



A Meta-analysis of the Impact of Bariatric Surgery on Back Pain

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Abstract

Background The functional aspects of obesity are increasingly recognised as a significant clinical and public health concern. Whilst there is substantial evidence for the beneficial impact of bariatric surgery on metabolic and cardiovascular disease, there is less understanding of the quantitative effect of bariatric surgery on back pain. The aim of this meta-analysis was to assess the impact of bariatric surgery on back pain in reported studies.

Methods Medline, Embase, conference proceedings and reference lists were searched for studies assessing quantitative back pain scores both before and after bariatric surgery. The primary outcome was visual analogue score for back pain pre- and post-bariatric surgery. Secondary outcomes were change in BMI, SF-36 quality of life scores and Oswestry Disability Index (ODI) scores. Weighted mean differences (MD) were calculated for continuous outcomes.

Results Seven studies were included in the analysis of 246 patients undergoing bariatric surgery. Mean study follow-up was between 3 and 24 months. There was a statistically significant reduction in visual analogue score for back pain following bariatric surgery (MD – 3.01; 95% CI – 4.19 to – 1.89; $p < 0.001$). Bariatric surgery also resulted in statistically significant improvements in BMI, SF-36 score and ODI score.

Conclusions Bariatric surgery produces significant and quantifiable reductions in back pain. This may be commuted through reductions in axial load or improved quality of life, but further studies will improve understanding and aid preoperative counselling.

Keywords Back pain · Bariatric surgery · Visual analogue score · Quality of life

Introduction

Global levels of obesity are increasing and constitute a major health concern due to obesity-related disease [1, 2]. The main health consequences related to obesity include

type 2 diabetes, cardiovascular disease, musculoskeletal disorders such as osteoarthritis and low back pain, and certain cancers. Metabolic surgery has been shown in multiple randomised trials and meta-analyses to be effective at improving obesity-related comorbidities and improving quality of life [3].

Whilst the focus on comorbidity management for patients with obesity has tended to focus on type 2 diabetes and cardiovascular disease, there is an increasing focus on quality of life and physical functioning [4]. The prevalence of joint and back pain increases progressively with greater BMI [4]. Joint pain symptoms are particularly prevalent in the load-bearing segments of the body, including the low back and lower limbs (ankles, knees, hips) [4, 5]. The incapacitating effect of back pain contributes to worsening of obesity and physical disability which in itself has a negative impact on physical functioning and leads to deterioration of health-related quality of life (QOL) [5]. A number of studies have explored the effect of bariatric surgery, as an

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obesity treatment, on the occurrence of back pain, but these are all small studies and no quantitative synthesis of this literature has been performed to date.

This article aims to undertake a systematic review and meta-analysis focussing on back pain related to obesity and specifically on the impact that bariatric surgery has on back pain.

Materials and Methods

Search Strategy

An electronic search was performed using the Embase and Medline databases, and the Cochrane Database of Controlled Trials from 1966 to November 2019. The search strategy terms ‘bariatrics’, ‘obesity surgery’, ‘gastric bypass’, ‘gastric sleeve’, ‘Roux-en-Y’, ‘RYGB’, ‘sleeve gastrectomy’ and ‘adjustable gastric band’ and ‘back pain’ were used in combination with the Boolean operator AND or OR. The electronic search was supplemented by a handsearch of published abstracts from meetings of the International Federation for the Surgery of Obesity and Metabolic Disorders, the British Obesity and Metabolic Surgery Society and the American Society for Metabolic and Bariatric Surgery from 1983 to 2019. The bibliography of articles obtained was additionally searched to identify further relevant citations.

Selection Criteria

Abstracts of the citations identified by the search were then reviewed to determine eligibility for inclusion in the meta-analysis by two independent reviewers (IS and ACC). Studies were included if they only included patients aged 18 years or over, where the primary outcome assessed was back pain in patients before and after bariatric surgery. Discrepancies were resolved by consensus and agreement of the wider authorship team. Exclusion criteria included non-English studies where no translation was available, duplicate studies, kin studies, or studies with an incorrect comparator. Full-text articles of all selected abstracts were further reviewed by two reviewers (IS and ACC) using the same criteria, and disputes were resolved by a senior reviewer. Included studies were then assessed for methodological quality and bias using the MINORS tool for non-randomised studies [6].

Data Extraction

Pertinent data was collected from selected trials by one reviewer (IS) and a second reviewer checked for accuracy (ACC). The primary outcome of interest included the mean visual analogue score (VAS) for back pain before and after bariatric surgery. A number rating scale (NRS) was substituted when the VAS was not available. Secondary outcomes included BMI, disability assessment and quality of life. The following patient characteristics were assessed: age, gender, pre- and postoperative measurements for

Fig. 1 PRISMA flow chart for study selection in the meta-analysis

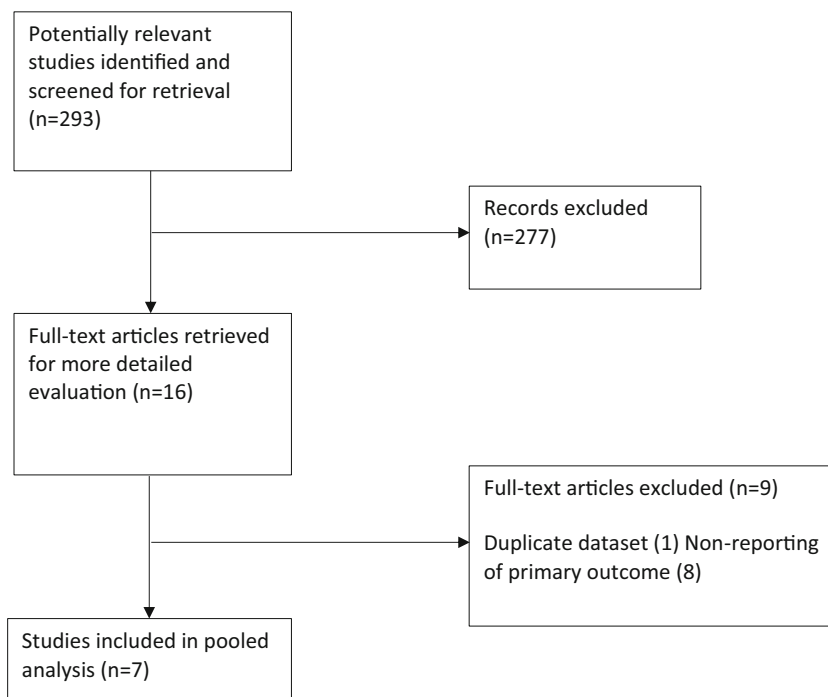


Table 1 Details of the included studies in the meta-analysis

Author	Year of publication	Number of patients	Male:female	Mean age	Operations performed	Follow-up (months)	Mean preoperative BMI (\pm SD or range as reported)	Mean postoperative BMI (\pm SD or range as reported)	Timepoint of back pain outcome postoperative assessment
Melissas	2005	29	23 F/6 M	37.5 \pm 11.2	Vertical banded gastroplasty	24 months	42.8 \pm 4.8	32.9 \pm 6.3	24 months
Khoueir	2009	38	30 F/8 M	48.4 \pm 10.1	Laparoscopic and open Roux-en-Y, duodenal switch, sleeve gastrectomy	12 months	52.3 \pm 12.6	38.32 \pm 9.66	12 months
Josbeno	2010	20	18 F/2 M	41.6 \pm 9.8	Gastric bypass	3 months	46.9 \pm 6.3	37.4 \pm 5.7	3 months
Lidar	2012	30	15 F/15 M	49 \pm 10.4	Laparoscopic gastric banding, sleeve gastrectomy, laparoscopic Roux-en-Y gastric bypass, duodenal switch	12 months	42.8 \pm 4.8	29.7 \pm 3.4	12 months
Vincent	2012	25	20 F/5 M	41 \pm 11	Laparoscopic Roux-en-Y gastric bypass, laparoscopic adjustable gastric banding	3 months	47 \pm 7	Not reported	3 months
Cakir	2015	39	39 F	37.69 \pm 11.33	Laparoscopic sleeve gastrectomy	6 months	46.49 \pm 4.48	32.33 \pm 6.31	6 months
Koulischer	2015	65	51 F/14 M	41 \pm 11	Gastric bypass, mini gastric bypass, sleeve gastrectomy	22 months	43 \pm 5.2	33 \pm 5.1	22 months

SD, standard deviation

BMI, weight, visual analogue score for back pain, Oswestry disability index and quality of life (QoL) assessment using Short-Form 36 (SF-36).

Statistical Analysis

Categorical variables were reported as frequencies and percentages, and continuous data was expressed as mean \pm standard deviation. Meta-analysis was conducted where possible for outcomes relating to back pain in patients before and after bariatric surgery. Outcomes assessed in the meta-analysis were assessed using weighted mean difference (MD). The estimated effects were calculated using Revman 5.3 software obtained from the Cochrane website. Where data was not available in the articles or from the authors, then Cochrane methods for missing data were followed. All pooled outcome measures were determined using the DerSimonian and Laird’s random effects model [7]. Heterogeneity in the results of the trials was assessed using a chi-square test of heterogeneity (significance level $P < 0.1$) and the I^2 measure of inconsistency [8].

Results

Study Selection

A preliminary database search of the literature yielded 293 articles after duplicates were removed (Fig. 1). After initial screening of titles and abstracts, 16 studies underwent full-text assessment for eligibility. Seven manuscripts met inclusion criteria and were included in the final systematic review. The included manuscripts consisted of seven cohort studies.

Basic Demographics

A total of seven studies [5, 9–14] with 246 patients were included (Table 1). In the meta-analysis, there were 206 females (83.7%), the mean age was 42.3 years and the mean follow-up was 11.7 months. There were a variety of operative techniques used including, where recorded, Roux-en-Y gastric bypass (148), sleeve gastrectomy (48) and vertical banded gastroplasty (29). The procedure types in Koulischer et al.’s study for the 47 of 65 patients included were unclear but the operations for the 65 patient group included gastric bypass or mini gastric bypass (60/65; 92%), and sleeve gastrectomy (5/65; 8%). The preoperative mean BMI for the total study population was 46.5 kg/m². The preoperative mean VAS for back pain was 5.71.

Table 2 Assessment of MINORS criteria

Criteria	Study						
	Melissas 2005	Khoueir 2009	Josbeno 2010	Lidar 2012	Vincent 2012	Cakir 2015	Koulischer 2015
A clearly stated aim	2	2	2	2	2	2	2
Inclusion of consecutive patients	2	2	2	2	2	2	2
Prospective data collection	2	2	2	2	2	2	2
Endpoint appropriate to the study	2	2	2	2	2	2	2
Unbiased assessment of the study endpoint	2	2	2	2	2	2	2
Follow-up period appropriate to the aim of the study	2	2	1	2	1	1	2
Loss of follow-up less than 5%	2	1	1	2	2	2	1
Prospective calculation of study size	2	2	2	2	2	2	2
An adequate control group	0	0	0	0	1	0	0
Contemporary groups	0	0	0	0	2	0	0
Baseline equivalence of groups	0	0	0	0	1	0	0
Adequate statistical analysis	2	2	2	2	2	2	2
Total	18	17	16	18	21	17	17

0—not reported
 1—reported but inadequate
 2—reported and adequate

Quality Assessment of Included Studies

Studies were assessed for bias and methodological quality using the MINORS criteria (Table 2). All studies were graded as low–moderate in quality.

Outcomes

Visual Analogue Score for Back Pain

Five studies used the VAS [5, 9, 10, 13, 14] and two studies used the NRS [11, 12] to quantitatively score back pain. Back pain was assessed preoperatively and at a median of 12 months follow-up postoperatively (range 3–24 months). Back pain was shown to be statistically significantly lower following bariatric surgery (Fig. 2) (seven studies [5, 9–14]; MD –

3.01; 95% CI –4.19 to –1.89; $p < 0.001$). Heterogeneity was high and statistically significant ($I^2 = 83%$; $p < 0.001$).

Mean BMI Change

There was a statistically significant reduction in mean BMI following bariatric surgery (Fig. 3) (six studies [9–14]; MD –12.23; 95% CI –14.07 to –10.39; $p < 0.001$). Heterogeneity was moderate but statistically non-significant ($I^2 = 55%$; $p = 0.05$).

Quality of Life

Four studies reported on SF-36 scores before and after bariatric surgery [5, 9, 11, 12]. There was a statistically significant improvement in SF-36 physical component scores following

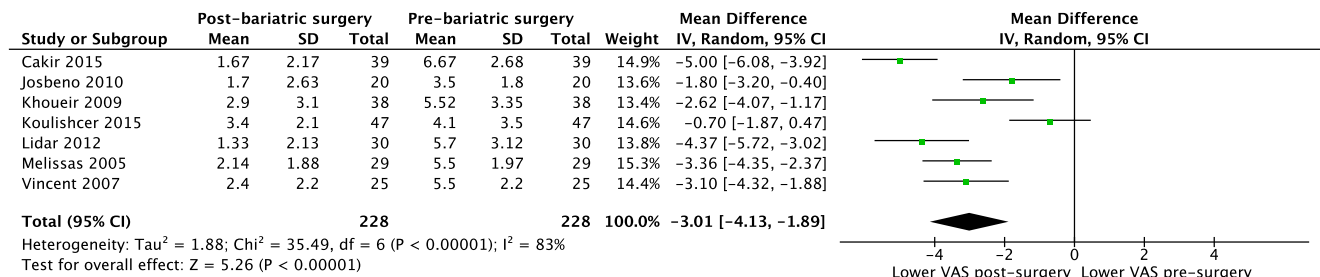


Fig. 2 Forest plot of visual analogue score for back pain before and after bariatric surgery

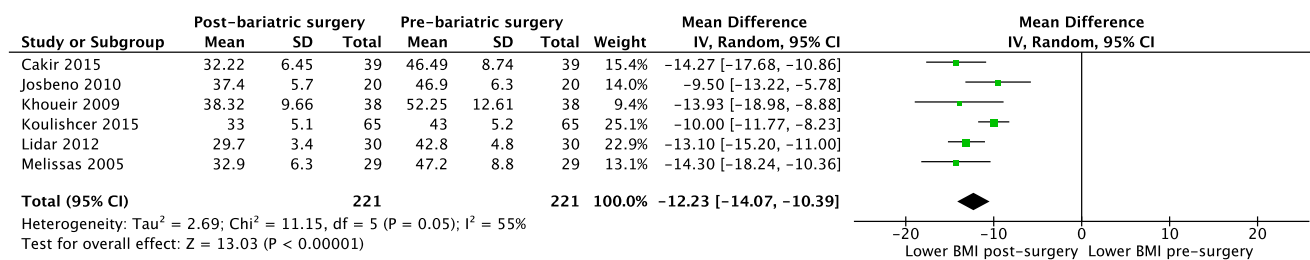


Fig. 3 Forest plot of Body Mass Index (BMI) before and after bariatric surgery

bariatric surgery (Fig. 4) (four studies [5, 9, 11, 12]; MD 26.46; 95% CI 12.88 to 40.04; *p* < 0.001). Heterogeneity was high and statistically significant (*I*² = 91%; *p* < 0.001).

Oswestry Disability Index

The impact of bariatric surgery on ODI scores was reported in three studies [9, 10, 12]. There was a statistically significant improvement (reduction) in ODI following bariatric surgery (Fig. 5) (three studies [9, 10, 12]; MD - 9.54; 95% CI - 15.41 to - 3.67; *p* < 0.001). Heterogeneity was moderately high but non-statistically significant (*I*² = 63%; *p* = 0.07).

Discussion

This is the first meta-analysis addressing the impact of bariatric surgery on back pain in patients with obesity. We identified a total of seven cohort studies with 246 patients who underwent various bariatric procedures including sleeve gastrectomy, Roux-en-Y gastric bypass, duodenal switch, vertical banded gastroplasty and laparoscopic adjustable banding. All studies utilised the VAS or equivalent as an assessment tool for back pain symptoms before and after bariatric surgery.

Results of our meta-analysis revealed that back pain in obese patients was statistically significantly lower following bariatric surgery. This was observed across all seven studies which met the inclusion criteria. The mean change in VAS following bariatric surgery was 3 points. This is equivalent to the minimal clinically important difference for radiofrequency interventions for chronic back pain [15] suggesting a clinically important impact on back pain. Moreover, an improvement of the quality of life was reported in four of the studies based on

SF-36 physical component score [5, 9, 11, 12]. Three studies reported a reduction in the Oswestry Disability Index score following bariatric surgery [9, 10, 12].

In exploring the causation of improved back pain following bariatric surgery, some authors have proposed that the overall improvement in wellbeing following metabolic surgery may account for alterations in back pain perception [9] as opposed to mechanical or musculoskeletal changes. Our meta-analysis provides some credence to this hypothesis with a demonstrable improvement in SF-36 physical component quality of life assessment. Alternatively, other groups contend that the improvement in back pain is more exclusively dependent on reduced axial load following post-bariatric intervention weight loss. The mechanisms leading to symptom improvement include changes in spinal biomechanics, a reduction in local inflammatory processes from mechanical loading, decreased muscular fatigue, and off-loading of the intervertebral disc or facet joints [9]. Further studies, incorporating pre- and postoperative spinal imaging, will be required to better understand the mechanism of improvements in back pain noted after bariatric surgery.

Weight loss following lifestyle modifications (change in diet and increase in physical activity) is also likely to have positive effect on back pain symptoms and quality of life. Non-surgical interventions produce less drastic and efficient weight loss over a longer period of time but it is difficult to compare the results [9]. Only Vincent et al. had a comparative non-surgical weight loss control group. They concluded that the bariatric group experienced significant improvement in back pain symptoms in the first 3 months. In contrast, there was no observed weight loss nor reduction in back pain severity in the control group. Some studies suggest that atherosclerosis, which is a common obesity-related condition, has

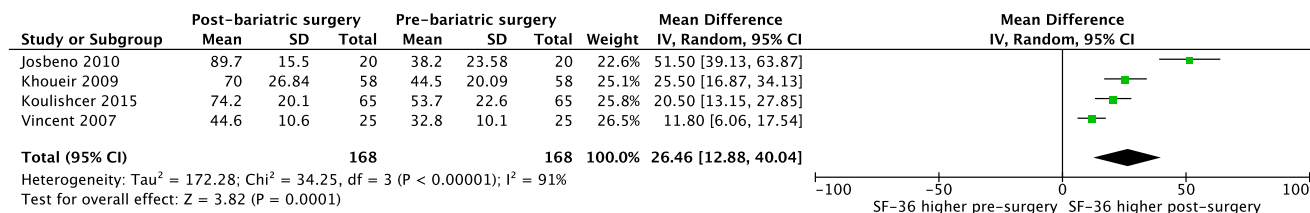


Fig. 4 Forest plot of SF-36 scores before and after bariatric surgery

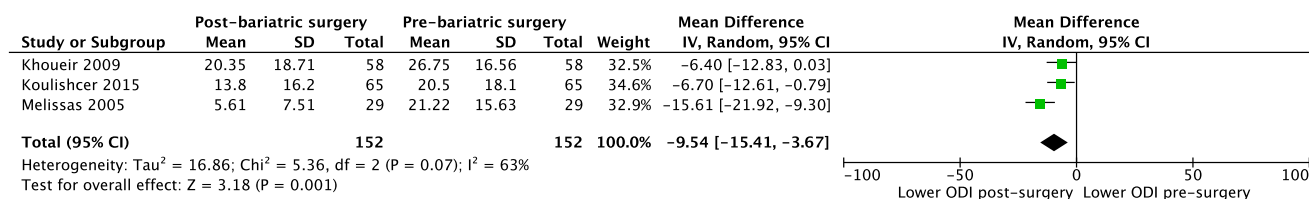


Fig. 5 Forest plot of Oswestry Disability Index (ODI) scores before and after bariatric surgery

additional consequence in regard to back pain. The four lumbar arteries and median sacral artery supply the lumbar segments and also perfuse the surrounding structures (intervertebral discs, nerve roots, and paraspinal muscles). Atherosclerosis of the abdominal aorta and of the lumbar arteries disrupts perfusion of lumbar structures, potentially resulting in structural degeneration and back pain [16]. Bariatric surgery has been shown to have significant improvements in markers of atherosclerosis and endothelial function [17] which may provide further explanation of the reductions in back pain noted in our study.

This study is not without limitations. Although we conducted an extensive search, the literature surrounding this topic is not broad. Previous studies have focussed more on the impact of bariatric surgery on conditions such as diabetes, cardiovascular disease and various musculoskeletal disorders generally and there is a paucity of studies focusing on back pain. We were able to identify only seven studies, which limits our study's generalisability. The overall median follow-up was 12 months but three of the studies (Vincent et al., Josbeno et al., Cakir et al.) [5, 11, 14] had follow-up less than 6 months which may not be a sufficient time to observe the durability of the improvement in pain symptoms as well as the long-term effect of obesity surgery [9]. All seven studies were low–moderate in quality as assessed by the MINORS criteria of evidence and relatively small sample size. Finally, some of the surgery performed in the included articles is non-contemporaneous, and therefore, aspects of practice and outcomes may not be relevant to current metabolic surgery.

Despite these limitations, our study is a comprehensive analysis of the impact of bariatric surgery on back pain. It is evident that obesity surgery does have a favourable effect on the intensity of back pain and improves quality of life. Nonetheless, it should be reserved for obese patients with BMI > 35 kg/m² with serious related comorbidities such as diabetes hypertension, cardiovascular disease and sleep apnoea [18]. Future studies are required to investigate the pathophysiologic mechanisms of development of back pain in obesity and its improvement following bariatric procedures.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval Statement This article does not contain any studies with human participants or animals performed by any of the authors.

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