OBES SURG (2015) 25:514–522
DOI 10.1007/s11695-014-1443-3

ORIGINAL CONTRIBUTIONS

Employment Outcomes One Year after Bariatric Surgery: the Role of Patient and Psychosocial Factors

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Published online: 24 September 2014

Abstract
Background Patients undergoing bariatric surgery generally report improved work performance after this procedure; however, previous research has been limited by a lack of standardized employment measures and a failure to account for the impact of psychiatric illness on employment outcomes. To address these limitations, this study aims to assess changes in patients' employment impairment and productivity 12 months post-surgery and to identify psychosocial predictors of change in employment outcomes.
Methods A total of 164 patients underwent bariatric surgery between February 2010 and November 2012 in this prospective cohort study. The primary outcome was a change in employment impairment (EI) as measured by total Lam Employment Absence and Productivity Scale (LEAPS) scores and changes in participants' job status category. Multiple linear regression models assessed whether baseline demographic or clinical factors, including a history of psychiatric illness and changes in depressive, anxiety and quality of life (QOL) symptoms, were associated with a change in LEAPS scores.
Results Participants reported a significant reduction in EI post-surgery ($p<0.0001$) and improvement in work productivity ($p<0.0001$) 12 months after surgery. Only changes in depression (confidence interval (CI) 0.46, 0.76, $p<0.0001$), anxiety (CI 0.49, 0.85, $p<0.0001$) and mental QOL (CI −0.30, −0.17, $p<0.0001$) were significant predictors of change in EI total scores. Logistic regression analysis did not identify significant predictors of change in participant job status.

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Conclusions Patients with pre-bariatric surgery psychiatric distress are more likely to report greater employment impairment and worse employment productivity pre-surgery. These patients also experience the greatest improvements in post-surgery employment functioning.

Keywords Employment · Bariatric · Obesity · Mental disorders · Quality of life

Introduction

With global obesity rates nearly doubling in the last 30 years [1], bariatric surgery has emerged as an effective treatment for class II and class III obesity (body mass index (BMI) exceeding 35 kg/m^2) [2]. In addition to facilitating significant weight loss, bariatric surgery can result in significant improvements in obesity-related co-morbidities, such as diabetes, hypertension, dyslipidaemia, sleep apnoea and depression [3–6]. As a result of these effects on weight and obesity-related co-morbidities, weight-loss post-surgery has been shown to increase life expectancy, overall quality of life, depressive symptoms, social interaction and body image [2, 7–9]. Considerable improvements have also been noted in overall physical activity and consequent work capacity [10].

Given the notable benefits of bariatric surgery on overall physical and mental health, there has been increasing focus on the impact of bariatric surgery on work-related disability and functioning. Obesity and related co-morbidities result in increased costs to employers [11], and increased sick leave, medical claims and workplace injuries have been noted in overweight and obese employees [12]. Annual health-care costs attributed to obesity-related illness in the USA have been estimated to be as high as US$190 billion dollars annually and full-time employees with stage III obesity account for 21 % of obesity-related costs [13, 14]. A retrospective survey found that 32 % of pre-operative bariatric surgery patients claimed at least one disability benefit (including Carer's Allowance) compared to only 10 % of post-operative patients [15]. In addition, obese employees have an estimated 83–88 % of the productivity of normal-weight workers [11, 16] due to a greater number of missed days, which are often attributed to such health problems [17]. In a non-surgical study sample, non-surgical obese patients also took nearly twice as many sick days in comparison to non-obese patients (8.45 vs. 3.73 sick days) over the 6-year study period [18]. A recent study reported that bariatric patients lost a mean of 33 work days due to illness or injury in the year prior to surgery, compared to only 3 days lost by an average US worker for those same reasons [16].

This impairment in employment outcomes is further compounded by the propensity for many obese individuals to suffer weight discrimination in the workforce. Several studies report increased rates of weight-based discrimination in employment settings, with obese individuals and severely obese individuals being 37 times and 100 times more likely than normal-weight individuals to report employment discrimination, respectively [19, 20]. Evidence from a systematic review of weight-based discrimination studies suggests that obese employees are more likely to experience wage penalties, receive negative job evaluations and have lower rates of employment [21], further reinforcing the negative impact of obesity-related stigma on employment outcomes.

Numerous studies have documented improved patient work performance after bariatric surgery, specifically decreases in absenteeism and increased productivity [22–24]. One of the earlier studies noted a 22 % increase in the number of patients in full-time or part-time employment 3 years after bariatric surgery [10]. Another study which tracked patients (N=59) for 14 months following surgery reported a 5.7-h increase in the number of hours worked per week following laparoscopic Roux-en-Y gastric bypass (LRYGBP) or laparoscopic adjustable gastric banding (LAGB) [15]. Their findings also outlined a decrease in the number of patients who claimed state benefits following bariatric surgery. Other studies support the finding of reductions of disability pensions in post-operative patients [19], specifically in older patients aged 47–60 years [25]. Collectively, the research conducted to date suggests that bariatric surgery has a promising impact on employment rates and work-related disability and functioning; however, the studies have been limited by the lack of formal standardized employment measures. Most studies examining employment outcomes after bariatric surgery have relied on self-report measures [16], retrospective surveys [15], broad health/medical state surveys [17, 26] or semi-structured interviews when gathering employment-related information [10]. A history of psychiatric illness, which occurs in nearly 70 % of bariatric surgery candidates [27], may also contribute to reductions in work productivity; for example, 29 % of non-bariatric patients with a history of major depressive disorder (MDD) reported reduced activity at work compared to 10 % without MDD [28]. Moreover, depressed patients from the USA showed a 1.5 to 3.2 increased likelihood of short-term work disability days per month [29]. The impact of psychiatric illness on employment outcomes post-bariatric surgery has not been accounted for in these previous studies.

To address these limitations in the literature, our study aimed to determine changes in patients' employment impairment and productivity 12 months post-bariatric surgery and to identify potential psychosocial predictors of changes in employment outcomes after surgery. We hypothesized that a history of psychiatric illness would be associated with a lower magnitude of a patients' change in employment impairment and productivity after bariatric surgery.

Methods

Study Sample

Study participants were recruited from the Toronto Western Hospital Bariatric Surgery Program (TWH-BSP), a level 1A bariatric centre accredited by the American College of Surgeons, which is one of two assessment centres in the University of Toronto Bariatric Surgery Collaborative. Patients are referred to the TWH-BSP through a centralized provincial bariatric surgery registry called the Ontario Bariatric Network. Patients are referred to the TWH-BSP if they have a body mass index (BMI) ≥40 kg/m^2 or a BMI ≥35 kg/m^2 with one or more obesity-related co-morbidity. All patients undergo an interdisciplinary bariatric surgery assessment process prior to receiving bariatric surgery. This pre-surgery assessment process has been described in previous studies [30, 31].

Consecutive patients (N=223) scheduled for bariatric surgery between February 2010 and November 2012 who were at least 18 years old, provided informed consent, were employed and underwent bariatric surgery and were included in this study. Participant suitability for bariatric surgery followed the National Institute Health Guidelines [32]. All patients received a Roux-en-Y gastric bypass surgery unless a sleeve gastrectomy was surgically indicated. The study was approved by the University Health Network Research Ethics Board in accordance with the ethical guidelines of the 1975 Declaration of Helsinki.

Measures

Demographic data consisting of gender, age, ethnicity and type of employment was collected by clinic nurse practitioners and social workers during participants' first pre-surgery assessment appointment. Employment type was classified using categories defined by the National Occupational Classification (see Table 1) [33]. Programme dietitians measured all patients' height and weight during the pre-surgery assessment process and at 12 months post-bariatric surgery in order to calculate body mass index (BMI; kg/m^2). Percent total weight loss (%TWL) was calculated at 12 months post-surgery [%TWL=(pre-surgery weight−12-month post-surgery weight)/pre-surgery weight].

Employment, depression, anxiety and health-related quality of life measures were administered once participants successfully completed the pre-surgery assessment process and at 12 months post-surgery. In addition, all patients underwent a psychiatric assessment by a psychiatrist, psychologist or psychometrist (Master's level psychologist trained in psychiatric assessment) prior to surgery to the diagnosis of psychiatric co-morbidity. All assessments were conducted as part of the programme's pre-bariatric surgery assessment process.

Table 1 Participant characteristics

Characteristics	
Gender (female), *n* (%)	133 (81.1 %)
Age (years)	43.5±9.7
Race, *n* (%)	
White	138 (84.1 %)
Black	10 (6.1 %)
Pre-surgery BMI (kg/m^2)	49.0±8.0
%TWL at 12 months post-surgery	34.3±11.6
Pre-surgery type of employment, *n* (%)	
Sales and service	40 (24.4 %)
Business, finance and administration	39 (23.8 %)
Education, law and social, community governmental services	35 (21.3 %)
Health	16 (9.8 %)
Trades and transport	9 (5.5 %)
Natural and applied sciences	7 (4.3 %)
Art, culture, recreation	4 (2.4 %)
Management	4 (2.4 %)
Other	10 (6.1 %)
History of any Axis I psychiatric illness, *n* (%)	89 (54.3 %)
History of a mood disorder, *n* (%)	57 (34.8 %)
History of an anxiety disorder, *n* (%)	22 (13.4 %)
History of a eating disorder, *n* (%)	31 (18.9 %)

Continuous variables reported as means±standard deviation

Employment Impairment and Productivity The Lam Employment Absence and Productivity Scale (LEAPS) is a validated self-report questionnaire used to assess impairment in work functioning and productivity [34]. It consists of seven items rated on a five-point Likert scale to yield a LEAPS total score (range 0–28), and it also generates a productivity sub-scale score based on three items (range 0–12). We considered raw sores and their differences (difference scores=LEAPS score 12 months post-surgery−LEAPS score pre-surgery) in our data analysis. Higher scores indicate impaired functioning and lower productivity, respectively. Lower scores represent improved functioning and productivity. The difference scores range from (28, 28) and (−12, 12), respectively. Positive difference scores indicate persons with impaired functioning over time whereas negative difference scores indicate improved functioning over time. The LEAPS has demonstrated high internal consistency (Cronbach's alpha was 0.89) and high correlations with other validated measures of work functioning and productivity [34]. Although the LEAPS has been used in non-depressed control groups [35], it has been used predominantly in depressed patient populations. Given the high rates of psychiatric co-morbidity in bariatric surgery candidates and that depression is considered an obesity-related co-morbidity, the LEAPS was considered an ideal employment impairment assessment measure for this patient

population [27]. In addition, the role of depression on LEAPS outcomes was accounted for in our analysis to determine if a history of major depression impacted LEAPS data analysis.

Depressive Symptoms Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ9), a nine-item scale with each item scored 0 to 3 and summed to yield a total score (range 0–27) [36]. PHQ9 severity cut-point scores are 5 for mild, 10 for moderate, 15 for moderately severe and 20 for severe depressive symptoms. The PHQ9 has been validated in bariatric surgery patient populations and has been shown to have good sensitivity and specificity when compared to structured clinical interview [37].

Anxiety Symptoms Participants' anxiety symptoms were measured using the generalized anxiety disorder seven-item scale (GAD7), a tool validated in 2,740 primary care patients [38]. The GAD7 has good sensitivity and specificity for a range of anxiety disorders: panic disorder (S=0.74, Sp=0.81), social anxiety disorder (S=0.72. Sp=0.82), generalized anxiety disorder (S=0.89, Sp=0.82) and post-traumatic stress disorder (S=0.66, Sp=0.91) [35, 39]. The seven items on the GAD7 are each scored between 0 and 3 and summed to generate a total score (range 0–21). The GAD7 severity cut points are 5 for mild, 10 for moderate, and 15 for severe anxiety.

Health-Related Quality of Life The Medical Outcomes Study Short-Form 36 Health Status Survey (SF-36) was used to measure patients' quality of life in physical and mental domains [40]. The SF-36 measures eight domains of functioning and yields a physical component score (SF36-PCS) and mental component score (SF36-MCS). Scores range from 0 (lowest or worst possible level of functioning) to 100 (highest or best possible level of functioning). The SF-36 has been used previously in bariatric surgery patient populations [41, 42] and has good construct validity, high internal consistency and high test-retest reliability [43].

Psychiatric Illness Participants were diagnosed with a lifetime history (past or current) of a psychiatric disorder using the Mini International Neuropsychiatric Interview (MINI) version 5.0 [44]. The modules of the MINI are used to diagnose mood, anxiety, psychotic, eating and substance use disorders. The MINI 5.0 was supplemented with modules to assess binge eating disorder, attention deficit hyperactivity disorder and lifetime generalized anxiety disorder based on Diagnostic and Statistical Manual of Mental Disorders IV (DSM IV) criteria. The MINI is a structured diagnostic interview with good reliability and validity, and it has high agreement with the Structured Clinical Interview for DSM Axis I Disorders (SCID; Kappa=0.84) in primary care settings [44].

Statistical Analysis

Due to the lack of previous studies using the LEAPS in bariatric populations, we estimated the sample size using data from non-bariatric samples [45]. Based upon our fixed sample of 164 patients, we anticipated a mean difference of 2.5 units and a standard deviation of 5.1 units would result in a power of 99 % to detect changes in LEAPS scores over time.

Data was analysed using SAS 9.3 [46]. Descriptive statistics were used to characterize the study population. Pre-surgery characteristics of participants who did not complete the 12-month post-surgery appointment in the study were compared with study completers to determine selection bias.

The primary outcomes for statistical analyses were changes in LEAPS total scores, changes in LEAPS productivity scores and changes in participants' job status category. To assess whether LEAPS scores or LEAPS productivity scores changed over this interval, we first calculated difference scores on the LEAPS (12 months post-surgery minus pre-surgery baseline) and assessed whether these change scores were centred about zero or not. To test these statistical hypotheses, we employed a non-parametric Wilcoxon signed-rank test. To assess changes in job status category, we classified participants as job "changers" versus "non-changers".

We used multiple linear regression models to assess whether baseline demographic or clinical factors were associated with change in LEAPS scores or LEAPS productivity scores, respectively. We used a multiple logistic regression model to assess demographic and clinical factors associated with changing job status (categorized as "yes" or "no") over this follow-up interval. We assessed potential bivariate associations between age, gender, %TWL, pre-surgery BMI, history of any Axis I psychiatric disorder, history of a mood disorder, history of an anxiety disorder, history of an eating disorder, change in PHQ9, change in GAD7, change in SF36-PCS and change in SF36-MCS in each of the three models, respectively. Change in PHQ9, GAD7 and SF36 scores was calculated as the difference between 12 month post-surgery scores and pre-surgery scores. Given that the LEAPS has been studied predominantly in depressed patient populations, we also conducted a linear regression analysis for both LEAPS total scores and LEAPS productivity scores controlling for a history of a major depressive disorder. Statistical significance for all analyses was set at $p<0.05$.

Results

A total of 164 participants attended the 12-month post-surgery appointment and completed the study measures (73.5 % follow-up rate). There were no significant differences between study completers (n=164) and non-completers (n=59) in

terms of gender, age, pre-surgery BMI, PHQ9, GAD7, SF36-PCS, SF36-PCS or history of an Axis I psychiatric disorder. Three non-completers were no longer employed post-surgery, and the remaining 56 did not attend the 12-month post-surgery appointment.

Table 1 summarizes the characteristics of the study sample. The sample was predominantly female (81.1 %), white (84.1 %) and had a mean pre-surgery BMI of 49.0 kg/m^2. Eight patients (4.9 %) underwent a sleeve gastrectomy as opposed to a Roux-en-Y gastric bypass. Patients experienced a mean total weight loss of 34.3 % at 12 months post-surgery.

Employment Outcomes Post-bariatric Surgery

Employment outcomes as measured by the LEAPS showed a significant reduction in work impairment post-bariatric surgery (change in total LEAPS score=−3.77±6.30, $p<0.0001$) and an improvement in work productivity (change in LEAPS productivity sub-scale score=−1.21±2.74, $p<0.0001$) (see Table 2). In addition, HRQOL improved in both physical (change in SF36-PCS=20.08±9.05, $p<0.0001$) and mental domains (change in SF36-MCS=3.76±13.31, $p=0.001$) 12 months post-bariatric surgery. Scores on the PHQ9 (mean difference −6.07±5.80, $p<0.0001$) and GAD7 (mean difference −2.98±5.00, $p<0.0001$) also significantly improved after surgery. A total of 31 patients (19.0 %) changed their job class within 12 months of receiving bariatric surgery. The four most popular job classes remained unchanged post-surgery, with the most popular job classes at both time points being sales and service (pre-surgery 24.4 % vs. post-surgery 27.4 %); business and finance (pre-surgery 23.8 % vs. post-surgery 20.1 %); education, law and social, community governmental services (pre-surgery 21.3 % vs. post-surgery 20.7 %) and health (pre-surgery 9.8 % vs. post-surgery 10.4 %).

Predictors of Employment Outcomes 12 Months After Bariatric Surgery

Linear regression analysis for change in LEAPS total score 12 months post-bariatric surgery identified difference in PHQ9 ($\beta=0.61$, confidence interval (CI) 0.46, 0.76, $p<0.0001$), difference in GAD7 ($\beta=0.67$, CI 0.49, 0.85, $p<0.0001$) and difference in SF36-MCS ($\beta=-0.24$, CI −0.30, −0.17, $p<0.0001$) as significant bivariate predictors in the linear regression model (see Table 3). After controlling for a history of a major depression, differences in PHQ9 scores ($\beta=0.61$, CI 0.46, 0.76, $p<0.0001$), GAD7 scores ($\beta=0.65$, CI 0.48, 0.83, $p<0.0001$) and SF36-MCS scores ($\beta=-0.25$, CI −0.31, −0.18, $p<0.0001$) remained the only significant predictors of LEAPS total scores amongst studied covariates. Post-surgery BMI was not a significant predictor of change in total and employment productivity LEAPS scores 12 months after surgery. Therefore, a decrease in the GAD and PHQ9 scores and increase in SF36-MCS scores resulted in an increase in LEAP change scores (decreased employment impairment).

PHQ9 difference scores ($\beta=0.20$, CI 0.13, 0.27, $p<0.0001$), GAD7 difference scores ($\beta=0.13$, CI 0.03, 0.23, $p=0.01$) and SF36-MCS difference scores ($\beta=-0.07$, CI: −0.11, −0.04, $p=0.001$) were also identified as significant predictors of LEAPS productivity scores on linear regression analysis (see Table 4). In addition, a history of a mood disorder ($\beta=0.96$, CI 0.07, 1.85, $p=0.03$) was significantly associated with a reduced change in LEAPS productivity scores. Change in PHQ9 scores ($\beta=0.20$, CI −0.13, 0.27, $p<0.0001$), in GAD7 scores ($\beta=0.20$, CI 0.12, 0.29, $p<0.0001$) and in pre-surgery SF36-MCS scores ($\beta=-0.07$, CI −0.11, −0.04, $p<0.0001$) continued to be significant predictors of LEAPS productivity scores after a history of a major depressive disorder was controlled for on linear regression analysis.

For the dichotomous change in job status response, analysed via logistic regression, none of the predictors under investigation significantly impacted the likelihood of a patient changing their job category following bariatric surgery.

Discussion

The current study sought to determine changes in work-related impairment and productivity 12 months following

Table 2 Changes in LEAPS and quality of life outcomes 12 months post-bariatric surgery

Employment and QOL outcome	Pre-surgery	12 months post-surgery	Mean difference±SD	*P* value
LEAPS total score	6.38±5.30	2.61±4.41	−3.76±6.30	*P*<0.0001
LEAPS productivity	1.99±2.26	0.79±1.87	−1.21±2.74	*P*<0.0001
PHQ9 score	9.54±5.81	3.47±4.08	−6.07±5.80	*P*<0.0001
GAD7 score	5.58±5.34	2.60±4.08	−2.98±5.00	*P*<0.0001
SF36-PCS	32.10±9.39	52.19±6.64	20.08±9.05	*P*<0.0001
SF36-MCS	49.13±10.42	52.89±11.25	3.76±13.31	*P*=0.001

Scores were reported as means±standard deviation. Higher LEAPS scores indicate greater impairment; Higher PHQ9 and GAD7 scores indicate greater distress; negative difference scores indicate improved employment, depression and anxiety outcomes 12 months post-surgery

Table 3 Bivariate and multiple linear regression analysis of change in LEAP total score

Variable	Bivariate				Multiple linear regression			
	Coefficient	LL 95 % CI	UL 95 % CI	*P* value	Adjusted coefficient	Adjusted LL 95 % CI	Adjusted UL 95 % CI	Adjusted *P* value
Pre-surgery age	0.06	−0.04	0.16	0.26	0.06	−0.04	0.16	0.24
Gender (female)	−0.52	−2.98	1.93	0.68	−0.02	−2.54	2.50	0.99
%TWL	−0.06	−0.14	0.03	0.18	−0.07	−0.15	0.02	0.12
Pre-surgery BMI	0.07	−0.05	0.19	0.25	0.08	−0.04	0.20	0.19
History of Axis I disorder	1.50	−0.49	3.48	0.14	0.34	−2.29	2.97	0.80
History of a mood disorder	2.00	−0.03	4.03	0.05	–	–	–	–
History of an anxiety disorder	−1.29	−4.13	1.55	0.37	−1.51	−4.33	1.30	0.29
History of an eating disorder	0.01	−2.49	2.50	1.00	−0.39	−2.88	2.10	0.76
Difference in GAD-7[a]	0.67	0.49	0.85	<0.0001	0.65	0.48	0.83	<0.0001
Difference in PHQ-9[a]	0.61	0.46	0.76	<0.0001	0.61	0.46	0.76	<0.0001
Difference in SF36-MCS[a]	−0.24	−0.30	−0.17	<0.0001	−0.25	−0.31	−0.18	<0.0001
Difference in SF36-PCS[a]	−0.07	−0.19	0.04	0.20	−0.07	−0.19	0.05	0.23

[a] Difference=post-surgery−pre-surgery score

bariatric surgery using a standardized measure of work-related functioning. The LEAPS assesses the extent to which respondents have been bothered by low energy or motivation, poor concentration or memory, anxiety or irritability or difficulty getting along with others while at work over the past 2 weeks. With respect to productivity, it inquires about the extent to which respondents have been getting less work done, doing poorer quality work or making more mistakes.

As hypothesized, bariatric surgery was associated with a significant reduction in total work impairment (negative LEAPS difference score) and a significant improvement in work productivity. The magnitude of the improvement in total work impairment following bariatric surgery was considered a clinically meaningful change, defined as difference in LEAPS scores of 2.5 or more [45]. Regarding the level of work-related impairment, on average, bariatric patients reported "mild impairment" on the LEAPS prior to surgery, and within 12 months following surgery, their scores fell within the "none/minimal impairment" range. In sum, bariatric surgery appears to have a statistically and clinically significant impact on employment-related functioning, such that it normalizes within 12 months following bariatric surgery.

A secondary objective of the study was to identify potential psychosocial predictors of employment outcomes following

Table 4 Bivariate and multiple linear regression analysis of change in LEAP productivity sub-scale

Variable	Bivariate				Multiple linear regression			
	Coefficient	LL 95 % CI	UL 95 % CI	*P* value	Adjusted coefficient	Adjusted LL 95 % CI	Adjusted UL 95 % CI	Adjusted *P* value
Pre-surgery age	0.03	−0.01	0.08	0.11	0.04	−0.01	0.08	0.11
Gender (female)	−0.30	−1.37	0.77	0.58	−0.05	−1.15	1.05	0.93
%TWL	−0.03	−0.06	0.01	0.16	−0.03	−0.07	0.01	0.13
Pre-surgery BMI	0.04	−0.02	0.09	0.17	0.04	−0.01	0.09	0.12
History of Axis I disorder	0.47	−0.40	1.35	0.29	−0.26	−1.42	0.89	0.65
History of a mood disorder	0.96	0.07	1.85	0.03	–	–	–	–
History of an anxiety disorder	−0.60	−1.85	0.64	0.34	−0.71	−1.94	0.52	0.26
History of an eating disorder	−0.13	−1.22	0.96	0.81	−0.33	−1.41	0.76	0.56
Difference in GAD-7[a]	0.13	0.03	0.23	0.01	0.20	0.12	0.29	<0.0001
Difference in PHQ-9[a]	0.20	0.13	0.27	<0.0001	0.20	0.13	0.27	<0.0001
Difference in SF36-MCS[a]	−0.07	−0.11	−0.04	<0.0001	−0.07	−0.11	−0.04	<0.0001
Difference in SF36-PCS[a]	−0.03	−0.08	0.02	0.23	−0.04	−0.09	0.02	0.17

[a] Difference=post-surgery−pre-surgery score

bariatric surgery. Improvements in quality of life, depressive symptoms and anxiety symptoms were also seen 12 months post-surgery, which parallel observed improvements in work impairment and productivity. After controlling for a lifetime history of a major depression, the significant predictors of changes in work-related impairment and productivity included difference scores on the PHQ9 (depression symptoms), GAD7 (anxiety symptoms), and SF36-MCS (mental quality of life). Contrary to our hypothesis, a history of psychiatric illness was not a predictor of change in work-related impairment and productivity after bariatric surgery. In fact, improvements in depression, anxiety and mental quality of life were the only significant predictors of work-related impairment and productivity. Collectively, the results suggest that obese individuals experience less work-related impairment after undergoing bariatric surgery, and the greatest change in LEAPS scores are observed in patients with greater psychopathology and work impairment prior to surgery.

The results of the current study lend additional support to the growing body of literature demonstrating the positive impact of bariatric surgery on work-related disability and functioning using a variety of employment outcome measures [10]. Cost-effectiveness analyses of bariatric surgery have focused primarily on the economic impact of surgery on the health-care system through improvement of obesity-related co-morbidities and reduction of medical expenditures [47]. However, the impact of bariatric surgery on employment-related outcomes is also an important consideration in light of accumulating evidence that bariatric surgery might also boost the economy by increasing employment rates [10, 48] and productivity [22–24] and by decreasing absenteeism [22–24], disability claims [15], and disability pensions [22]. The current study adds to our understanding of employment outcomes post-surgery and suggests that individuals with improvements in psychopathology after bariatric surgery experience the largest improvements in work-related functioning following surgery. Moreover, patients without a past history of psychiatric illness pre-surgery had minimal employment impairment prior to surgery and their employment impairment and performance remained relatively unchanged after surgery. The study further illustrates the bidirectional relationship and shared patho-aetiology between obesity and mental illness, such as mood disorders [49, 50], and how employment outcomes related to bariatric surgery are potentially influenced by improvements in psychiatric symptoms. Based on data from non-bariatric depressed populations demonstrating improvement in employment outcomes with depression treatment, it is possible that the improvements in employment outcomes were primarily attributable to bariatric surgery-related improvements in depression [51]. Interestingly, demographic factors, extent of weight loss and past psychiatric history were not found to be significant predictors of employment outcomes in our study.

The strengths of this research include the prospective design to assess changes in work-related functioning from pre-surgery to 12 months post-surgery, the inclusion of a standardized measure of work-related functioning, the inclusion of measures of psychopathology with strong psychometric properties that have previously been used in bariatric surgery samples and the sample of consecutive referrals to minimize selection bias. However, a discussion of the study limitations is warranted. First, given that the LEAPS assesses employment impairment and productivity, it was only completed by individuals who were engaged in paid employment. This is important given that approximately 19 % of patients receiving bariatric surgery are unemployed [48]. Although it was possible to determine the percentage of employed bariatric surgery patients changing their job class within 12 months of undergoing surgery (19 % of participants), it was not possible to determine the percentage of patients moving from being unemployed or on disability at pre-surgery to being employed at 12 months post-surgery in our study. Second, patients completed the pre-surgery measures as part of the screening and approval process for bariatric surgery, and patients might have minimized their mental health symptoms. Previous research has demonstrated that patients tend to underreport symptoms on diagnostic interviews relative to self-report inventories [37], and perhaps, this finding helps account for history of psychiatric illness not being a significant predictor of patients' employment impairment in the current study. As stated earlier in this article, weight-based discrimination has been associated with worse employment outcomes and weight loss secondary to surgery may have affected the impact of weight-based discrimination on employment impairment in our study [21]. Future studies are needed to clearly elucidate the relationship between weight-based discrimination in the workplace, psychosocial factors and bariatric surgery outcomes. Finally, the study was conducted in a Canadian setting in which all patients received provincially funded bariatric surgery, and it is uncertain if the results would generalize to bariatric surgery patients in other countries who must pay for surgery out-of-pocket or through private insurance coverage.

In summary, the current findings suggest that bariatric surgery improves employment-related impairment and productivity overall. Furthermore, changes in employment-related impairment are significantly associated with improvements in psychiatric distress post-bariatric surgery. Interventions aimed at supporting and maintaining mental health improvement after bariatric surgery may further enhance employment outcomes and warrant further study. An important area of inquiry for future research would be to prospectively examine beyond 12 months post-surgery changes in employment status from pre-surgery to post-surgery using more comprehensive employment measures in order to determine the percentage of individuals who are unemployed, on sick leave, or on disability and who are able to return to paid employment.

Acknowledgments We would like to thank our patients who participated in the study. We would also like to thank our Toronto Western Hospital Bariatric Interdisciplinary team for their support and the Ministry of Health of Ontario and the Ontario Bariatric Network for their ongoing psychosocial program funding.

Conflicts of Interest The authors have no conflicts of interest related to this work.

Statement of Informed Consent Informed consent was obtained from all individual participants included in the study.

Statement of Human and Animal Rights The study was approved by the Research Ethics Board at the University Health Network in accordance with the ethical guidelines of the 1975 Declaration of Helsinki.

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