




Effect of COVID-19 Lockdowns on Physical Activity, Eating Behavior, Body Weight and Psychological Outcomes in a Post-Bariatric Cohort

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Abstract

Purpose Little is known about the consequences of COVID-19 lockdowns on physical activity (PA), eating behavior, and mental health in post-bariatric surgery (BS) patients. We aimed to analyze the relations between changes in PA during COVID-19 lockdowns and changes in body weight and a comprehensive set of lifestyle and psychological outcomes in patients who have undergone BS.

Material and Methods In April–May 2020 (lockdown#1), we performed an online survey in a cohort of 937 adults who underwent BS and were followed-up at our university medical center for at least one year. We assessed changes in PA, eating behavior, body weight, fatigue, and depression (PHQ-9). In November–December 2020 (lockdown#2), we recorded body weight in 280 patients who had reported decreased PA during lockdown #1.

Results During lockdown #1 ($N=420$ patients included, 44% response rate), decreased PA was reported by 67% patients. Compared to those who reported increased or unchanged PA, patients with decreased PA were more likely to report a $\geq 5\%$ weight gain (OR (95% CI): 3.15 (1.46–7.65)), increased fatigue (2.08 (1.36–3.23)), a worsening of eating behavior (2.29 (1.47–3.58)), and moderate-to-severe depressive symptoms (4.74 (2.14–11.76)). During lockdown #2 ($N=225$ patients, 80% response rate), significant weight gain since before lockdown #1 was reported (+2.8 (95% CI : 1.7–3.8) kg, $p < 0.001$), with 36% patients reporting a $\geq 5\%$ weight gain.

Conclusions PA may counteract detrimental effects of COVID-19 lockdown on post-BS weight trajectories and mental health outcomes. Follow-up measures are needed in this setting to assess the long-term impact of lockdown.

Keywords COVID-19 · Lockdown · Bariatric surgery · Physical activity · Nutrition

Key points

- Sixty-seven percent of post-bariatric patients reported decreased physical activity during lockdown.
- Patients who reported decreased physical activity reported greater weight regain.
- They were also more likely to report moderate-to-severe depressive symptoms.
- Eating behavior was adversely modified in patients with decreased physical activity.

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Introduction

In response to the COVID-19 pandemic, numerous countries around the world implemented periods of lockdown during the year 2020 [1]. In France, strict lockdown measures took place between March and May 2020 and between November and December 2020. These measures included the closure

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of most “non-essential” public places, businesses, and services, the placement on partial/technical unemployment or the adoption of telework by the majority of the working population, and the prohibition of being outdoors except to take care of essential needs [2]. Recreational activity was only allowed for 1 h within a 1-km radius from one’s residential address. As a consequence, a decrease in physical activity (PA) occurred during the COVID-19 lockdown throughout many countries and in different populations [3]. In France, 47% of a representative sample of 2000 adults reported decreased PA during compared to before lockdown [4].

PA is an important component of the management of patients undergoing bariatric surgery (BS), as it is associated with a substantial improvement in physical fitness and a slightly greater weight loss after BS [5]. PA may also prevent weight regain after BS [5]. Two online surveys conducted in the USA reported a decrease in PA during the COVID-19 lockdown in 49% and 55% of patients with a history of BS [6, 7]. In addition, two studies conducted in the context of COVID-19 lockdown in the USA and in Italy in 208 and 48 patients after BS, respectively, found that a decrease in PA, or a lower weekly duration of PA, was associated with a greater weight gain, thus suggesting the importance of PA for weight control after BS [6, 8].

Dietary habits and mental health have also been negatively impacted by the COVID-19 lockdown in post-BS cohorts, although their relations with PA have not been investigated in this population [6]. A large proportion of patients with a history of BS reported a decrease in healthy food eating (46%) and an increase in snacking (63%), loss of control when eating (48%) or depressed mood (44%) [6], or anxiety (67%) and depression (83%) [7]. In the general population [9], as well as in patients with obesity [10], PA during lockdown has been associated with a lower prevalence of depressive symptoms and anxiety disorders [9, 10]. The associations between the change in PA during the lockdown and mental health outcomes warrant further investigation in patients with a history of BS.

Therefore, the aim of this study was to analyze the relations between changes in PA during COVID-19 lockdown and changes in body weight and a comprehensive set of lifestyle and psychological outcomes in patients with obesity who had undergone BS.

Material and Methods

Study Cohort

The study is based on a BS cohort of 937 patients followed-up at a single academic medical center (Nutrition department of Pitié-Salpêtrière university hospital; Paris, France) since 2014. Patients were operated by Roux-en-Y

gastric bypass (RYGB), sleeve gastrectomy (SG), or laparoscopic adjustable gastric band (LAGB). However, we excluded LAGB patients due to their small number ($N=3$) and their worse BS outcomes in general [11]. Furthermore, we excluded patients who had been operated less than 1 year before the first COVID-19 lockdown, since maximum weight loss usually occurs at approximately 1 year after BS. Detailed clinical and anthropometric measures were obtained before surgery [12]. Body composition was assessed based on whole-body dual energy X-ray absorptiometry (DXA) scan (Hologic Discovery W, software v12.9; Hologic, Bedford, MA) [13]. Ethical approval was obtained from the French Research Ethics Committee of CPP Ile de France-1 N°13533 and the “Commission nationale de l’informatique et des libertés” No. 1222666.

Data Collection During COVID-19 Lockdowns

A first COVID-19 lockdown (lockdown #1) took place in France from March 17th to May 11th 2020. The 937 BS patients followed in the cohort were contacted by phone and 738 patients provided information about their current medical situation (Fig. 1) [12]. Of these, 500 patients also contributed to an online survey including a set of standardized questions that has been used in a large cohort study at the national level [14]. Eighty patients were further excluded for the reasons detailed above. Therefore, 420 patients were included in the present analyses.

The questions pertained to professional occupation and characteristics of lockdown, as well as the perceived changes during lockdown in PA and sedentary behavior, diet quality and eating behavior, alcohol consumption and smoking, sleep duration, and fatigue. Subjects were asked whether they had, in general, increased, decreased, or not modified their habitual PA level during lockdown (question formulated as follows: “Compared to before the lockdown, your physical activity level: increased/ did not change/ decreased/ do not know”). Detailed information was also collected regarding the different types of PA performed over the last 7 days, and whether this activity had been started during lockdown. Questions related to eating behavior were formulated as follows: “Compared to before the lockdown... 1) Your current diet is: better/ neither better nor less good/ less good/ do not know”, 2) You snack: more often/ neither less nor more/ less often, 3) You have more/neither more nor less/less cravings for food, 4) You experience more/ neither more nor fewer/ fewer episodes of eating large amounts of food and feeling like you lose control, 5) You experience more/ neither more nor less/ less night-time food consumption.” Patients were asked to report body weight measured at home before lockdown and at the time of the survey only if specifically measured with a scale. Finally, the presence of depressive

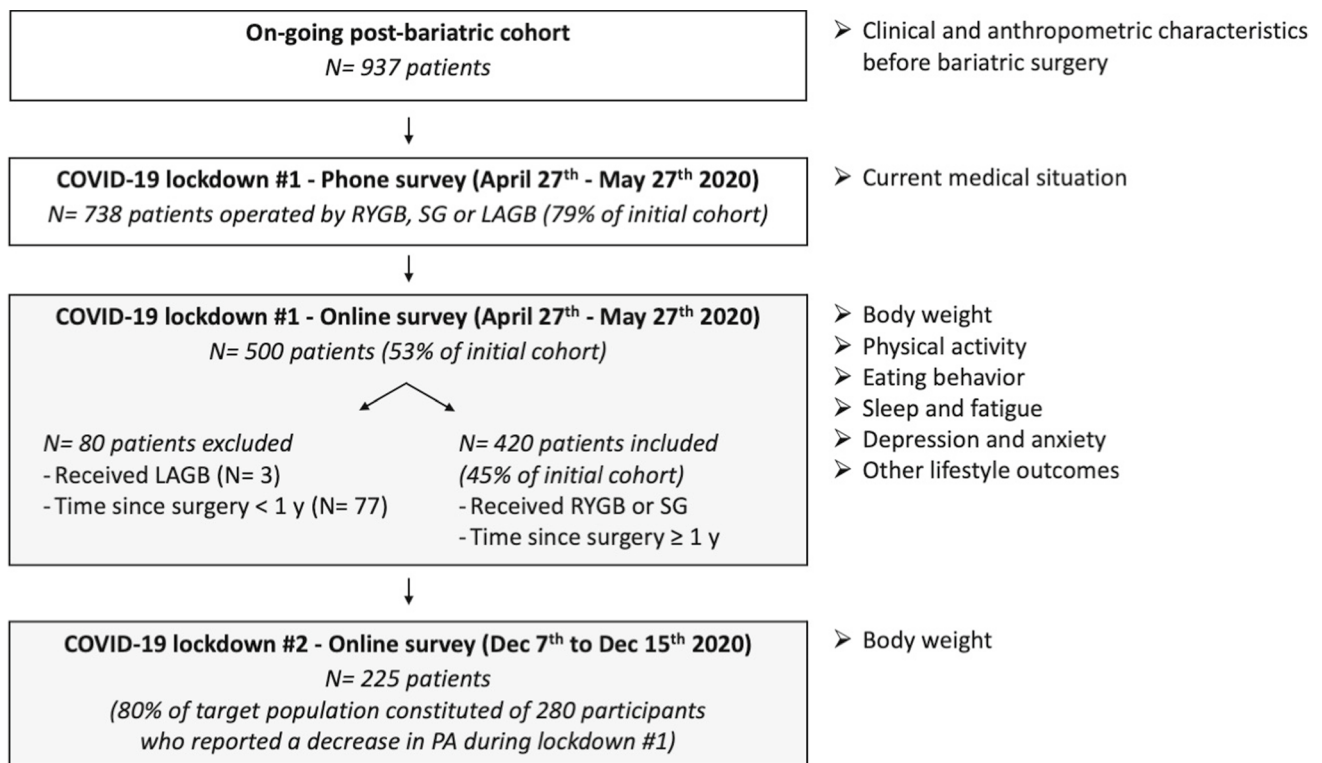


Fig. 1 Flow chart.

LAGB, laparoscopic gastric banding; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy

symptoms and anxiety was assessed using the Patient Health Questionnaire–9 scale (PHQ-9) [15] and the Generalized Anxiety Disorder–7 scale (GAD-7) [16], respectively.

A second lockdown period (lockdown #2) took place in France 7 months later from October 30th to December 15th, 2020. For practical reasons, only patients who had reported a decrease in PA during the first lockdown ($N=280$) were contacted by email and by phone before and during lockdown #2 to report their current body weight. A total of 225 patients responded to this survey (i.e., a response rate of 80%).

Statistical Analysis

Values are presented as mean (SD) for continuous variables and as absolute values (percentages) for categorical variables. Individual characteristics were compared according to gender using Student's t -tests for continuous variables and Pearson's chi-square (χ^2) test or Fisher's exact test for categorical variables. Individual characteristics were also compared according to the change in PA during lockdown #1 (decrease vs. no change or increase in PA) using multivariate logistic regression models including age, gender, type of surgery, and time elapsed since BS as covariates. Linear mixed models adjusted for baseline body weight (before

lockdown #1) were used to assess changes in body weight over time. The terms "gender," "time," and "gender \times time" were included as fixed effects. All tests were two-sided and a P -value < 0.05 was considered statistically significant. Analyses were conducted using R software version 4.0.3 (<http://www.r-project.org>).

Results

Individual Characteristics of Participants

Participants were middle-aged, mostly women (81%), and the most frequent procedure performed was RYGB (56%) (Supplementary Table 1). Patients included in this study did not differ from the non-included patients in terms of gender, preoperative age, BMI, or body mass (Supplementary Table 2). However, they were more likely to present a comorbidity such as type 2 diabetes, hypertension, or sleep apnea syndrome. The mean (SD) time elapsed between the time of BS and the time of the survey was 4.0 (2.5) y, and the mean percent total weight loss since the surgery was 28.7 (10.0) % (Supplementary Table 3). The mean weight loss at 1-year post-surgery was 29.7 (8.2) %. Since then, 45.0% of the patients experienced additional weight

Table 1 Characteristics of post-bariatric patients according to changes in physical activity during COVID-19 lockdown #1 (April–May 2020)

	Change in physical activity during lockdown			Adjusted P-value ^a
	Increase/no change (N = 140)	Decrease (N= 280)	OR [95% CI] ^a	
Gender, ref: Women	118 (84.3%)	221 (78.9%)	1.00	ref
Men	22 (15.7%)	59 (21.1%)	1.34 [0.78-2.34]	0.29
Age, y	48.1 (13.3)	51.4 (11.2)	1.03 [1.01-1.05]	0.003
Type of surgery, ref: RYGB	74 (52.9%)	159 (56.8%)	1.00	ref
Sleeve	66 (47.1%)	121 (43.2%)	0.74 [0.48-1.14]	0.18
BMI at surgery, kg/m ²	46.1 (6.9)	44.2 (6.5)	0.96 [0.93-0.99]	0.02
Current BMI, kg/m ²	32.1 (6.5)	32.2 (5.7)	1.00 [0.96-1.04]	0.98
% total weight loss since surgery, %	-30.2 (10.6)	-28.0 (9.6)	1.02 [1.00-1.05]	0.09
Time elapse since surgery, y	4.4 (2.5)	3.9 (2.5)	0.89 [0.81-0.97]	0.005
Time elapse since surgery, y, ref: [1-5]	82 (58.6%)	202 (72.1%)	1.00	ref
> 5	58 (41.4%)	78 (27.9%)	0.89 [0.81; 0.97]	0.005
Type of lockdown, ref: Partial	118 (84.3%)	232 (83.8%)	1.00	ref
Total	22 (15.7%)	45 (16.2)	1.07 [0.61-1.91]	0.81
Lockdown at usual place, ref: Yes	131 (93.6%)	269 (96.8%)	1.00	ref
No	9 (6.4%)	9 (3.2%)	0.49 [0.18-1.31]	0.15
Professional activity during lockdown, ref: No change	48 (34.3%)	70 (25.1%)	1.00	ref
Work from home	21 (15.0%)	63 (22.6%)	2.08 [1.12-3.98]	0.02
No professional activity prior lockdown	28 (20.0%)	52 (18.6%)	1.15 [0.63-2.14]	0.64
Temporary unemployment	17 (12.1%)	22 (7.9%)	1.07 [0.50-2.30]	0.86
Other situation	26 (18.6%)	72 (25.8%)	1.99 [1.11-3.65]	0.02
Number of outings per week	3.3 (2.3)	3.0 (2.3)	0.93 [0.84-1.03]	0.15
Duration of outings, min/week	171 (253)	137 (214)	1.00 [0.99-1.00]	0.24
Went out for work, ref: Yes	28 (20.0%)	48 (17.1%)	1.00	ref
No	112 (80.0%)	232 (82.9%)	1.140 [0.66-1.86]	0.64
Went out for food shopping, ref: Yes	91 (65.0%)	202 (72.1%)	1.00	ref
No	49 (35.0%)	78 (27.9%)	0.73 [0.47-1.14]	0.17
Went out for physical activity, ref: Yes	41 (29.3%)	53 (18.9%)	1.00	ref
No	99 (70.7%)	227 (81.1%)	2.02 [1.23-3.31]	0.006
Smoking status, ref: Not smoker	120 (87.0%)	242 (87.7%)	1.00	ref
Current smoker	18 (13.0%)	34 (12.3%)	1.07 [0.57-2.04]	0.84
Use of anti-anxiety drugs, ref: No	129 (92.1%)	233 (83.2%)	1.00	Ref
Yes	11 (7.9%)	47 (16.8%)	2.70 [1.37-5.76]	0.006
Use of anti-depressant drugs, ref: No	126 (90.0%)	231 (82.8%)	1.00	ref
Yes	14 (10.0%)	48 (17.2%)	1.85 [0.97-3.66]	0.05

^aLogistic regression with age, gender, type of surgery, and time since bariatric surgery as covariates

Bold values indicate significance with $P < 0.05$

loss (− 5.8 (4.8) % of 1-year body weight on average), and 55.0% experienced weight maintenance or weight regain (+ 7.2 (7.7) % of 1-year body weight on average). The vast majority of participants spent the lockdown #1 period at their usual place of residence, and a minority of participants reported following strict lockdown measures (i.e., no outings during the lockdown period).

Change in PA During Lockdown #1

Two thirds of the participants reported a decrease in PA during lockdown #1 whereas one-third reported either an increase or no change in PA (Supplementary Table 4). As shown in Table 1, a decrease in PA during lockdown #1 was associated with older age, a shorter time elapsed since BS, lower BMI loss since surgery, working from home, and a higher use of anti-anxiety drugs. The most frequently performed PAs during lockdown #1 were house cleaning, walking, and gardening, with no significant differences according to the change in PA

(Fig. 2). Compared to participants who reported a decrease in PA, those reporting an increase or no change in PA were more likely to have engaged in indoor cycling or resistance training, and more likely to have started these PA during lockdown #1 (all $P < 0.05$). Bold values indicate significance with $P < 0.05$

Changes in Body Weight, Lifestyle and Psychological Outcomes During Lockdown #1, and Associations with the Change in PA

Body weight increased on average by 1.5 (3.4) % during lockdown #1, and 13% of participants reported a $\geq 5\%$ increase in body weight (Supplementary Table 4). Overall, 65% of participants reported an increase in sitting time, 30% reported a lower diet quality, and 64% reported a worsening in at least one eating behavior. A minority of participants reported an increase in alcohol consumption or smoking (10% and 8%, respectively). Increased fatigue and shorter sleep duration were reported by 45% and 30% of participants, respectively.

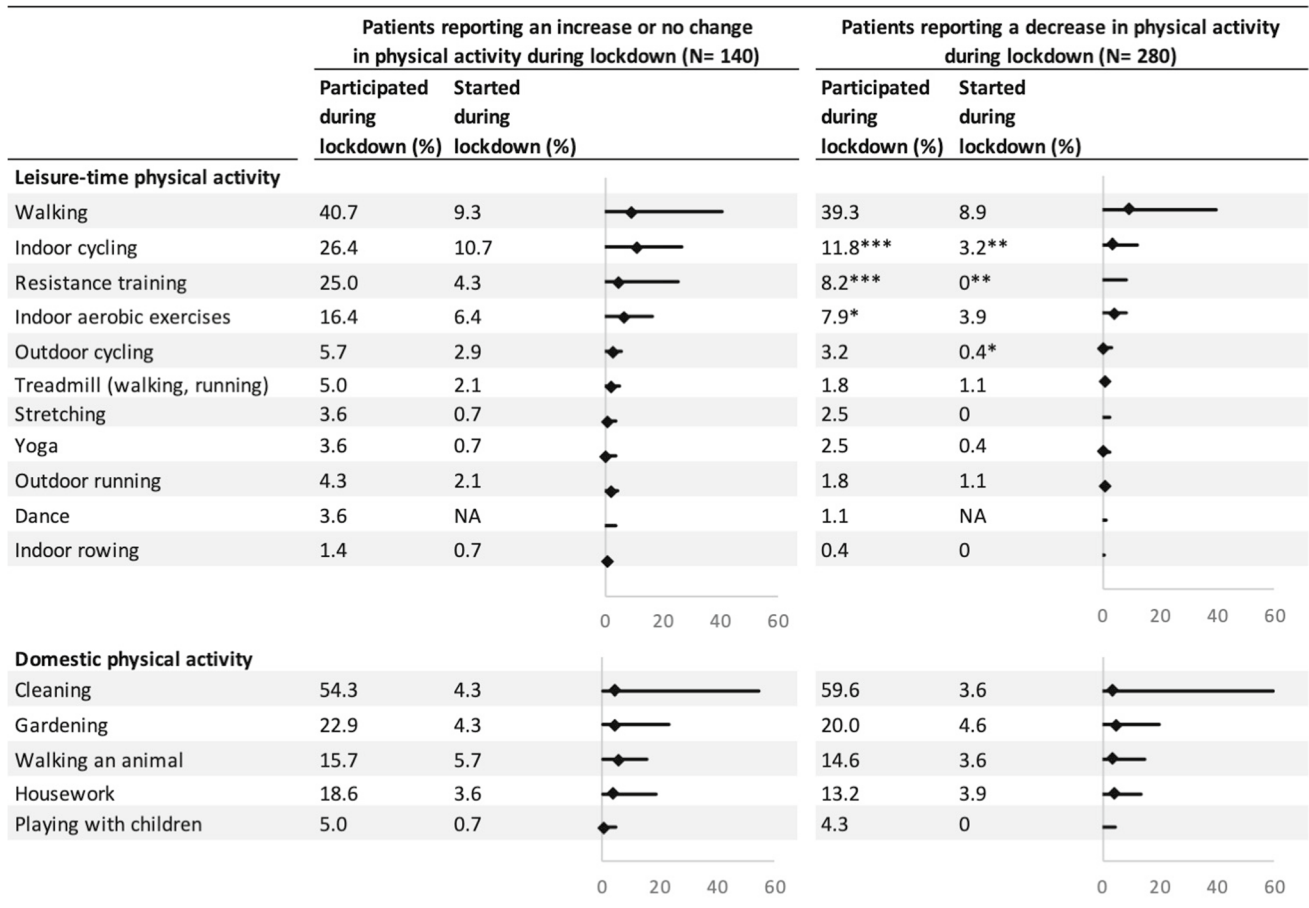


Fig. 2 Participation (%) in leisure-time and domestic physical activity during lockdown #1 (April–May 2020). The lines represent the proportion of patients who participated in each type of physical activity during the lockdown period. The symbol (black diamond) represents the proportion of patients who started this physical activity during

the lockdown. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. P -values from χ^2 test or Fisher’s exact test, representing the difference between patients who experienced a decrease vs. an increase or no change in physical activity during lockdown

Table 2 Changes in body weight, health-related behaviors, and mental health outcomes in post-bariatric patients according to changes in physical activity during COVID-19 lockdown #1 (April–May 2020)

	Change in physical activity during lockdown			
	Increase/ no change (N = 140)	Decrease (N= 280)	OR [95% CI] ^a	Adjusted P-value ^a
Body weight				
Change in body weight, %	0.4 (2.6)	2.1 (3.6)	1.20 [1.11-1.30]	< 0.001
Change in body weight, %, ref: Moderate increase: [0 to 5%]	98 (76.0%)	187 (73.3%)	1.00	ref
Decrease: < 0%	23 (17.8%)	28 (11.0%)	0.70 [0.37-1.31]	0.25
Large increase: ≥ 5%	8 (6.2%)	40 (15.7%)	3.15 [1.46-7.65]	0.006
Sitting time				
Change in sitting time, ref: Decrease/no change	75 (54.3%)	69 (25.0%)	1.00	Ref
Increase	63 (45.7%)	207 (75.0%)	3.83 [2.46-6.02]	< 0.001
Sitting time, h/d	6.8 (3.8)	7.5 (3.6)	1.05 [0.99-1.12]	0.10
Screen time, h/d	5.1 (3.0)	6.4 (3.4)	1.15 [1.07-1.24]	< 0.001
Diet quality and eating behavior				
Change in diet quality, ref: No change/better	103 (75.7%)	178 (67.2%)	1.00	Ref
Lower quality	33 (24.3%)	87 (32.8%)	1.68 [1.05-2.75]	0.034
Unfavorable change in eating behavior*, ref: No	65 (48.5%)	81 (30.3%)	1.00	ref
Yes	69 (51.5%)	186 (69.7%)	2.29 [1.47-3.58]	< 0.001
Change in snacking, ref: No change/decrease	96 (68.6%)	137 (49.5%)	1.00	Ref
Increase	44 (31.4%)	140 (50.5%)	2.33 [1.51-3.63]	< 0.001
Change in cravings, ref: No change/decrease	99 (70.7%)	138 (49.8%)	1.00	ref
Increase	41 (29.3%)	139 (50.2%)	2.80 [1.79-4.44]	< 0.001
Change in loss of control episodes, ref: No change/decrease	101 (74.3%)	184 (66.7%)	1.00	ref
Increase	35 (25.7%)	92 (33.3%)	1.57 [0.99-2.54]	0.06
Change in night-time eating, ref: No change/decrease	111 (82.2%)	200 (73.0%)	1.00	ref
Increase	24 (17.8%)	74 (27.0%)	1.85 [1.10-3.19]	0.02
Alcohol and smoking consumption				
Change in alcohol consumption, ref: No change/decrease	127 (92.0%)	247 (88.8%)	1.00	ref
Increase	11 (8.0%)	31 (11.2%)	1.47 [0.72-3.18]	0.29
Change in smoking, ref: No change/decrease	129 (93.5%)	251 (90.6)	1.00	ref
Increase	9 (6.5%)	26 (9.4%)	1.65 [0.76-3.89]	0.21
Sleep and fatigue				
Change in sleep duration, ref: No change/increase	108 (77.1%)	185 (66.8%)	1.00	ref
Decrease	32 (22.9%)	92 (33.2%)	1.82 [1.13-2.98]	0.01
Sleep duration, h	6.9 (1.6)	6.8 (1.6)	0.99 [0.87-1.13]	0.88
Change in fatigue, ref: No change/decrease	92 (65.7%)	139 (49.6%)	1.00	ref
Increase	48 (34.3%)	141 (50.4%)	2.08 [1.36-3.23]	< 0.001
Mental health outcomes				
GAD-7 score, ref: Minimal	81 (61.4%)	135 (51.9%)	1.00	ref
Mild	26 (19.7%)	63 (24.2%)	1.85 [1.06-3.28]	0.03
Moderate	17 (12.9%)	39 (15.0%)	1.69 [0.89-3.36]	0.12
Severe	8 (6.1%)	23 (8.8%)	2.42 [1.03-6.18]	0.05
PHQ-9 score, ref: Minimal	76 (58.5%)	109 (42.6%)	1.00	ref
Mild	32 (24.6%)	69 (27.0%)	1.91 [1.12-3.31]	0.02
Moderate	14 (10.8%)	37 (14.5%)	2.28 [1.14-4.76]	0.02
Moderately severe to severe	8 (6.2%)	41 (16.0%)	4.74 [2.14-11.76]	< 0.001

^aLogistic regression with age, gender, type of surgery, and time since bariatric surgery as covariates. *Patients reporting at least one negative change among the following outcomes: snacking, cravings, loss of control episodes, night-time eating

Bold values indicate significance with $P < 0.05$

Finally, 13% of participants reported moderately severe to severe depressive symptoms, and 8% reported severe anxiety. A decrease in PA was associated with a greater weight gain (mean (SD): 2.1 (3.6) vs. 0.4 (2.6) %, $P < 0.001$) and longer screen time (Table 2). Participants who reported a decrease in PA were also more likely to report a $\geq 5\%$ weight gain, lower diet quality, an increase in snacking, cravings and night-time eating, a decrease in sleep time, an increase in fatigue, and mild to severe depressive symptoms (all $P < 0.05$). Bold values indicate significance with $P < 0.05$

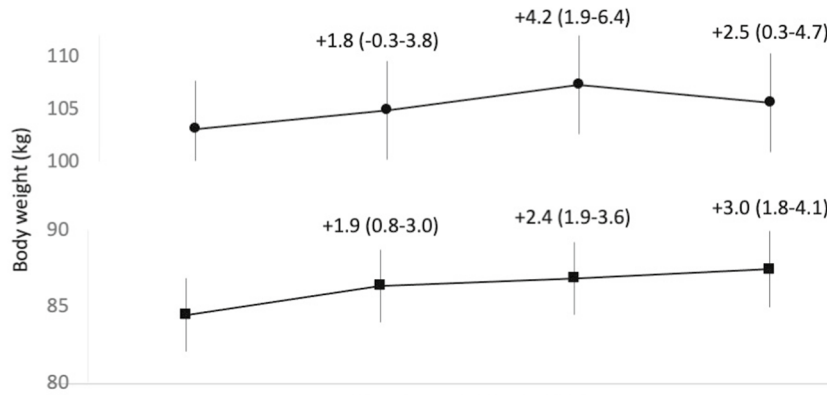
Changes in Body Weight Between Before Lockdown #1 to Lockdown #2

Since a significant weight gain was observed in patients who had reported decreased PA during lockdown #1, these patients were followed-up 7 months later before and during lockdown #2 to record changes in body weight over this period of time. Of these, 71.6% reported a decrease in PA during lockdown #2. There was a significant weight gain (mean (95% CI): +2.8 (1.7–3.8) kg, $p < 0.001$ for time effect), which was greater in women (+3.0 (1.8–4.1) kg in women, +2.5 (0.3–4.7) kg in men, $p < 0.05$ for gender x time interaction) (Fig. 3). Overall, 77.3% reported weight gain and 36.3% of participants reported a $\geq 5\%$ weight gain.

Discussion

This study aimed to analyze the relations between the self-reported change in PA during the COVID-19 lockdown and a set of lifestyle and psychological outcomes in a cohort of 420 patients with a history of BS. Two thirds of patients reported a decrease in PA, which is in line with previous studies that found decreased PA in 40 to 61% of adults with obesity [10, 17] and 49 to 55% of patients who underwent BS [6, 7]. Although outdoor PA was restricted to 1 h per day in a 1-km radius around home, outdoor walking was the most frequently performed leisure-time PA. Interestingly, patients who were able to maintain or increase PA during the lockdown were more likely to engage in indoor activities such as cycling or resistance training and to have started these activities during the lockdown. This shift toward indoor activities may have been favored by the communication campaigns that were carried out to promote home-based PA during the lockdown [18–20].

-During the first period of lockdown that occurred in France between March and May 2020, we observed a mean weight gain of 1.5% of pre-lockdown body weight in our cohort of patients with at least 1 year of follow-up after BS. This is comparable to the 2 kg average weight



		Mean body weight (95% CI)				P-value		
		Before lockdown #1	During lockdown #1	Before lockdown #2	During lockdown #2	Gender	Time	Gender x Time
All	N	262	260	203	225	0.67	< 0.001	0.047
	kg	87.7 (87.1-88.4)	89.5 (88.8-90.1) ^a	91.0 (90.3-91.7) ^{a,b}	90.5 (89.8-91.2) ^a			
Men (●)	N	58	55	45	46	--	--	--
	kg	103.1 (98.5-107.8)	104.9 (100.2-109.6)	107.3 (102.6-112.0) ^{a,b}	105.6 (100.9-110.3) ^a			
Women (■)	N	204	205	158	179	--	--	--
	kg	84.4 (82.0-86.9)	86.3 (83.9-88.7) ^a	86.8 (84.4-89.3) ^a	87.4 (84.9-89.8) ^a			

Fig. 3 Body weight (kg) during lockdown #1 (April–May 2020) and lockdown #2 (Nov–Dec 2020) in post-bariatric patients who had reported a decrease in physical activity during lockdown #1 (N=280). Data are mean (95% CI). P-values for gender, time, and

interaction (gender x time) terms in mixed models (adjusted for body weight reported before lockdown #1). ^aSignificantly different from body weight reported before lockdown #1. ^bSignificantly different from body weight reported during lockdown #1

gain previously reported in patients who were more than 18 months post-BS [6]. The average weight gain reached a total of 2.8 kg at the second period of lockdown that took place in November and December 2020 among patients who had reported decreased PA during the first lockdown, with 36% of them reporting more than 5% weight gain. These findings show the detrimental effect of COVID-19 lockdown on weight trajectories after BS, with potentially negative consequences such as a relapse in obesity comorbidities and decreased quality of life, both tightly linked to weight regain after BS [28, 29].

Importantly, during the first lockdown, the self-reported decrease in PA was associated with a greater weight gain (2.1% vs. 0.4%) and an increased proportion of patients with a $\geq 5\%$ weight gain (16% vs. 6%). The decrease in PA was also associated with other behaviors that may have favored weight gain, such as increased screen time and a worsening of diet quality and eating behavior (i.e., snacking, cravings, loss of control episodes, and night-time eating). These findings show the importance of providing extra care and support to post-BS patients who experienced important weight gain and a worsening of weight-related behavior or mental health outcomes during lockdown.

Our study presents some limitations. First, it relied on self-reported data, as is most often the case for online surveys. This may be of particular concern regarding the change in body weight reported during the lockdown periods, although evidence suggests that self-reported weight can be considered sufficiently accurate in patients undergoing BS when objective weight measurements are not available [30, 31]. Second, most questions focused on the perceived change in health-related behaviors during the lockdown. This was specifically the case for the assessment of PA, where no information was collected regarding PA frequency or duration. Although our data showed a worsening of several outcomes in post-bariatric patients with decreased PA during the COVID-19 lockdown, they do not allow firm conclusions to be drawn on the potential benefits that PA may have in this context. Third, the generalization of our findings may be limited in the sense that most patients followed-up at our medical center live in the same area, and regional disparities were reported during the pandemic [32]. The patients included in this study were also more likely to suffer from a comorbidity before surgery compared to other patients followed up at our center, and they may, therefore, not be representative of the post-bariatric population as a whole. Finally, only selected patients were followed during the second lockdown (i.e., those with decreased PA during the first lockdown), and we were not able to describe the changes occurring in the remaining patients who had reported no change or an increase in PA during the first lockdown.

In conclusion, French patients with a history of BS who reported decreased PA during the first period of COVID-19

lockdown (April–May 2020) were more likely to report weight gain, a worsening of eating behavior, increased fatigue, and more severe depressive symptoms. During the second period of lockdown (November–December 2020), one third of these same patients reported a $\geq 5\%$ weight gain, suggesting a detrimental effect of the COVID-19 pandemic on post-BS weight trajectories. Overall, these results point out the need to strengthen the behavioral management of patients who have undergone BS to counteract the negative impact of the pandemic.

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Declarations

Ethics Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Written informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

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