CRD summary
The authors concluded that bariatric surgery significantly changed body weight, fasting plasma glucose, glycated haemoglobin, triglyceride and cholesterol in mildly obese people with type 2 diabetes mellitus. Given the unclear study quality, the differences between studies, the small evidence base and the restricted study populations, the authors’ conclusions should be treated with caution as they may not be reliable.

Authors’ objectives
To evaluate the impact of bariatric surgery on remission of diabetes in mildly to moderately obese patients with type 2 diabetes mellitus.

Searching
PubMed, EMBASE and The Cochrane Library were searched up to June 2011 for published articles written in any language. Search terms were reported. The related articles function of PubMed was used. References of relevant studies were handsearched.

Study selection
Published studies of gastric surgery in patients with type 2 diabetes mellitus who had a body mass index (BMI) of less than 35 kg/m$^2$ were eligible for inclusion. Outcomes of interest were change in body weight loss, fasting plasma glucose, haemoglobin A1c (glycated haemoglobin), insulin levels, C-peptide, total cholesterol, triglyceride, high-density lipoprotein cholesterol and waist circumference. Studies had to report data that enabled the calculation of the mean difference (MD) with 95% confidence intervals (CI) to be eligible. Studies where patients underwent gastric surgery because of other diseases were excluded.

Included studies evaluated laparoscopic Roux-en-Y gastric bypass, duodenal-jejunal exclusion surgery, biliopancreatic diversion, laparoscopic mini-gastric bypass and sleeve gastrectomy. The mean age of participants ranged from 34 to 56.4 years; their mean BMI was 29.72 kg/m$^2$. Just over half of patients were female (56.6%). Most patients had poor glycaemic control. The percentage of patients off diabetes medication ranged from 0 to 100%. Comorbid hypertension (76.2%) and dyslipidaemia (83%) were common. The studies were carried out in Brazil, the USA, Taiwan, Italy and India.

Two reviewers independently selected the studies for review.

Assessment of study quality
The authors did not report that they assessed study quality.

Data extraction
Differences between groups were extracted for each outcome and used to calculate mean differences with 95% confidence intervals. Where two studies reported the same research data, the study with the largest sample was included.

Two reviewers independently extracted the data onto standardized data extraction forms. Disagreements were resolved through discussion.

Methods of synthesis
Pooled weighted mean differences (WMD) with 95% confidence intervals were calculated for each outcome. Statistical heterogeneity was assessed using $X^2$ and $I^2$. Where significant statistical heterogeneity was found, a random-effects model was used. Where there was no significant statistical heterogeneity, a fixed-effect model was used. Subgroup analyses were performed according to surgery type.
Results of the review
Thirteen studies were included in the review (357 patients; range 5 to 69); they appeared to be before-after studies (11 prospective and two retrospective). The follow-up period ranged from six months to 18 years (median follow up of 26.8 months).

There was a significant decrease in body weight (WMD 17.23kg, 95% CI 14.13 to 20.34kg; five studies; 84 patients), BMI (WMD 5.18kg/m$^2$, 95% CI 3.79 to 6.57; 12 studies; 320 patients) and waist circumference (WMD 17.81cm, 95% CI 21.64 cm; four studies; 151 patients) following bariatric surgery. There was evidence of significant statistical heterogeneity for BMI ($I^2=92.7\%$), but not for weight loss or waist circumference ($I^2=0\%$).

There was a significant decrease in fasting plasma glucose (WMD 4.80mmol/L, 95% CI 3.88 to 5.71; 12 studies; 352 patients; $I^2=76.5\%$) and glycated haemoglobin levels (WMD 2.59%, 95% CI 2.12% to 3.07%; 11 studies; 313 patients; $I^2=81.4\%$) following bariatric surgery. There was evidence of significant statistical heterogeneity for both these outcomes.

There was a significant decrease in triglyceride (WMD 56.67mg/dL, 95% CI 11.53 to 101.82 ;seven studies; 206 patients; $I^2=85.3\%$), total cholesterol (WMD 48.38mg/dl, 95% CI 21.08 to 75.68; seven studies; 152 patients; $I^2=94.8\%$) and low-density lipoprotein cholesterol (WMD 36.7mg/dl, 95% CI 26.41 to 45.72; four studies; 162 patients; $I^2=71.8\%$) significantly decreased following bariatric surgery. There was evidence of significant statistical heterogeneity for these outcomes.

Insulin levels, C-peptide and high-density lipoprotein cholesterol did not significantly change following bariatric surgery.

The incidence of major complications was 3.2%. No mortality was observed.

The authors reported that subgroup analysis by type of surgery did not significantly alter the findings.

Authors’ conclusions
Bariatric surgery significantly changed body weight, fasting plasma glucose, glycated haemoglobin, triglyceride and cholesterol in mildly obese people (BMI below 35kg/m$^2$) with type 2 diabetes mellitus.

CRD commentary
The review addressed a clear question with well-defined inclusion criteria. Several relevant databases were searched for articles in any language. This minimised the risk of language bias. Publication bias was not assessed and steps did not appear to have been taken to identify unpublished studies, so publication bias could not be ruled out. Appropriate steps were taken during the study selection and data extraction process to minimise the risk of reviewer error and bias.

The quality of included studies was not assessed and the included studies were of weaker design. Therefore, the reliability and quality of the included data was unclear. High levels of statistical heterogeneity were found for many outcomes, so combining the studies in a meta-analysis may not have been appropriate.

Given the unclear quality of the included studies, the differences between studies, the small number of studies with small sample sizes and the restricted study populations, the authors’ conclusions should be treated with caution as they may not be reliable.

Implications of the review for practice and research
Practice: The authors stated that the findings were only applicable to a similar population used in the studies (middle-aged people with poor glycaemic control).

Research: The authors stated that further large scale trials with long-term follow up were needed to evaluate the safety and efficacy of bariatric surgery in mildly obese people with type 2 diabetes mellitus.

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