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The longitudinal trajectory of post-surgical % total weight loss among middle-aged women who had undergone bariatric surgery

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ABSTRACT

Middle-aged women are at a higher risk of being obese. We examined the trajectory of post-surgical % total weight loss (%TWL) among middle-aged female bariatric patients. We fitted sequential generalized estimating equations models to analyze a sample of women who received bariatric surgery in 1995–2012, aged 40–65 years at the time of surgery (N = 158,292) whose pre-operative body mass index (BMI) was ≥30 kg/m^2 in the Bariatric Outcomes Longitudinal Database. The %TWL computed by 100% × (pre-surgery BMI − post-surgery BMI) / pre-surgery BMI showed different trajectories depending on type of surgery. For gastric banding, %TWL increased rapidly right after bariatric surgery and started to decrease around 1 year after surgery. For Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy, %TWL overall did not show remarkable changes from around 1 year after surgery. The highest increase in %TWL was observed in patients whose pre-operative BMI was 40 or higher and those who had undergone RYGB (*ps* < 0.001). Whereas the trajectories of %TWL among patients with sleeve gastrectomy and gastric banding did not differ much between different pre-operative BMI groups, the trajectories for RYGB were notably different between different pre-operative BMI groups (*ps* < 0.001). Middle-aged female bariatric patients are likely to achieve the highest %TWL if they receive RYGB and if their pre-operative BMI is 40 or higher. Further research is warranted to corroborate the present study's finding on the long-term effect of different types of bariatric surgery on %TWL among middle-aged women.

1. Introduction

More than one-third of U.S. adults aged 20 years or older are obese, (Flegal et al., 2012) posing a grave public health concern and hefty disease burden to U.S. society (Wang et al., 2011). According to a recent review, middle-aged women are at a higher risk of being obese because of the change in hormonal milieu during the menopausal transition (Davis et al., 2012). A study found in Latin American women that the menopause increased the risk of metabolic syndrome and abdominal obesity as much as by 18% (Royer et al., 2007) A decline in ovarian hormone among middle-aged women can generate metabolic changes and other symptoms that help gain weight (Davis et al., 2012; Royer et al., 2007). It has been reported that women with a higher body mass index (BMI) are more likely to experience vasomotor symptoms, which is one of the important features of climacteric disturbance (Da Fonseca et al., 2013). This warrants an effective weight-reduction intervention for middle-aged women.

Most traditional weight-reduction interventions such as behavioral modification programs and pharmacological therapies often result in short-term, not long-term, weight-loss (Karmali et al., 2013). By contrast, bariatric surgery has been reported as one of the most dependable methods of treating obesity, producing not only sustained weight-loss but also improvements in many obesity-related comorbidities (Buchwald, 2005; Valezi et al., 2010; Chang et al., 2014). As the number of people who receive bariatric surgery is rapidly increasing, it is important to have a good understanding of types of surgery or specific preoperative factors that may affect weight loss outcomes.

Several meta-analyses showed that mean weight loss varied by the type of bariatric surgery. The greatest weight loss occurred among patients who had undergone Roux-en-Y gastric bypass (RYGB); intermediate weight loss occurred among patients who had undergone gastroplasty, and the lowest weight loss occurred among patients who had undergone adjustable gastric band (Buchwald et al., 2004; Buchwald et al., 2009; Maggard et al., 2005). All the review studies and meta-analyses that compared % excess weight loss (%EWL) in bariatric patients indicate that patients with RYGB achieved higher %EWL

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than patients with adjustable gastric band (Buchwald et al., 2004; Buchwald et al., 2009; Garb et al., 2009; Franco et al., 2011; O'Brien et al., 2006; Tice et al., 2008) or sleeve gastrectomy.(Franco et al., 2011; Li et al., 2012).

Preoperative BMI was also found to have an important effect on weight loss outcomes among patients who had bariatric surgery (Livhits et al., 2012). The majority of previous studies that examined the association between preoperative BMI and weight loss after bariatric surgery showed a negative association (i.e., the heavier the patients, the lower the weight loss), whereas other studies found a positive or no association between the preoperative BMI and weight loss after bariatric surgery (Livhits et al., 2012). Interestingly, the majority of studies that showed a negative or no association between the preoperative BMI and weight loss were based upon %EWL measure (Livhits et al., 2012). To the contrary, most studies that showed a positive association between the preoperative BMI and weight loss were based upon absolute values of weight loss rather than %EWL (Livhits et al., 2012). The finding of a recent study is noteworthy that %EWL, computed by 100% × (initial BMI − nadir BMI) / (initial BMI − ideal BMI) with the ideal BMI reference point between 0 and 25 kg/m^2, is inappropriate as a weight-loss outcome measure in bariatric patients (van de Laar, 2012). Rather, the study argued that % total weight loss (%TWL), computed by 100% × (initial BMI − nadir BMI) / (initial BMI), should be used.(van de Laar, 2012) Thus, given that the present study investigated the dynamics of post-surgical longitudinal weight loss in bariatric patients that typically vary over time, the present study computed %TWL by 100% × (pre-surgery BMI − post-surgery BMI) / pre-surgery BMI and used such %TWL in examining weight loss in bariatric patients.

Few studies investigated trajectories of post-surgical %TWL in bariatric patients. More importantly, to date, no study has examined weight loss (%TWL) after bariatric surgery among middle-aged female patients who are more likely to gain weight than other ages due to hormonal changes (Davis et al., 2012; Royer et al., 2007). The purpose of the present study was to examine long-term (i.e., up to 5 years) trajectories of post-surgical weight loss in terms of %TWL among middle-aged women aged 40 to 65 years who had undergone bariatric surgery. Based on previous literature, it was hypothesized that trajectories of %TWL in middle-aged female bariatric patients would differ based on type of bariatric surgery and pre-surgical BMI level.

2. Methods

2.1. Data

The data of the present study was drawn from the Bariatric Outcomes Longitudinal Database (BOLD). The BOLD is the world's largest and most comprehensive database of clinical bariatric surgery patient information collected from diverse geographical and provider settings (Bariatric Outcomes Longitudinal Database (BOLD)). Surgical Review Corporation manages the BOLD and collects prospective data on all bariatric surgery patients treated by participants in the Center of Excellence in Metabolic and Bariatric Surgery (COEMBS) program (Bariatric Outcomes Longitudinal Database (BOLD)). Such bariatric patient information is delivered via a secure website and stored in the BOLD database system (Bariatric Outcomes Longitudinal Database (BOLD)). Data entry users appointed by provisional participants and surgeon designees in the COEMBS program are required within 30 days of each pre-, intra- and post-operative encounter to enter prospective data into BOLD (Bariatric Outcomes Longitudinal Database (BOLD)). The main aim of the BOLD is to examine short- and long-term outcomes of various kinds of bariatric surgery and to assess the relationship between these outcomes and patients' comorbidities, demographics, surgical and clinical characteristics, and pre- and post-operative treatment (Bariatric Outcomes Longitudinal Database (BOLD)).

A separate study sample (N = 158,292) was drawn from the BOLD for patients who met the following inclusion criteria: (Flegal et al., 2012) women aged 40 to 65 years on the day of bariatric surgery, (Wang et al., 2011) patients who received RYGB, sleeve gastrectomy, or gastric banding procedure for the first time (to avoid confounding due to multiple bariatric procedures given to a single patient), (Davis et al., 2012) pre-operative BMI ≥ 30 kg/m^2, (Royer et al., 2007) 100 cm ≤ pre- and post-operative height ≤ 210 cm (to minimize confounding due to extreme height), (Da Fonseca et al., 2013) 50 kg ≤ pre- and post-operative mass ≤ 400 kg (to minimize confounding due to extreme mass), (Karmali et al., 2013) z-score of % TWL < 3.3 (to minimize undue influence of outliers), and (Buchwald, 2005) 1 week ≤ follow-up period ≤5 years.

2.2. Measures

The dependent variable of the present study is %TWL which was computed by 100% × (pre-surgery BMI − post-surgery BMI) / pre-surgery BMI (van de Laar, 2012). The independent variables are time, type of bariatric surgery, and pre-surgical BMI group. Time was measured as the number of weeks that passed since a patient received her first bariatric surgery. The effect of quadratic and cubic time as well as linear time was examined. The examined type of bariatric surgery included the three most common bariatric procedures such as RYGB, sleeve gastrectomy, and gastric banding. Pre-surgery BMI was categorized into Class I obesity (30–34.9), Class II obesity (35–39.9), and Class III obesity (40 or above). Age at surgery and race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and others) were included as demographic control variables. Age was calculated by subtracting birth date from surgery date.

2.3. Statistical analysis

All the variables were initially examined on their descriptive statistics and effect sizes (Cohen's *d*). Generalized estimating equations models with the autoregressive correlation structure were fit using SAS GENMOD procedure to examine the trajectory of post-surgical %TWL. By using REPEATED statement, the correlations within repeated measures were taken into account. To test the hypothesis that trajectories of %TWL in middle-aged female bariatric patients would differ based on type of bariatric surgery and pre-surgical BMI level, interaction effects as well as main effects were examined. Both two-way interactions ("time × type of surgery" and "time × pre-surgery BMI group") and three-way interactions (time × type of surgery × pre-surgery BMI group) were probed. Linear time variable was centered at the first week since surgery to help interpret analysis results. All the analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC).

3. Results

3.1. Descriptive statistics

Table 1 describes the characteristics of female patients aged 40–65 years who received bariatric surgery from 1995 to 2012. The mean %TWL was the highest among patients whose pre-operative BMI was 40 or higher and patients who had undergone RYGB. Patients whose pre-operative BMI was <35 and patients who had undergone gastric banding achieved the lowest mean %TWL. In terms of weight loss relative to standard deviation units (i.e., Cohen's d), however, patients whose pre-operative BMI was between 35 and 40 showed better results than the other two BMI groups. As for the type of surgery, patients who had undergone RYGB still showed better results than the other two types of surgery even in terms of Cohen's d of weight loss. The mean age of patients at surgery was 50.9 years. The mean and median follow-up periods, respectively, were 386 days (55 weeks) and 324 days (46 weeks). A total of 68,541 (43% of the sample) patients were followed up >1 year.

Table 1
Descriptive characteristics of female patients, ages 40–65 years, who received bariatric surgery from 1995 to 2012.

Characteristics	n	%	Pre-surgery weight (kg)		Post-surgery weight (kg)		Weight changes (kg)		%TWL		Effect size
			Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Cohen's *d*
BMI (before surgery) group											
30 ≤ BMI < 35	4287	2.71	91.01	7.76	80.25	11.09	−10.67	9.27	11.60	10.12	1.124
35 ≤ BMI < 40	35,437	22.39	101.80	8.90	87.25	12.71	−14.55	10.58	14.24	10.23	1.326
40 ≤ BMI	118,568	74.90	126.95	18.84	105.67	20.68	−20.64	15.18	16.26	11.40	1.076
Type of surgery											
Gastric bypass	84,519	53.39	123.31	20.91	98.48	22.52	−24.91	16.32	20.13	12.45	1.143
Sleeve gastrectomy	14,482	9.15	119.60	21.49	101.79	21.34	−18.69	12.59	15.43	9.74	0.832
Gastric banding	59,291	37.46	116.30	18.74	102.45	18.75	−13.83	10.26	11.83	8.35	0.739

Note. BMI = body mass index. %TWL = % total weight loss which is computed as 100% × (pre-surgery BMI − post-surgery BMI at the time of measurement) / pre-surgery BMI. Post-surgery weight is mean of weights during the follow-up period that spanned from 7 days to 5 years. The mean and median follow-up periods, respectively, were 364 days and 305 days for gastric bypass, 214 days and 174 days for sleeve gastrectomy, and 458 days and 380 days for gastric banding. The number of patients who were followed up for more than a year were 34,694 (41%) for gastric bypass, 2754 (19%) for sleeve gastrectomy, and 31,093 (52%) for gastric banding.

3.2. Trajectory of %TWL

Table 2 presents the results of sequential generalized estimating equations models that examined the trajectory of %TWL. As expected, %TWL increased over time, indicating the utility of bariatric surgery in long-term weight loss ($p < 0.001$). To have a better understanding of these temporal changes, the trajectories were plotted in Figures. As shown in Figs. 1 to 3, %TWL increased at a rapid speed right after bariatric surgery across all the three different types of surgery and BMI groups. But, around 50 weeks after surgery, %TWL plateaued or decreased with RYGB showing smallest decreases and gastric banding showing largest decreases among the three types of surgery. Whereas the pattern of %TWL trajectories is relatively similar across different BMI groups within each surgery type, largest gaps in %TWL between different BMI groups were found in RYGB patients.

As shown in Table 2, the type of bariatric surgery and pre-operative BMI were significant predictors of %TWL not only at one week after surgery but also during the study period of 5 years as indicated by the significant interactions with time (*ps* < 0.001). The mean of and the rate of increase over time in %TWL was the highest among patients whose pre-operative BMI was 40 or higher and patients who had undergone RYGB. The significant (*ps* < 0.001) three-way interactions (see Table 2) indicate that whereas the trajectories of %TWL among patients with sleeve gastrectomy and gastric banding did not differ much between different

Table 2
Generalized estimating equation models examining trajectory of weight changes in terms of %TWL (N = 158,292).

	Model 1		Model 2		Model 3		Model 4	
	b	*SE*	b	*SE*	b	*SE*	b	*SE*
Main effect								
Linear time (weeks after surgery)	−1.046***	0.003	−1.054***	0.003	−0.982***	0.003	−0.980***	0.003
Quadratic time	−0.007***	<0.001	−0.007***	<0.001	−0.006***	<0.001	−0.006***	<0.001
BMI (before surgery) group								
30 ≤ BMI < 35			−2.491***	0.124	−1.507***	0.115	−1.525***	0.114
35 ≤ BMI < 40			−0.856***	0.037	−0.187***	0.033	−0.208***	0.032
40 ≤ BMI (ref.)								
Type of surgery								
Gastric bypass					−5.399***	0.030	−5.398***	0.030
Sleeve gastrectomy					−4.623***	0.042	−4.622***	0.042
Gastric banding (ref.)								
Interaction effect								
Time × BMI group								
Time × 30 ≤ BMI < 35			−0.062***	0.003	−0.030***	0.003	−0.016***	0.004
Time × 35 ≤ BMI < 40			−0.033***	0.001	−0.016***	0.001	−0.007***	0.002
Time × 40 ≤ BMI (ref.)								
Time × type of surgery								
Time × gastric bypass					−0.114***	0.001	−0.120***	0.001
Time × sleeve gastrectomy					−0.077***	0.002	−0.079***	0.003
Time × gastric banding (ref.)								
Time × BMI group × type of surgery								
Time × 30 ≤ BMI < 35 × gastric bypass							−0.048***	0.007
Time × 30 ≤ BMI < 35 × sleeve gastrectomy							−0.001***	0.009
Time × 30 ≤ BMI < 35 × gastric banding (ref.)								
Time × 35 ≤ BMI < 40 × gastric bypass							−0.020***	0.002
Time × 35 ≤ BMI < 40 × sleeve gastrectomy							−0.005***	0.005
Time × 35 ≤ BMI < 40 × gastric banding (ref.)								
Time × 40 ≤ BMI × gastric bypass (ref.)								
Time × 40 ≤ BMI × sleeve gastrectomy (ref.)								
Time × 40 ≤ BMI × gastric banding (ref.)								

Note. BMI = body mass index. b = unstandardized regression coefficient; ref. = reference category. %TWL = % total weight loss which is computed as 100% × (pre-surgery BMI − post-surgery BMI at the time of measurement) / pre-surgery BMI. Linear time is centered at the first week since surgery. All four models were controlled for age and race/ethnicity.
*** $p < 0.001$.

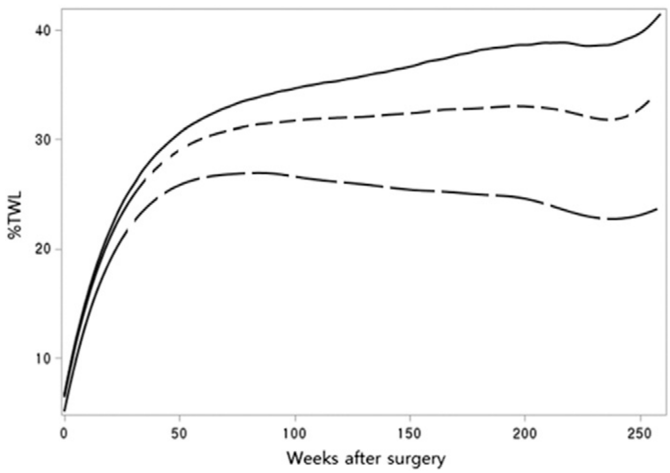

Fig. 1. The trajectories of %TWL among patients who had undergone Roux-en-Y gastric bypass from 1995 to 2012.

40 ≤ pre-operative BMI ———
35 ≤ pre-operative BMI < 40 – – – –
30 ≤ pre-operative BMI < 35 — — ·

pre-operative BMI groups, the trajectories of RYGB patients were notably different between different BMI groups.

4. Discussions

To our knowledge, this is the first study that investigated the effect of both the type of bariatric surgery and the pre-surgery BMI on the trajectory of %TWL post-bariatric surgery among large sample of female bariatric patients who were aged 40 to 65 at the time of surgery. Since this study examined longitudinal data of the world's largest sample of bariatric patients from diverse ethnic, geographical, and provider settings, the results of this study may be generalizable to the entire female population in the same age group.

The findings of this study showed that the rate of increase in %TWL was highest among patients whose pre-operative BMI was 40 or higher and patients who had undergone RYGB. An interesting finding was that

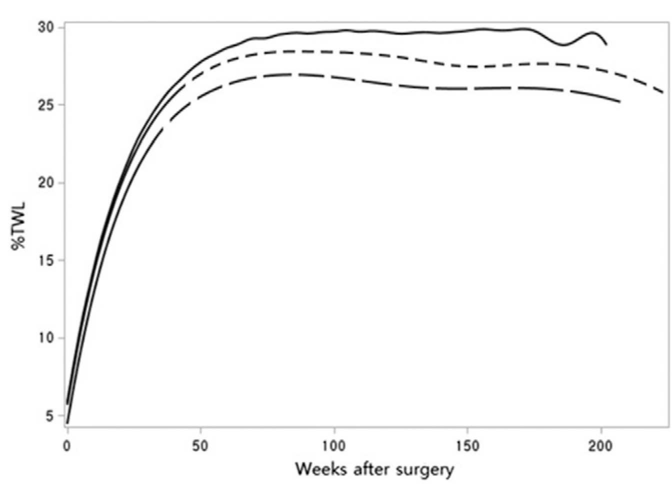

Fig. 2. The trajectories of %TWL among patients who had undergone sleeve gastrectomy from 1995 to 2012.

40 ≤ pre-operative BMI ———
35 ≤ pre-operative BMI < 40 – – – –
30 ≤ pre-operative BMI < 35 — — ·

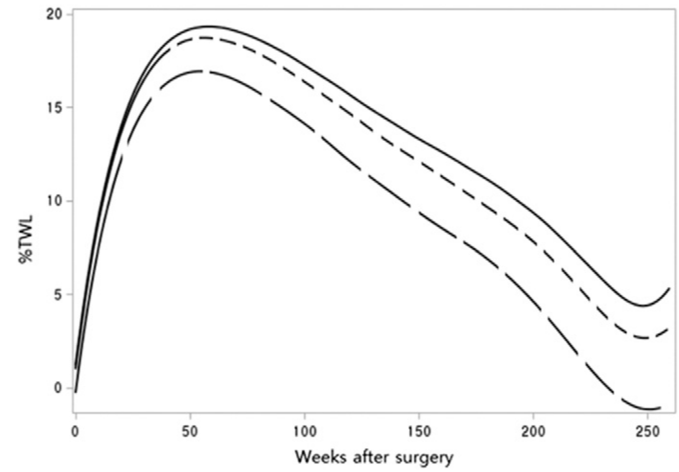

Fig. 3. The trajectories of %TWL among patients who had undergone gastric banding from 1995 to 2012.

40 ≤ pre-operative BMI ———
35 ≤ pre-operative BMI < 40 – – – –
30 ≤ pre-operative BMI < 35 — — ·

%TWL kept increasing even up to 5 years after surgery among patients whose pre-operative BMI was 40 or higher and patients who had undergone RYGB (see Fig. 1). Findings of previous studies on the association between post-surgical weight loss and the type of bariatric surgery also showed that the greatest weight loss occurred among patients who had undergone RYGB followed by patients with sleeve gastrectomy and adjustable gastric band (Buchwald et al., 2004; Buchwald et al., 2009; Maggard et al., 2005; Garb et al., 2009; Franco et al., 2011; O'Brien et al., 2006; Tice et al., 2008; Li et al., 2012). Although the majority of previous studies (at least 37 studies) showed a negative association between post-surgical weight loss and pre-operative BMI, quite many studies (at least 16 studies) found a positive association between them (Livhits et al., 2012). An important thing to note was that the majority of studies that showed a negative association between preoperative BMI and weight loss used %EWL as an outcome, whereas most studies that found a positive association used absolute value of weight loss (which is conceptually similar to %TWL) as an outcome (Livhits et al., 2012). Since %EWL has been proven to be unsuited for a comparison of patients, future studies should avoid using %EWL and utilize %TWL which is more similar to absolute measure of weight loss (van de Laar, 2012).

An interesting finding was that some of the "time × type of surgery × pre-surgery BMI" three-way interaction terms were also significant. Although the trajectories of %TWL among patients with sleeve gastrectomy and gastric banding did not differ much between different pre-operative BMI groups, the trajectories of %TWL among patients who had undergone RYGB were notably different depending on pre-operative BMI groups. This result is in line with findings of previous studies that indicate a positive association between absolute value of post-surgical weight loss and pre-surgical BMI among patients with RYGB (Livhits et al., 2012). More studies are needed to examine whether the trajectory of weight loss differs according to different pre-operative BMI among patients with sleeve gastrectomy and gastric banding to confirm our findings.

Another finding of note was the shape of %TWL trajectory. The %TWL increased sharply right after bariatric surgery and then plateaued or decreased about 1 year after surgery. This result is in line with previous findings that show a similar pattern of post-surgical weight loss (Courcoulas et al., 2013; van de Laar & Acherman, 2014; Puzziferri et al., 2008a; Manning et al., 2015; Song et al., 2008; de Hollanda et al., 2014; Puzziferri et al., 2008b). To our knowledge, only a few studies investigated the trajectory of post-surgical weight loss longer than

3 years, (de Hollanda et al., 2014) and most of previous studies used %EWL as an outcome (Puzziferri et al., 2008a; Song et al., 2008; de Hollanda et al., 2014; Puzziferri et al., 2008b). By analyzing 5-year post-surgical weight loss results of female bariatric patients aged 40 to 65 years, our study contributes to the literature. It documents unique trajectories of weight loss by type of surgery and pre-operative BMI in those middle-aged women where the rate of increase in %TWL plateaus or decreases about 1 year after surgery.

The findings of this study have limitations. First, because the BOLD study consists of data from Bariatric Surgery Center of Excellence or Fellow of the American Society for Metabolic and Bariatric Surgery, there is a possibility that the results of this study may not be representative of all female bariatric patients aged 40 to 65 years in the U.S. However, the BOLD study has a higher generalizability than most other studies with small sample sizes. Second, selection bias may exist due to the level of motivation and compliance among patients seeking treatment or due to the level of care provided by surgeons. Third, there was a substantial number of sample attrition around 1 year after surgery. Thus, differential attrition may have biased the findings of the present study.

Despite these limitations, this study provided meaningful results about the longitudinal trajectory of post-surgical %TWL in middle-aged women who had undergone bariatric surgery. The results of our study suggest that middle-aged female patients who are seeking bariatric surgery are likely to achieve the highest weight loss if they receive RYGB surgery rather than gastric banding or sleeve gastrectomy and if their pre-operative BMI is 40 or higher. The finding that %TWL kept increasing even up to 5 years after surgery among patients whose pre-operative BMI was 40 or higher and patients who had undergone RYGB indicates a need for further research that follows up with bariatric patients for >5 years.

Conflict of interest

The authors declare no conflict of interest.

Transparency document

The transparency document associated with this article can be found, in online version.

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References

Bariatric Outcomes Longitudinal Database (BOLD). ClinicalTrials.gov. Identifier: NCT01002352.

Buchwald, H., 2005. Bariatric surgery for morbid obesity: health implications for patients, health professionals, and third-party payers. J. Am. Coll. Surg. 200, 593–604.

Buchwald, H., Avidor, Y., Braunwald, E., et al., 2004. Bariatric surgery: a systematic review and meta-analysis. JAMA 292 (14), 1724–1737.

Buchwald, H., Estok, R., Fahrbach, K., et al., 2009. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. Am. J. Med. 122 (3) (248-56.e5).

Chang, S.H., Stoll, C.R., Song, J., Varela, J.E., Eagon, C.J., Colditz, G.A., 2014. The effectiveness and risks of bariatric surgery: an updated systematic review and meta-analysis, 2003–2012. JAMA Surg. 149 (3), 275–287.

Courcoulas, A.P., Christian, N.J., Belle, S.H., et al., 2013. Weight change and health outcomes at 3 years after bariatric surgery among individuals with severe obesity. JAMA 310, 2416–2425.

Da Fonseca, A.M., Bagnoli, V.R., Souza, M.A., et al., 2013. Impact of age and body mass on the intensity of menopausal symptoms in 5968 Brazilian women. Gynecol. Endocrinol. 29, 116–118.

Davis, S.R., Castelo-Branco, C., Chedraui, P., et al., 2012. Understanding weight gain at menopause. Climacteric 15, 419–429.

de Hollanda, A., Ruiz, T., Jiménez, A., Flores, L., Lacy, A., Vidal, J., 2014. Patterns of weight loss response following gastric bypass and sleeve gastrectomy. Obes. Surg. (Epub ahead of print).

Flegal, K.M., Carroll, M.D., Kit, B.K., Odgen, C.L., 2012. Prevalence and trends in the distribution of body mass index among US adults, 1999–2010. JAMA 307, 491–497.

Franco, J.V., Ruiz, P.A., Palermo, M., Gagner, M., 2011. A review of studies comparing three laparoscopic procedures in bariatric surgery: sleeve gastrectomy, Roux-en-Y gastric bypass and adjustable gastric banding. Obes. Surg. 21 (9), 1458–1468.

Garb, J., Welch, G., Zagarins, S., Kuhn, J., Romanelli, J., 2009. Bariatric surgery for the treatment of morbid obesity: a meta-analysis of weight loss outcomes for laparoscopic adjustable gastric banding and laparoscopic gastric bypass. Obes. Surg. 19 (10), 1447–1455.

Karmali, S., Brar, B., Shi, X., Sharma, A.M., de Gara, C., Birch, D.W., 2013. Weight recidivism post-bariatric surgery: a systematic review. Obes. Surg. 23, 1922–1933.

Li, P., Fu, P., Chen, J., Wang, L.H., Wang, D.R., 2012. Laparoscopic Roux-en-Y gastric bypass vs. laparoscopic sleeve gastrectomy for morbid obesity and diabetes mellitus: a meta-analysis of sixteen recent studies. Hepato-Gastroenterology 60 (121), 132–137.

Livhits, M., Mercado, C., Yermilov, I., et al., 2012. Preoperative predictors of weight loss following bariatric surgery: systematic review. Obes. Surg. 22, 70–89.

Maggard, M.A., Shugarman, L.R., Suttorp, M., et al., 2005. Meta-analysis: surgical treatment of obesity. Ann. Intern. Med. 142 (7), 547–559.

Manning, S., Pucci, A., Carter, N.C., et al., 2015. Early postoperative weight loss predicts maximal weight loss after sleeve gastrectomy and Roux-en-Y gastric bypass. Surg. Endosc. 29 (6), 1484–1491.

O'Brien, P.E., McPhail, T., Chaston, T.B., Dixon, J.B., 2006. Systematic review of medium-term weight loss after bariatric operations. Obes. Surg. 16 (8), 1032–1040.

Puzziferri, N., Nakonezny, P.A., Livingston, E.H., Carmody, T.J., Provost, D.A., Rush, A.J., 2008a. Variations of weight loss following gastric bypass and gastric band. Ann. Surg. 248 (2), 233–242.

Puzziferri, N., Nakonezny, P.A., Livingston, E.H., Carmody, T.J., Provost, D.A., Rush, A.J., 2008b. Variations of weight loss following gastric bypass and gastric band. Ann. Surg. 248 (2), 233–242.

Royer, M., Castelo-Branco, C., Blümel, J.E., et al., 2007. Collaborative group for research of the climacteric in Latin America. The US National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III): prevalence of the metabolic syndrome in postmenopausal Latin American women. Climacteric 10, 164–170.

Song, Z., Reinhardt, K., Buzdon, M., Liao, P., 2008. Association between support group attendance and weight loss after Roux-en-Y gastric bypass. Surg. Obes. Relat. Dis. 4 (2), 100–103.

Tice, J.A., Karliner, L., Walsh, J., Petersen, A.J., Feldman, M.D., 2008. Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. Am. J. Med. 121 (10), 885–893.

Valezi, A.C., Junior, J.M., de Menezes, M.A., Brito, E.M., de Souza, S.A.F., 2010. Weight loss outcome after silastic ring Roux-en-Y gastric bypass: 8 years of follow-up. Obes. Surg. 20, 1491–1495.

van de Laar, A., 2012. Bariatric Outcomes Longitudinal Database (BOLD) suggests excess weight loss and excess BMI loss to be inappropriate outcome measures, demonstrating better alternatives. Obes. Surg. 22, 1843–1847.

van de Laar, A.W., Acherman, Y.I., 2014. Weight loss percentile charts of large representative series: a benchmark defining sufficient weight loss challenging current criteria for success of bariatric surgery. Obes. Surg. 24 (5), 727–734.

Wang, Y.C., McPherson, K., Marsh, T., Gortmaker, S.L., Brown, M., 2011. Health and economic burden of the projected obesity trends in the USA and the UK. Lancet 378 (9793), 815–825.