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**Physical activity and its association with psychosocial health following bariatric surgery**

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**Abstract**

Physical activity (PA) helps sustain weight loss and may also provide psychological benefits in patients undergoing bariatric surgery. Using a set of questionnaires, we demonstrated that bariatric patients with increased level of PA at 1-year follow-up had better psychosocial outcomes including depressive symptoms and mental health-related quality of life compared with those who had reduced or unchanged level of PA. Our findings indicate the benefit of incorporating PA in the postoperative care for bariatric patients.

- Postoperative behavioral change in terms of physical activity improves psychosocial health in patients undergoing bariatric surgery.

**Keywords:** bariatric surgery, obesity, physical activity, psychosocial health, quality of life, questionnaire

## Introduction

The prevalence of obesity in Canada has increased over the past decade; it is estimated that half of the Canadian provinces will have more overweight or obese adults than normal-weight adults by 2019 (Twells et al. 2014). The treatment of obesity includes lifestyle management, pharmacological treatments, and surgery. Bariatric surgery is the most effective option that results in a clinically significant weight loss of over 30% 1 year after the surgery (Colquitt et al. 2014; O'Brien et al. 2019). However, a subset of patients will regain weight typically within 2-5 years after the surgery (Magro et al. 2018). Various lifestyle factors and psychological health issues are associated with weight regain, resulting in return of obesity-related co-morbidities (Lauti et al. 2016). While there are several treatment options for patients experiencing weight regain (Cassin et al. 2016), there is currently no optimal preventive strategy aimed at minimizing weight regain. Exercise interventions have shown benefits in maintaining a high level of physical activity (PA) and improving postoperative weight loss in bariatric patients (Bond et al. 2017; Egberts et al. 2012). PA was also shown to provide both short- and long-term benefits on psychological outcomes in healthy adults (DiLorenzo et al. 1999). Thus, PA may also provide benefits to bariatric patients who suffer from persistent psychological issues, and may reduce the risk of weight regain. However, little is known about the potential benefit of PA on psychosocial outcomes in patients undergoing bariatric surgery. In the present study, we examined the effect of PA on weight loss and psychosocial well-being, including mood, anxiety, body image, and health-related quality of life (HRQOL).

## Materials and Methods

### *Patient population*

Patients who underwent sleeve gastrectomy and Roux-en-Y gastric bypass procedures between January 2013 and March 2017 at the Toronto Western Hospital Bariatric Surgery Program were recruited. Patients were included in the study if they 1) had body mass index (BMI)  $\geq 40$  or  $\geq 35$  kg/m<sup>2</sup> with significant obesity related medical co-morbidities, 2) were receiving their bariatric surgery assessment and follow-up at the Toronto Western Hospital, 3) were over the age of 18, 4) were able to speak and read English, and 5) were able to provide informed consent. Weight and height measurements were taken preoperatively and at 1-year follow-up. At the same time, patients were administered a set of validated self-report questionnaires. Only those patients who completed all components of the questionnaires were included in the analysis. The study was approved by the University Health Network Research Ethics Board.

### *Self-reported questionnaires*

The Social Desirability Scale (SDS) was administered preoperatively in order to take into account the impact of social desirability on self-reported measures of PA (Crowne and Marlowe, 1960). The level of PA was assessed by the International Physical Activity Questionnaire Short Form (IPAQ) (Craig et al. 2003), and was reported as a measure in median metabolic equivalent of task (MET)-minutes per week. Body shape dissatisfaction was measured by the Body Shape Questionnaire (BSQ, version 34) (Cooper et al. 1987; Rosen et al. 1996). Depressive symptoms were assessed by the Patient Health Questionnaire-9 (PHQ9) (Kroenke et al. 2001), and anxiety symptoms were assessed by the Generalized Anxiety Disorder-7 (GAD7) (Spitzer et al. 2006). HRQOL was measured using the Medical Outcomes Study Short-Form 36 Health Status Survey

(SF-36) (Ware and Sherbourne 1992). The SF-36 generates a physical component score (SF36-PCS) and a mental component score (SF36-MCS) (Brazier et al. 1992).

### *Statistical analysis*

Two-tailed paired t-test was performed to examine changes in the level of PA based on IPAQ scores. Weight and height were measured at baseline and at 1-year follow-up to calculate the change in BMI and % TBWL, and Spearman's rank correlation was used to determine the correlation between postoperative PA and %TBWL or change in BMI. Multiple linear regression analyses were performed to determine factors that predict the level of PA at 1-year follow-up, as well as the association between social desirability and the self-reported measure of PA. Study subjects were further divided into those with increased level of PA and those with unchanged or decreased level of PA at 1-year follow-up based on the total MET-minutes per week. Mann-Whitney nonparametric test and chi-squares test were performed for continuous and categorical variables, respectively, to compare demographics, %TBWL, change in BMI, and postoperative psychosocial scores for the two groups. All analyses were performed using R (version 3.4.2), and  $p < 0.05$  was considered statistically significant.

## **Results**

### *Patient Characteristics*

A total of 171 patients with a mean age of  $45.7 \pm 10.9$  years were included in the study. Among them, 80.7% (n=138) were female, and 88.9% (n=152) underwent Roux-en-Y gastric bypass procedure while the remaining 11.1% (n=19) underwent sleeve gastrectomy. Patients had a mean weight of  $137.1 \pm 26.3$  kg and BMI of  $49.9 \pm 10.6$  kg/m<sup>2</sup>.

### *Level of PA and Weight Outcome*

Change in the level of PA (MET-minutes/week) was measured for walking, moderate PA, and vigorous PA. On average, patients reported a significant increase in the amount of time spent on walking ( $p=0.03$ ), moderate PA ( $p=0.04$ ), and vigorous PA ( $p<0.0001$ ) at 1-year follow-up (Figure 1). There was no correlation between the level of PA at 1-year follow-up and %TBWL ( $r=-0.019$ ) and change in BMI ( $r=0.054$ ). Similarly, there was no correlation between the change in the level of PA and %TBWL ( $r=-0.033$ ) and change in BMI ( $r=-0.138$ ).

### *Associations between Baseline Measures and PA outcomes*

Associations between demographics, PA, and psychosocial variables at baseline and PA at 1-year follow-up were examined to determine predictors of the postoperative level of PA. The baseline level of PA was a strong predictor for the level of PA at 1-year follow-up ( $p<0.001$ ). No significant associations were found for any of the remaining demographics or psychosocial variables. A model consisting of demographics and PA level at baseline accounted for 17.1% of variance in PA at 1-year follow-up, and the incorporation of psychosocial variables weakened the model and reduced variance in PA at 1-year follow-up to 16.6%<sup>1</sup>. Social desirability did not have a significant influence on total PA reported at baseline ( $\beta=-0.04$ ,  $p=0.52$ ) and at 1-year follow-up ( $\beta=0.08$ ,  $p=0.72$ ). Variance due to age and sex were included in these models.

### *Association between Change in PA and Postoperative Psychosocial Outcomes*

A total of 125 patients (73.1%) reported an increase in their level of PA, while 46 (26.9%) reported no change or decrease in their level of PA at 1-year follow-up. At the follow-up, patients with increased level of PA reported a significantly higher level of mental components of HRQOL (SF-36 MCS,  $53.9 \pm 9.67$  vs.  $47.7 \pm 14.6$ ,  $p=0.012$ ), lower body shape dissatisfaction (BSQ,  $63.5 \pm 25.8$  vs.  $75.6 \pm 34.3$ ,  $p=0.043$ ), and lower depressive symptoms (PHQ,  $2.6 \pm 3.0$  vs.  $4.5 \pm 5.2$ ,

<sup>1</sup> Supplemental Table S1

$p=0.015$ ) than those who had reduced or unchanged levels of PA (Table 1). There were no significant differences between the groups for age, gender, change in BMI, % TBWL, as well as anxiety and physical HRQOL scores at 1-year follow-up.

## **Discussion**

Approximately 30% of patients considering bariatric surgery suffer from active major depressive disorder, binge eating disorder, personality disorders, and substance use disorders (Kalarchian et al. 2007). Postoperatively, these psychological issues can remain and may manifest years after the procedure, affecting weight regain (de Zwaan et al. 2011). In the present study, we demonstrated that patients with increased postoperative PA reported higher mental components of HRQOL, lower body shape concern, and lower degree of depressive symptoms at 1-year follow-up than those with decreased or unchanged levels of PA. Our findings suggest that PA may improve the psychosocial well-being of bariatric patients.

We demonstrated that the level of PA increased at 1-year follow-up. However, surgery alone may not be sufficient to achieve long-term improvements in physical functioning. For example, a study of 2,221 patients demonstrated that while over 75% of patients improved their physical functioning 1 year after bariatric surgery, the rate of improvement decreased significantly between 1-3 years after the surgery (King et al. 2016). Thus, continued engagement in PA may help patients maintain surgery-induced improvements in physical functioning and help prevent weight regain, which becomes common years after the surgery.

The Clinical Practice Guidelines recommend moderate aerobic PA and postoperative monitoring of adherence to PA recommendations in bariatric patients (Mechanick et al. 2013). Several studies described the implementation of supervised preoperative exercise programs and demonstrated that



while these programs did not result in significant changes in weight during the preoperative period, they improved the level of moderate to vigorous PA and quality of life (Bond et al. 2015a; Bond, et al. 2015b). Similarly, a study implemented a 12-week postoperative exercise program and demonstrated that patients achieved significant improvements in the level of PA, body composition, physical function, and cardiovascular and self-efficacy measures (Herring et al. 2017). Therefore, incorporation of exercise programs that are specifically adapted to bariatric patients, such as group exercise classes, self-directed PA, and frequent telephone counseling (Coleman et al. 2017), may be beneficial for bariatric patients. We also demonstrated that only the baseline level of PA predicted the level of PA at 1-year follow-up. Similarly, a study demonstrated that the baseline level of PA, as well as having less pain and not having asthma predicted postoperative level of PA (King et al. 2012). Addressing these factors before surgery may also improve the efficacy of these interventions.

We demonstrated that there was no significant relationship between the level of PA and weight outcomes (%TBWL, change in BMI); however, these outcomes were collected only at 1-year follow-up. In fact, the majority of studies that reported positive effects of PA on weight outcomes had follow-up periods of 1 to 4.5 years (Egberts et al. 2012). Thus, the effect of PA on weight outcomes needs to be re-examined on a long-term basis. Other limitations of the current study include the reliance on self-reported measure of PA. While a study demonstrated that social desirability biased self-reports of PA in children (Klesges et al. 2004), others demonstrated that it did not have any influence on self-report measurements of PA in adults (Crutzen and Göritz 2011; Motl et al. 2005). Our finding also indicates that social desirability does not influence self-reported measure of PA in bariatric patient population. Future studies are warranted in a larger population using self-reported and/or objective measures of PA, including the use of active monitors.

In conclusion, our findings indicate that PA following bariatric surgery may improve the psychosocial well-being of patients. Additional studies are needed to examine whether a formal PA program helps sustain weight loss in the long-term. We anticipate that such program would be a positive contribution to the multidisciplinary treatment approach of bariatric candidates.

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**Conflict of interest**

The authors have no conflicts of interest to report.

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Table 1:

	Increased PA level (n=125)	Decreased/ unchanged PA level (n=46)	p-value
Age at baseline	5.9 ± 0.97	44.9 ± 1.54	0.68
Female (n, %)	99 (79.2)	39 (84.8)	0.41
Change in BMI	-15.62 ± 7.51	-14.7 ± 6.6	0.60
% TBWL	30.66 ± 9.41	29.38 ± 10.65	0.44
Body Shape Dissatisfaction (BSQ)	63.5 ± 25.8	75.6 ± 34.3	0.043*
Anxiety (GAD)	2.2 ± 3.6	3.0 ± 4.0	0.095
Depressive symptoms (PHQ)	2.6 ± 3.0	4.5 ± 5.2	0.015*
Mental HRQOL (SF_MCS)	53.9 ± 9.67	47.7 ± 14.6	0.012*
Physical HRQOL (SF_PCS)	51.0 ± 8.9	49.4 ± 11.7	0.657

Comparison of patient demographics and postoperative psychosocial scores between those with increased level of PA and with decreased or unchanged levels of PA. Values are presented as mean ± SD unless otherwise noted. \*p<0.05

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Figure Legend:

Figure 1: Levels of PA measured preoperatively and at 1-year follow-up. IPAQ score was measured in MET-minutes per week. \* $p < 0.05$ , \*\*\* $p < 0.0001$

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