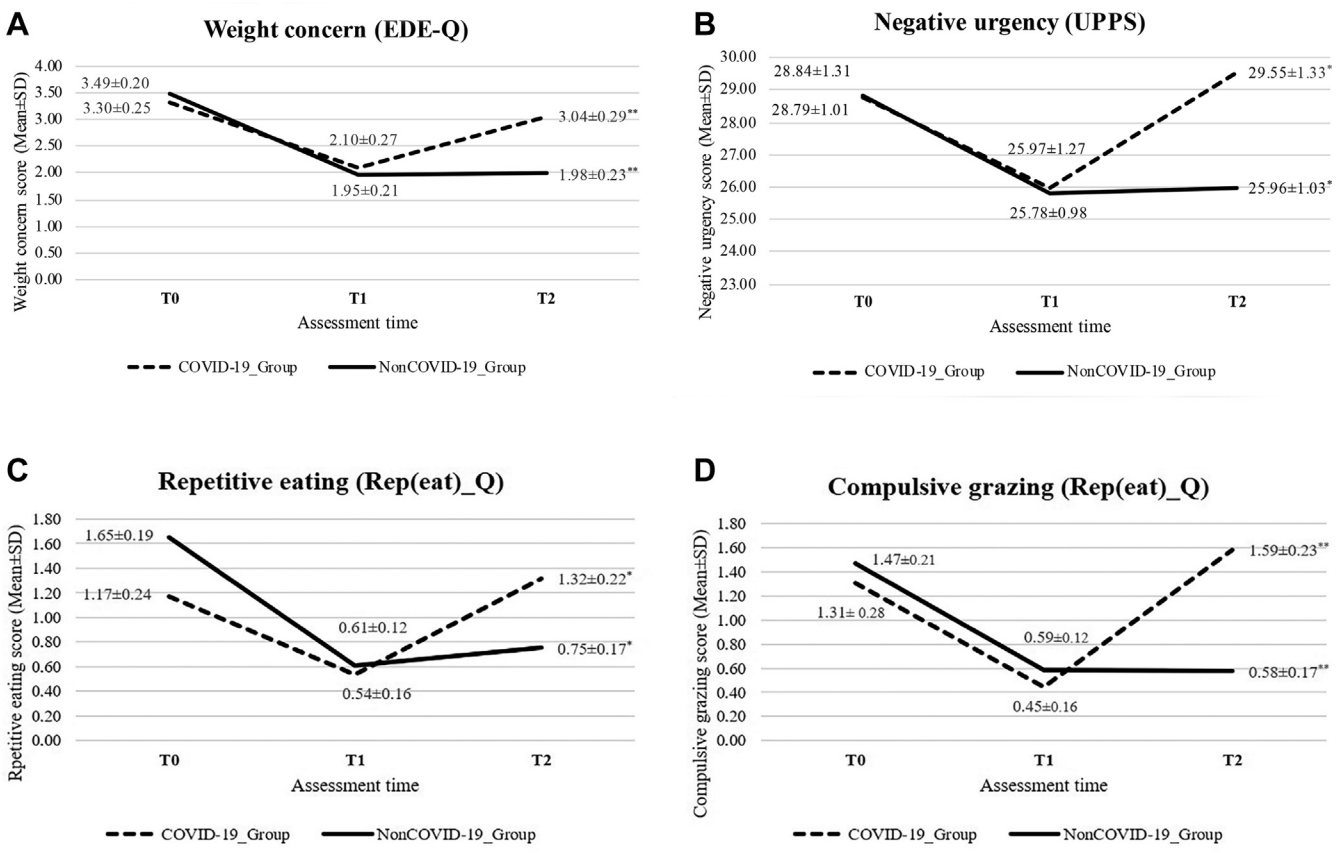

Fig. 1. Scores on the psychological measures throughout the different assessment times (T_0 = presurgery; T_1 = 1.5 yr after surgery; T_2 = 3 yr after surgery). (a) Weight concern subscale of the Eating Disorder Examination Questionnaire (EDE-Q); (b) Scores on the negative urgency scale of the Urgency, Premeditation, Perseverance, and Sensation Seeking Scales (UPPS); (c) Scores on the repetitive eating subscale of the Repetitive Eating Questionnaire (Rep(eat)-Q); (d) Scores on the compulsive grazing subscale of the Repetitive Eating Questionnaire (Rep(eat)-Q). *$P < .05$; **$P < .01$. Note: for the COVID-19_Group, T_0 and T_1 took place before the pandemic started, and T_2 at the end of the lockdown. The NonCOVID-19_Group completed T_0, T_1 and T_2, assessments before the epidemic began.

psychological measures throughout the different assessment times.

Eating-related variables

Concerning the weight concern subscale of the EDE-Q, the model showed a significant main effect of time, a nonsignificant main effect of groups, and a significant interaction effect of time × groups. These data suggest that levels of weight concern for both groups evolved similarly from T_0 to T_1, but the COVID-19_Group showed a greater change in the weight concern scores compared with the NonCOVID-19_Group from T_1 to T_2 (Fig. 1a). At their 3-year follow-up (T_2), the COVID_Group presented significantly higher scores on the weight concern subscale than the NonCOVID-19_Group ($F = 8.403$, $P < .01$, $\eta^2_p = .094$). There were no differences between both groups at T_0 ($F = .370$, $P = .545$) and T_1 ($F = .194$, $P = .661$).

For the remaining EDE-Q subscales, the results showed that there were no differences between both groups on any of the assessment times suggesting that both groups evolved similarly throughout time. The analysis for shape concern (EDE-Q) showed a significant main effect of time. No significant main effect of group or interaction effect of time X groups was found. Similarly, for food concern (EDE-Q), the results showed a significant main effect of time, a nonsignificant main effect of group, and a nonsignificant interaction effect of time X groups. For the restraint eating subscale (EDE-Q), results showed a nonsignificant main effect of time, of group, and a nonsignificant interaction effect time X groups.

Concerning the repetitive eating subscale of the Rep(eat)-Q, results showed a significant main effect of time, a nonsignificant main effect of groups, and a significant interaction effect time X groups. These findings suggest that there is a similar trend for both groups between T_0 and T_1 with a decrease in the repetitive eating scores for both groups, followed by a greater increase for the COVID-19_Group compared with the NonCOVID-19_Group (Fig. 1c). While both groups showed comparable scores at T_0 ($F = 2.494$, $P = .118$) and T_1 ($F = .107$, $P = .744$), the COVID-19_Group scored significantly

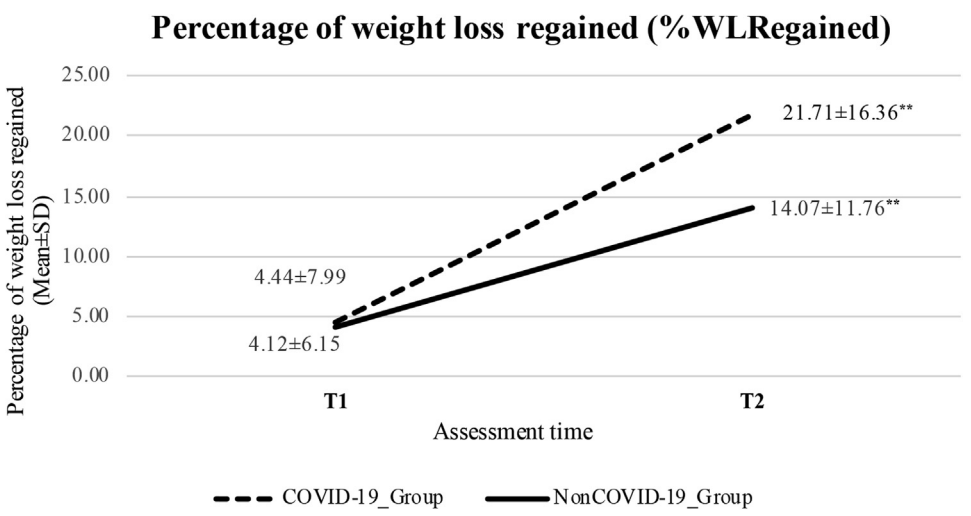

Fig. 2. Weight loss regained (%WLRegained) throughout the different assessment times (T_1 = 1.5 yr after surgery; T_2 = 3 yr after surgery). *$P < .05$; **$P < .01$. Note: for the COVID-19_Group, T_0 and T_1 took place before the pandemic started, and T_2 at the end of the lockdown. The NonCOVID-19_Group completed T_0, T_1 and T_2 assessment before the epidemic began.

higher than the NonCOVID-19_Group at T_2 (F = 4.244, $P = .042$, $\eta^2_p = .047$).

Similarly, concerning the compulsive grazing Rep(eat)-Q subscale, a nonsignificant main effect of time, a nonsignificant main effect of groups, and a significant interaction effect time X groups was found. These results suggest that both groups evolved similarly from T_0 to T_1 assessment, which is followed by a greater increase for the COVID-19_Group between T_1 and T_2 comparatively to the NonCOVID-19_Group (Fig. 1d). While both groups showed comparable scores at T_0 (F = .186, $P = .667$) and T_1 (F = .427, $P = .515$), the COVID-19_Group scored significantly higher than the NonCOVID-19_Group at T_2 (F = 11.498, $P < .01$, $\eta^2_p = .118$).

Other psychological variables

Results for the negative urgency scale (UPPS) showed a significant main effect of time, a nonsignificant main effect of groups, and there was a nonsignificant trend ($P = .06$) for an interaction effect time X groups. While both groups showed comparable scores at T_0 (F = .001, $P = .977$) and T_1 (F =.014, $P = .907$), the COVID-19_Group scored significantly higher than the NonCOVID-19_Group at T_2 (F = 4.522, $P < .05$, $\eta^2_p = .05$) (Fig. 1b).

Analyses for anxiety scale (DASS) showed a significant main effect of time, a nonsignificant main effect of groups, and a nonsignificant main interaction effect time X groups. For depression and stress scores (DASS), results showed a nonsignificant main effect of time, a nonsignificant main effect of groups, and nonsignificant interaction effect time x groups. There were no significant differences between the groups on the anxiety, depression, and stress scores within each assessment time. These results suggest that both groups evolved similarly throughout time and had comparable scores on anxiety, depression, and stress at each assessment time.

Weight outcomes

Concerning %WLRegained throughout time, the model showed a significant main effect of time, a nonsignificant main effect of groups, and a significant interaction effect of time x groups. These data suggest that the COVID-19_Group presented a larger increase in the %WLRegained compared with the NonCOVID-19_Group from T_1 to T_2 (Fig. 2). At their 3-year follow-up (T_2), the COVID_Group presented significantly higher %WLRegained than the NonCOVID-19_Group (F = 7.102, $P < .01$, $\eta^2_p = .068$). Notably, the mean difference between the 2 groups on the %WLRegained at T_2 was 8.315 which corresponds to a mean difference of approximately 2 kg between the groups. There were no differences between both groups at T_1 (F = .049, $P = .825$).

Finally, the COVID-19_Group had a significantly higher percentage of participants with excessive weight regain (% WLRegained > 40%) than the NonCOVID-19_Group (20% [n = 7] versus 4.5% [n = 3], respectively; $\chi^2[1] = 8.114$, $P < .01$).

Discussion

The present study explored the impact of the mandatory COVID-19 lockdown in Portugal on eating-related psychopathology, psychological distress, and weight outcomes of bariatric patients throughout the first 3 years following surgery. This study investigates psychological aspects of the bariatric surgery population during the COVID-19 outbreak, and these findings bring support to the hypothesis that the

COVID-19 pandemic can lead to increased disorder eating and weight changes after bariatric surgery [7,29].

Our data suggest that bariatric patients who experienced the mandatory COVID-19 lockdown in Portugal while reaching their 3-year follow-up assessment present significantly higher weight concern, grazing behavior, and negative urgency than patients who achieved this follow-up time before the epidemic began. Specifically, we show that while both groups have a comparable trajectory between the preoperative and 1.5-year follow-up assessment, the COVID_19 group presents a greater increase in the scores of these variables from the 1.5- to the 3-year follow-up assessment. These data represent the first evidence that stay-at-home orders may exacerbate a problematic psychological state in patients that are already at increased risk for weight recidivism.

As previously hypothesized, it is plausible that the dramatic alterations in daily life produced by stay-at-home orders can impact the eating patterns of bariatric surgery patients. Past research has shown that more time spent at home favors a less structured eating schedule and potentially increases exposure to food availability, which can prompt the repetitive consumption of small amounts of food throughout the day—grazing behavior [30]. Moreover, these participants also presented exacerbated negative urgency suggesting that they experience a greater tendency to impulsive actions (e.g., eating) under negative emotions [22]. Given the directionality of these findings, we could hypothesize that the observed increased graze eating may also be a result of greater negative urgency. Graze eating could further be exacerbated in a context of low eating concern and low restraint eating as observed in our sample throughout the time and across groups. Future research could test these hypothesized associations between grazing, negative urgency, eating concern, and restraint eating.

With the added stressor of the COVID-19 pandemic and the consequent difficulties in sustaining an organized eating pattern and exercise routine, it is reasonable that bariatric patients are more concerned with their weight during this period [31]. However, although we found greater weight concerns for the COVID-19_Group, we did not find a difference in the shape concern subscale of the EDE-Q. Past research suggests that expectations of bariatric surgery success are overly grounded in weight loss achievements both for patients and clinicians [32] and that patients' unrealistic weight loss expectations have a significant impact on treatment outcomes [33]. In fact, existent reports show that these patients are constantly reminded by healthcare professionals of the importance to control their weight. These constant reminders may set the patients off to a controlling state of mind that may favor the engagement in maladaptive weight control behaviors and the development of full syndrome and subthreshold eating disorders, which are serious mental health problems among postbariatric patients [34]. On the other hand, body shape after surgery is highly marked by the excessive skin resulting from massive weight loss—a "price to pay" for successful weight loss that is frequently managed with body contouring surgery [35]—and is out of the patients' control.

Contrary to what we expected, there were no differences between the groups on the scores of anxiety, depression, and stress, and scores on these measures were particularly low for both groups. Recent studies also showed that, among noneating disorder individuals (general community), scores of depression, anxiety, and stress were within nonclinical levels during the COVID-19 pandemic in Australia [36], supporting the idea that little variability should be expected for these variables. While symptoms of depression, anxiety, and stress could take a longer time to settle in, these participants might have experienced an increase in situations of momentary negative affect. A strong body of evidence grounded on ecological momentary assessment designs shows that negative affect is a robust precursor of disordered eating behavior [37] across samples. Although our study does not include an assessment measure for negative affect, the increased scores on the negative urgency scale at T_2 support such an assumption. Future research should investigate the myriad of expressions of altered mood/distress/affect for short periods to better capture its relationship with disordered eating.

Difficulties in long-term weight loss maintenance are a common well-established reality for bariatric patients [9,10], specifically because of the onset or reemergence of problematic eating behaviors [15,38]. Accordingly, our findings further show that weight regain was significantly higher and weight loss significantly lower for participants reaching their third-year assessment during lockdown compared with the NonCOVID-19_Group. Moreover, the COVID-19_Group had 15.5% more participants with excessive weight regained (40% of their total weight loss) which is of both statistical and clinical significance. These poorer weight outcomes for the COVID-19_Group may be a consequence of the increased disordered eating reported by these groups.

Together, our findings highlight the importance of specialized clinical attention for postbariatric patients, particularly for those in the risk period for weight recidivism [11]. Moreover, not only do altered eating patterns seem to have an immediate impact on weight outcomes, but also sustaining problematic eating behaviors will probably result in further weight gain in the long-term [39]. It is therefore imperative that patients are continuously monitored to mitigate the impact of the pandemic on eating behavior, and support sustained improvement in weight and QoL. Furthermore, considering the possibility of future outbreaks it is extremely important to explore alternative intervention strategies to support and continuously monitor this clinical population. The COVID-19 pandemic challenged our world in unprecedented ways and set the grounds for future investigations to prioritize new and more flexible approaches that

articulate both in-person care and remotely delivered care such as telephone-based interventions, online platforms, or online social groups in a timely and systematic manner.

While the longitudinal design is a notable strength of this study, some limitations should be mentioned. First, the generalization of the results might be hindered by the different realities lived during the mandatory lockdown across countries or regions within the same country. It is also possible that these results do not generalize individuals who do not experience a significant impact on their lives secondary to the epidemic outbreak. The number of days under lockdown and the degree of home confinement could also influence the associations found. Variables that may serve as moderators should be investigated in future research to understand ways in which protective factors may buffer the impact of lockdown on psychological and weight outcomes after bariatric surgery [32]. For instance, there is anecdotal evidence that deprivation of family/social support is one of the difficulties mostly reported by these patients during the lockdown and past research highlights the importance of social support in psychological and weight outcomes following bariatric surgery [32]. Moreover, a different socioeconomic or professional situation could also potentially curb the impact of COVID-19 lockdown for those who have more favorable household conditions and stable professional positions. Closely related to these socioeconomic factors, food insecurity is thought to be prevalent among bariatric patients [16,40] and associated with increased consumption of high-energy foods, which can favor weight regain. Another limitation is that weight was self-reported for the COVID-19_Group, but cumulating evidence suggests that bariatric patients self-report their weight reasonably accurately and self-reported weights can be used to produce reliable results [41,42]. Finally, we have a limited sample size, although we show evidence of power for our analyses. Moreover, given the short timeframe we had for data collection (end of the lockdown period but before lockdown restrictions were removed) we could not contact 51 participants and 37 accepted participating but did not complete the assessment during the lockdown period. However, there is no reason to believe that these patients would represent a biased subgroup in their reaction T_2 characteristics, as they are comparable to the COVID-19_Group at T_0 and T_1, as shown in the Supplementary material. Despite the potential limits for generalization, our results point to a clear impact of COVID-19 lockdown on the psychological and weight status of a subgroup of bariatric patients that should not be neglected.

Our findings support the impact of the coronavirus outbreak on eating-related psychopathology and weight outcomes in postbariatric surgery patients. These observations have potential implications for clinicians and public health professionals that face the challenge to mitigate short- and long-term repercussions of this pandemic and prevent forthcoming situations involving lockdown and social isolation, making specialized and systematic care an urgent matter for this high-risk population.

Disclosures

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.soard.2021.02.025.

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