Effects of surgical weight loss on measures of obstructive sleep apnea: a meta-analysis
Greenburg DL, Lettieri CJ, Eliasson AH

CRD summary
This review concluded that bariatric surgery significantly improved obstructive sleep apnoea, but moderately severe disease can persist, and patients should not expect a cure. The studies were poor quality and the results only indicate a correlation between weight loss and severity of obstructive sleep apnoea, not causation.

Authors' objectives
To investigate the effects of surgical weight loss on the diagnosis and severity of obstructive sleep apnoea.

Searching
MEDLINE and EMBASE were searched up to March 2008. Search terms were provided. The bibliographies of relevant articles and reviews were also searched.

Study selection
Case series of patients undergoing bariatric surgery that reported polysomnography measured parameters of sleep apnoea, before and at least three months after surgery, were eligible for inclusion. Polysomnography had to be performed in accordance with the Academy of Sleep Medicine recommendations, which included measures of electroencephalography for sleep staging and measures of airflow.

All the included studies reported the apnoea-hypopnoea index. Several different types of surgery were used in the studies, including laparoscopic gastric banding, Roux-en-Y and gastric bypass. All the participants were adults, except of one study of adolescents.

All three authors were involved in selecting studies for inclusion. Disagreements were resolved by consensus.

Assessment of study quality
A modified Downs and Black checklist was used to assess study quality. All three authors independently assessed study quality. Disagreements were resolved by consensus.

Data extraction
Extracted data included mean pre- and post-surgery body mass index and the apnoea-hypopnoea index. Individual patient data were extracted, where available. All three authors independently extracted data. Disagreements were resolved by consensus.

Methods of synthesis
Pre- and post-surgery body mass index and apnoea-hypopnoea index, as well as change in body mass index, were each pooled using DerSimonian and Laird random-effects model. Statistical heterogeneity was assessed using the X² and I² statistics (I² greater than 50% indicating moderate heterogeneity). To investigate sources of heterogeneity, studies were stratified by year of publication (before and after 2003), country of origin and quality (presence of selection bias). Meta-regression was also undertaken to investigate the effect of age and gender on post-surgery apnoea-hypopnoea index.

A separate analysis was also undertaken of the individual patient data which included a logistic regression model to identify the predictors of a sleep apnoea cure, which was defined as an apnoea-hypopnoea index of less than five events per hour.

Publication bias was assessed using funnel plots and Egger's and Begg's statistics.

Results of the review
Twelve case series (n=342 patients) were included; five prospective and seven retrospective studies. Sample sizes
ranged from eight to 101. Ten of the studies were classified as being subject to selection bias. There was no evidence of publication bias.

The pooled mean body mass index (10 studies) decreased from 55.3kg/m\(^2\) (95% CI 53.5 to 57.1) at baseline to 37.7kg/m\(^2\) (95% CI 36.6 to 38.9) after surgery. Mean apnoea-hypopnoea index (12 studies) decreased from 54.7 events per hour (95% CI 49.0 to 60.3) to 15.8 events per hour (95% CI 12.6 to 19.0). Heterogeneity was reported to be high (I\(^2\)=74%), but it was unclear which pooling this applied to.

There was a trend towards lower apnoea-hypopnoea index (better outcome) post-surgery in the retrospective studies and in studies with selection bias, that is the poorer quality studies.

Individual patient data were available from six studies (n=80 patients). Patients classified as cured (apnoea-hypopnoea index less than 5) after surgery had a lower body mass index and were younger than those who had residual sleep apnoea. In logistic regression models, age and follow-up weight of less than 100kg independently predicted cure.

**Authors' conclusions**

Bariatric surgery significantly improved obstructive sleep apnoea, measured by the apnoea-hypopnoea index, but the mean apnoea-hypopnoea index after surgery was consistent with moderately severe residual disease, suggesting that patients should not expect a cure of sleep apnoea following surgical weight loss.

**CRD commentary**

There was a clearly stated review question and appropriate inclusion criteria. Although there was no indication of publication bias, this analysis was limited by the small number of studies. No specific attempts were made to identify unpublished studies, so relevant studies may have been missed. Appropriate methods were used to reduce error and bias in the review processes. Quality was assessed and taken into consideration in the analysis. Although the approach taken to the analysis was reasonable, given the data available, it was limited by the poor quality of the data and can only indicate a correlation between the two variables investigated.

**Implications of the review for practice and research**

**Practice:** The authors stated that clinicians should have a low threshold for evaluating patients after bariatric surgery, with repeat polysomnograms particularly for patients with other independent risk factors for obstructive sleep apnoea, such as male, older age, severe sleep apnoea at baseline or residual obesity.

**Research:** The authors stated that large prospective studies are required to identify patients, for whom follow-up polysomnograms are warranted.

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