National Institute for Health and Care Excellence

Final

Weight management suite

[C] Evidence review for referral for bariatric surgery

NICE guideline CG189

Evidence reviews underpinning recommendations 1.10.1 to 1.10.2 and 1.10.6 to 1.10.7 and research recommendations in the NICE guideline

July 2023

FINAL

The National Institute for Health and Care Excellence

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Referral for bariatric surgery

1.1 Review question

What referral criteria for bariatric surgery are most effective to achieve weight loss and maintain a healthier weight in adults living with obesity?

1.1.1 Introduction

Bariatric surgery is a treatment option for people living with obesity. The 2014 NICE guidance on obesity identification, assessment and management (CG189) recommends that bariatric surgery is a treatment option for people living with obesity if the person has a BMI of 40 kg/m^2 or more, or between 35 kg/m^2 and 40 kg/m^2 and other significant diseases (for example, type 2 diabetes or high blood pressure) that could be improved if they lost weight. The recommendation also highlights that the person should have tried all appropriate non-surgical measures but had not achieved or maintained adequate clinically beneficial weight loss, should be receiving or will receive intensive management in a tier 3 service, be fit for anaesthesia and surgery and be able to commit to the need for long-term follow up to be considered for bariatric surgery.

It was noted that there may be specific subgroups not listed in the existing recommendations who would benefit from bariatric surgery. Based on this understanding, a review was conducted to evaluate the effectiveness of bariatric surgery across different subpopulations of adults living with obesity. These groups included people with different comorbidities, people in different BMI categories and ethnicity (see table 1 for full list of subgroups). This evidence on effectiveness of bariatric surgery across different subpopulations was then used to inform the appropriate referral criteria for bariatric surgery.

1.1.2 Summary of the protocol

Table 1: PICO table for referral to bariatric surgery

Population	**Inclusion:** • Adults over the age of 18 living with obesity **Subgroups:** Analysis will be conducted on different sub-group populations based on: • BMI • Ethnicity • People prevented from receiving treatment because of their obesity (e.g., bone marrow and renal transplant, fertility treatment, hip/joint replacements) • People with impaired physical functionality (including musculoskeletal impairment) Comorbidities including: • Non-alcoholic fatty liver disease • Sleep apnoea • Severe Asthma • Cardiovascular disease • Idiopathic intracranial hypertension • Depression/anxiety **Exclusion:** • Children and young people under 18

	• Pregnant women • Studies with a population where more than 50% have type 2 diabetes will be excluded.
Intervention	**Bariatric Surgery including:** • Roux-en-Y gastric bypass • Mini gastric bypass / one-anastomosis gastric bypass • Sleeve gastrectomy • Gastric band • Biliopancreatic diversion (with duodenal switch) Studies will compare any weight-loss surgery specified in the list above to non-surgery **Procedures that are not included as they are no longer in current use:** • Jejunoileal bypass • Horizontal gastroplasty • Vertical banded gastroplasty or vertical gastroplasty (not banded) • Banded gastroplasty that is not adjustable • Banded gastric bypass • Biliopancreatic diversion (without duodenal switch)
Comparator	No treatment / standard care / non-surgical intervention for obesity

Outcome (s)	**Primary outcomes (critical outcomes)**
	• Measures of weight change (including change in weight or BMI)
	• Health related quality of life (the overall scores will be reported, as well as domains relating to everyday function and mental health)
	• Obesity related comorbidities (type 2 diabetes, hypertension, heart disease, stroke, non-alcoholic fatty liver disease, sleep apnoea, hypercholesterolemia, Idiopathic intracranial hypertension, asthma), depression and anxiety).
	• Fertility
	
	All outcomes will be reported at 12 months and for the longest available time point followed up in studies, provided that this is at least 2 years.
	
	Secondary outcomes (important outcomes)
	• Mortality (perioperative and at the latest time point in the study)
	• Adverse events:
	  ○ Serious adverse events (according to the European medicines agency definition).
	  ○ Specific adverse events: nutritional deficiencies, wound infections, hypoglycaemia, postprandial pain, gastric side effects
	• Revision rates (reversal or conversions to normal or other procedures)

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in Table 1 and appendix A and the methods described in appendix B.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

Use of systematic reviews

Systematic reviews of randomised controlled trials (RCTs) were used to cross check the included RCTs in the evidence review and were not included directly as evidence.

Systematic reviews of comparative observational studies were included directly as evidence if they included information about a subgroup of interest. In these cases, quality of the systematic review was assessed (see appendix B). A separate risk of bias assessment was not conducted on the individual studies identified through the systematic but instead the quality assessment as reported in the systematic review was used.

One systematic review was included in this review (Sutanto 2021) which used the Newcastle Ottawa scale to assess the quality of each included study and reported a risk of bias for each of the domains in the checklist. Based on these domain ratings, an overall risk of bias for each study was derived by considering the impact of each domain on the overall certainty in the evidence. GRADE ratings were derived and then applied in the same way as for pairwise analysis as detailed in appendix B. The applicability of studies contributing to the systematic review was assessed by considering the study information provided by the systematic review. All studies in Sutanto 2021 included systematic review were considered directly applicable.

Protocol deviation

As previously highlighted, RCTs and comparative observational studies were included in the review. High quality comparative observational studies were used to supplement data identified from RCTs. Seven comparative observational studies (reported across 8 studies) were included in the review that included data on specific subgroups. An additional 22 observational studies were identified that matched the protocol but did not have information on a particular subgroup and did not contain data stratified by BMI or ethnicity. As RCT evidence had already been identified that included a broad population, the additional observational studies with a broad population would not provide further useful information on referral criteria. Following discussion with the committee, it was decided that evidence from these studies would not be useful to inform recommendations about referral criteria, and so these studies were not included in the review.

1.1.4 Effectiveness evidence

1.1.4.1 Included studies

A systematic search was conducted (see appendix C for the search strategy) which had 23,277 results, and after removing 9,174 references duplicate references, 14,103 references were screened at title and abstract stage. At this stage, 356 articles were identified for full text review. Following full text review, 21 papers were included that focused on the following subgroups:

- **1 systematic review**
    - Cardiovascular disease
- **8 randomised controlled trials (reported across 12 studies)**
    - Obstructive sleep apnoea
    - Idiopathic intracranial hypertension (IH)
    - Hypertension
    - No specific comorbidity (presence of a specific comorbidity was not an inclusion criteria for the study)
- **7 observational study papers (reported across 8 studies)**
    - Sleep apnoea
    - Hypertension
    - Cardiovascular disease (CVD)
    - Non-Alcoholic Fatty Liver Disease (NAFLD)
    - No specific comorbidity (presence of a specific comorbidity was not an inclusion criteria for the study)

Included studies compared bariatric surgery to the following comparators:

- No treatment
- No surgery
- Non-surgical intervention
- Standard care to treat condition of interest (e.g., positive airway pressure for sleep apnoea)

One study [Moussa 2020] was identified in the search which also appeared in the systematic review [Sutanto 2021] which focused on obesity with CVD. The inclusion criteria of Moussa 2020 were patients who had a diagnosis of obesity or ≥30 kg/m2 during follow-up. Based on this, the study was included as covering obesity with no specific comorbidity.

Sutanto 2021 considered this study as an inclusion on the basis that the study focused on the comparison of major adverse cardiovascular event (MACE) in people with obesity and CVD. However, it should be noted that Moussa 2020 included people with a number of comorbidities, including hypertension which formed the largest majority (52.1% of the people in the intervention arm and 49.2% of the people in comparator arm).

As the study included data on BMI, the study appears under evidence for no specific comorbidity where data for the outcome MACE is reported for different BMI categories. The study also appears as evidence for obesity with CVD through the inclusion of Sutanto 2021, where the overall estimate for MACE (irrespective of BMI threshold) is included.

See Appendix D for more detail on the study selection and Appendix K for excluded studies.

1.1.5 Summary of studies included in the effectiveness evidence

Table 2: Summary of studies included in the effectiveness evidence review

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
No specific comorbidity						
Aguiar, 2014 Brazil	RCT	N = 52 BMI 40 to 50 kg/m2 or 35 to 39.9 kg/m2 with associated comorbidities Women and men	Gastric band (N=16)	No treatment (N=36)	3 months	Primary outcomes: • Weight • BMI • apnoea/hypopnoea index (AHI)
Freitas, 2018 Brazil	RCT	N = 81 BMI ≥40 kg/ m2 or ≥35 kg/m2 when associated with comorbidities Women and men	Roux-en-Y gastric bypass (N=62)	No treatment (N=19)	6 months	Primary outcomes: • Weight • BMI
O'Brien, 2006 Australia	RCT	N = 80 BMI 30 to 35 kg/m2 including an obesity-related comorbidity (such as hypertension, dyslipidaemia, diabetes, obstructive sleep apnoea or gastroesophageal reflux disease) Women and men	Laparoscopic adjustable gastric band (N=40)	Non-surgical intervention for obesity - Behavioural modification, very-low-calorie diet, and pharmacotherapy (N=40)	6 months 1 year 18 months 10 years	Primary outcomes: • Weight • BMI • Health related quality of life • Secondary outcomes • Adverse events

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
Moussa 2020 UK	Observational	N=7402 BMI: Surgery: Median (IQR) - 40.5 (37.1 to 45.5), Non Surgery: 40.3 (36.6 to 43.9)	Bariatric surgery (n=3701)	No Surgery (n=3701)	140.7 months (SD = 79.9 months)	• Weight (kg) • Composite of fatal or non-fatal myocardial infarction and fatal or non-fatal acute ischaemic stroke (MACE) • Heart failure • Fatal or non-fatal myocardial infarction • Fatal or non-fatal ischaemic stroke
Jamaly 2019 (Including Carlson 2020 analysis)	Observational	N=4033 (Jamaly) N=4047 (Carlson) BMI: Bariatric 42.4kg/m^2 (4.5) Non Surgery 40.1kg/m^2 (4 7) Male and Female	Bariatric surgery - vertical banded gastroplasty (68%), gastric banding (19%), and gastric bypass (13%) (n =2003) (Jamaly) n=2010 (Carlson)	No Surgery (n=2030) (Jamaly) (n=2037 (Carlson)	Median follow-up of 22 (IQR 18-24)	• BMI (kg/m2) • Adverse events • Heart failure • Mortality • Type 2 diabetes • Overall mortality
Booth 2014 UK	Observational	N=4334, Mean BMI: Surgery 43.1 (8.1) kg/m^2 , No Surgery 43.2 (8.6) kg/m^2 Male and female	laparoscopic gastric banding, gastric bypass, or sleeve gastrectomy (N=2167)	No Surgery (n=2167)	Median 2.8 years, Maximum 7 years	Type 2 Diabetes

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
Doumoras 2020 Canada	Observational	N= 27358 BMI: Surgery 47.21kg/m^2 (8.01) No Surgery 46.7kg/m^2 (8.44) Male and female	Sleeve gastrectomy Gastric bypass (n=13679)	No Surgery (n=13679)	Median 4.8 years	All-cause mortality
Sleep Apnoea						
Bakker, 2018 US	RCT	N = 49 BMI 35 to 45 kg/m2 Severe obstructive sleep apnoea Women and men	Laparoscopic gastric band (N=28)	Standard care - Continuous positive airway pressure (N=21)	9 months 18 months	Primary outcomes • Weight • BMI • AHI
Agosta, 2016, France	Observational	N=87, BMI mean: Surgery 44.2 (4.7), Control 47 (9) Male and Female	Gastric banding, bypass, sleeve gastrectomy (n=28)	No Surgery (n=59)	2 years	Percentage of patients who pursued nocturnal positive airway pressure therapy after the start point
Dixon, 2012 Australia	RCT	N = 60 BMI 35 to 55 kg/m2 Obstructive sleep apnoea Women and men	Laparoscopic adjustable gastric band (N=30)	Non-surgical intervention for obesity - Conventional weight loss programme (N=30)	2 years	Primary outcomes: • Weight • BMI • Health related quality of life • Depression Secondary outcomes • Adverse events
Feigel-Guiller, 2015 France	RCT	N = 63 BMI >35 kg/m2	Laparoscopic adjustable gastric banding (N=30)	Non-surgical intervention for obesity - Intensive	1 year 3 years 10 years	Primary outcomes • Weight

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
		Obstructive sleep apnoea Women and men		nutritional care (N=33)		• BMI • AHI
Intracranial hypertension						
Mollan, 2021 Yiangou, 2021 UK	RCT	N = 66 BMI >35 kg/m2 Idiopathic intracranial hypertension Only women	Bariatric surgery: Roux-en-Y gastric bypass, gastric band, and laparoscopic sleeve gastrectomy (N=33)	Non-surgical intervention for obesity - Community weight management (N=33)	1 year 2 years	Primary outcomes • Weight • BMI • Health related quality of life • Anxiety • Depression • Intracranial pressure • Idiopathic intracranial hypertension symptoms • Obstructive sleep apnoea • AHI Secondary outcomes • Serious adverse events
Hypertension						
Schiavon 2018 Schiavon 2020 Furlan 2021	RCT	N=100 BMI 30.0 to 39.9 kg/m^2 Hypertension Women and men	Roux-en-Y gastric bypass (N=50)	Standard care - Medical treatment for hypertension (N=50)	1 year 3 years	Primary outcomes • Weight • BMI • Obstructive sleep apnoea • Resistant hypertension

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
						• Secondary outcomes • Adverse events
Jamaly 2019 / Carlson 2020 analysis	Observational	N=4033 (Jamaly) N=4047 (Carlson) BMI: Bariatric 42.4kg/m^2 (4.5) Non-Surgery 40.1kg/m^2 (4.7) Male and Female	Bariatric surgery - vertical banded gastroplasty (68%), gastric banding (19%), and gastric bypass (13%) (n =2003) (Jamaly) n=2010 (Carlson)	No Surgery (n=2030) (Jamaly) (n=2037 (Carlson)	Median follow-up of 22 (IQR 18-24)	• BMI (kg/m2) • Adverse events • Heart failure • Mortality • Type 2 diabetes • Overall mortality
CVD						
Douglas 2015 UK	Observational	N=7764, Mean BMI Surgery 44.7kg/m^2 (8.8) No Surgery 42.1 kg/m^2 (6.5), Male and Female	Gastric band 1,829 (47.1%), Gastric bypass 1,421 (36.6%), Sleeve gastrectomy 613 (15.8%) (n=3882)	No Surgery (n=3882)	Mean 3.4 years	• Weight (kg) • BMI (kg/m2) • All-cause mortality • Cardiovascular event • Cancer • Obstructive sleep apnoea • Type 2 Diabetes
Sutanto 2021 *Includes:* *Amінian 2019*	Systematic review	N=1,772,305 BMI mean: Surgery: 46.62, No Surgery 44.59kg/m^2 Male and female	Roux-en-Y gastric bypass, gastric banding, sleeve gastrectomy, biliopancreatic diversion, vertical	No surgery (n= 1,698263)	3 to 9 years	MACE

Author / Country	Study design	Population	Intervention	Comparator	Follow-up	Outcome(s)
Batsis 2007 *Hung 2007* *Moussa 2020* *Nasland 2021* *Nguyen 2020* *Pirlet 2020* *Sjostrom 2021* *Stenberg 2020*			banded gastroplasty and duodenal switch (n=74042)			
Non-Alcoholic Fatty Liver Disease						
Aminian 2021 USA	Observational	N=924. BMI Median /IQR - Bariatric: 45.7 (41.2 to 52.8), Control: 36.0 (32.9 to 39.9)	Roux-en-Y gastric bypass surgery, Sleeve gastrectomy (n=462)	No Surgery (n=462)	Median - 7 years	• MACE • Major adverse liver outcome

See Appendix E for full evidence tables.

1.1.6 Summary of the effectiveness evidence

No specific comorbidity (presence of specific comorbidity not inclusion criteria for study)

Table 3: Bariatric surgery vs no treatment

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No treatment			
Weight (kg) [MID +/- 13.05] (follow-up 6 months[(a)]; Better indicated by lower values)						
2[(a)]	RCT	71	50	MD: -32.19 (-41.39 to -22.99)	LOW	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 2.88] (follow-up 6 months[(a)]; Better indicated by lower values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No treatment			
2[(a)]	RCT	71	50	MD: -13.4 (-15.98 to -10.82)	LOW	**Favours bariatric surgery**
AHI score [MID +/- 4.57] (follow-up 3 months; Better indicated by lower values)						
1[(b)]	RCT	16	36	MD: -9.39 (-16.62 to -2.16)	LOW	**Favours bariatric surgery**
AHI <5 [MID 0.8 to 1.25] (follow-up 3 months; Better indicated by higher values)						
1[(b)]	RCT	9/16 (56.3%)	27.8%	RR: 2.03 (1.02 to 4)	LOW	**Favours bariatric surgery**
AHI severity - AHI 5<15 [MID 0.8 to 1.25] (follow-up 3 months; Better indicated by lower values)						
1 [(b)]	RCT	6/16 (37.5%)	38.9%	RR: 0.96 (0.45 to 2.05)	VERY LOW	Evidence could not differentiate between arms
AHI severity - AHI 15<30 [MID 0.8 to 1.25] (follow-up 3 months; Better indicated by lower values)						
1 [(b)]	RCT	1/16 (6.3%)	13.9%	RR: 0.45 (0.06 to 3.55)	VERY LOW	Evidence could not differentiate between arms
AHI severity - AHI ≥30 [MID 0.8 to 1.25] (follow-up 3 months; Better indicated by lower values)						
1 [(b)]	RCT	0/16 (0%)	19.4%	RR: 0.15 (0.01 to 2.4)	VERY LOW	Evidence could not differentiate between arms

(a) Aguiar 2014 (3 months follow-up); Freitas 2018 (6 months follow-up)
(b) Aguiar 2014

Table 4: Bariatric surgery vs no surgery

Evidence stratified by BMI

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No treatment			
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years; Better indicated by lower values) - BMI 30-34.9 kg/m^2						
1[(a)]	Observational	339	332	HR: 0.39 (0.11 to 1.4)	VERY LOW	Evidence could not differentiate between arms
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years; Better indicated by lower values) - BMI 35-39.9 kg/m^2						
1[(a)]	Observational	535	551	HR: 0.24 (0.12 to 0.48)	MODERATE	**Favours bariatric surgery**
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years; Better indicated by lower values) - BMI >= 40 kg/m2						
1[(a)]	Observational	1293	1284	HR 0.15 (0.09 to 0.25)	MODERATE	**Favours bariatric surgery**
MACE [MID 0.8 to 1.25] (11 years; Better indicated by lower values) - BMI 35-40 kg/m2 (n=3528)						
1[(b)]	Observational	No data provided	No data provided	HR: 0.62 (0.35 to 1.12)	VERY LOW	Evidence could not differentiate between arms
MACE [MID 0.8 to 1.25] (11 years; Better indicated by lower values) - BMI 40-50 kg/m2 (n=3026)						
1[(b)]	Observational	No data provided	No data provided	HR: 0.29 (0.15 to 0.57)	LOW	**Favours bariatric surgery**
MACE [MID 0.8 to 1.25] (11 years; Better indicated by lower values) - BMI >50 kg/m2 (n=848)						
1[(c)]	Observational	No data provided	No data provided	HR: 0.27 (0.07 to 0.95)	VERY LOW	**Favours bariatric surgery**
Heart Failure [MID 0.8 to 1.25] (Median follow up 22 years; Better indicated by lower values) - BMI <40.8 kg/m2						
1[(c)]	Observational	792	1225	RR: 0.72 (0.56 to 0.93)	VERY LOW	**Favours bariatric surgery**
Heart Failure [MID 0.8 to 1.25] (Median follow up 22 years; Better indicated by lower values) - BMI >40.8 kg/m2						
1[(c)]	Observational	1211	805	RR: 0.72 (0.56 to 0.92)	VERY LOW	**Favours bariatric surgery**
Overall mortality [MID: Line of no effect] (Median follow up 19 years; Better indicated by lower values) – BMI <39kg/m2						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No treatment			
1[d]	Observational	No data provided	No data provided	HR: 0.78 (0.61-0.99)	LOW	**Favours Bariatric surgery**
Overall mortality [MID: Line of no effect] (Median follow up 19 years; Better indicated by lower values) – BMI 39-42kg/m2						
1[d]	Observational	No data provided	No data provided	HR: 0.73 (0.57-0.93)	LOW	**Favours Bariatric surgery**
Overall mortality [MID: Line of no effect] (Median follow up 19 years; Better indicated by lower values) – BMI >42.6 kg/m2						
1[d]	Observational	No data provided	No data provided	HR: 0.66 (0.52-0.83)	LOW	**Favours Bariatric surgery**
Overall mortality [MID: Line of no effect] (Median follow up 4.84 years; Better indicated by lower values) - BMI <40kg/m2						
1[e]	Observational	2152	2152	HR: 1.00 (0.66-1.51)	LOW	Evidence could not differentiate between arms
Overall mortality [MID: Line of no effect] (Median follow up 4.84 years; Better indicated by lower values) – BMI 40 -50kg/m^2						
1[e]	Observational	7340	7340	HR: 0.62 (0.48-0.80)	MODERATE	**Favours Bariatric surgery**
Overall mortality [MID: Line of no effect] (Median follow up 4.84 years; Better indicated by lower values) – BMI >50kg/m^2						
1[e]	Observational	4187	4187	HR: 0.64 (0.47-0.88)	MODERATE	**Favours Bariatric surgery**

(a) *Booth 2014*
(b) *Moussa 2020*
(c) *Jamaly 2019*
(d) *Jamaly 2019 (Carlsson 2020 analysis)*
(e) *Doumoras 2020*

Table 5: Bariatric surgery vs non-surgical intervention

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Weight (kg) [MID +/- 3.06] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	40	40	MD: -9.20 (-11.86 to -6.54)	MODERATE	**Favours bariatric surgery**
Weight (kg) [MID +/- 2.11] (follow-up 2 years; Better indicated by lower values)						
1[(a)]	RCT	40	40	MD: -15.2 (-17.44 to -12.96)	MODERATE	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 1.29] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	40	40	MD: -3.1 (-4.2 to -2.0)	MODERATE	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 1.33] (follow-up 2 years; Better indicated by lower values)						
1[(a)]	RCT	40	40	MD -5.3 (-6.42 to -4.18)	MODERATE	**Favours bariatric surgery**

(a) O'Brien 2006

Obstructive sleep apnoea

Table 4: Bariatric surgery vs non-surgical intervention

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Weight (kg) [MID +/- 13.39] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	26	30	MD: -12.9 (-26.13 to 0.33)	VERY LOW	Evidence could not differentiate between arms
Weight (kg) [MID +/- 8.47] (follow-up 10 years[(b)]; Better indicated by lower values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
2[c]	RCT	51	52	MD: -20.25 (-27 to -13.5)	LOW	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 4.43] (follow-up 12 months; Better indicated by lower values)						
1[a]	RCT	26	30	MD: -4.6 (-9.55 to 0.35)	VERY LOW	Evidence could not differentiate between arms
BMI (kg/m²) [MID +/- 4.03] (follow-up 10 years; Better indicated by lower values)						
1[a]	RCT	21	22	MD: -6.8 (-11.82 to -1.78)	VERY LOW	**Favours bariatric surgery**
AHI score [MID +/- 12.57] (follow-up 12 months; Better indicated by lower values)						
1[a]	RCT	26	30	MD: -22.1 (-34.9 to -9.3)	VERY LOW	**Favours bariatric surgery**
AHI score [MID +/- 13.95] (follow-up 10 years[b]; Better indicated by lower values)						
2[c]	RCT	52	54	MD: -12.25 (-22.79 to -1.71)	VERY LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Physical component summary [MID +/- 8.69] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[d]	RCT	30	30	MD: 9.3 (0.5 to 18.1)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Mental component summary [MID +/- 4.94] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[d]	RCT	30	30	MD: -0.3 (-5.3 to 4.7)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Physical function [MID +/- 19.96] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[d]	RCT	30	30	MD: 16.8 (-3.4 to 37)	LOW	Evidence could not differentiate between arms

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Health related quality of life (SF-36) - Role-Physical [MID +/- 30.92] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 33.5 (2.2 to 64.8)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Body pain [MID +/- 13.73] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 7.4 (-6.5 to 21.3)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - General health [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 18.4 (3.6 to 33.2)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Vitality [MID +/- 16.70] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 17.3 (0.4 to 34.2)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Social function [MID +/- 19.46] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 10.6 (-9.1 to 30.3)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Role emotional [MID +/- 34.87] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 15.6 (-19.7 to 50.9)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Mental health [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(d)]	RCT	30	30	MD: 4.3 (-10.5 to 19.1)	LOW	Evidence could not differentiate between arms
Depression (Beck Depression Inventory) [MID +/- 5.82] (follow-up 2 years; range of scores: 0-63; Better indicated by lower values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
1[(d)]	RCT	30	30	MD: -1.80 (-7.7 to 4.1)	LOW	Evidence could not differentiate between arms

(a) Feigel-Guiller 2015
(b) Longest follow-up (Dixon 2012 [2 years]; Feigel-Guiller 2015 [10 years])
(c) Dixon 2012; Feigel-Guiller 2015
(d) Dixon 2012

Table 7: Bariatric surgery vs standard of care (continuous positive airway pressure)

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Standard of care			
Weight (kg) [MID +/- 7.46] (follow-up 9 months; Better indicated by lower values)						
1[(a)]	RCT	25	18	MD: -3.6 (-13.32 to 6.12)	LOW	Evidence could not differentiate between arms
Weight (kg) [MID +/- 8.02] (follow-up 18 months; Better indicated by lower values)						
1[(a)]	RCT	24	16	MD: -4.5 (-15.02 to 6.02)	LOW	Evidence could not differentiate between arms
BMI (kg/m²) [MID +/- 1.72] (follow-up 9 months; Better indicated by lower values)						
1[(a)]	RCT	25	18	MD: -1.9 (-3.93 to 0.13)	LOW	Evidence could not differentiate between arms
BMI (kg/m²) [MID +/- 1.99] (follow-up 18 months; Better indicated by lower values)						
1[(a)]	RCT	24	16	MD: -2.1 (-4.51 to 0.31)	LOW	Evidence could not differentiate between arms
AHI (events per hour) off continuous positive airway pressure treatment [MID +/- 15.77] (follow-up 9 months; Better indicated by lower values)						
1[(a)]	RCT	25	18	MD: 0.6 (-16.98 to 18.18)	VERY LOW	Evidence could not differentiate between arms
AHI (events per hour) off continuous positive airway pressure treatment [MID +/- 16.56] (follow-up 18 months; Better indicated by lower values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Standard of care			
1[(a)]	RCT	24	16	MD: -6.3 (-27.75 to 15.15)	LOW	Evidence could not differentiate between arms

(a) Bakker 2018

Table 8: Bariatric surgery vs no surgery

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No surgery			
Discontinuation of positive airway pressure (PAP) [MID 0.8 to 1.25] 6 months - 1 year (Better indicated by higher value)						
1[(a)]	Observational	28	59	HR: 15.93 (3.29 to 77.06)	LOW	**Favours Bariatric surgery**
Discontinuation of positive airway pressure (PAP) [MID 0.8 to 1.25] 12 months - 2 year (Better indicated by higher value)						
1[(a)]	Observational	28	59	HR: 8.33 (0.95 to 73.25)	VERY LOW	**Favours Bariatric surgery**

(a) Agosta 2016

Idiopathic intracranial hypertension

Table 5: Bariatric surgery vs non-surgical intervention

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Weight (kg) [MID +/- 10.96] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -21.4 (-31.98 to -10.82)	LOW	**Favours bariatric surgery**

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Weight (kg) [MID +/- 11.47] (follow-up 2 years; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -26.6 (-37.58 to -15.62)	MODERATE	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 3.86] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -7.3 (-11.02 to -3.58)	LOW	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 3.86] (follow-up 2 years; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -9.4 (-13.12 to -5.68)	MODERATE	**Favours bariatric surgery**
Health related quality of life (SF-36) - Physical component summary [MID +/- 7.31] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 7.3 (0.24 to 14.36)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Mental component summary [MID +/- 6.50] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 1.6 (-4.67 to 7.87)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Physical functioning [MID +/- 13.81] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 20.2 (6.87 to 33.53)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Role limitations due to physical health [MID +/- 23.96] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 10.5 (-12.63 to 33.63)	LOW	Evidence could not differentiate between arms

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
Health related quality of life (SF-36) - Role limitations due to emotional problems [MID +/- 24.78] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 5.9 (-18.01 to 29.81)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Energy/fatigue [MID +/- 13.00] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 14.9 (2.36 to 27.44)	LOW	**Favours bariatric surgery**
Health related quality of life (SF-36) - Emotional well-being [MID +/- 14.01] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 2.3 (-11.22 to 15.82)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Social functioning [MID +/- 5.07] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 1.8 (-3.1 to 6.7)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Pain [MID +/- 15.43] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 8.4 (-6.5 to 23.3)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - General health [MID +/- 11.37] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 9.9 (-1.08 to 20.88)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Physical component summary [MID +/- 7.72] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
1(a)	RCT	33	33	MD 10.4 (2.95 to 17.85)	LOW	Favours bariatric surgery
Health related quality of life (SF-36) - Mental component summary [MID +/- 6.90] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1(a)	RCT	33	33	MD -0.5 (-7.16 to 6.16)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Physical functioning [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1(a)	RCT	33	33	MD 27.7 (13.59 to 41.81)	LOW	Favours bariatric surgery
Health related quality of life (SF-36) - Role limitations due to physical health [MID +/- 25.39] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1(a)	RCT	33	33	MD 5 (-19.5 to 29.5)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Role limitations due to emotional problems [MID +/- 26.60] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1(a)	RCT	33	33	MD 7.9 (-17.78 to 33.58)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Energy/fatigue [MID +/- 13.81] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1(a)	RCT	33	33	MD 7.5 (-5.83 to 20.83)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Emotional well-being [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
1[(a)]	RCT	33	33	MD 4.3 (-9.81 to 18.41)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Social functioning [MID +/- 5.48] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD -1.1 (-6.39 to 4.19)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - Pain [MID +/- 16.45] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 11.9 (-3.98 to 27.78)	LOW	Evidence could not differentiate between arms
Health related quality of life (SF-36) - General health [MID +/- 12.18] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)						
1[(a)]	RCT	33	33	MD 22.8 (11.04 to 34.56)	LOW	**Favours bariatric surgery**
Hospital anxiety and depression scores (HADS) - HADS - anxiety [MID +/- 2.64] (follow-up 12 months; range of scores: 0-21; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -1.1 (-3.65 to 1.45)	LOW	Evidence could not differentiate between arms
Hospital anxiety and depression scores (HADS) - HADS - depression [MID +/- 2.43] (follow-up 12 months; range of scores: 0-21; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -1.6 (-3.95 to 0.75)	LOW	Evidence could not differentiate between arms
Hospital anxiety and depression scores (HADS) - HADS - anxiety [MID +/- 2.84] (follow-up 2 years; range of scores: 0-21; Better indicated by lower values)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
1[(a)]	RCT	33	33	MD -0.2 (-2.94 to 2.54)	LOW	Evidence could not differentiate between arms
Hospital anxiety and depression scores (HADS) at 2 years - HADS - depression [MID +/- 2.64] (follow-up 2 years; range of scores: 0-21; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -1.5 (-4.05 to 1.05)	LOW	Evidence could not differentiate between arms
Intracranial pressure (cm CFS) [MID +/- 3.65] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -6 (-9.53 to -2.47)	LOW	**Favours bariatric surgery**
Intracranial pressure (cm CFS) [MID +/- 4.06] (follow-up 2 years; Better indicated by lower values)						
1[(a)]	RCT	33	33	MD -8.2 (-12.12 to -4.28)	MODERATE	**Favours bariatric surgery**
Idiopathic intracranial hypertension symptoms - Pulsatile tinnitus [MID 0.8 to 1.25] (follow-up 12 months)						
1[(a)]	RCT	14/30 (46.7%)	18/29 (62.1%)	RR 0.76 (0.5 to 1.16)	LOW	Evidence could not differentiate between arms
Idiopathic intracranial hypertension symptoms - Visual loss [MID 0.8 to 1.25] (follow-up 12 months)						
1[(a)]	RCT	10/30 (33.3%)	14/29 (48.3%)	RR 0.69 (0.37 to 1.29)	VERY LOW	Evidence could not differentiate between arms
Idiopathic intracranial hypertension symptoms - Diplopia [MID 0.80 to 1.25] (follow-up 12 months)						
1[(a)]	RCT	4/30 (13.3%)	4/29 (13.8%)	RR 0.33 (0.07 to 1.56)	VERY LOW	Evidence could not differentiate between arms
Idiopathic intracranial hypertension symptoms - Visual obscurations [MID 0.80 to 1.25] (follow-up 12 months)						

No of studies	Design	No of participants		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Non-surgical intervention for obesity			
1[(a)]	RCT	7/30 (23.3%)	4/29 (13.8%)	RR 1.53 (0.54 to 4.34)	VERY LOW	Evidence could not differentiate between arms
Idiopathic intracranial hypertension symptoms - Headache [MID 0.80 to 1.25] (follow-up 12 months)						
1[(a)]	RCT	22/30 (73.3%)	23/39 (59%)	RR 0.98 (0.67 to 1.43)	VERY LOW	Evidence could not differentiate between arms
Serious adverse events - 0 to 12 months [MID 0.80 to 1.25]						
1[(a)]	RCT	12/33 (36.4%)	3/33 (9.1%)	RR 4.0 (1.24 to 12.88)	VERY LOW	**Favours non-surgical intervention**
Serious adverse events - 12 months to 2 years [MID 0.80 to 1.25]						
1[(a)]	RCT	1/33 (3%)	8/33 (24.2%)	RR 0.13 (0.02 to 0.94)	VERY LOW	**Favours bariatric surgery**
Diagnosis of obstructive sleep apnoea (only women) - By American Academy of Sleep Medicine criteria [MID 0.80 to 1.25] (follow-up 12 months)						
1[(b)]	RCT	1/8 (12.5%)	6/11 (54.5%)	RR 0.23 (0.03 to 1.55)	VERY LOW	Evidence could not differentiate between arms
Diagnosis of obstructive sleep apnoea (only women) - By apnoea/hypopnoea index (score 15 or more) [MID 0.80 to 1.25] (follow-up 12 months)						
1[(b)]	RCT	1/8 (12.5%)	2/11 (18.2%)	RR 0.69 (0.07 to 6.34)	VERY LOW	Evidence could not differentiate between arms

(a) Idiopathic Intracranial Hypertension Weight Trial (IIH WT) reported by Mollan 2021
(b) Idiopathic Intracranial Hypertension Weight Trial (IIH WT) reported by Yiangou 2021

Obesity with Hypertension

Table 6: Bariatric surgery vs standard care (medical treatment for hypertension)

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Standard of care			
Weight (kg) [MID +/- 6.72] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	48	44	MD -26.9 (-32.4 to -21.4)	MODERATE	**Favours bariatric surgery**
Weight (kg) [MID +/- 4.59] (follow-up 3 years; Better indicated by lower values)						
1[(b)]	RCT	50	50	MD -28.6 (-32.2 to -25)	MODERATE	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 1.58] (follow-up 12 months; Better indicated by lower values)						
1[(a)]	RCT	48	44	MD -9.6 (-10.9 to -8.3)	MODERATE	**Favours bariatric surgery**
BMI (kg/m²) [MID +/- 1.65] (follow-up 3 years; Better indicated by lower values)						
1[(b)]	RCT	50	50	MD -10.5 (-11.8 to -9.2)	MODERATE	**Favours bariatric surgery**
Reduction of ≥30% of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg [MID 0.8 to 1.25] (follow-up 12 months; Better indicated by higher values)						
1[(a)]	RCT	41/49 (83.7%)	6/47 (12.8%)	RR 6.55 (3.07 to 13.98)	MODERATE	**Favours bariatric surgery**
Reduction of ≥30% of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg [MID 0.8 to 1.25] (follow-up 3 years; Better indicated by higher values)						
1[(b)]	RCT	27/50 (54%)	4/50 (8%)	RR 6.52 (2.5 to 17.01)	MODERATE	**Favours bariatric surgery**
Resistant hypertension [MID 0.80 to 1.25] (follow-up 3 years; Better indicated by lower value)						

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Standard of care			
1[(b)]	RCT	1/44 (2.3%)	6/40 (15%)	RR 0.15 (0.02 to 1.20)	LOW	Evidence could not differentiate between arms
Obstructive sleep apnoea - Obstructive sleep apnoea vs no obstructive sleep apnoea [MID 0.8 to 1.25] (follow-up 3 years; Better indicated by higher value)						
1[(c)]	RCT	17/24 (70.8%)	1/13 (7.7%)	OR 29.14 (3.16 to 268.73)	MODERATE	**Favours bariatric surgery**
Obstructive sleep apnoea - Obstructive sleep apnoea vs no or mild obstructive sleep apnoea [MID 0.8 to 1.25] (follow-up 3 years; Better indicated by higher value)						
1[(c)]	RCT	22/24 (91.7%)	4/13 (30.8%)	OR 24.75 (3.83 to 159.92)	MODERATE	**Favours bariatric surgery**

(a) GATEWAY 2020 reported by Schiavon 2018
(b) GATEWAY 2020 reported by Schiavon 2020
(c) GATEWAY 2020 reported by Furlan 2021

Table 11: Bariatric surgery vs No Surgery

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	Standard of care			
Overall mortality [MID 0.8 to 1.25] – median follow up 19 years (Better indicated by lower value)						
1[(a)]	Observational	1571	1301	HR 0.69 (0.59-0.81)	LOW	**Favours bariatric surgery**

(a) Jamaly 2019 (Carlsson 2020 analysis)

Obesity with Cardiovascular disease

Table 12: Bariatric surgery vs no surgery

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No surgery			
MACE [MID 0.8 to 1.25] (composite of cardiovascular death, non-fatal stroke and non-fatal myocardial infarction), latest timepoint in study (Better indicated by lower value)						
10[a]	Systematic review of observational studies	73734	1657962	RR 0.55 (0.46 to 0.65)	VERY LOW	**Favours bariatric surgery**
Myocardial infarction [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1[b]	Observational	53	40	HR 0.30 (0.1 to 0.91)	VERY LOW	**Favours bariatric surgery**
Stroke [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1[b]	Observational	53	40	HR 1.03 (0.43 to 2.47)	VERY LOW	Evidence could not differentiate between arms
Hypertension [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1[b]	Observational	53	40	HR 0.18 (0.04 to 0.86)	LOW	**Favours bariatric surgery**
Type 2 diabetes [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1[b]	Observational	53	40	HR 0.61 (0.43 to 0.86)	LOW	**Favours bariatric surgery**
NAFLD [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1[b]	Observational	53	40	HR 0.65 (0.23 to 1.83)	LOW	Evidence could not differentiate between arms
Obstructive Sleep Apnoea [MID 0.8 to 1.25] (Better indicated by lower value)						

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No surgery			
1(b)	Observational	53	40	HR 0.58 (0.32 to 1.06)	LOW	Evidence could not differentiate between arms
Mortality [MID 0.8 to 1.25] (4 years; Better indicated by lower value)						
1(b)	Observational	53	40	RR 0.58 (0.32 to 1.06)	LOW	Evidence could not differentiate between arms

(a) Sutanto 2021 systematic review
(b) Douglas 2015

Obesity with non-alcoholic fatty liver disease

Table 13: Bariatric surgery vs no surgery

No of studies	Design	No of patients		Effect (95% CI)	Quality	Interpretation
		Bariatric surgery	No surgery			
Major adverse liver outcome [MID 0.8 to 1.25] (10 years, Better indicated by lower value)						
1(a)	Observational	462	462	HR 0.09 (0.02 to 0.38)	LOW	**Favours bariatric surgery**
MACE [MID 0.8 to 1.25] (10 years, Better indicated by lower value)						
1(a)	Observational	462	462	HR 0.25 (0.12 to 0.51)	LOW	**Favours bariatric surgery**

(a) Aminian 2021

See appendix F for forest plots and appendix G for full GRADE profiles.

Serious adverse events- All populations

Table14: Specific adverse events listed in the protocol

Study	Design	Bariatric surgery (events/total sample)	Non-surgical intervention for obesity (events/total sample)
O'Brien 2006 Throughout 2 years	RCT	Wound infection (1/39) Laparoscopic revision (4/39)	
Dixon 2012 Throughout 2 years	RCT	Replacement of laparoscopic adjustable gastric banding (1/30)	Acute abdomen (1/30) Diarrhoea with very low-calorie diet (1/30)
Schiavon 2018 Throughout 1 year	RCT	Serious adverse events: • Rehospitalisation (6/49) Gastrointestinal events: • Reoperation for abscess (1/49) • Cholelithiasis requiring laparoscopic cholecystectomy (4/49) • Anastomotic ulcer (1/49) • Vomiting and dehydration (1/49) Nutritional events • Dumping syndrome (5/49) • Anaemia (5/46) • Hypovitaminosis B12 (12/43) • Ferritin deficiency (2/43)	Cardiovascular events: • Hypertensive crisis (1/47) Nutritional events • Anaemia (4/40)
Schiavon 2018 Throughout 3 years	RCT	Nutritional events • Anaemia (5/47) • Hypovitaminosis B12 (13/44) • Ferritin deficiency (2/44)	Nutritional events • Anaemia (4/41)

1.1.7 Economic evidence

1.1.7.1 Included studies

A single search was performed to identify published economic evaluations of relevance to this review question in this guideline update (see Appendix B). The search retrieved 1,307 results and after removing duplicates, 855 were screened. 801 studies were excluded after the title and abstract screening, and an additional 50 studies were excluded following the full-text review.

1.1.7.2 Excluded studies

See Appendix K for excluded studies and reasons for exclusion.

1.1.8 Summary of included economic evidence

Table 15 provides summary details of the included studies. See Appendix I for a full evidence table and assessment of applicability and limitations.

Table 15: Summary of economic evidence

<table>
<tr><th rowspan="2">Applicability & limitations</th><th rowspan="2">Other comments</th><th rowspan="2">Intervention</th><th colspan="2">Absolute</th><th colspan="3">Incremental</th><th rowspan="2">Uncertainty</th></tr>
<tr><th>Cost (£)</th><th>QALYs</th><th>Cost (£)</th><th>QALYs</th><th>ICER</th></tr>
<tr><td colspan="9">Avenell et al. (2018)</td></tr>
<tr><td rowspan="2">Directly applicable (Appendix I; table 5) with minor limitations (Appendix I; table 6)</td><td rowspan="2">Approach to analysis: A semi-Markovian microsimulation model was used. A Monte-Carlo process was used to stochastically apply incident obesity related disease, dependent on age, sex and BMI.
BMI related complications considered: Type 2 diabetes, coronary heart disease, stroke, hypertension, knee osteoarthritis, and BMI-related cancers (breast, colorectal, endometrial, oesophageal, pancreatic and renal).
Perspective: UK National Health Service.</td><td>No intervention</td><td>£2,898 (£m/100k population)</td><td>1,135,676 (per 100k Population)</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Deterministic: Sensitivity analyses were conducted to reflect the uncertainty surrounding the weight regain assumption applied in the model due to the lack of long-term evidence on this model parameter. Most notably, when using a shorter time-horizon (either 5 years, 10 years, or 20 years) surgery was >£20,000 per QALY gained. Additionally, using a discount rate of 6% resulted in an ICER for surgery of £23,756 per QALY gained.
Probabilistic: The model did not investigate the impact of parametric uncertainty, for example through probabilistic sensitivity analyses, on the model outputs such as estimates of the ICER.</td></tr>
<tr><td>Roux-en-Y gastric bypass (RYGB) surgery</td><td>£4,319 (£m/100k population)</td><td>1,276,038 (per 100k Population)</td><td>£1,421 (£m/100k population)</td><td>140,362 (per 100K population)</td><td>£10,126</td></tr>
<tr><td colspan="9">Galvain et al. (2021)</td></tr>
<tr><td rowspan="6">Partially applicable (Appendix I; table 5) with minor limitations (Appendix I; table 6)</td><td rowspan="6">Approach to analysis: A Markov model was used. 30 day mortality rates were assigned to the surgery arm. BMS and conventional treatment led to changes in BMI, blood pressure, lipid ratio, and rate of type 2 diabetes (T2D) remission accordingly. BMI affected the probability of transitioning to T2D. Age, sex, BP, LR, and T2D status</td><td colspan="6">Group A (BMI>= 40kg/m2)</td><td rowspan="6">Deterministic: Sensitivity analyses were performed to look at the impact of covid, delayed surgery and endoscopy on results. Covid and delayed surgery both resulted in an increase in the net monetary benefit for groups A and B.
Probabilistic: In the PSA, BMS was associated with cost savings in all simulations for both groups</td></tr>
<tr><td>Conventional treatment</td><td>£51,519</td><td>7.81</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Bariatric and metabolic surgery (BMS)</td><td>£46,691</td><td>12.02</td><td>-£4,828</td><td>4.21</td><td>Dominated</td></tr>
<tr><td colspan="6">Group B (BMI>= 35kg/m2)</td></tr>
<tr><td>Conventional treatment</td><td>£67,085</td><td>7.03</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Applicability & limitations	Other comments	Intervention	Absolute		Incremental			Uncertainty
			Cost (£)	QALYs	Cost (£)	QALYs	ICER	
	affected the risk of stroke and MI, based on Framingham risk equations. Patients could occupy a diabetes health state, and transition between T2D and remission on an ongoing basis. Patients could occupy and transition between mutually exclusive health states (stroke, MI, cancer). **BMI related complications considered:** Type 2 diabetes, coronary heart disease, stroke, and cancer. **Perspective:** UK National Health Service.	BMS	£59,258	9.30	-£7,827	2.27	Dominated	and generated higher QALYs in 99.9% and 100% of simulations in Group A and Group B,
Gulliford et al. (2016)								
Directly applicable (Appendix I; table 5) with minor limitations (Appendix I; table 6)	**Approach to analysis:** A probabilistic Markov model was used. Health states were stratified by status of depression, BMI category, gender and age. Participants could transition between BMI categories. Intervention effects were applied to diabetes, CHD, Stroke, Cancer and Depression. **BMI related complications considered:** Type 2 diabetes, coronary heart disease, stroke, cancer, and depression. **Perspective:** UK National Health Service.	Bariatric surgery	£67,250	14.509	-	-	-	**Deterministic:** Sensitivity analyses were performed to look at the cost-effectiveness of Bariatric surgery for different age categories, genders, BMI groups, and categories of deprivation (defined by IMD groups). Sensitivity analyses was also performed by varying the cost of Bariatric surgery, discount rates, assuming diminishing intervention effects. Results did not vary significantly across gender, age, and deprivation categories. ICERs increased marginally when considering a population with BMI of 35-39 kg/m2. Results were very sensitive to changes in costs of procedure, and decline in treatment effects over time.
		No Bariatric surgery	£51,990	12.367	£15,260	2.142	£7,129	

Applicability & limitations	Other comments	Intervention	Absolute		Incremental			Uncertainty
			Cost (£)	QALYs	Cost (£)	QALYs	ICER	
								Probabilistic: A PSA was performed with 95% confidence intervals included for all projected results.
Harrison et al. (2021)								
Partially applicable (Appendix I; table 5) with minor limitations (Appendix I; table 6)	**Approach to analysis:** A cost-utility analysis was performed using mendelian randomisation. Using observational data from UK Biobank, in addition to medical data for hospital episode statistics, primary care, and secondary care, authors were able to calculate the costs and QALYs associated with BMI. Authors then performed a cost-utility analysis assuming bariatric surgery reduces BMI by 25%. **BMI related complications considered:** Cancer, cardiovascular disease, stroke, type 2 diabetes. **Perspective:** UK National Health Service.	No intervention	NR	NR	-	-	-	**Deterministic:** Sensitivity analysis undertaken to test the mendelian randomisation assumption of no pleiotropy, stratifying the main analysis by age group, accounting for prediction uncertainty in QALYs and testing whether decision analytic simulation models incorporate enough health conditions to accurately estimate the effect of BMI on QALYs. The final sensitivity analysis found a substantial difference between models only using a limited number of health conditions, indicating BMI affects more health conditions than just cancer, cardiovascular disease, stroke and type 2 diabetes and that other health conditions have a considerable impact on QoL. **Probabilistic:** NR
		Laparoscopic bariatric surgery	NR	NR	-£5,096 (-£3,459 to -£6,852)	0.92 (0.66 to 1.17)	Dominant	

Abbreviations: HUI2 = Health Utilities Index; NR = Not reported

1.1.9 Economic model

No economic modelling was conducted for this review question.

1.1.10 Unit costs

Not applicable.

1.1.11 The committee's discussion and interpretation of the evidence

1.1.11.1. The outcomes that matter most

Measures of weight change, quality of life, obesity-related comorbidities, and fertility were considered the most important for this review. The initial aim of bariatric surgery is weight loss, and crucial to assessing effectiveness. Then it is important to measure the impact of the weight loss on reducing obesity-related co-morbidities causing poor health and quality of life.

The committee noted that people with non-alcoholic fatty liver disease (NAFLD) most commonly died from cardiovascular complications and agreed the MACE outcome (a composite measure of cardiovascular events) was particularly important for this group.

Other important outcomes included mortality, adverse events, and revision rates. Revision rates were important to identify how many procedures are unsuccessful or resulted in complications. However, no evidence was identified for this outcome or for the fertility, hypercholesterolemia, and asthma outcomes/subgroups.

1.1.11.2 The quality of the evidence

The committee noted that the evidence from RCTs, comparative observational studies, and systematic reviews of comparative observational studies ranged from very low to moderate quality, with the majority of the evidence being very low to low. The moderate quality evidence came mainly from 3 RCTs with small sample sizes; one in a population without a specified comorbidity, one in people with idiopathic intracranial hypertention and the third in people with hypertension. Overall, the evidence was downgraded mainly due to risk of bias from unknown confounders in observational studies, missing detail on allocation concealment in RCTs and imprecision.

Seven studies (3 RCTs and 4 observational) were identified which did not specify a particular comorbidity as an inclusion criteria but included people with obesity related comorbidities such as hypertension, dyslipidemia and sleep apnoea. While these studies did not specifically look at one particular comorbidity of interest, these studies did include data on different BMI categories. For example, Aguiar 2014 which included people with BMI between 40 and 50 kg/m^2 or BMI between 35 and 39.9 kg/m^2 with associated comorbidities. These studies were identified as providing relevant information, and were included in this review.

One study [Moussa 2020] was identified through the search and was also included in a systematic review [Sutanto 2021]. As previously highlighted in section 1.1.4.1, this study was included under evidence for no specific comorbidity where data was reported for different BMI thresholds and also included as evidence for obesity with hypertension through the inclusion of Sutanto 2021, where the overall estimate for outcome MACE was included.

In terms of the intrepretation of the evidence, the committee looked at the two sets of evidence idependently. The committee found it useful to include the study in both analyses as they were able to obtain evidence on specific BMI categorises which was not available through the inclusion of Sutanto 2021, which informed referral critieria based on BMI. Evidence from Sutanto 2021 was used to then inform referral criteria on comorbidity.

Additionally, publication bias was explored when 10 or more studies were included as part of a single meta-analysis. A funnel plot for the outcome MACE in people living with obesity with CVD demonstrated absense of publication bias. Data for this outcome and subgroup was obtained from Sutanto 2021. The authors from this systematic review also concluded that there was absense of apparent publication bias.

The committee also noted that in 1 study which included people with obstructive sleep apnoea [Bakker 2018], participants in the non-surgical group receiving continuous positive airway pressure (CPAP) as standard care also lost weight. The NICE team confirmed that no weight loss interventions was given alongside CPAP in this group. The evidence was not downgraded but this was taken into consideration when discussing the results of this study.

While it was noted that there was a lack of evidence for other conditions such as fertility (see further discussion in section 1.1.11.5), asthma and hypercholestrolemia, the committee did acknowledge that evidence did help identify examples of common conditions that could be improved by weight loss.

The lack of evidence in specific subgroups such as people who are unable to receive treatment for other conditions because they are living with obesity and people from minority ethnic family backgrounds also faciliated the development of research recommendations. During the discussion, the committee highlighted that as effectiveness evidence was used to inform the appropriate referral critieria in this review, this would also be the best approach for further research. While it may have been ideal to have a multi-arm study comparing different referral thresholds for bariatric surgery, the committee noted that in research, it would be hard to conduct such a study as typically people present with multiple comorbidities, which means that it would be difficult to separate out the population. Furthermore, while they agreed RCT evidence is gold standard, these studies typically have shorter follow up whereas observational studies can include long follow periods, which would be ideal for further research. For further information on the research recommendations see section 1.1.11.3 and appendix L.

1.1.11.3 Benefits and harms

BMI categories and comorbidities

The 2014 NICE guidance (CG189) on obesity identification, assessment and management recommended bariatric surgery as a treatment option for people with a BMI of 40 kg/m^2 or more, or between 35 kg/m^2 and 40 kg/m^2 and other significant disease (for example, type 2 diabetes or high blood pressure) that could be improved if they lost weight.

While the evidence stratified by BMI was limited, it demonstrated that in people with a BMI ranging from 35 to greater than 50 kg/m^2 with no specific co-morbidities, bariatric surgery resulted in a reduction in the incidence of type 2 diabetes, MACE, heart failure and overall mortality compared to no surgery or non-surgical interventions for obesity. Evidence identified in people with BMI of less than 35 kg/m^2 did not show a benefit of bariatric surgery compared to no surgery for outcomes such as type 2 diabetes.

In terms of comorbidities, the majority of the evidence was identified in people with obstructive sleep apnoea, idiopathic intracranial hypertension (IIH), hypertension, cardiovascular disease, and non-alcoholic fatty liver disease (NAFLD) with biopsy-proven fibrotic non-alcoholic steatohepatitis (NASH). The evidence demonstrated that bariatric surgery was clinically effective in reducing weight, BMI and overall mortality rates for people in these subgroups.

Evidence in people with obstructive sleep apnoea (OSA) also demonstrated that along with reduction in BMI and weight, bariatric surgery resulted in a reduction in the apnoea hypopnea index (AHI), discontinuation of positive airway pressure as well as improvement in quality of life, particularly in the physical, general health and vitality components of the short form-36 (SF-36) health survey when compared to non-surgical interventions for obesity and no surgery. No statistical difference was identified for outcomes such as quality of life (particularly the mental, body pain, social function mental health components of SF-36) and depression measured using the Beck Depression Inventory.

In people with IIH, bariatric surgery resulted in the reduction of intracranial pressure, as well as improvement in quality of life (particularly the physical, physical functioning, general health and energy/fatigue components of SF-36) compared to non-surgical interventions. Serious adverse events (SAEs) were higher in the intervention arm during 0 to 12 months follow up compared to non-surgical interventions. The study further specified that out of the 12 SAEs that occurred during 0 to 12 months follow up, only 4 were related to the bariatric surgery. At 12-24 months, fewer adverse events occurred in the intervention arm, with only 1 event being related to bariatric surgery. It was also noted that no statistical difference was identified for outcomes such as idiopathic intracranial hypertension symptoms, hospital anxiety and depression scores (HADS) and diagnosis of obstructive sleep apnoea.

In people with hypertension, bariatric surgery resulted in the reduction in the total number of antihypertensive medications, obstructive sleep apnoea and overall mortally when compared to standard care. Furthermore, in people with cardiovascular disease (CVD), evidence supported bariatric surgery in the reduction of MACE, myocardial infarction, hypertension and type 2 diabetes. However, no statistical difference was identified for outcomes such as stroke, NAFLD and obstructive sleep apnoea.

In people with NAFLD, bariatric surgery also results in the reduction of major adverse liver outcome and MACE. This was considered important as people with NAFLD were considered by the committee to be at higher risk of cardiovascular mortality.

While acknowledging that majority of the evidence was of very low to low quality the committee noted that the direction of the evidence strongly favoured bariatric surgergy in improving health conditions. They also stated that while some outcomes did demonstrate no statistical difference between bariatric surgery and comparator, the committtee highlighted that the evidence did demonstrate the effectiveness of bariatric surgery in several key outcomes across the different populations. They also highlighted that this evidence supported their clinical experience.

Based on the evidence, the committee agreed that people with BMI of 40 kg/m^2 or more should be offered assessment for bariatric surgery. They also highlighted that at a higher BMI, there is an urgent need to manage obesity, so presence of comorbidites in this group should not be a deciding factor.

The committee also highlighted that in people with a BMI between 35 kg/m^2 and 39.9 kg/m^2 comorbidities are likely to be present. In people whose BMI falls into this range, the committee highlighted it would be important to not only manage obesity but also manage the comorbidities earlier.

Based on this understanding, the committee retained the existing recommendation but amended it to highlight that people who have a BMI of 40 kg/m^2 or more, or between 35 kg/m^2 and 39.9 kg/m^2 with a significant health condition that could be improved if they lost weight should be offered a referral for an assessment for bariatric surgery. The committee also noted that as people are assessed for their suitability for bariatric surgery before the treatment is offered, it was important to make that explicit in the recommendation. This is a move from the recommendation in the 2014 guidance which recommended bariatric surgery as a treatment option for people living with obesity with no emphasis on having a comprehensive assessment first.

Furthermore, the committee agreed it was important to include examples of conditions that could be improved by bariatric surgery. Based on the evidence and their clinical expertise, the committee included IIH, NAFLD (with or without steatohepatitis), OSA and CVD as examples of conditions that can be improved by weight loss. The committee retained hypertension (high blood pressure) as an example of conditions that can also be improved. While evidence on populations with type 2 diabetes was out of scope, the committee retained type 2 diabetes in the list of conditions based on the evidence and their clinical understanding.

As previously highlighted, evidence was not identified for a number of conditions such as asthma and hypercholesterolemia. However, these conditions may also be improved by bariatric surgery. Although, specific evidence was not identified as part of this update there is a potential for evidence to be identified in the future. It was also highlighted that there are a number of other conditions such as polycystic ovarian syndrome (PCOS) which were not included at review protocol stage, that could also be improved through bariatric surgery. However, as it was not possible to look at every potentially relevant condition as part of this review, the committee were unable to draft recommendations relating to these conditions, but agreed that research may be included in future updates. Based on these discussions, the committee agreed that the list of conditions specified in the recommendation should be considered as examples rather than a definitive list of conditions.

The 2014 version of this guideline (CG189) also recommended that bariatric surgery is the option of choice (instead of lifestyle interventions or drug intervention) for adults with a BMI of more than 50 kg/m^2 when other interventions have not been effective. The committee noted that as the BMI ranges highlighted in the updated recommendation capture people with BMI of more than 50 kg/m^2, a separate recommendation for this population was not needed and could be removed.

People from South Asian, Middle Eastern, Chinese, other Asian, Middle Eastern, Black African or African-Caribbean family background

During protocol development, ethnicity was identified as an important subgroup. No evidence for the effectiveness of bariatric surgery in people from different minority ethnic family backgrounds was found. However, the committee noted that people from South Asian, Middle Eastern, Chinese, other Asian, Middle Eastern, Black African or African-Caribbean family background are affected by obesity related comorbidities at lower BMI levels because they have higher central adiposity at the same BMI than people with other family backgrounds.

While reviewing evidence for a review question on accuracy of anthropometric measures (See evidence review A, CG189), the committee developed a recommendation to highlight that obesity classes 2 and 3 can be identified in people of South Asian, Middle Eastern, Chinese, other Asian, Middle Eastern, Black African or African-Caribbean family backgrounds by reducing the existing thresholds for the obesity classes by 2.5 kg/m^2. Based on this understanding, the committee agreed that it was important to recommend lower thresholds to be considered for people from South Asian, Chinese, other Asian, Middle Eastern, Black African, or African-Caribbean family background and that this threshold should be reduced by 2.5 kg/m^2 to match the earlier review.

Furthermore, the evidence identified in this review showed less benefit for type 2 diabetes related outcomes in lower BMI groups however, this evidence did not include people from different minority ethnic family backgrounds. The committee highlighted that in clinical practice, type 2 diabetes is more prevalent at lower BMI categorises in people from different minority ethnic family backgrounds. While the evidence presented excluded populations with type 2 diabetes as this was out of scope of the current review, the committee stressed the importance of using lower thresholds in these groups due to the higher prevalence of the condition.

Based on their clinical expertise, the committee also updated an existing 2014 recommendation for people with recent onset of type 2 diabetes to highlight that expedited assessment for bariatric surgery can be considered in people of with South Asian, Middle Eastern, Chinese, other Asian, Middle Eastern, Black African or African-Caribbean family background at a lower BMI threshold (reduced by 2.5 kg/m^2). The 2014 guidance defined recent onset as diagnosis within the last 10 years. This definition was identified by the previous guideline committee who based the definition on the understanding that remission from diabetes following surgery was possible up to 10 years after an initial diabetes diagnosis. This definition was retained as part of this update.

It was noted that while the lowering of BMI thresholds will result in an increase in referrals, there are long term benefits associated with the new recommendation (See section on cost effectiveness and resource use). To further facilitate research in the committee a drafted a research recommendation to identify the effectiveness and cost effectiveness of bariatric surgery in people from minority ethnic family backgrounds.

Previous attempts at non-surgical weight loss interventions and tier 3 services

The 2014 guidance specified that bariatric surgery is a treatment option for people who have tried all appropriate non-surgical measures and the person has not achieved or maintained adequate, clinically beneficial weight loss. The committee agreed that this criterion was vague and did not specify which measures should be used. They also raised concerns with this recommendation as this has been interpreted differently across the country, creating variations in practice. It was also highlighted that in practice, non-surgical weight loss measures varied greatly in clinical effectiveness, and this was not reviewed as part of this question.

Furthermore, the 2014 guidance also stated that bariatric surgery should be offered as a treatment option for people who have been receiving or will receive intensive management in a tier 3 service. However, the committee noted that there is variation in the commissioning of weight loss services across the NHS and one third of England and Wales does not have access to Tier 3 services.

Without access to tier 3 services, people are unable to progress on to accessing bariatric surgery. This is supported by 'The Getting It Right the First Time (GRIFT)' Programme National Speciality Report published in 2017 which highlighted that while there has been a rise in surgical activity due to the prevalence of obesity, only 0.6% of potential surgical activity is currently delivered. Additionally, there is a critical point when the risks of surgery increase. This means that it is crucial to intervene early but the existing criterion for assessment means that many people miss out on receiving appropriate treatment at the right time.

Additionally, the GRIFT report also states that access to surgery varied widely between regions and that provision was not necessarily higher in areas that had the greatest prevalence of obesity. The briefing report produced for NICE guideline developers and committee members on obesity, weight management services and health inequalities also highlighted that there is a regional variation in admissions for bariatric surgery, ranging from 7 to 22 admissions per 100,000 of population against the England average of 12 per 100,00 population. Admissions were the highest in the Northeast, which also has the highest regional level of obesity but other regions with high levels of obesity (such as North West and Yorkshire and Humber) had some of the lowest bariatric admissions. The briefing also highlighted that the mismatch between the burden of obesity and surgical volume expected to be seen suggests that inequalities in uptake in areas of greatest need may occur. Research has shown that obesity has increased in the most deprived communities in England which has led to a widening gap between the most and least deprived areas. Based on this understanding, the committee noted that restricting assessment for bariatric surgery to those who have been able to access tier 3 services runs the risk of further exacerbating health inequalities.

The committee further highlighted that where tier 3 services are funded, there is variation in the time in the service until surgery. People may be referred to bariatric surgery after trying non-surgical measures in tier 3 services for a year while in other parts of the country, people may find themselves trying tier 3 services for up to 5 years. This can mean that those people who may require bariatric surgery urgently, may find themselves unable to progress on to bariatric surgery.

The studies included as evidence in this review did not have the requirement for all non-surgical treatment to have been tried before study entry. Taking this into account and the evidence on clinical and cost effectiveness of bariatric surgery, the committee agreed that requiring all non-surgical interventions or tier 3 services to be tried before assessment for bariatric surgery could be considered as an unjustified barrier that could limit or delay access to effective treatment. Also, in people with genetic causes of obesity or hypothalamic obesity, non-surgical approaches may not be appropriate, therefore there should not be a barrier to surgery and the most effective intervention should be offered. Based on the evidence and the committee's understanding of current practice, the committee agreed that this criterion should be removed from the recommendation so that this isn't a barrier at point of referral for assessment for bariatric surgery.

Commitment to long term follow up

While bariatric surgery is an effective method of achieving weight loss, there are a number of risks associated with the procedure including but not limited to nutritional deficiencies, psychological impacts, excess skin and problems maintaining weight or managing weight regain. Evidence of long-term effect was not directly identified for these outcomes, however the committee noted that in practice, these are seen in people who undergo the procedure. This means that extensive follow up post-surgery is required.

The 2014 guidance (CG189) specified that bariatric surgery is a treatment option for people living with obesity if the person commits to the need for long-term follow up. The committee highlighted that commitment to long term follow up is an important factor to consider at the point of referral. As highlighted in CG189, there is extensive follow-up associated with bariatric surgery and people should be offered a follow up package for a minimum of 2 years within the bariatric service. During this follow up, people require monitoring of macronutrient and micronutrient deficiencies as well as monitoring of comorbidities and medication. The committee highlighted that while NICE guidance specifies a minimum of 2 years, people who undergo bariatric surgery may require life-long annual reviews. Based on this understanding, the committee retained the existing criteria but amended it to highlight that people should be offered referral for an assessment if they agree to necessary long-term follow up, for example the possibility of life-long annual reviews.

Referral pathway

As previously highlighted, one of the major concerns with bariatric surgery is the lack of service provision. While this is not a direct risk of surgery itself, the risk associated with the lack of provision is that people are not getting access to the service that could be of benefit to them. The committee noted that it was important to highlight where referrals should go once someone has been identified as meeting the criteria for the assessment for bariatric surgery. While this was outside the remit of the review question, the committee stressed the importance of providing information to health and care professionals and people about how this service can be accessed.

During the 2014 update of recommendations on bariatric surgery for people with recent-onset type 2 diabetes, it was highlighted that if there are areas where tier 3 services are not commissioned or available, individuals must be supported and evaluated in the short term by equivalent services until tier 3 services are available.

However, the present committee noted that this problem persists as there is still variation in the delivery of weight management services. This has resulted in a variation in the referral pathway for bariatric surgery. In some areas, tier 3 and tier 4 services may not be based in the same trust and can be both community and hospital based. This means that assessment for bariatric surgery can take place in tier 3 services, with further referrals to tier 4 services, usually via the general practitioner (GP) after the person has spent 6-12 months in tier 3 services. However, in other areas, tier 3 and tier 4 services are based in the same trust which means GPs and other healthcare professionals only need to make one referral for consideration for surgery.

Commissioning guidance to support devolution to CCGs of adult obesity surgical services published in 2016 defined tier 3 services as a primary care, community care, secondary care based specialist, multi-disciplinary obesity team and specialist weight management programme. The guidance also defines tier 4 services as severe and complex obesity services, including obesity surgery and obesity medicine multi-disciplinary teams (MDTs) and specialist weight management programmes, post-surgical and annual follow-up. While typical models for managing obesity are outlined, the committee noted that the variation in referral pathway may be due to the differences in the interpretation of these models.

Based on typical model, referrals should ideally go through tier 3 services however, the committee noted that by specifying tiers, this further adds a barrier to access to assessment as in some areas such services are not available. They noted that the crucial element of assessment for bariatric surgery is that people are assessed and supported by a weight management MDT who are typically found in specialist weight management services, which can either be in tier 3 or tier 4 services as locally available. Based on this understanding, the committee recommended that people who meet the criteria for assessment for bariatric surgery should be offered a referral for a comprehensive assessment by a MDT in a specialist weight management service.

Initial assessment for bariatric surgery

The risk of complications associated with bariatric surgery are complex, particularly the long term risks of surgery such as psychological disturbances, including weight stigma, nutritional deficiencies and weight regain. In order to manage these risks effectively post-surgery, it is important people are comprehensively assessed for bariatric surgery.

Assessment for bariatric surgery is a comprehensive assessment that includes medical assessment (i.e., assessing for comorbidities and any medical causes of obesity) and checking a person’s dietary patterns and eating behaviour. A crucial part of this is assessing whether there are any psychological (such as emotional eating or internalised weight stigma) and social barriers (such as caring responsibilities or limited access to cooking facilities) to weight loss in order for these to be addressed.

The committee noted that the evidence in people with IIH and OSA, highlighted that there was no difference in mental health outcomes between those who received surgery and those in the non-surgery group. The committee suggested that this may be due to these being small trials with an unrepresentative population, however other members commented that they were unsurprised by this and that they had seen no short-term mental health benefits from bariatric surgery in their professional or lay experience. People may still experience weight stigma, and they may have issues with body image because of loose skin following surgery. Also, internalised weight stigma or bias may not necessarily improve post-surgery.

The 2014 guidance recommended that surgery for obesity should be undertaken only by a MDT that can provide preoperative assessment, management of comorbidities and psychological support before and after surgery. However, the committee stressed the importance of highlighting the specific skills that are required for conducting the comprehensive assessment.

Based on their understanding of practice, the committee recommended that weight management MDT should include or have access to health and social care professionals with expertise in conducting medical, nutritional, psychological and surgical assessments as well as suitability for surgery. It was also noted that in practice, most people would be assessed by a non-surgical team first before proceeding to a surgical team. However, some people may require expedited assessment for surgery and in such cases having access to surgical assessment would be beneficial.

The committee did acknowledge that due to variation in commissioning of services there may be difference in the structure of the MDT but ideally the MDT should include or have access to a physician, surgeon or bariatric surgeon (as appropriate), registered dietitian and specialist psychologist. This means that some teams may not necessarily include all relevant health and social care professionals, but the expertise can be accessed.

The committee also highlighted that a comprehensive assessment should be conducted based on the person’s needs. This means that it may be important to assess the person’s medical and nutritional needs as well as any psychological needs and where support can be provided to ensure adherence and suitability for surgery. Other factors that may affect someone’s response after surgery, for example learning disabilities, neurodevelopmental disabilities, deprivation and other factors of health inequalities or language barriers should also be considered at this assessment stage.

Additionally, the MDT would also assess whether any arrangements need to be made, based on the person’s need ahead of surgery. This can include managing any existing or new comorbidities, taking part in weight management interventions, or offering them psychological support before surgery The MDT should also have access to or include healthcare professionals who can assess if the person is fit for anaesthesia and surgery, which is a point that was retained from existing recommendations. The committee also highlighted that due to the presence of comorbidities, specialist input from other MDT’s already involved in someone’s care may be required.

It is also important to note that not everyone referred for assessment for bariatric surgery are appropriate for surgery. This decision is based on the comprehensive assessment, which places the MDT in an important position as they can effectively communicate the next steps for someone who has not have been offered surgery in this instance. Also, some people may not want surgery. In such instances, if an MDT approach is utilised, the MDT team can conduct an assessment and discuss possible alternative treatment options (for example, other locally available specialist weight management services) with the individual. The committee noted that patient choice is important, therefore principles outlined in the NICE guidance on shared decision making (NG197) should be followed.

The committee also noted that 2014 CG189 guidance does include recommendations on preoperative and postoperative assessment, but the committee highlighted that while recommendations on the MDT and initial assessment before surgery were outside the remit of the review question, it was important to provide information for health and care professionals and people about what should constitute an initial assessment for surgery. Additionally, as provision of services varies greatly across the country, it was important to set out what should be expected during initial assessments and the level of support people require.

Previous weight management attempts

As previously discussed, a person trying all non-surgical measures, including tier 3 services at point of referral for assessment (as outlined in the existing CG189 2014 guideline) is no longer required, however, the committee noted that previous attempts at managing weight and a person's response to treatment should be considered as part of the assessment as this highlights the amount of support an individual has received and how much further support they may need.

In some cases, the person may have already engaged with specialist weight management services but there may be instances where someone may have not had a chance to engage with these services, due to the lack of availability or difficulties in accessing them for example. This means it is important to assess a person's previous weight management history and understand why they haven't engaged with services previously if this is the case. Based on this understanding, the committee retained the sentiments from the 2014 recommendations but recommended that as part of the assessment, the MDT should also assess the person's previous weight management attempts, their response to treatment and whether they have engaged or been able to access weight management services.

1.1.11.4 Cost effectiveness and resource use

The committee considered the evidence stemming from published cost-utility analyses evaluating the cost-effectiveness of bariatric surgery in the UK, details of which are summarised in section 1.1.8. Although there is no direct evidence that compared the cost-effectiveness of different referral criteria for bariatric surgery, the committee agreed that previous studies examining the cost-effectiveness of the surgery across different BMI groups and people with and without co-morbidities can be used to inform the recommendations. We identified four UK studies, and two of them were directly applicable to our research question with minor limitations as outlined in appendix I. Therefore, the committee agreed to focus on UK evidence only, and no original economic modelling was deemed necessary.

The committee acknowledged the fact that there was strong evidence supporting the use of the bariatric surgery in patients with a BMI above 35 kg/m^2 with results ranging from bariatric surgery dominating the non-intervention arm to having an ICER of £10,126 as an upper limit. The committee noted that even at the upper limit, the ICER for bariatric surgery was comfortably below £20,000 per QALY, signalling of strong evidence supporting the cost-effectiveness for a referral criterion of bariatric surgery for patients with a BMI above 35 kg/m^2. It is also worth noting that even when considering costs of preoperative assessments, such as medical and psychological assessments, as done by Avenell 2018, bariatric surgery remained cost-effective for patients with a BMI above 35 kg/m^2.

Hence given the clinical and economic evidence available in the literature, the committee agreed that we should keep the current referral criteria but remove the criteria of trying all appropriate non-surgical measures before obtaining the surgery. This stemmed from the fact the interpretation of the criteria varies considerably in the real practice, and it might lead to a low referral rate to bariatric surgery in some cases. Many people who tend to benefit from the surgery could not receive it in time and end up seeking care from private services in the UK or abroad. The committee also highlighted the importance of a multidisciplinary team to conduct pre-surgery assessment. While the new recommendation may lead to an increase in the number of referrals and assessments for bariatric surgery, it was clear from the economic evidence that the additional costs will be outweighed by the reduction in costs and increase in QALYs achieved through the reduction in obesity-related complications.

The committee noted that obesity-related diseases tend to occur at lower BMIs in people from South Asian, Middle Eastern, Chinese, other Asian, Black African or African-Caribbean family backgrounds due to greater abdominal adiposity. Hence, they felt that it is appropriate to consider bariatric surgery at lower BMI thresholds in these minority ethnic groups, even if there was no economic evidence in previous literature particularly looking at the cost-effectiveness and in turn the referral criteria for bariatric surgery in these populations. Although the reduction in the BMI thresholds is likely to increase the number of referrals to bariatric surgery in this population, the potential reduction in obesity-related complications is likely to compensate for this.

1.1.11.5 Other factors the committee took into account

Existing guidance on referral for bariatric surgery

During committee discussions it was highlighted that the new recommendations support current clinical practice and advice endorsed by other organisations. For example, the 2022 guidance from the American Society for Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity of Metabolic Disorders (IFSO) recommended bariatric surgery for individuals with BMI > 35 kg/m^2, regardless of presence, absence, or severity of comorbidities. While this guidance includes a lower BMI cut-off, it does retain the sentiment that presence of comorbidities does not need to be considered for referral, which matches the recommendations This guidance also specifies that surgery is recommended for people with metabolic disease and lower BMI threshold (30-34.9 kg/m^2) which is inline with the new recommendation..

Furthermore, the committee noted that this new recommendation around the use of lower BMI thresholds in people from different minority ethnic family backgrounds is in line with practice and guidelines endorsed by other governing bodies. For example, the BOMSS guideline also stipulates that BMI threshold should be reduced by 2.5 kg/m^2 for people from an Asian background. The AMBS/IFSO 2022 guidance also suggests that BMI thresholds should be adjusted in the Asian population such that BMI >25 kg/m^2 suggests clinical obesity and individuals with BMI > 27.5 kg/m^2 should be offered bariatric surgery.

People who cannot receive treatment

No evidence was identified in people who cannot receive or are not offered treatment because of their obesity. This can include people who may require kidney transplant, fertility treatment and hip or joint replacement surgery. The committee noted in practice, people are often urged to lose weight before receiving treatments for other conditions but may find it difficult to get referred for bariatric surgery or may have to wait a long time for surgery. It was noted that in some centres, people who require bariatric surgery for appropriate cancer intervention can be expediated to urgently receive surgery. However, this is not covered in existing guidance.

The committee also noted that wider evidence on benefits of weight loss through bariatric surgery before receiving other treatments is unclear. The committee noted that people may benefit from bariatric surgery as it means that they are able to receive their desired treatment which can greatly improve their quality of life and may improve intervention outcomes (such as success rate), however more robust evidence is required to support this statement. As evidence was not identified in this subgroup, the committee were unable to develop recommendations. But to facilitate further research in this, the committee drafted a research recommendation to identify the effectiveness and cost effectiveness of bariatric surgery in this population.

People with learning disabilities and neurodevelopmental disabilities

The health inequality briefing report produced for NICE guideline developers and committee members on obesity, weight management services and health inequalities highlighted that among adults with disabilities, the prevalence of obesity is 20% higher than among those not reporting disabilities. The prevalence of obesity in adults with severe mental illness is almost double other adults aged 15-74 years. Additionally, adults with a learning disability have high levels of obesity, at 31% and 45% for men and women respectively. Within people with learning disabilities, there are increased risks of obesity for people with Down's syndrome.

While evidence on these populations were not identified in the review, the committee did not think the new recommendations would adversely impact these groups and thought it important to be explicit about these groups as part of the initial assessment. They also highlighted that input from a learning disability team or liaison nurse may be required when conducting initial assessments in people with learning or neurodevelopmental disabilities.

Furthermore, they highlighted that there are existing NICE guidelines that can help health and care professionals plan the care for people with learning disabilities and neurodevelopment disabilities. These include guidance on learning disabilities and behaviour that challenges: service design and delivery (NG93), care and support for people growing older with learning disabilities (NG96), autism spectrum disorder in adults: diagnosis and management (CG142).

Gender differences in accessing services

The briefing report produced for NICE guideline developers and committee members on obesity, weight management services and health inequalities highlighted that there are gender differences in accessing services, specifically bariatric surgery. This report made reference to the findings of the National Bariatric Surgery Registry report published in 2020 which highlighted that men seek bariatric surgery later in the course of their disease and generally have a higher BMI and more obesity-related comorbidities. It was highlighted that while there is inequality in terms of accessing services, the updated recommendations now allow a number of obesity-related comorbidities to be considered when considering referral for assessment for bariatric surgery.

1.1.12 Recommendations supported by this evidence review

This evidence review supports recommendations 1.10.1- 1.10.2, 1.10.6- 1.10.7 and the research recommendation on the effectiveness and cost effectiveness of bariatric surgery in people who need treatment for other conditions and people from minority ethnic family backgrounds.

1.1.13 References – included studies

1.1.14.1 Effectiveness evidence

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1.1.14.2 Economic

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1 # Appendix A – Review protocols

2 ## Review protocol for referral for Bariatric Surgery

ID	Field	Content
0.	PROSPERO registration number	NA
1.	Review title	Effectiveness of referral criteria for bariatric surgery to achieve weight loss and maintain a healthier weight in adults living with obesity.
2.	Review question	What referral criteria for bariatric surgery are most effective to achieve weight loss and maintain a healthier weight in adults living with obesity?
3.	Objective	To find and systematically review evidence on the effectiveness of bariatric surgery across different sub populations of adults with obesity, in order to determine appropriate referral criteria.
4.	Searches	The included studies from the following Cochrane review will be assessed against the review protocol for inclusion in this review: • Colquitt (2014, What are the effects of weight loss (bariatric) surgery for overweight or obese adults?) The following databases will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Embase • MEDLINE Searches will be restricted by:

		• Studies published from December 2013 onwards (studies included in the Cochrane review (Colquitt 2014, Surgery for weight loss in adults) will also be evaluated for inclusion in this review). • English language • Conference abstracts will be excluded from the search Other searches: None The searches will be re-run 6 weeks before final submission of the review and further studies retrieved for inclusion. The full search strategies for MEDLINE database will be published in the final review.
5.	Condition or domain being studied	Obesity in adults
6.	Population	Inclusion: • Adults over the age of 18 living with obesity • Population will be stratified as specified in section 17. Exclusion: • Children and young people under 18 • Pregnant women • Studies with a population where more than 50% have type 2 diabetes will be excluded.
7.	Intervention	Bariatric Surgery including: • Roux-en-Y gastric bypass

		• Mini gastric bypass / one-anastomosis gastric bypass • Sleeve gastrectomy • Gastric band • Biliopancreatic diversion (with duodenal switch) Studies will compare any weight-loss surgery specified in the list above to non-surgery Procedure that are not included as they are no longer in current use: • Jejunoileal bypass • Horizontal gastroplasty • Vertical banded gastroplasty or vertical gastroplasty (not banded) • Banded gastroplasty that is not adjustable • Banded gastric bypass • Biliopancreatic diversion (without duodenal switch)
8.	Comparator	No treatment / standard care / non-surgical intervention for obesity
9.	Types of study to be included	The review will use a two-step approach. Firstly, randomised controlled trials and systematic reviews of comparative non-randomised studies will be identified. Subsequently, individual comparative non-randomised studies will be identified that were published after the search date for an included systematic review in the same subpopulation, or which includes subpopulations in section 17 that are not covered by an included systematic review. **Randomised Control Trials (RCTs**). Included studies in the Cochrane review Colquitt (2014, Surgery for weight loss in adults) will be evaluated to check whether they match the review protocol specified here. Data not relevant to this review from the Cochrane review will be excluded – such as those studies conducted on a type 2 diabetes population and those comparing different types of surgery with each other. A search will be carried out to identify studies published after the search date for the Cochrane review. **Systematic reviews of comparative observational studies or non-randomised controlled studies.** If several systematic reviews are found covering the same subpopulation, only the most recent review will be included. The results of systematic reviews will be included directly as evidence (rather than as a source of individual studies).

		Non-randomised controlled or comparative observational studies with a concurrent control group and adjustment for a minimum of the following confounding factors: age, sex, BMI at baseline, obesity-related comorbidities at baseline. Adjustment must use one of the methods specified in NICE TSD 17: The use of observational data to inform estimates of treatment effectiveness in technology appraisal. Studies may adjust for a range of co-morbidities – they will be included in the review for consideration by the committee if adjustment for any comorbidity is included in the analysis. When a systematic review has been included that covers a particular subpopulation mentioned in section 17, individual cohort studies relating to that subpopulation will only be included if they were published after the date of an included systematic review. **Systematic reviews of RCTs** will also be searched for and used to cross check the RCTs included in the review. They will not be included as a direct source of data.
10.	Other exclusion criteria	Population exclusions as listed above. • Studies comparing different types of surgery • Studies including surgery not available on the NHS (e.g., primary obesity surgery endolumena) • Studies with inclusion criteria based on a comorbidity, condition or procedure that is not specified in section 17 as a subgroup of interest.
11.	Context	This is an update to recommendation 1.10.1 from CG189 – Obesity: identification, assessment, and management. New evidence on referral criteria for bariatric surgery was highlighted during the scoping process. This question forms part of an update and amalgamation of the following guidelines: • Obesity: identification, assessment and management (2014) NICE guideline CG189 • Weight management: lifestyle services for overweight or obese children and young people (2013) NICE guideline PH47 • BMI: preventing ill health and premature death in black, Asian and other minority ethnic groups (2013) NICE guideline PH46

		• Obesity prevention (2006) NICE guideline CG43.
12.	Primary outcomes (critical outcomes)	• Measures of weight change (including change in weight or BMI) • Health related quality of life (the overall scores will be reported, as well as domains relating to everyday function and mental health) • Obesity related comorbidities (type 2 diabetes, hypertension, heart disease, stroke, non-alcoholic fatty liver disease, sleep apnoea, hypercholesterolemia, Idiopathic intracranial hypertension, asthma, depression and anxiety). Dichotomous outcomes related to the presence absence of these comorbidities will be included, as well as outcomes relating to the severity of the co-morbidity. • Fertility Continuous outcomes such as weight change and BMI reduction will be reported as mean differences. Dichotomous outcomes such as heart disease, mortality or stroke will be reported as hazard ratios or risk ratios. All outcomes will be reported at 12 months and for the longest available time point followed up in studies, provided that this is at least 2 years.

13.	Secondary outcomes (important outcomes)	• Mortality (perioperative and at the latest time point in the study)
		• Adverse events:
		  o Serious adverse events (according to the European medicines agency definition).
		  o Specific adverse events: nutritional deficiencies, wound infections, hypoglycaemia, postprandial pain, gastric side effects
		  o Revision rates (reversal or conversions to normal or other procedures)

14.	Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. A standardised form will be used to extract data from studies (see

		Developing NICE guidelines: the manual section 6.4). Study investigators may be contacted for missing data where time and resources allow.
15.	Risk of bias (quality) assessment	Risk of bias for RCTs will be assessed using the Cochrane RoB 2.0 checklist observational studies using ROBINS-I as described in Developing NICE guidelines: the manual. Systematic reviews will be appraised using the ROBIS checklist.
16.	Strategy for data synthesis	**Randomised controlled trials:** Meta-analyses of outcome data will be conducted for all comparators that are reported by more than one study, with reference to the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al. 2011). Fixed- and random-effects models (der Simonian and Laird) will be fitted for all comparators, with the presented analysis dependent on the degree of heterogeneity in the assembled evidence. Fixed-effects models will be the preferred choice to report, but in situations where the assumption of a shared mean for fixed-effects model is clearly not met, even after appropriate pre-specified subgroup analyses is conducted, random-effects results are presented. Fixed-effects models are deemed to be inappropriate if one or both of the following conditions was met: • Significant between study heterogeneity in methodology, population, intervention or comparator was identified by the reviewer in advance of data analysis. • The presence of significant statistical heterogeneity in the meta-analysis, defined as I2≥50%. Meta-analyses will be performed in Cochrane Review Manager V5.3. **Systematic reviews of non-randomised studies:** Data from included systematic reviews will be reported directly, with no further synthesis. **Comparative observational studies:**

		Data from comparative observational studies will be synthesised in the same way as described for randomised controlled trials above, where appropriate (taking into account whether populations across studies are sufficiently similar and whether studies adjust for the same confounding factors).

17.	Analysis of sub-groups	Analysis will be conducted on different sub-group populations based on:
		• BMI
		• Ethnicity
		• People prevented from receiving treatment because of their obesity (e.g., bone marrow and renal transplant, fertility treatment, hip/joint replacements)
		• People with impaired physical functionality (including musculoskeletal impairment)
		• Comorbidities including:
		    ○ Non-alcoholic fatty liver disease
		    ○ Sleep apnoea
		    ○ Severe Asthma
		    ○ Cardiovascular disease
		    ○ Idiopathic intracranial hypertension
		    ○ Depression/anxiety
		
		The effectiveness and cost effectiveness of bariatric surgery for each subgroup (or combination of subgroups) will be used to define appropriate referral criteria for bariatric surgery.
		
		In the case of heterogeneity in a meta-analysis that is not explained by the subgroups described above, data will be split by surgery type (the primary analysis will look at any surgery vs no surgery). If heterogeneity cannot be explained, a random effects model will be used.

18.	Type and method of review	☒ Intervention ☐ Diagnostic ☐ Prognostic

		☐ Qualitative ☐ Epidemiologic ☐ Service Delivery ☐ Other (please specify)
19.	Language	English
20.	Country	England
21.	Anticipated or actual start date	February 2022
22.	Anticipated completion date	TBC
23.	Stage of review at time of this submission	See table below

Review stage	Started	Completed
Preliminary searches	☐ ☐	☐ ☐
Piloting of the study selection process	☐ ☐	☐ ☐
Formal screening of search results against eligibility criteria	☐ ☐	☐ ☐
Data extraction	☐ ☐	☐ ☐
Risk of bias (quality) assessment	☐ ☐	☐ ☐

		Data analysis	☐ ☐	☐ ☐
24.	Named contact	**5a. Named contact** Guideline Development Team **5b Named contact e-mail** weightmgt@nice.org.uk **5e Organisational affiliation of the review** National Institute for Health and Care Excellence (NICE) and NICE Guideline Updates Team		
25.	Review team members	From the NICE Guideline development team: Technical lead: Dr Kathryn Hopkins/ Shreya Shukla Technical analyst: Anthony Gildea/Sarah Matthews Health economist: Kusal Lokuge/ Miaoqing Yang Information specialist: Paul Levay		
26.	Funding sources/sponsor	This systematic review is being completed by the Guideline Development Team which receives funding from NICE.		
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.		

28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/gid-ng10182
29.	Other registration details	NA
30.	Reference/URL for published protocol	NA
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: notifying registered stakeholders of publication publicising the guideline through NICE's newsletter and alerts issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.
32.	Keywords	Obesity, Bariatric surgery
33.	Details of existing review of same topic by same authors	-
34.	Current review status	☐ Ongoing ☐ Completed but not published ☐ Completed and published ☐ Completed, published and being updated

		☐ Discontinued
35..	Additional information	-
36.	Details of final publication	www.nice.org.uk

Appendix B – Methods

Reviewing research evidence

Review protocols

Review protocols were developed with the guideline committee to outline the inclusion and exclusion criteria used to select studies for each evidence review.

Searching for evidence

Evidence was searched for each review question using the methods specified in the 2018 NICE guidelines manual.

Selecting studies for inclusion

All references identified by the literature searches and from other sources (for example, previous versions of the guideline or studies identified by committee members) were uploaded into EPPI reviewer software (version 5) and de-duplicated. Titles and abstracts were assessed for possible inclusion using the criteria specified in the review protocol. 10% of the abstracts were reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer.

The full text of potentially eligible studies was retrieved and assessed according to the criteria specified in the review protocol. A standardised form was used to extract data from included studies. Study investigators were contacted for missing data when time and resources allowed (when this occurred, this was noted in the evidence review and relevant data was included).

Incorporating published evidence syntheses

If published evidence syntheses were identified in the review process, they were considered for use as the primary source of data, rather than extracting information from primary studies. Syntheses considered for inclusion in this way were quality assessed to assess their suitability using the appropriate checklist, as outlined in table 16. Note that this quality assessment was solely used to assess the quality of the synthesis in order to decide whether it could be used as a source of data, as outlined in table 17, not the quality of evidence contained within it. In this review, a separate risk of bias assessment was not conducted on the individual studies identified through the systematic but instead the quality assessment as reported in the systematic review was used.

Table 16: Checklists for published evidence syntheses

Type of synthesis	Checklist for quality appraisal
Systematic review of quantitative evidence	ROBIS
Network meta-analysis	Modified version of the PRISMA NMA tool (see appendix K of 'Developing NICE guidelines, the manual')
Qualitative evidence synthesis	ENTREQ reporting standard for published evidence synthesis (https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-12-181) is the generic reporting standard for QES, however specific reporting standards exist for meta-ethnography (eMERGe [https://emergeproject.org/]) and for realist synthesis (RAMESES II [https://www.ramesesproject.org/]). If these reporting standards are not

Type of synthesis	Checklist for quality appraisal
	appropriate to the QES then an adapted PRISMA framework is used (see Flemming K, Booth A, Hannes K, Cargo M, Noyes J. Cochrane Qualitative and Implementation Methods Group guidance series-paper 6: reporting guidelines for qualitative, implementation, and process evaluation evidence syntheses. Journal of Clinical Epidemiology 2018; 97: 79-85).
Individual patient data meta-analysis	Checklist based on Tierney, Jayne F., et al. "Individual participant data (IPD) meta-analyses of randomised controlled trials: guidance on their use." PLoS Med 12.7 (2015): e1001855.

Each published evidence synthesis was classified into one of the following three groups:

- High quality – It is unlikely that additional relevant and important data would be identified from primary studies compared to that reported in the review, and unlikely that any relevant and important studies have been missed by the review.
- Moderate quality – It is possible that additional relevant and important data would be identified from primary studies compared to that reported in the review, but unlikely that any relevant and important studies have been missed by the review.
- Low quality – It is possible that relevant and important studies have been missed by the review.

Each published evidence synthesis was also classified into one of three groups for its applicability as a source of data, based on how closely the review matches the specified review protocol in the guideline. Studies were rated as follows:

- Fully applicable – The identified review fully covers the review protocol in the guideline.
- Partially applicable – The identified review fully covers a discrete subsection of the review protocol in the guideline (for example, some of the factors in the protocol only).
- Not applicable – The identified review, despite including studies relevant to the review question, does not fully cover any discrete subsection of the review protocol in the guideline.

The way that a published evidence synthesis was used in the evidence review depended on its quality and applicability, as defined in table 17. When published evidence syntheses were used as a source of primary data, data from these evidence syntheses were quality assessed and presented in GRADE tables in the same way as if data had been extracted from primary studies. In questions where data was extracted from both systematic reviews and primary studies, these were checked to ensure none of the data had been double counted through this process.

Table 17: Criteria for using published evidence syntheses as a source of data

Quality	Applicability	Use of published evidence synthesis
High	Fully applicable	Data from the published evidence synthesis were used instead of undertaking a new literature search or data analysis. Searches were only done to cover the period of time since the search date of the review. If the review was considered up to date (following discussion with the guideline committee and NICE lead for quality assurance), no additional search was conducted.
High	Partially applicable	Data from the published evidence synthesis were used instead of undertaking a new literature search and data analysis for the relevant subsection of the protocol. For this section, searches were only done to cover the period of time since the search date of the review. If the review was considered up to date (following discussion with the guideline committee and NICE lead for quality assurance), no additional search was conducted. For

Quality	Applicability	Use of published evidence synthesis
		other sections not covered by the evidence synthesis, searches were undertaken as normal.
Moderate	Fully applicable	Details of included studies were used instead of undertaking a new literature search. Full-text papers of included studies were still retrieved for the purposes of data analysis. Searches were only done to cover the period of time since the search date of the review.
Moderate	Partially applicable	Details of included studies were used instead of undertaking a new literature search for the relevant subsection of the protocol. For this section, searches were only done to cover the period of time since the search date of the review. For other sections not covered by the evidence synthesis, searches were undertaken as normal.

Methods of combining evidence

Data synthesis for intervention studies

Where possible, meta-analyses were conducted to combine the results of quantitative studies for each outcome.

Pairwise meta-analysis

Pairwise meta-analyses were performed in Cochrane Review Manager V5.3, with the exception of incidence rate ratio analyses which were carried out in R version 3.3.4. using the package 'metafor'. A pooled relative risk was calculated for dichotomous outcomes (using the Mantel–Haenszel method) reporting numbers of people having an event, and a pooled incidence rate ratio was calculated for dichotomous outcomes reporting total numbers of events. Both relative and absolute risks were presented, with absolute risks calculated by applying the relative risk to the risk in the comparator arm of the meta-analysis (calculated as the total number events in the comparator arms of studies in the meta-analysis divided by the total number of participants in the comparator arms of studies in the meta-analysis).

A pooled mean difference was calculated for continuous outcomes (using the inverse variance method) when the same scale was used to measure an outcome across different studies. Where different studies presented continuous data measuring the same outcome but using different numerical scales (e.g. a 0-10 and a 0-100 visual analogue scale), these outcomes were all converted to the same scale before meta-analysis was conducted on the mean differences. Where outcomes measured the same underlying construct but used different instruments/metrics, data were analysed using standardised mean differences (SMDs, Hedges' g).

For continuous outcomes analysed as mean differences, change from baseline values were used in the meta-analysis if they were accompanied by a measure of spread (for example standard deviation). Where change from baseline (accompanied by a measure of spread) were not reported, the corresponding values at the timepoint of interest were used. If only a subset of trials reported change from baseline data, final timepoint values were combined with change from baseline values to produce summary estimates of effect.

For continuous outcomes analysed as standardised mean differences this was not possible. In this case, if all studies reported final timepoint data, this was used in the analysis. If some studies only reported data as a change from baseline, analysis was done on these data, and for studies where only baseline and final time point values were available, change from baseline standard deviations were estimated, assuming a correlation coefficient derived from studies reporting both baseline and endpoint data, or if no such studies were available, assuming a correlation of 0.5 as a conservative estimate (Follman et al., 1992; Fu et al., 2013). In cases where SMDs were used they were back converted to a single scale to aid interpretation by the committee where possible.

Random effects models were fitted when there was significant between-study heterogeneity in methodology, population, intervention or comparator was identified by the reviewer in advance of data analysis. This decision was made and recorded before any data analysis was undertaken. For all other syntheses, fixed- and random-effects models were fitted, with the presented analysis dependent on the degree of heterogeneity in the assembled evidence. Fixed-effects models were the preferred choice to report, but in situations where the assumption of a shared mean for fixed-effects model were clearly not met, even after appropriate pre-specified subgroup analyses were conducted, random-effects results are presented. Fixed-effects models were deemed to be inappropriate if there was significant statistical heterogeneity in the meta-analysis, defined as $I^2 \geq 50\%$.

However, in cases where the results from individual pre-specified subgroup analyses were less heterogeneous (with $I^2 < 50\%$) the results from these subgroups were reported using fixed effects models. This may have led to situations where pooled results were reported from random-effects models and subgroup results were reported from fixed-effects models.

Appraising the quality of evidence

Intervention studies (relative effect estimates)

RCTs and quasi-randomised controlled trials were quality assessed using the Cochrane Risk of Bias Tool. Non-randomised controlled trials and cohort studies were quality assessed using the ROBINS-I tool. Other study types (for example controlled before and after studies) were assessed using the preferred option specified in the NICE guidelines manual 2018 (appendix H). Evidence on each outcome for each individual study was classified into one of the following groups:

- Low risk of bias – The true effect size for the study is likely to be close to the estimated effect size.
- Moderate risk of bias – There is a possibility the true effect size for the study is substantially different to the estimated effect size.
- High risk of bias – It is likely the true effect size for the study is substantially different to the estimated effect size.
- Critical risk of bias (ROBINS-I only) - It is very likely the true effect size for the study is substantially different to the estimated effect size.

Each individual study was also classified into one of three groups for directness, based on if there were concerns about the population, intervention, comparator and/or outcomes in the study and how directly these variables could address the specified review question. Studies were rated as follows:

- Direct – No important deviations from the protocol in population, intervention, comparator and/or outcomes.
- Partially indirect – Important deviations from the protocol in one of the following areas: population, intervention, comparator and/or outcomes.
- Indirect – Important deviations from the protocol in at least two of the following areas: population, intervention, comparator and/or outcomes.

Minimally important differences (MIDs) and clinical decision thresholds

The Core Outcome Measures in Effectiveness Trials (COMET) database was searched to identify published minimal clinically important difference thresholds relevant to this guideline that might aid the committee in identifying clinical decision thresholds for the purpose of GRADE. Identified MIDs were assessed to ensure they had been developed and validated in a methodologically rigorous way, and were applicable to the populations, interventions and outcomes specified in this guideline. In addition, the Guideline Committee were asked to prospectively specify any outcomes where they felt a consensus clinical decision threshold could be defined from their experience. In particular, any questions looking to evaluate non-inferiority (that one treatment is not meaningfully worse than another) required a clinical decision threshold to be defined to act as a non-inferiority margin.

Clinical decision thresholds were used to assess imprecision using GRADE and aid interpretation of the size of effects for different outcomes. Clinical decision threshold that were used in the guideline are given in table 18 and also reported in the relevant evidence reviews.

Table 18: Identified Clinical decision thresholds

Outcome	Clinical decision threshold	Source
Percentage change in weight (%)	5%	The committee agreed that a 5% change in weight is likely to be important and this value has been used in other guidelines on weight management, for example: Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, Hu FB, Hubbard VS, Jakicic JM, Kushner RF, Loria CM, Millen BE, Nonas CA, Pi-Sunyer FX, Stevens J, Stevens VJ, Wadden TA, Wolfe BM, Yanovski SZ, Jordan HS, Kendall KA, Lux LJ, Mentor-Marcel R, Morgan LC, Trisolini MG, Wnek J, Anderson JL, Halperin JL, Albert NM, Bozkurt B, et al. 2013 AHA/ACC/TOS Guideline for the Management of Overweight and Obesity in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. Circulation. 2014;129:S102–S138 Lau D, Douketis J, Morrison K, Hramiak I, Sharma A, Ur E. Canadian Clinical Practice Guidelines on the management and prevention of obesity in adults and children. CMAJ. 2006;2007:S1–S130.

For continuous outcomes expressed as a mean difference where no other clinical decision threshold was available, a clinical decision threshold of 0.5 of the median standard deviations of the comparison group arms was used (Norman et al. 2003). For continuous outcomes expressed as a standardised mean difference where no other clinical decision threshold was available, a clinical decision threshold of 0.5 standard deviations was used. For SMDs that were back converted to one of the original scales to aid interpretation, rating of imprecision was carried out before back calculation. For relative risks and hazard ratios, where no other clinical decision threshold was available, a default clinical decision threshold for dichotomous outcomes of 0.8 to 1.25 was used. For outcomes such as mortality, line of no effect was used. Odds ratios were converted to risk ratios where possible before presentation to the committee to aid interpretation.

GRADE for intervention studies analysed using pairwise analysis

GRADE was used to assess the quality of evidence for the outcomes specified in the review protocol. Data from randomised controlled trials, non-randomised controlled trials and cohort studies (which were quality assessed using the Cochrane risk of bias tool or ROBINS-I) were initially rated as high quality while data from other study types were initially rated as low quality. The quality of the evidence for each outcome was downgraded or not from this initial point, based on the criteria given in table 19.

Table 19: Rationale for downgrading quality of evidence for intervention studies

GRADE criteria	Reasons for downgrading quality
Risk of bias	Not serious: If less than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the outcome was downgraded one level. Very serious: If greater than 33.3% of the weight in a meta-analysis came from studies at high risk of bias, the outcome was downgraded two levels. Extremely serious: If greater than 33.3% of the weight in a meta-analysis came from studies at critical risk of bias, the outcome was downgraded three levels
Indirectness	Not serious: If less than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the outcome was downgraded one level. Very serious: If greater than 33.3% of the weight in a meta-analysis came from indirect studies, the outcome was downgraded two levels.
Inconsistency	Concerns about inconsistency of effects across studies, occurring when there is unexplained variability in the treatment effect demonstrated across studies (heterogeneity), after appropriate pre-specified subgroup analyses have been conducted. This was assessed using the I^2 statistic. N/A: Inconsistency was marked as not applicable if data on the outcome was only available from one study. Not serious: If the I^2 was less than 33.3%, the outcome was not downgraded. Serious: If the I^2 was between 33.3% and 66.7%, the outcome was downgraded one level. Very serious: If the I^2 was greater than 66.7%, the outcome was downgraded two levels.
Imprecision	If an MID other than the line of no effect was defined for the outcome, the outcome was downgraded once if the 95% confidence interval for the effect size crossed one line of the MID, and twice if it crosses both lines of the MID. If the line of no effect was defined as an MID for the outcome, it was downgraded once if the 95% confidence interval for the effect size crossed the line of no effect (i.e. the outcome was not statistically significant), and twice if the sample size of the study was sufficiently small that it is not plausible any realistic effect size could have been detected.
Publication bias	Where 10 or more studies were included as part of a single meta-analysis, a funnel plot was produced to graphically assess the potential for publication bias. When a funnel plot showed convincing evidence of publication bias, or the review team became aware of other evidence of publication bias (for example, evidence of unpublished trials where there was evidence that the effect estimate differed in published and unpublished data), the outcome was downgraded once. If no evidence of publication bias was found for any outcomes in a review (as was often the case), this domain was excluded from GRADE profiles to improve readability.

For outcomes that were originally assigned a quality rating of 'low' (when the data was from observational studies that were not appraised using the ROBINS-I checklist), the quality of evidence for each outcome was upgraded if any of the following three conditions were met and the risk of bias for the outcome was rated as 'no serious':

- Data from studies showed an effect size sufficiently large that it could not be explained by confounding alone.
- Data showed a dose-response gradient.
- Data where all plausible residual confounding was likely to increase our confidence in the effect estimate.

Reviewing economic evidence

Inclusion and exclusion of economic studies

Literature reviews seeking to identify published cost–utility analyses of relevance to the issues under consideration were conducted for all questions. In each case, the search undertaken for the clinical review was modified, retaining population and intervention descriptors, but removing any study-design filter and adding a filter designed to identify relevant health economic analyses. In assessing studies for inclusion, population, intervention and comparator, criteria were always identical to those used in the parallel clinical search; only cost–utility analyses were included. Economic evidence profiles, including critical appraisal according to the Guidelines manual, were completed for included studies.

Appraising the quality of economic evidence

Economic studies identified through a systematic search of the literature were appraised using a methodology checklist designed for economic evaluations (NICE guidelines manual; 2014). This checklist is not intended to judge the quality of a study per se, but to determine whether an existing economic evaluation is useful to inform the decision-making of the committee for a specific topic within the guideline.

There are 2 parts of the appraisal process. The first step is to assess applicability (that is, the relevance of the study to the specific guideline topic and the NICE reference case); evaluations are categorised according to the criteria in table 20.

Table 20: Applicability criteria

Level	Explanation
Directly applicable	The study meets all applicability criteria, or fails to meet one or more applicability criteria but this is unlikely to change the conclusions about cost effectiveness
Partially applicable	The study fails to meet one or more applicability criteria, and this could change the conclusions about cost effectiveness
Not applicable	The study fails to meet one or more applicability criteria, and this is likely to change the conclusions about cost effectiveness. These studies are excluded from further consideration

In the second step, only those studies deemed directly or partially applicable are further assessed for limitations (that is, methodological quality); see categorisation criteria in table 21.

Table 21: Methodological criteria

Level	Explanation
Minor limitations	Meets all quality criteria, or fails to meet one or more quality criteria but this is unlikely to change the conclusions about cost effectiveness
Potentially serious limitations	Fails to meet one or more quality criteria and this could change the conclusions about cost effectiveness
Very serious limitations	Fails to meet one or more quality criteria and this is highly likely to change the conclusions about cost effectiveness. Such studies should usually be excluded from further consideration

Where relevant, a summary of the main findings from the systematic search, review and appraisal of economic evidence is presented in an economic evidence profile alongside the clinical evidence.

Appendix C – Literature search strategies

Background

Search design and peer review

A NICE information specialist conducted the literature searches for the evidence review. The effectiveness searches were run on 19 January 2022. The searches for the cost effectiveness evidence were run on 3 February 2022. This search report is compliant with the requirements of PRISMA-S.

The MEDLINE strategy below was quality assured (QA) by a trained NICE information specialist. All translated search strategies were peer reviewed to ensure their accuracy. Both procedures were adapted from the 2016 PRESS Checklist.

The principal search strategy was developed in MEDLINE (Ovid interface) and adapted, as appropriate, for use in the other sources listed in the protocol, taking into account their size, search functionality and subject coverage.

Review management

The search results were managed in EPPI-Reviewer v5. Duplicates were removed in EPPI-R5 using a two-step process. First, automated deduplication is performed using a high-value algorithm. Second, manual deduplication is used to assess 'low-probability' matches. All decisions made for the review can be accessed via the deduplication history.

Prior work

The search was designed as an update of the Colquitt Cochrane review from 2014, which was based on searches done in November 2013:

Colquitt J et al. (2014) Surgery for weight loss in adults. *Cochrane Database of Systematic Reviews*, 10.1002/14651858.CD003641.pub4

The current search also drew on the searches for NICE guideline CG189, published in 2014, with searches in November 2013.

Limits and restrictions

English language limits were applied in adherence to standard NICE practice and the review protocol.

Limits to exclude letters, editorials, news items and conferences were applied in adherence to standard NICE practice and the review protocol.

The search was limited from November 2013 to Current as defined in the review protocol, in order to update the Colquitt Cochrane review.

The limit to remove animal studies in the searches was the standard NICE practice, which has been adapted from: Dickersin, K., Scherer, R., & Lefebvre, C. (1994). Systematic Reviews: Identifying relevant studies for systematic reviews. *BMJ*, 309(6964), 1286.

Search filters

Systematic reviews

The MEDLINE SR filter was “Health-evidence.ca Systematic review search filter” from Lee et al. (2012).

The standard NICE modifications were used: pubmed.tw added; systematic review.pt added from MeSH update 2019.

The Embase SR filter was “Health-evidence.ca Systematic review search filter” from Lee et al. (2012).

The standard NICE modifications were used: pubmed.tw added to line medline.tw.

Lee, E. et al. (2012) An optimal search filter for retrieving systematic reviews and meta-analyses. *BMC Medical Research Methodology*, 12(1), 51.

Randomised controlled trials

The MEDLINE RCT filter was McMaster Therapy – Medline - “best balance of sensitivity and specificity” version.

The standard NICE modifications were used: randomized.mp changed to randomi?ed.mp.

Haynes RB et al. (2005) Optimal search strategies for retrieving scientifically strong studies of treatment from Medline: analytical survey. *BMJ*, 330, 1179-1183.

The Embase RCT filter was McMaster Therapy – Embase “best balance of sensitivity and specificity” version.

Wong SSL et al. (2006) Developing optimal search strategies for detecting clinically sound treatment studies in EMBASE. *Journal of the Medical Library Association*, 94(1), 41-47.

Cohort studies

The terms for Cohort Studies have been updated from those used in previous NICE guidance on tobacco (NG209) in April 2019. This in turn had been adapted in 2019 from the terms used in the SIGN filter and the BMJ Best Practice filter.

Cost effectiveness searches

The NICE cost utility (sensitive) filter was applied to the Medline and Embase searches to identify cost utility studies. The Cost Utility filter is available via the ISSG search filters resource

Key decisions

The strategy is in the format:

(((Obesity AND General Interventions) OR Bariatric Surgery) AND Limits AND 2013-Current AND (Reviews OR RCTs OR Cohorts))

This was intended to be an update of the Cochrane Review search, which was done in November 2013. There is also a related search in NICE CG189. A number of adaptations had to be made:

- the scope is different, as a number of interventions were not included in the current protocol that were in the Cochrane review. Free text and subject headings were altered accordingly.

- subject headings and free text for the population with obesity were updated to reflect the current protocol.

- MeSH and Emtree had been updated and so new terms were included.

- the standard NICE limits and study filters were applied.

- the structure of the search was altered so that Bariatric Surgery was not combined with Obesity, in order to broaden the search results.

- in addition, the studies included in the Colquitt Cochrane review were identified and included in the search results.

Clinical effectiveness searches

Main search – Databases

Database	Date searched	Database platform	Database segment or version	No. of results downloaded
Cochrane Central Register of Controlled Trials (CENTRAL)	19/01/2022	Wiley	Cochrane Central Register of Controlled Trials Issue 12 of 12, December 2021	1493
Cochrane Database of Systematic Reviews	19/01/2022	Wiley	Cochrane Database of Systematic Reviews Issue 1 of 12, January 2022	12
Embase	19/01/2022	Ovid	Embase 1974 to 2022 January 14	10582
MEDLINE ALL	19/01/2022	Ovid	Ovid MEDLINE(R) ALL 1946 to January 18, 2022	11148

Main search – Additional method

Additional method	Date searched	No. of results downloaded
Reference checking	19/01/2022	41

Search strategy history

Database name: CENTRAL

#1 [mh ^obesity] or [mh ^"obesity, abdominal"] or [mh ^"obesity, morbid"] 14023

#2 (obesity* or obese*):ti,ab 41136

#3 [mh ^"Weight loss"] 6610

#4 [mh ^"Weight Reduction Programs"] 849

#5 [mh ^"Obesity Management"] 20

#6 (weight* near/2 (loss* or management* or reduc* or control*)):ti,ab 26182

#7 {OR #1-#6} 56112

#8 [mh ^"Gastric Bypass"] 537

#9 [mh ^"biliopancreatic diversion"] 29

#10 [mh ^Gastroenterostomy] 55

#11 [mh ^gastrectomy] 1100

#12 [mh ^"Anastomosis, Roux-en-Y"] 136

#13 ((gastro* or gastric* or stomach* or biliopancreatic* or (bilio NEXT pancreatic*) or malabsorptive* or restrictive*) near/2 (surgery* or surgical* or diversion* or bypass* or procedure*)):ti,ab 4243

#14 ((gastric* or silicon*) near/2 (band* or sleeve*)):ti,ab484

#15 (Gastroenterostomy* or (Gastro NEXT enterostomy*) or Gastrogastrostomy* or (Gastro NEXT gastrostomy*) or Gastrectomy* or (Roux NEXT en NEXT Y) or RouxEnY or RYGB or LAGB):ti,ab 4603

#16 (lapband* or (lap NEXT band*)):ti,ab 45

#17 {OR #8-#16} 7526

#18 #7 and #17 2592

#19 [mh ^obesity/su] 226

#20 [mh ^"obesity, abdominal"/su]1

#21 [mh ^"obesity, morbid"/su] 715

#22 [mh ^"bariatric surgery"] 360

#23 ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or (weight NEXT loss*)) near/3 (surgery* or surgical*)):ti,ab 2963

#24 {OR #18-#23} 4411

#25 {OR #18-#23} in Trials 4390

#26 {OR #18-#23} with Publication Year from 2013 to 2022, in Trials 3311

#27 conference:pt 194054

#28 #26 not #27 2568

#29 (clinicaltrials or trialsearch):so 388528

#30 #28 not #29 1493

Database name: CDSR

#1 [mh ^obesity] or [mh ^"obesity, abdominal"] or [mh ^"obesity, morbid"] 14023

#2 (obesity* or obese*):ti,ab 41136

#3 [mh ^"Weight loss"] 6610

#4 [mh ^"Weight Reduction Programs"] 849

#5 [mh ^"Obesity Management"] 20

#6 (weight* near/2 (loss* or management* or reduc* or control*)):ti,ab 26182

#7 {OR #1-#6} 56112

#8 [mh ^"Gastric Bypass"] 537

#9 [mh ^"biliopancreatic diversion"] 29

#10 [mh ^Gastroenterostomy] 55

#11 [mh ^gastrectomy] 1100

#12 [mh ^"Anastomosis, Roux-en-Y"] 136

#13 ((gastro* or gastric* or stomach* or biliopancreatic* or (bilio NEXT pancreatic*) or malabsorptive* or restrictive*) near/2 (surgery* or surgical* or diversion* or bypass* or procedure*)):ti,ab 4243

#14 ((gastric* or silicon*) near/2 (band* or sleeve*)):ti,ab484

#15 (Gastroenterostomy* or (Gastro NEXT enterostomy*) or Gastrogastrostomy* or (Gastro NEXT gastrostomy*) or Gastrectomy* or (Roux NEXT en NEXT Y) or RouxEnY or RYGB or LAGB):ti,ab 4603

#16 (lapband* or (lap NEXT band*)):ti,ab 45

#17 {OR #8-#16} 7526

#18 #7 and #17 2592

#19 [mh ^obesity/su] 226

#20 [mh ^"obesity, abdominal"/su]1

#21 [mh ^"obesity, morbid"/su] 715

#22 [mh ^"bariatric surgery"] 360

#23 ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or (weight NEXT loss*)) near/3 (surgery* or surgical*)):ti,ab 2963

#24 {OR #18-#23} 4411

#25 {OR #18-#23} in Cochrane Reviews 14

#26 {OR #18-#23} with Cochrane Library publication date Between Oct 2013 and Jan 2022, in Cochrane Reviews 12

Database name: Embase

Database(s): Embase 1974 to 2022 January 14

Search Strategy:

#	Searches	Results
1	obesity/ or abdominal obesity/ or morbid obesity/ or diabetic obesity/	501156
2	(obesity* or obese*).ti,ab.	491913
3	body weight loss/	59196
4	weight loss program/	2781
5	obesity management/	1005
6	(weight* adj2 (loss* or management* or reduc* or control*)).ti,ab.	213137
7	or/1-6	783515
8	gastric bypass surgery/ or roux-en-y gastric bypass/	13639
9	biliopancreatic bypass/	3693
10	gastroenterostomy/	1982
11	exp gastrectomy/	61316
12	Gastric Banding/	7755
13	((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*)).ti,ab.	46618
14	((gastric* or silicon*) adj2 (band* or sleeve*)).ti,ab.	9086
15	(Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB).ti,ab.	61305
16	(lapband* or "lap band*").ti,ab.	648
17	or/8-16	110931
18	7 and 17	37314

19	obesity/su	11608
20	abdominal obesity/su	78
21	morbid obesity/su	8470
22	diabetic obesity/su	104
23	bariatric surgery/	36342
24	((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*)).ti,ab.	42000
25	or/18-24	68391
26	nonhuman/ not human/	4915541
27	25 not 26	67048
28	(letter or editorial).pt.	1917634
29	27 not 28	63020
30	case report/	2695451
31	29 not 30	57040
32	limit 31 to medline	5353
33	31 not 32	51687
34	(conference abstract* or conference review or conference paper).db,pt.	5072690
35	33 not 34	29574
36	limit 35 to english language	27987
37	limit 36 to dc=20131101-20300101	17013
38	(MEDLINE or pubmed).tw.	326845
39	exp systematic review/ or systematic review.tw.	392745
40	meta-analysis/	234349

41	intervention$.ti.	229661
42	or/38-41	796712
43	37 and 42	1708
44	random:.tw.	1742566
45	placebo:.mp.	487343
46	double-blind:.tw.	226576
47	or/44-46	2007799
48	37 and 47	1861
49	cohort analysis/	794487
50	longitudinal study/	165991
51	prospective study/	738068
52	retrospective study/	1185239
53	follow up/	1785672
54	comparative study/	932170
55	((followup* or follow-up* or concurrent* or incidence* or population* or comparative*) adj3 (study or studies or analy* or observation* or design* or method*)).ti,ab.	948462
56	(longitudinal* or prospective* or retrospective* or cohort*).ti,ab.	3501070
57	or/49-56	6085913
58	37 and 57	9057
59	43 or 48 or 58	10582
60	43	1708
61	48 not 43	1287
62	58 not (43 or 48)	7587

63	60 or 61 or 62	10582

Database name: MEDLINE

Database(s): Ovid MEDLINE(R) ALL 1946 to January 18, 2022

Search Strategy:

#	Searches	Results
1	obesity/ or obesity, abdominal/ or obesity, morbid/	223638
2	(obesity* or obese*).ti,ab.	333539
3	Weight loss/	40194
4	Weight Reduction Programs/	2655
5	Obesity Management/	213
6	(weight* adj2 (loss* or management* or reduc* or control*)).ti,ab.	137969
7	or/1-6	478361
8	Gastric Bypass/	11131
9	biliopancreatic diversion/	1067
10	Gastroenterostomy/	3571
11	gastrectomy/	38328
12	"Anastomosis, Roux-en-Y"/	3720
13	((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*)).ti,ab.	28520
14	((gastric* or silicon*) adj2 (band* or sleeve*)).ti,ab.	4730
15	(Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB).ti,ab.	41995
16	(lapband* or "lap band*").ti,ab.	298
17	or/8-16	80105

18	7 and 17	20346
19	obesity/su	6401
20	obesity, abdominal/su	32
21	obesity, morbid/su	16670
22	bariatric surgery/	12883
23	((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*)).ti,ab.	23832
24	or/18-23	38378
25	Animals/ not Humans/	4911159
26	24 not 25	37465
27	limit 26 to (letter or historical article or comment or editorial or news or case reports)	7100
28	26 not 27	30365
29	limit 28 to english language	28433
30	limit 29 to ed=20131101-20300101	15361
31	limit 29 to dt=20131101-20300101	16824
32	30 or 31	17744
33	(MEDLINE or pubmed).tw.	262849
34	systematic review.tw.	210380
35	systematic review.pt.	182317
36	meta-analysis.pt.	150912
37	intervention$.ti.	173912
38	or/33-37	568894
39	32 and 38	1604

40	randomized controlled trial.pt.	556112
41	randomi?ed.mp.	980144
42	placebo.mp.	232211
43	or/40-42	1042148
44	32 and 43	1665
45	exp Cohort Studies/	2281248
46	((followup* or follow-up* or concurrent* or incidence* or population* or comparative*) adj3 (study or studies or analy* or observation* or design* or method*)).ti,ab.	635765
47	(longitudinal* or prospective* or retrospective* or cohort*).ti,ab.	2224852
48	Comparative Study.pt.	1906932
49	or/45-48	4998459
50	32 and 49	9596
51	39 or 44 or 50	11148

Additional search methods

Source name: reference checking

Date of search	19/01/2022
How the base papers were identified and the types of references examined	Identified in scoping and surveillance and cited in the protocol.
Databases used	NR Haddaway, MJ Grainger, CT Gray (2021) citationchaser: An R package and Shiny app for forward and backward citations chasing in academic searching. Zenodo, https://estech.shinyapps.io/citationchaser/
Date of last update	Colquitt was published on 8 August 2014.
How results were managed	In EPPI-Reviewer.
How the results were selected	Citationchaser was used to download a RIS file the full list of 130 references cited by the Colquitt Cochrane review. These were added to EPPI-R5. The list was manually screened to identify the included publications. A new RIS file of these 41 was downloaded to use in the current review.
Total no. of records downloaded	41
List of base papers used	Colquitt J et al. (2014) Surgery for weight loss in adults. *Cochrane Database of Systematic Reviews*, 10.1002/14651858.CD003641.pub4

Cost-effectiveness searches

Main search – Databases

Database	Date searched	Database Platform	Database segment or version	No. of results downloaded
MEDLINE	03/02/2022	Ovid	1946 to February 02, 2022	647
Embase	03/02/2022	Ovid	1974 to 2022 February 02	555
Econlit	03/02/2022	Ovid	1886 to January 27, 2022	7
NHS Economic Evaluation Database (NHS EED)	03/02/2022	CRD	Legacy database - last updated on 31 March 2015 with content up to 31	13

			December 2014	
International HTA Database (INAHTA)	03/02/2022	INAHTA https://database.inahta.org/	N/A	85

Search strategy history

Database name: MEDLINE

1 obesity/ or obesity, abdominal/ or obesity, morbid/ (224344)

2 (obesity* or obese*).ti,ab. (334638)

3 Weight loss/ (40342)

4 Weight Reduction Programs/ (2676)

5 Obesity Management/ (215)

6 (weight* adj2 (loss* or management* or reduc* or control*)).ti,ab. (138375)

7 or/1-6 (479803)

8 Gastric Bypass/ (11164)

9 biliopancreatic diversion/ (1069)

10 Gastroenterostomy/ (3574)

11 gastrectomy/ (38418)

12 "Anastomosis, Roux-en-Y"/ (3730)

13 ((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*)).ti,ab. (28622)

14 ((gastric* or silicon*) adj2 (band* or sleeve*)).ti,ab. (4734)

15 (Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB).ti,ab. (42180)

16 (lapband* or "lap band*").ti,ab. (298)

17 or/8-16 (80352)

18 7 and 17 (20419)

19 obesity/su (6425)

20 obesity, abdominal/su (32)

21 obesity, morbid/su (16719)

22 bariatric surgery/ (12949)

23 ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*)).ti,ab. (23937)

24 or/18-23 (38536)

25 Animals/ not Humans/ (4919602)

26 24 not 25 (37617)

27 limit 26 to (letter or historical article or comment or editorial or news or case reports) (7119)

28 26 not 27 (30498)

29 limit 28 to english language (28565)

30 limit 29 to ed=20131101-20300101 (15467)

31 limit 29 to dt=20131101-20300101 (16956)

32 30 or 31 (17876)

33 Cost-Benefit Analysis/ (88289)

34 Quality-Adjusted Life Years/ (14335)

35 Markov Chains/ (15568)

36 exp Models, Economic/ (16028)

37 cost*.ti. (132663)

38 (cost* adj2 utilit*).tw. (6735)

39 (cost* adj2 (effective* or assess* or evaluat* or analys* or model* or benefit* or threshold* or quality or expens* or saving* or reduc*)).tw. (242836)

40 (economic* adj2 (evaluat* or assess* or analys* or model* or outcome* or benefit* or threshold* or expens* or saving* or reduc*)).tw. (40433)

41 (qualit* adj2 adjust* adj2 life*).tw. (15449)

42 QALY*.tw. (12403)

43 (incremental* adj2 cost*).tw. (15018)

44 ICER.tw. (4949)

45 utilities.tw. (8214)

46 markov*.tw. (27956)

47 (dollar* or USD or cents or pound or pounds or GBP or sterling* or pence or euro or euros or yen or JPY).tw. (49079)

48 ((utility or effective*) adj2 analys*).tw. (21813)

49 (willing* adj2 pay*).tw. (8084)

50 (EQ5D* or EQ-5D*).tw. (10864)

51 ((euroqol or euro-qol or euroquol or euro-quol or eurocol or euro-col) adj3 ("5" or five)).tw. (2993)

52 (european* adj2 quality adj3 ("5" or five)).tw. (543)

53 or/33-52 (446273)

54 32 and 53 (647)

Database name: Embase

1 obesity/ or abdominal obesity/ or morbid obesity/ or diabetic obesity/ (503209)

2 (obesity* or obese*).ti,ab. (494090)

3 body weight loss/ (59913)

4 weight loss program/ (2802)

5 obesity management/ (1022)

6 (weight* adj2 (loss* or management* or reduc* or control*)).ti,ab. (214004)

7 or/1-6 (786992)

8 gastric bypass surgery/ or roux-en-y gastric bypass/ (13780)

9 biliopancreatic bypass/ (3712)

10 gastroenterostomy/ (1988)

11 exp gastrectomy/ (61544)

12 Gastric Banding/ (7761)

13 ((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*)).ti,ab. (46790)

14 ((gastric* or silicon*) adj2 (band* or sleeve*)).ti,ab. (9102)

15 (Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB).ti,ab. (61556)

16 (lapband* or "lap band*").ti,ab. (648)

17 or/8-16 (111318)

18 7 and 17 (37469)

19 obesity/su (11646)

20 abdominal obesity/su (79)

21 morbid obesity/su (8508)

22 diabetic obesity/su (104)

23 bariatric surgery/ (36534)

24 ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*)).ti,ab. (42220)

25 or/18-24 (68710)

26 nonhuman/ not human/ (4927691)

27 25 not 26 (67358)

28 (letter or editorial).pt. (1923804)

29 27 not 28 (63308)

30 case report/ (2702634)

31 29 not 30 (57315)

32 limit 31 to medline (5418)

33 31 not 32 (51897)

34 (conference abstract* or conference review or conference paper).db,pt. (5085627)

35 33 not 34 (29761)

36 limit 35 to english language (28172)

37 limit 36 to dc=20131101-20300101 (17198)

38 cost utility analysis/ (10892)

39 quality adjusted life year/ (30760)

40 cost*.ti. (176454)

41 (cost* adj2 utilit*).tw. (11078)

42 (cost* adj2 (effective* or assess* or evaluat* or analys* or model* or benefit* or threshold* or quality or expens* or saving* or reduc*)).tw. (338260)

43 (economic* adj2 (evaluat* or assess* or analys* or model* or outcome* or benefit* or threshold* or expens* or saving* or reduc*)).tw. (57512)

44 (qualit* adj2 adjust* adj2 life*).tw. (23556)

45 QALY*.tw. (23105)

46 (incremental* adj2 cost*).tw. (24790)

47 ICER.tw. (10927)

48 utilities.tw. (13253)

49 markov*.tw. (34836)

50 (dollar* or USD or cents or pound or pounds or GBP or sterling* or pence or euro or euros or yen or JPY).tw. (63908)

51 ((utility or effective*) adj2 analys*).tw. (32733)

52 (willing* adj2 pay*).tw. (12213)

53 (EQ5D* or EQ-5D*).tw. (21263)

54 ((euroqol or euro-qol or euroquol or euro-quol or eurocol or euro-col) adj3 ("5" or five)).tw. (4054)

55 (european* adj2 quality adj3 ("5" or five)).tw. (758)

56 or/38-55 (557914)

57 37 and 56 (555)

Database name: Econlit

1 (obesity* or obese*).ti,ab. (1951)

2 (weight* adj2 (loss* or management* or reduc* or control*)).ti,ab. (477)

3 or/1-2 (2333)

4 ((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*)).ti,ab. (17)

5 ((gastric* or silicon*) adj2 (band* or sleeve*)).ti,ab. (1)

6 (Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB).ti,ab. (1)

7 (lapband* or "lap band*").ti,ab. (0)

8 or/4-7 (17)

9 3 and 8 (1)

10 ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*)).ti,ab. (12)

11 or/9-10 (12)

12 (letter or editorial).pt. (0)

13 11 not 12 (12)

14 limit 13 to (yr="2013-Current" and english) (7)

Database name: NHS EED

https://www.crd.york.ac.uk/CRDWeb/

1	MeSH DESCRIPTOR obesity	775
2	MeSH DESCRIPTOR obesity, abdominal	3
3	MeSH DESCRIPTOR obesity, morbid	228
4	(obesity* or obese*)	1517
5	MeSH DESCRIPTOR weight loss	464
6	MeSH DESCRIPTOR Weight Reduction Programs	39
7	MeSH DESCRIPTOR Obesity Management	0
8	(weight* adj2 (loss* or management* or reduc* or control*))	1115
9	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8	1997

10	MeSH DESCRIPTOR Gastric Bypass	139
11	MeSH DESCRIPTOR biliopancreatic diversion	13
12	MeSH DESCRIPTOR Gastroenterostomy	10
13	MeSH DESCRIPTOR gastrectomy	167
14	MeSH DESCRIPTOR Anastomosis, Roux-en-Y	29
15	((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) adj2 (surgery* or surgical* or diversion* or bypass* or procedure*))	655
16	((gastric* or silicon*) adj2 (band* or sleeve*))	97
17	(Gastroenterostomy* or "Gastro enterostomy*" or Gastrogastrostomy* or "Gastro gastrostomy*" or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB)	308
18	(lapband* or "lap band*")	7
19	#10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18	768
20	#9 AND #19	237
21	MeSH DESCRIPTOR obesity WITH QUALIFIER SU	69
22	MeSH DESCRIPTOR obesity, abdominal WITH QUALIFIER SU	0
23	MeSH DESCRIPTOR obesity, morbid WITH QUALIFIER SU	179
24	MeSH DESCRIPTOR bariatric surgery	131
25	((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) adj3 (surgery* or surgical*))	354
26	#20 OR #21 OR #22 OR #23 OR #24 OR #25	389
27	(#26) IN NHSEED WHERE LPD FROM 01/11/2013 TO 03/02/2022	13

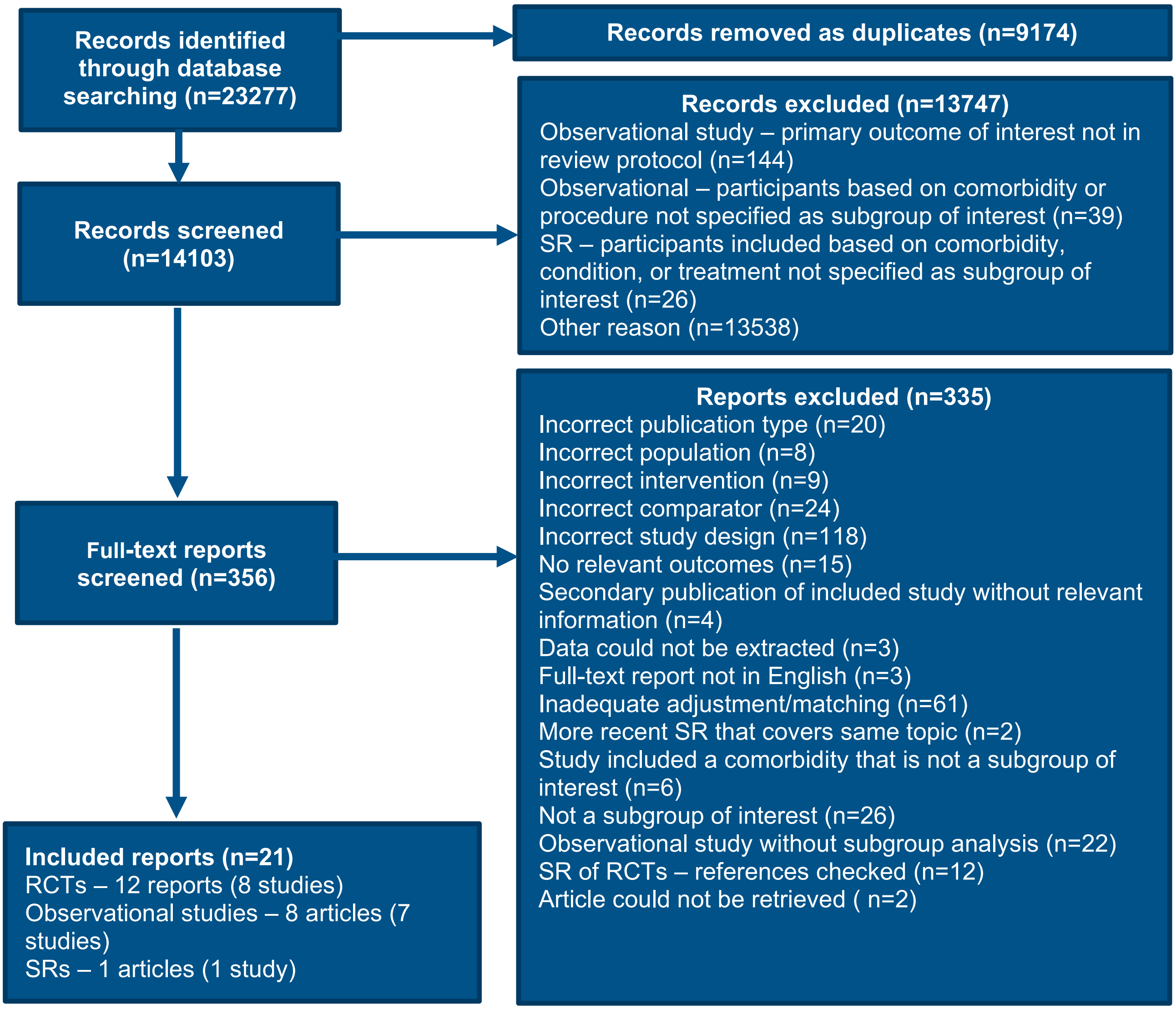
Database name: INAHTA

1	"Obesity"[mh]	214
2	"Obesity Abdominal"[mh]	0

3	"Obesity Morbid"[mh]	80
4	(obesity* or obese*)[Title] OR (obesity* or obese*)[abs]	267
5	"Weight Loss"[mh]	74
6	"Weight Reduction Programs"[mh]	9
7	"Obesity Management"[mh]	8
8	(weight* AND (loss* or management* or reduc* or control*))[Title] OR (weight* AND (loss* or management* or reduc* or control*))[abs]	337
9	#8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1	493
10	"Gastric Bypass"[mh]	36
11	"Biliopancreatic Diversion"[mh]	6
12	"Gastroenterostomy"[mh]	0
13	"Gastrectomy"[mh]	9
14	"Anastomosis Roux-en-Y"[mh]	5
15	((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) AND (surgery* or surgical* or diversion* or bypass* or procedure*))[Title] OR ((gastro* or gastric* or stomach* or biliopancreatic* or bilio pancreatic* or malabsorptive* or restrictive*) AND (surgery* or surgical* or diversion* or bypass* or procedure*))[abs]	214
16	((gastric* or silicon*) AND (band* or sleeve*))[Title] OR ((gastric* or silicon*) AND (band* or sleeve*))[abs]	38
17	(Gastroenterostomy* or Gastro-enterostomy* or Gastrogastrostomy* or Gastro-gastrostomy* or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB)[Title] OR (Gastroenterostomy* or Gastro-enterostomy* or Gastrogastrostomy* or Gastro-gastrostomy* or Gastrectomy* or "Roux en Y" or RouxEnY or RYGB or LAGB)[abs]	95
18	(lapband* or lap-band*)[Title] OR (lapband* or lap-band*)[abs]	150
19	#18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10	382
20	#19 AND #9	102
21	"Bariatric Surgery"[mh]	32

22	((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) AND (surgery* or surgical*))[Title] OR ((bariatric* or obesity* or obese* or antiobesity* or antiobese* or weight loss*) AND (surgery* or surgical*))[abs]	328
23	#22 OR #21 OR #20	354
24	Limit #23 to Year 2013-2022	108
25	Limit #24 to English Language	85

Appendix D – Effectiveness evidence study selection



Appendix E – Effectiveness evidence

Systematic reviews

Sutanto, 2021

Bibliographic Reference	Sutanto, Andryanto; Wungu, Citrawati Dyah Kencono; Susilo, Hendri; Sutanto, Henry; Reduction of Major Adverse Cardiovascular Events (MACE) after Bariatric Surgery in Patients with Obesity and Cardiovascular Diseases: A Systematic Review and Meta-Analysis.; Nutrients; 2021; vol. 13 (no. 10)

Study Characteristics

Study design	Systematic review
Study details	Dates searched All publications from the inception to July 2021 were evaluated Databases searched PubMed/MEDLINE, ScienceDirect, Cochrane Library, Wiley Online Library and Springer databases Sources of funding No external funding
Inclusion criteria	Study - RCT Study - primary endpoint was occurrence of MACE

	Study - comparing surgery and no-surgery groups Participants - adults Participants - with cardiovascular disease Participants - with obesity Full text article is accessible Study - cohort studies Studies published in English
Exclusion criteria	Study - reviews Study - case reports Study - case series Participants - aged less than 18 years Participants - aged more than 80 years Participants - pregnant women Participants - with malignancy
Intervention(s)	Intervention - bariatric surgery Roux-en-Y gastric bypass, gastric banding, sleeve gastrectomy, biliopancreatic diversion, vertical banded gastroplasty and duodenal switch

	Control - no surgery
Outcome(s)	Incidence of MACE
Number of studies included in the systematic review	11 studies
Additional comments	Study reports both unadjusted and adjusted analyses

Study arms

Bariatric surgery (N = 74042)

No surgery (N = 1698263)

Critical appraisal - GDT Crit App - ROBIS checklist

Section	Question	Answer
Overall study ratings	Overall risk of bias	Low
Overall study ratings	Applicability as a source of data	Fully applicable

Primary studies – RCTs

Aguiar, 2014

Bibliographic Reference	Aguiar, Isabella C; Freitas, Wilson R Jr; Santos, Israel R; Apostolico, Nadua; Nacif, Sergio R; Urbano, Jessica Julioti; Fonseca, Nina Teixeira; Thuler, Fabio Rodrigues; Ilias, Elias Jirjoss; Kassab, Paulo; LeitaoFilho, Fernando Ss; Laurino Neto, Rafael M; Malheiros, Carlos A; Insalaco, Giuseppe; Donner, Claudio F; Oliveira, Luis Vf; Obstructive sleep apnea and

pulmonary function in patients with severe obesity before and after bariatric surgery: a randomized clinical trial.; Multidisciplinary respiratory medicine; 2014; vol. 9 (no. 1); 43

Study details

Trial registration number and/or trial name	The protocol for this study was registered with the World Health Organisation (Universal Trial Number: U1111-1121-8873) and Brazilian Registry of Clinical Trials – ReBEC (RBR-9k9hhv).
Study type	Randomised controlled trial (RCT)
Study location	Brazil
Study setting	Gastric Surgery Service Bariatric Surgery Group Sleep Laboratory
Study dates	2011 to 2013
Sources of funding	The Sleep Laboratory receives funding from the Nove de Julho University (Brazil) and research projects approved by the Brazilian fostering agencies Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq; Domestic Grants/Universal Notice MCT/CNPQ14/2008, process N° 481169/2008-3) and Fundaçao de Amparo a Pesquisa do Estado de São Paulo (FAPESP) (protocol number 2003/01810-4).
Inclusion criteria	BMI between 40 and 50 kg/m2 or BMI between 35 and 39.9 kg/m2 with associated comorbidities
Exclusion criteria	Any active malignancy Active alcohol and/or drug abuse Dementia or treatment-refractory psychiatric diseases leading to an inability to provide informed consent

	Use of medication that may interfere with the sleep structure, such as hypnotic drugs or stimulants of the central nervous system
Intervention(s)	**Gastric band** No further details were provided.
Comparator	**No treatment** At the end of a mean period of 90 days, participants in the 'no treatment' arm returned to the waiting list to undergo bariatric surgery.
Outcome measures	Weight (kg) BMI (kg/m2) Apnoea/hypopnoea index The apnoea/hypopnoea index was calculated as the number of (apnoeas + hypopnoeas)/ hour of sleep time.
Number of participants	Gastric band (N=16) No treatment (N=36)
Duration of follow-up	3 months
Loss to follow-up	None reported.
Additional comments	The number of women were only reported for the 'gastric band' arm (n=13 women). It was unclear whether data for the 'no treatment' arm was from baseline or follow-up. The authors stated that "the individuals in this group ['no treatment' arm] did not demonstrate any changes in anthropometric variables at the follow-up while on the waiting list for surgery."

Study arms

Gastric band (N = 16)

No treatment (N = 36)

Characteristics

Arm-level characteristics

Characteristic	Gastric band (N = 16)	No treatment (N = 36)
Mean age (SD) Mean (SD)	40.08 (9.86)	42.3 (11.87)
BMI (kg/m²) Mean (SD)	48.15 (5.58)	46.2 (6.13)
Weight (kg) Mean (SD)	118.92 (19.68)	118.48 (23.13)
Apnoea/hypopnoea index Mean (SD)	15.65 (15.51)	15.34 (9.14)
Apnoea/hypopnoea index <5 Sample size	n = 2 ; % = 12.5	n = 10 ; % = 27.77
Apnoea/hypopnoea index 5<15	n = 7 ; % = 43.75	n = 14 ; % = 38.88

Characteristic	Gastric band (N = 16)	No treatment (N = 36)
Sample size		
Apnoea/hypopnoea index 15<30 Sample size	n = 4 ; % = 25	n = 5 ; % = 13.88
Apnoea/hypopnoea index ≥30 Sample size	n = 3 ; % = 18.75	n = 7 ; % = 19.44
Epworth Sleepiness scale Mean (SD)	6.92 (6.54)	9.18 (5.34)
Berlin Questionnaire Mean (SD)	1.75 (0.45)	1.45 (0.5)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Moderate *(Only baseline data was reported for the 'no treatment' arm.)*
Overall bias and Directness	Overall Directness	Directly applicable

Bakker, 2018

Bibliographic Reference	Bakker, JP; Tavakkoli, A; Rueschman, M; Wang, W; Andrews, R; Malhotra, A; Owens, RL; Anand, A; Dudley, KA; Patel, SR; Gastric Banding Surgery versus Continuous Positive Airway Pressure for Obstructive Sleep Apnea: a Randomized Controlled Trial; American journal of respiratory and critical care medicine; 2018; vol. 197 (no. 8); 1080-1083

Study details

Trial registration number and/or trial name	Trial registration number: NCT01187771.
Study type	Randomised controlled trial (RCT)
Study location	US
Study setting	Hospital and Medical Centre
Study dates	2010 to 2017
Sources of funding	University of Pittsburgh
Inclusion criteria	Age 18 to 65 years BMI 35 to 45 kg/m2 Severe obstructive sleep apnoea (apnoea-hypopnoea index 30 events/hour or more [level 1 study] or apnoea-hypopnoea index 20 events/hour or more [level 3 study]) At least one obstructive sleep apnoea symptom
Exclusion criteria	Prior continuous positive airway pressure Prior bariatric surgery Hypoventilation syndrome Increased perioperative risk Drowsy driving Non-English fluency

	Any unstable medical condition
Intervention(s)	**Laparoscopic gastric band** Participants undergoing laparoscopic gastric band were provided auto-continuous positive airway pressure (REMstar Auto M Series; Philips Respironics) during the perioperative period to minimise obstructive sleep apnoea complications.
Comparator	**Standard care** Continuous positive airway pressure. Initiation and management of obstructive sleep apnoea care once treatment was assigned were performed by the managing clinician as per usual care.
Outcome measures	Weight (kg) BMI (kg/m2) Apnoea/hypopnoea index The effective apnoea/hypopnoea index (AHI) was calculated as (× X AHIon-CPAP) + 1[(1 - ×) X AHIoff-CPAP], where × is (CPAP adherence)/(habitual sleep duration). Adherence and AHIon-CPAP were downloaded from the device and averaged across the previous 30 days. AHIoff-CPAP was calculated from polysomnography data obtained at 9 or 18 months.
Number of participants	Laparoscopic gastric band (N=28) Standard care (N=21)
Duration of follow-up	9 and 18 months
Additional comments	Suitability for both treatments was established by a sleep specialist and bariatrician before consent was obtained.

Study arms

Laparoscopic gastric band (N = 28)

Loss to follow-up	9-month follow-up: • voluntary drop-put n=3 18-month follow-up: • voluntary drop-put n=1

Standard care (N = 21)
Continuous positive airway pressure

Loss to follow-up	9-month follow-up: • voluntary drop-put n=1 • lost to follow-up n=2 18-month follow-up: • voluntary drop-put n=1 • lost to follow-up n=1
Methods of analysis	

Characteristics

Arm-level characteristics

Characteristic	Laparoscopic gastric band (N = 28)	Standard care (N = 21)
% Female Sample size	n = 12 ; % = 43	n = 9 ; % = 43
Mean age (SD) (years) Mean (SD)	50.7 (9.2)	46.3 (10.5)
BMI (kg/m²) Mean (SD)	39.1 (2.9)	38.7 (3.1)
Weight (kg) Mean (SD)	115.4 (16.9)	111.1 (16.1)
Non-Hispanic White ethnicity/race Sample size	n = 21 ; % = 75	n = 14 ; % = 67
Apnoea–hypopnoea index off continuous positive airway pressure treatment (events/hour) Mean (SD)	51.5 (23.5)	47.5 (31.5)
Epworth Sleepiness scale (scale 0 to 24) Mean (SD)	10.4 (4.2)	9.8 (5)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	**Question**	**Answer**
Overall bias and Directness	Risk of bias judgement	Moderate *(There was no information on concealment of allocation sequence. The authors stated that there were crossovers from laparoscopic gastric band to continuous positive airway pressure, but they did not provide the number of participants who crossed over. The authors also stated that the results indicating greater improvement with continuous positive airway pressure in per-protocol analyses supported the findings from the intention-to-treat analyses. There was no information on: balance in co-interventions across arms; participants adherence to assigned intervention.)*
Overall bias and Directness	Overall Directness	Directly applicable

Dixon, 2012

Bibliographic Reference	Dixon, John; Schachter, Linda M; O'Brien, Paul E.; Jones, Kay Margaret; Grima, Mariee T.; Lambert, Gavin; Brown, Wendy A.; Bailey, Michael; Naughton, Matthew T.; Surgical vs conventional therapy for weight loss treatment of obstructive sleep apnea: a randomized controlled trial.; JAMA; 2012; vol. 308 (no. 11); 1142-1149

Study details

Trial registration number and/or trial name	anzctr.org Identifier: ACTRN12605000161628.
Study type	Randomised controlled trial (RCT)
Study location	Australia
Study setting	Sleep clinics
Study dates	2006 - 2011

Sources of funding	The study was funded by the National Health and Medical Research Council of Australia project grant 436728 awarded to Monash University and the Baker IDI Heart and Diabetes Institute. The continuous positive airway pressure (CPAP) pumps were provided for all study participants by ResMed Australia, Fisher and Paykel New Zealand, and Phillips Respironics United States. The laparoscopic adjustable gastric bands (Allergan Health) and the laparoscopic ports (Applied Medical) were provided without charge by the manufacturers. The Avenue Hospital subsidised the hospitalisation costs for the surgical study participants.
Inclusion criteria	Age 18 to 60 years BMI 35 to 55 kg/m2 Apnoea-hypopnoea index of 20 events/hour or more diagnosed within the previous 6 months with recommendation to commence continuous positive airway pressure therapy At least 3 prior significant weight loss attempts
Exclusion criteria	Contraindications for surgery including cognitive impairment, drug or alcohol addiction, and significant cardiopulmonary, neurological, vascular, gastrointestinal, or neoplastic disease Prior bariatric surgery Hypoventilation syndrome requiring bilevel positive airway pressure
Intervention(s)	**Laparoscopic adjustable gastric band** Participants underwent 2 weeks of intensive very low energy diet to reduce liver size prior to placement of an laparoscopic adjustable gastric band (LAP-BAND System, Allergan Health) via the pars flaccida pathway by 1 of 3 experienced surgeons, within 1 month of randomisation. Adjustments to band volume were made using standard clinical criteria.
Comparator	**Non-surgical intervention for obesity**

	The conventional weight loss program delivered the best available medical practice for the treatment, education, and follow-up of severely obese patients with moderate to severe obstructive sleep apnoea. Dietary, physical activity, and behavioural programs were individualised. The advice regarding physical activity encouraged walking and 200 minutes/week of structured activity, including moderate-intensity aerobic activity and resistance exercise. Dietary advice was based on the Dietary Guidelines for Australian Adults and the Australian Guide to Healthy Eating and included a planned daily deficit of 500 kcal from estimated energy requirements. All participants were offered an initial intensive very low energy diet (Optifast, Nestle-Australia) program, with the meal replacements provided. The intensive very low energy diet meal replacements continued to be available for further intensive, intermittent, or occasional use throughout the study.
Outcome measures	Weight (kg) BMI (kg/m2) Apnoea/hypopnoea index Measured by diagnostic laboratory polysomnography from baseline to 2 years. Polysomnography was performed using standard electroencephalogram, electrooculogram, electromyogram, nasal pressure cannulae, oronasal thermistor, respiratory inductance plethysmography, finger oximetry, electrocardiography, and video monitoring for body position. Diagnostic polysomnography at years 1 and 2 was performed after a 48-hour continuous positive airway pressure washout at the same institution as the initial test, scored by staff blinded to randomisation group, and using the same precise apnoea/hypopnoea index scoring criteria for each study. Health related quality of life Short Form-36 Health Survey Depression Beck Depression Inventory
Number of participants	Laparoscopic adjustable gastric band (N=30) Non-surgical intervention for obesity (N=30)

Duration of follow-up	2 years
Additional comments	Patients in both programs had open access to a bariatric physician, sleep physician, and dietitian, and had their progress reviewed every 4 to 6 weeks throughout the 2 years. The management of obstructive sleep apnoea, the intensity, and nature of the lifestyle program were common to both groups.

Study arms

Laparoscopic adjustable gastric band (N = 30)

Loss to follow-up	2 participants were lost to follow-up

Non-surgical intervention for obesity (N = 30)

Loss to follow-up	4 participants were lost to follow-up

Conventional weight loss programme

Characteristics

Arm-level characteristics

Characteristic	Laparoscopic adjustable gastric band (N = 30)	Non-surgical intervention for obesity (N = 30)
% Female Sample size	n = 13 ; % = 43	n = 12 ; % = 40
Mean age (SD) (years) Mean (SD)	47.4 (8.8)	50 (8.2)
BMI (kg/m^2)	46.3 (6)	43.8 (4.9)

Characteristic	Laparoscopic adjustable gastric band (N = 30)	Non-surgical intervention for obesity (N = 30)
Mean (SD)		
Comorbidities Sample size	n = NA	n = NA
Hypertension Sample size	n = 15 ; % = 50	n = 17 ; % = 57
Diabetes Sample size	n = 10 ; % = 33	n = 10 ; % = 33
Depression Sample size	n = 12 ; % = 40	n = 11 ; % = 37
Weight (kg) Mean (SD)	134.9 (22.1)	126 (19.3)
Apnea-hypopnoea index (events/hour) Mean (SD)	65 (32.8)	57.2 (30.3)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Moderate *(There was no information on concealment of allocation sequence. 4 participants randomised to laparoscopic adjustable gastric band crossed over to standard care (conventional weight loss programme) and 1 participant*

Section	Question	Answer
		randomised to standard care crossed over to laparoscopic adjustable gastric band. There was crossover between arms but the proportion who did not adhere was not high enough to raise concerns.)
Overall bias and Directness	Overall Directness	Directly applicable

Feigel-Guiller, 2015

Bibliographic Reference	Feigel-Guiller, Barbara; Drui, Delphine; Dimet, Jerome; Zair, Yassine; Le Bras, Maelle; Fuertes-Zamorano, Nuria; Cariou, Bertrand; Letessier, Eric; Nobecourt-Dupuy, Estelle; Krempf, Michel; Laparoscopic Gastric Banding in Obese Patients with Sleep Apnea: A 3-Year Controlled Study and Follow-up After 10 Years.; Obesity surgery; 2015; vol. 25 (no. 10); 1886-92

Study details

Secondary publication of another included study- see primary study for details	
Other publications associated with this study included in review	
Trial registration number and/or trial name	This trial was registered in the database of the French Ministry of Health (PHRC no. 990-069).
Study type	Randomised controlled trial (RCT)

Study location	France
Study setting	University Hospital
Study dates	1999 to 2003
Sources of funding	Not reported
Inclusion criteria	Age 18 to 65 years BMI more than 35 kg/m2 two months before study inclusion Receiving nocturnal non-invasive ventilation treatment for obstructive sleep apnoea and/or obesity-hypoventilation syndrome
Exclusion criteria	Contraindications for surgery Severe eating disorders
Intervention(s)	**Laparoscopic adjustable gastric banding** Performed by a single experienced surgeon.
Comparator	**Non-surgical intervention for obesity** Intensive nutritional care. No further details were provided.
Outcome measures	Weight (kg) BMI (kg/m2) Apnoea/hypopnoea index Apnoea-hypopnoea index (events/hour)
Number of participants	Laparoscopic adjustable gastric banding (N=30) Non-surgical intervention for obesity (N=33)

Duration of follow-up	1, 3 and 10 years
Additional comments	Participants in both arms were advised to consume a low-energy (5862 kJ [1400 kcal/day]) diet and to performed physical exercise.

Study arms

Laparoscopic adjustable gastric banding (N = 30)

Loss to follow-up	At year 1: 4 participants removed their consent (1 refused surgery) At year 3: 4 participants dropped out At year 10: 1 participant was lost to follow-up

Non-surgical intervention for obesity (N = 33)
Intensive nutritional care

Loss to follow-up	At year 1: 3 participants dropped out At year 3: 6 participants dropped out At year 10: 2 participants were lost to follow-up

Characteristics

Arm-level characteristics

Characteristic	Laparoscopic adjustable gastric banding (N = 30)	Non-surgical intervention for obesity (N = 33)
Mean age (SD)	46.9 (8.6)	50.1 (7.4)

Characteristic	Laparoscopic adjustable gastric banding (N = 30)	Non-surgical intervention for obesity (N = 33)
Mean (SD)		
BMI (kg/m²) Mean (SD)	48.8 (9.9)	44.4 (9)
Sex ratio (M/F) Custom value	1.1	1.5
Weight (kg) Mean (SD)	135 (25.3)	123 (25.1)
Apnoea/hypopnoea index (events/hour) Mean (SD)	56.5 (24.9)	46.3 (25.3)
Type of ventilatory disorder Sample size	n = NA	n = NA
Obstructive sleep apnoea Sample size	n = 19 ; % = 63	n = 19 ; % = 58
Obesity-hypoventilation syndrome Sample size	n = 3 ; % = 10	n = 1 ; % = 3
Mixed syndrome Sample size	n = 8 ; % = 27	n = 13 ; % = 39

Characteristic	Laparoscopic adjustable gastric banding (N = 30)	Non-surgical intervention for obesity (N = 33)
Time evolution of ventilatory disorder (Months) Mean (SD)	19.6 (22.4)	26.6 (31.9)
Type of respiratory equipment Sample size	n = NA	n = NA
Barometric ventilation (BI-PAP, C-PAP) BIPAP: bilevel positive airway pressure; CPAP: continuous positive airway pressure Sample size	n = 24 ; % = 80	n = 24 ; % = 73
Volumetric ventilation Sample size	n = 5 ; % = 17	n = 6 ; % = 18
Unknown Sample size	n = 1 ; % = 3	n = 3 ; % = 9

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High *(There was no information on: randomisation methods; concealment of allocation sequence. Naïve per-protocol analyses were used. More than 20% were lost to follow-up at year 3. Reasons for withdrawal from the study were not reported. Pre-specified analysis plan was not reported.)*

Section	Question	Answer
Overall bias and Directness	Overall Directness	Directly applicable

Freitas, 2018

Bibliographic Reference	Freitas, Wilson R Jr; Oliveira, Luis Vicente Franco; Perez, Eduardo A; Ilias, Elias J; Lottenberg, Carina P; Silva, Anderson S; Urbano, Jessica J; Oliveira, Manoel C Jr; Vieira, Rodolfo P; Ribeiro-Alves, Marcelo; Alves, Vera L S; Kassab, Paulo; Thuler, Fabio R; Malheiros, Carlos A; Systemic Inflammation in Severe Obese Patients Undergoing Surgery for Obesity and Weight-Related Diseases.; Obesity surgery; 2018; vol. 28 (no. 7); 1931-1942

Study details

Trial registration number and/or trial name	This trial was registered at ClinicalTrials.gov (02409160).
Study type	Randomised controlled trial (RCT)
Study location	Brazil
Study setting	Medical School
Study dates	2015 - 2018
Sources of funding	WRFJ, EAP and ASS receives grants of Coordenaçao de Apoio ao Pessoal de Nível Superior (CAPES/PROSUP); LVFO receive grants Research Productivity, modality PQ1B; process no. 313053/2014-6 of Conselho Nacional de Desenvolvimento Cientifico e Tecnologico (local acronym CNPq), Brazil.
Inclusion criteria	Age 18 to 65 years Severe level III obesity (BMI 40 kg/ m2 or more, or 35 kg/m2 or more when associated with comorbidities)

	Documented history of failure in conventional weight loss Intellectual capacity to understand, agree, and sign the informed consent form People waiting for bariatric surgery
Exclusion criteria	Contraindications for surgery from any cardiorespiratory and/or medical condition Active alcohol and/or drug abuse Unrealistic expectations regarding surgical treatment Pregnancy Breastfeeding Pregnancy planned within 2 years BMI more than 65 kg/m2 Safe access to the abdominal cavity or gastrointestinal tract was lacking Cancer Previous diagnosis of autoimmune disease
Intervention(s)	**Roux-en-Y gastric bypass** All participants were operated on by three surgeons who alternated between the surgeon and two assistants in each surgery. Informed consent for the surgery and research study was obtained from all participants. Participants were placed in the horizontal dorsal decubitus position with a sequential compression device for deep vein thrombosis prophylaxis. Skin

	prepping using chlorhexidine and draping were performed in the usual standard surgical manner. The abdominal incision was marked and started from 2 cm below the xiphoid process to 7 cm above the umbilicus. Surgical procedures were of the gastric bypass type with Roux-en-Y reconstruction, with a small pouch kind of Capella with gastrointestinal anastomosis in two sutures, being one of continuous 4-0 Vicryl and the other of seromuscular cotton 3-0 with sutures, with lateral anastomosis (1.5 cm in diameter). No silastic ring was placed. The loop food was 100 cm, and the handle was 70 cm biliopancreatic with enteroanastomosis lateral side 3-0 Vicryl running suture in two layers with a diameter of 4 cm.
Comparator	**No treatment** Participants in the 'no treatment' arm (control group) returned to the waiting list after the 180-day study period, or if they presented with any clinical complications indicating urgent bariatric surgery.
Outcome measures	Weight (kg) BMI (kg/m2)
Number of participants	Roux-en-Y gastric bypass (N=62) No treatment (N=19)
Duration of follow-up	6 months

Study arms

Roux-en-Y gastric bypass (N = 62)

Loss to follow-up	Lost to follow-up (n=3) Other reasons (n=2)

No treatment (N = 19)

Loss to follow-up	Lost to follow-up (n=5) Other reasons (n=2)

Characteristics

Arm-level characteristics

Characteristic	Roux-en-Y gastric bypass (N = 62)	No treatment (N = 19)
% Female Custom value	90.9%	78.5%
Mean age (SD) (years) Mean (SD)	41.8 (*empty data*)	40.7 (11.8)
Ethnicity Custom value	NA	NA
Caucasian Custom value	85.4%	71.5%
Black Custom value	14.6%	28.5%
Weight (kg) Mean (SD)	126.1 (19.7)	125 (29)
BMI (kg/m²) Mean (SD)	47.1 (6.3)	47.5 (5.6)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	High *(Naïve per-protocol analyses were used. Exclusions from analysis were 11.3% from the Roux-en-Y gastric bypass arm and 26.3% from the no treatment arm. Reasons for exclusions from data analysis were not reported.)*
Overall bias and Directness	Overall Directness	Directly applicable

Mollan, 2021

Bibliographic Reference	Mollan, Susan P; Mitchell, James L; Ottridge, Ryan S; Aguiar, Magda; Yiangou, Andreas; Alimajstorovic, Zerin; Cartwright, David M; Grech, Olivia; Lavery, Gareth G; Westgate, Connar S J; Vijay, Vivek; Scotton, William; Wakerley, Ben R; Matthews, Tim D; Ansons, Alec; Hickman, Simon J; Benzimra, James; Rick, Caroline; Singhal, Rishi; Tahrani, Abd A; Brock, Kristian; Frew, Emma; Sinclair, Alexandra J; Effectiveness of Bariatric Surgery vs Community Weight Management Intervention for the Treatment of Idiopathic Intracranial Hypertension: A Randomized Clinical Trial.; JAMA neurology; 2021; vol. 78 (no. 6); 678-686

Study details

Other publications associated with this study included in review	Yiangou, Andreas, Mitchell, James L, Nicholls, Matthew et al. (2021) Obstructive sleep apnoea in women with idiopathic intracranial hypertension: a sub-study of the idiopathic intracranial hypertension weight randomised controlled trial (IIH: WT). Journal of neurology.
Trial registration number and/or trial name	Idiopathic Intracranial Hypertension Weight Trial (IIH:WT); NCT02124486.
Study type	Randomised controlled trial (RCT)
Study location	UK

Study setting	NHS hospitals
Study dates	2014 - 2017
Sources of funding	This clinical trial was funded by grant NIHR-CS-011-028 (clinician scientist fellowship) from the National Institute for Health Research (Dr Sinclair) and grant MR/K015184/1 from the Medical Research Council of the UK (Dr Sinclair).
Inclusion criteria	Women aged 18 to 55 years Met the diagnostic criteria for idiopathic intracranial hypertension Diagnosed according to the Friedman Jacobson criteria, active disease (papilloedema [Frisén grade ≥1 in at least one eye], significantly raised LP OP ≥25 cmCSF) of over 2 months' duration. Normal results from brain imaging, including magnetic resonance venography or computed tomographic venography (apart from radiological signs of increased intracranial pressure) BMI 35 kg/m2 or higher Had not succeeded in losing weight or maintaining weight loss
Exclusion criteria	Prior bariatric surgery Pregnancy Planning pregnancy Significant comorbidity, Cushing's syndrome, Addison's disease or the use of oral or injected glucocorticoid therapy Previously undergone optic nerve sheath fenestration Definite indication for or contraindication against surgery or dieting

	Specific medical or psychiatric contraindication for surgery, including drug misuse, eating disorder or major depression (suicidal ideation, drug overdose or psychological admission in the last 12 months) Inability to give informed consent for example, due to cognitive impairment.
Intervention(s)	**Bariatric surgery** The bariatric surgery pathway participants were screened to ensure their suitability, initially for medical and psychological assessment in the weight management clinic. This assessment continued for as long as thought appropriate, as per routine care. Once suitable, the case was discussed in the joint multi-disciplinary meeting, prior a group session for education regarding surgery. The participant then attended a consultant bariatric surgeon and was given a date for surgery. Twelve weeks was permitted for further consideration of the procedure if required. The standard patient pathway was envisioned to take approximately 4 months. The choice of surgical intervention was decided between the surgeon and participant, based on the participant's health and preference. These included laparoscopic adjustable gastric banding, laparoscopic Roux-en-Y gastric bypass or laparoscopic sleeve gastrectomy.
Comparator	**Community weight management** WeightWatchers™ program was chosen as the community weight management intervention because it had superior weight loss, was the best attended and most cost-effective. Participants in this arm were given exemption vouchers for 52 consecutive and specified weeks of their local WeightWatchers™ group with access to WeightWatchers™ online and mobile tools for 12 months. Vouchers provided 12 sessions at baseline, 3, 6 and 9 months.
Outcome measures	Weight (kg) BMI (kg/m2) Apnoea/hypopnoea index Health related quality of life

	Measured using the 36-item Short Form Health Survey and the 5-level EuroQoL 5-Dimension questionnaire. Depression Measured using the Hospital Anxiety and Depression scale Adverse events Intracranial pressure Measured by lumbar puncture opening pressure Idiopathic intracranial hypertension symptoms Obstructive sleep apnoea Anxiety Measured using the Hospital Anxiety and Depression scale
Number of participants	Bariatric surgery (N=33) Community weight management (N=33)
Duration of follow-up	1 year and 2 years

Study arms

Bariatric surgery (N = 33)

Roux-en-Y gastric bypass, gastric banding, or laparoscopic sleeve gastrectomy

Loss to follow-up	At 12 months: • form not available (n=3) • declined lumbar puncture (n=1) At 24 months: • forms not available (n=5) • withdrew consent (n=2) • declined lumbar puncture (n=2)

Community weight management (N = 33)

Weight Watchers

Loss to follow-up	At 12 months: • form not available (n=2) • declined lumbar puncture (n=4) At 24 months: • forms not available (n=1) • withdrew consent (n=4) • declined lumbar puncture (n=4) • lost to follow-up (n=2)

Characteristics

Arm-level characteristics

Characteristic	Bariatric surgery (N = 33)	Community weight management (N = 33)
% Female Sample size	n = 33 ; % = 100	n = 33 ; % = 100
Mean age (SD) (years) Mean (SD)	31 (8)	33 (7.7)
Race/ethnicity Sample size	n = NA	n = NA
White Sample size	n = 27 ; % = 81.8	n = 28
Mixed or multiple Sample size	n = 3 ; % = 9.1	n = 2 ; % = 6.1
Black, African, or Caribbean Sample size	n = 3 ; % = 9.1	n = 2 ; % = 6.1
Asian or British Asian Sample size	n = 0	n = 1 ; % = 3
Weight (kg) Mean (SD)	118.4 (21.8)	118.5 (20.7)

Characteristic	Bariatric surgery (N = 33)	Community weight management (N = 33)
BMI (kg/m²) Mean (SD)	44.2 (7.1)	43.7 (7.1)
Duration of idiopathic intracranial hypertension diagnosis (years) Custom value	Median 1.1 (range 0.6 to 2.7)	Median 0.8 (range 0.4 to 2.5)
Intracranial pressure (cm CSF) Mean (SD)	34.8 (5.8)	34.6 (5.6)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Moderate *(Two participants in the weight management arm underwent bariatric surgery but intention-to-treat analysis was used to estimate the effect of assignment to intervention.)*
Overall bias and Directness	Overall Directness	Directly applicable

O'Brien, 2006

Bibliographic Reference	O'Brien, Paul E.; Dixon, John; Laurie, Cheryl F; Skinner, Stewart; Proietto, Joseph; McNeil, John J; Strauss, Boyd Josef Gimnicher; Marks, Sharon; Schachter, Linda M.; Chapman, Leon; Anderson, Margaret Louise; Treatment of Mild to Moderate Obesity with Laparoscopic Adjustable Gastric Banding or an Intensive Medical Program: A Randomized Trial; Annals of internal medicine; 2006; vol. 144 (no. 9); 625-633

Study details

Trial registration number and/or trial name	Australian New Zealand Clinical Trials Registry no. ACTRN12605000113651.
Study type	Randomised controlled trial (RCT)
Study location	Australia
Study setting	Outpatient clinics and hospital
Study dates	2000 - 2003
Sources of funding	By the Department of Surgery, Monash University. INAMED Health, manufacturer of the LAP-BAND System; Novartis, manufacturer of Optifast; and US Surgical Corp., manufacturer of disposable laparoscopic instruments, provided the equipment devices or products.
Inclusion criteria	Age 20 to 50 years BMI 30 to 35 kg/m2 Identifiable problems associated with their obesity including an obesity-related comorbidity (such as hypertension, dyslipidaemia, diabetes, obstructive sleep apnoea, or gastroesophageal reflux disease), severe physical limitations, or clinically significant psychosocial problems associated with their obesity Attempted to reduce weight over at least the previous 5 years Could understand the options offered and the randomisation process Willing to comply with the requirements of each programme
Exclusion criteria	Prior bariatric surgery

	Medical problems that contraindicated treatment in either study arm such as impaired mental status, drug or alcohol addiction, or portal hypertension Undergone an intensive, physician-supervised programme that used very-low-calorie diets or pharmacotherapy Did not attend the 2 initial participant information visits
Intervention(s)	**Laparoscopic adjustable gastric band** Two experienced surgeons performed the laparoscopic adjustable gastric band procedure, by a standardised method, within 1 month of randomisation. The band was placed along the perigastric pathway in all cases. The treating surgeon reviewed participant progress every 4 to 6 weeks during the study period and made adjustments to the volume of saline within the band in the office by using standard clinical criteria.
Comparator	**Non-surgical intervention for obesity** This intervention was a programme centred on the used of behavioural modification, very-low-calorie diet, and pharmacotherapy with education and professional support on appropriate eating and exercise behaviour. During the 2-year period, 3 trained physicians developed a programme using all the available modalities for each participant on the basis of guidelines prepared and continually reviewed by a panel of experienced bariatric physicians. The programme began with an intensive 6-month period of very-low-calorie diet (500 to 550 kcal/d) using 1 to 3 packets of Optifast (Novartis, Freemont, Michigan) daily for 12 weeks, followed by a transition phase over 4 weeks combining some very-low-calorie meals with 120 mg of orlistat before non-very-low calorie meals, and then 120 mg of orlistat before all meals until the completion of the intensive phase. This intensive 6-month programme was followed by further courses of very-low-calorie diets or orlistat as tolerated, as well as continual behavioural, dietary, and exercise advice to assist the participant in maintaining weight loss over a prolonged period. Sibutramine was not approved for use in Australia during the first 12 months of the study and, therefore, was not incorporated into the medical programme. The management programme for each participant was designed to reflect good clinical practice. A physician saw each participant every 2 weeks during the very-low-calorie diet programme and every 4 to 6 weeks during the rest of the study. All participants were seen at least every 6 weeks.
Outcome measures	Weight (kg)

	BMI (kg/m2) Adverse events
Number of participants	Laparoscopic adjustable gastric band (N=40) Non-surgical intervention for obesity (N=40)
Duration of follow-up	6 months, 1 year, 18 months, 10 years
Loss to follow-up	
Additional comments	All participants were instructed and encouraged to follow appropriate lifestyle behaviour of good eating practices and increased exercise and activity. They were also encouraged to exercise for at least 200 minutes per week.

Study arms

Laparoscopic adjustable gastric band (N = 40)

Loss to follow-up	Participant withdrew preoperatively (n=1)

Non-surgical intervention for obesity (N = 40)

Behavioural modification, very-low-calorie diet, and pharmacotherapy with education and professional support on appropriate eating and exercise behaviour.

Loss to follow-up	Participants withdrew at 4, 6, 8, 10, and 52 weeks (n=5) Participants moved overseas at 26 and 29 weeks (n=2)

Characteristics

Arm-level characteristics

Characteristic	Laparoscopic adjustable gastric band (N = 40)	Non-surgical intervention for obesity (N = 40)
% Female Custom value	75%	77.5%
Mean age (SD) (years) Mean (SD)	41.8 (6.4)	40.7 (7)
Weight (kg) Mean (SD)	96.1 (11.2)	93.6 (11.9)
BMI (kg/m²) Mean (SD)	33.7 (1.8)	33.5 (1.4)

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Moderate *(There was no information on whether there were deviations from the intended interventions. No information provided on whether there were any missing data.)*
Overall bias and Directness	Overall Directness	Directly applicable

Schiavon, 2020

Bibliographic Reference	Schiavon, Carlos A; Bhatt, Deepak L; Ikeoka, Dimas; Santucci, Eliana V; Santos, Renato Nakagawa; Damiani, Lucas P; Oliveira, Juliana D; Machado, Rachel Helena V; Halpern, Helio; Monteiro, Frederico L J; Noujaim, Patricia M; Cohen, Ricardo V; de Souza, Marcio G; Amodeo, Celso; Bortolotto, Luiz A; Berwanger, Otavio; Cavalcanti, Alexandre B; Drager, Luciano F; Three-Year Outcomes of Bariatric Surgery in Patients With Obesity and Hypertension : A Randomized Clinical Trial.; Annals of internal medicine; 2020; vol. 173 (no. 9); 685-693

Study details

Other publications associated with this study included in review	Furlan, Sofia F, Drager, Luciano F, Santos, Renato Nakagawa et al. (2021) Three-year effects of bariatric surgery on obstructive sleep apnea in patients with obesity grade 1 and 2: a sub-analysis of the GATEWAY trial. International journal of obesity (2005) 45(4): 914-917 Schiavon, Carlos Aurelio, Bersch-Ferreira, Angela Cristine, Santucci, Eliana Vieira et al. (2018) Effects of Bariatric Surgery in Obese Patients With Hypertension: The GATEWAY Randomized Trial (Gastric Bypass to Treat Obese Patients With Steady Hypertension). Circulation 137(11): 1132-1142 Schiavon, Carlos A, Ikeoka, Dimas, Santucci, Eliana V et al. (2019) Effects of Bariatric Surgery Versus Medical Therapy on the 24-Hour Ambulatory Blood Pressure and the Prevalence of Resistant Hypertension. Hypertension (Dallas, Tex. : 1979) 73(3): 571-577
Trial registration number and/or trial name	The GATEWAY Randomized Trial (Gastric Bypass to Treat Obese Patients With Steady Hypertension). NCT01784848.
Study type	Randomised controlled trial (RCT)
Study location	Brazil
Study setting	Hospital
Study dates	2013 - 2016
Sources of funding	Research reported in this publication was supported by Ethicon Inc and represented in Brazil by Johnson & Johnson do Brasil Indústria e Comércio de Produtos para Saúde Ltda (grant no. 100238).

Inclusion criteria	Age 18 to 65 years BMI between 30.0 and 39.9 kg/m2 Established hypertension with at least 2 antihypertensive medications at maximum doses or more than 2 antihypertensive medications at moderate doses
Exclusion criteria	Active alcohol and/or drug abuse Pregnancy (or women of childbearing age not using effective contraceptive methods) Mean systolic blood pressure greater than or equal to 180 mmHg or diastolic blood pressure greater than or equal to 120 mmHg Cardiovascular disease (myocardial infarction or stroke within 6 months, angina, coronary revascularisation, heart failure) Severe psychiatric disorders (because of increased risk of low compliance with the study procedures) Secondary hypertension (except because sleep apnoea) Type 1 diabetes Latent autoimmune diabetes for adults

	Type 2 diabetes with glycated haemoglobin level greater than 7.0% Current smoking Cancer (in the past 5 years) Chronic kidney disease (diabetic nephropathy or glomerular filtration rate <30 mL/min) Peripheral arterial disease Atrophic gastritis Previous abdominal surgery Severe hepatic diseases Use of immunosuppressive drugs Chemotherapy Radiotherapy Inability to understand or adhere to study procedures
Intervention(s)	**Bariatric surgery and medical treatment for hypertension** Roux-en-Y gastric bypass performed by a single surgeon.

	Medical treatment for hypertension was the same as for the 'standard care' arm and the necessity of reintroducing antihypertensive medications for participants undergoing bariatric surgery was initially checked on a daily basis in the immediate postoperative period, in the first visit 1 week after the procedure, and in the remaining follow-up visits.
Comparator	**Standard care** Medical treatment for hypertension was standardised for all participants based on office blood pressure. Participants were preferably treated with angiotensin converting enzyme inhibitors or angiotensin receptor blockers and a calcium-channel blocker, except if these were contraindicated or if participants already had controlled blood pressure with their current regimen. If the previously mentioned association was already in use and the systolic and diastolic blood pressure remained >130 mm Hg or 80 mm Hg, respectively, a combination with a thiazide diuretic was preferred. If a thiazide diuretic was contraindicated or if other medications were deemed necessary, then spironolactone or clonidine was used. Medications were reduced or discontinued if participants presented systolic blood pressure <110 mm Hg or diastolic blood pressure <70 mm Hg. For participants with systolic blood pressure between 110 and 130 mm Hg or diastolic blood pressure between 70 and 80 mm Hg associated with symptoms of orthostatic hypotension, dose reduction of antihypertensive medications was attempted.
Outcome measures	Weight (kg) BMI (kg/m2) Adverse events Obstructive sleep apnoea Reduction of 30% or more of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg (for example, participants using 2 or 3 medications needed to reduce ≥1 medication to achieve the target reduction; participants using 4 or 5 medications need to reduce ≥2) Resistant hypertension Blood pressure that remains above goal despite the concurrent use of 3 antihypertensive agents of different classes

Number of participants	Bariatric surgery and medical treatment for hypertension N=50 Standard care N=50
Duration of follow-up	12 months, 3 years
Loss to follow-up	
Additional comments	Participants from both groups received nutritional advice based on national statements for hypertension and obesity. A visit to a dietitian from the investigation team followed each medical visit at the hospital to reinforce the nutritional recommendations previously indicated. Nutritional advice in the standard care group was mainly directed at weight reduction and blood pressure control. Aimed at progressive weight loss over time, a total daily energy consumption calculated as 20 kcal/kg of ideal body weight per day was recommended among participants. Similarly, for the improvement of blood pressure control, the ingestion of high-sodium food, such as snacks, sausages, and fast food, was discouraged, and the reduction of salt used for cooking at home or added to already prepared food was encouraged. Fruit and vegetable consumption was also recommended to increase potassium intake. For participants submitted to bariatric surgery, the nutritional advice included information about food consistency in the postoperative period. During nutritional visits, a detailed evaluation regarding diet tolerance was performed. In addition, all participants received psychological and physical activity counselling and were treated for other comorbidities according to current guidelines.

Study arms

Bariatric surgery and medical treatment for hypertension (N = 50)
Roux-en-Y gastric bypass

Loss to follow-up	Lost to follow-up (n=6) Died (n=1)

Standard care (N = 50)
Medical treatment for hypertension

Loss to follow-up	Lost to follow-up (n=9) Withdrew consent (n=1)

Characteristics

Arm-level characteristics

Characteristic	Bariatric surgery and medical treatment for hypertension (N = 50)	Standard care (N = 50)
% Female Sample size	n = 41 ; % = 82	n = 35 ; % = 70
Mean age (SD) (years) Mean (SD)	43.1 (9.2)	44.6 (9.2)
Race Sample size	n = NA	n = NA
White Sample size	n = 31 ; % = 62	n = 34 ; % = 68
Black or brown Sample size	n = 19 ; % = 38	n = 16 ; % = 32
Weight (kg) Mean (SD)	102 (13.6)	100.1 (14)

Characteristic	Bariatric surgery and medical treatment for hypertension (N = 50)	Standard care (N = 50)
BMI (kg/m²) Mean (SD)	37.4 (2.4)	36.4 (2.9)
Duration of hypertension (years) Median (IQR)	7 (3 to 15)	7 (4 to 14)
Number of antihypertensive medications in use Median (IQR)	3 (2 to 3)	3 (3 to 3)
Comorbidities Sample size	n = NA	n = NA
Dyslipidaemia Sample size	n = 20 ; % = 40	n = 16 ; % = 32
Diabetes mellitus Sample size	n = 4 ; % = 8	n = 4 ; % = 8

Critical appraisal - GDT Crit App - Cochrane Risk of Bias tool (RoB 2.0) Normal RCT

Section	Question	Answer
Overall bias and Directness	Risk of bias judgement	Moderate *(There was no information on whether there were deviations from the intended interventions.)*
Overall bias and Directness	Overall Directness	Directly applicable

Primary studies – Observational studies

Agosta, 2016

Bibliographic Reference	Agosta, Claire; Borel, Jean-Christian; Reche, Fabian; Arvieux, Catherine; Wion, Nelly; Jaber, Samir; Jaffuel, Dany; Pepin, Jean-Louis; Borel, Anne-Laure; Treatment Discontinuation Following Bariatric Surgery in Obstructive Sleep Apnea: a Controlled Cohort Study.; Obesity surgery; 2016; vol. 26 (no. 9); 2082-2088

Study details

Study type	Retrospective cohort study
Study location	France
Study setting	tertiary hospital.
Study dates	2016
Sources of funding	The present study was supported by BFond Agir pour les maladies chroniques
Inclusion criteria	Severe OSA (apnea-hypopnea index >30 events/h) diagnosed by either polygraphy or polysomnography, daytime sleepiness, and at least three clinical symptoms of OSA. Obesity
Intervention(s)	Bariatric surgery - gastric banding, bypass, sleeve gastrectomy
Comparator	No Surgery
Outcome measures	The percentage of patients who pursued nocturnal positive airway pressure therapy after the start point
Number of participants	n=87
Duration of follow-up	2 years

Methods of analysis	Comparative analysis of surgery vs matched OSA control population - same sex, modality of positive airway pressure therapy (CPAP or bilevel positive airway pressure), and treatment duration before surgery (i.e., matched controls had similar duration of treatment to that of operated patients before surgery), then age (±5 years), body mass index (BMI, ±1 kg/m2), and year of starting positive airway pressure treatment (±2.5 years). Results are expressed as means (standard deviation) for normally distributed variables and as median (interquartile range) for variables that did not show normal distribution. Categorical variables are presented as n (%). The normal distribution of residuals was verified by the Shapiro-Wilk test.
Additional comments	

Study arms

OSA and bariatric surgery (N = 28)

OSA without surgery (N = 59)

Characteristics

Study-level characteristics

Characteristic	**Study (N = 87)**
% Female Custom value	75%
Mean age (SD) Custom value	Surgery: 45(9), Control: 47 (9)

Characteristic	Study (N = 87)
Smoking status Custom value	No reported
BMI Custom value	surgery: 44.2 (4.7), control: 43.4 (4.6)
Comorbidities Custom value	OSA

Critical appraisal - GDT Crit App - ROBINS-I: a tool for non-randomised studies of interventions

Section	Question	Answer
Overall bias	Risk of bias judgement	High *(Confounding expected, all known important confounding domains appropriately measured and controlled for (sex, medical history of CVD, percent of body weight loss at 6 months, AHI) but other comorbidities not controlled for and unmeasured confounding possible. Some aspects of the assignments of intervention status were determined retrospectively. There was no pre-registered protocol or statistical analysis plan.)*
Overall bias	Directness	Directly applicable

Aminian, 2021

Bibliographic Reference	Aminian, Ali; Al-Kurd, Abbas; Wilson, Rickesha; Bena, James; Fayazzadeh, Hana; Singh, Tavankit; Albaugh, Vance L; Shariff, Faiz U; Rodriguez, Noe A; Jin, Jian; Brethauer, Stacy A; Dasarathy, Srinivasan; Alkhouri, Naim; Schauer, Philip R; McCullough, Arthur J; Nissen, Steven E; Association of Bariatric Surgery With Major Adverse Liver and Cardiovascular Outcomes in Patients With Biopsy-Proven Nonalcoholic Steatohepatitis.; JAMA; 2021; vol. 326 (no. 20); 2031-2042

Study details

Secondary publication of another included study- see primary study for details	
Study type	Retrospective cohort study
Study location	USA
Study setting	Cleveland Clinic health system
Study dates	2004 to 2016
Sources of funding	Unclear
Inclusion criteria	BMI >30kg/m2 fibrotic NASH without cirrhosis required having at least 1 point for each of steatosis, hepatocellular ballooning, and lobular inflammation Age 18-80 had presence of fibrosis on the baseline liver biopsy (stages F1-F3)
Exclusion criteria	had evidence of histological (F4) or clinical diagnosis of cirrhosis had a cause of chronic liver disease other than NASH, including drug-induced, viral, autoimmune, and genetic diseases had a history of excessive alcohol use or any medical conditions related to alcohol use disorder Exclusion:

	had hepatocellular carcinoma, (5) had received an organ transplantation, (6) had HIV infection, (7) were undergoing dialysis treatment prior to the liver biopsy, (8) had a history of severe heart failure (ejection fraction <20%) at any time before the liver biopsy, (9) had a diagnosis of any type of cancerwithin 1 year prior to the liver biopsy, or (10) had received total parenteral nutrition within the 6 months prior to the liver biopsy.
Intervention(s)	Roux-en-Y gastric bypass surgery Underwent sleeve gastrectomy
Comparator	No Surgery
Outcome measures	MACE Major adverse liver outcome
Number of participants	n=924
Duration of follow-up	Median - 7 years
Loss to follow-up	Not reported
Methods of analysis	Weights are assigned to each patient that are proportional to the probability of that patient belonging to the opposite treatment group, resulting in inclusion of all available patients and exact balance for theme an of all covariates included in the model. Six a priori–identified potential confounders (age at index date, sex, smoking status, presence of type 2 diabetes, histological NAFLD activity score, and histological liver fibrosis stage) were used for overlap weighting. The Firth penalized method in the fully adjusted Cox proportional hazard framework19 was used by adjusting the models for the indexdate and for the following variables

	at baseline: BMI; race; annual zip code income; Cleveland Clinic location (Ohio vs Florida); Charlson Comorbidity Index score; presence of hypertension, dyslipidemia, heart failure, coronary artery disease, or cerebrovascular disease; levels of serum bilirubin, albumin, international normalized ratio, and creatinine; and use of insulin and noninsulin diabetes medication.

Study arms

Bariatric Surgery (N = 462)

Non surgical (N = 462)

Characteristics

Study-level characteristics

Characteristic	Study (N = 924)
% Female Custom value	Surgery: 67.1% female, Control: 59.8%
Mean age (SD) Custom value	Bariatric - median: 49.0 (41.0 to 57.0), Control - median: 50.2 (40.5 to 58.1)
Smoking status Custom value	Current smoker 8.4% both groups
BMI Custom value	Median /IQR - Bariatric: 45.7 (41.2 to 52.8), Control: 36.0 (32.9 to 39.9)

Characteristic	Study (N = 924)
Comorbidities Custom value	Hypertension - Bariatric 83%, Control 46.9%, Type 2 Diabetes - Bariatric 40.6% Control 40.6%
Comorbidities Custom value	Heart failure - Bariatric 6.1%, Control 1.7%

Critical appraisal - GDT Crit App - ROBINS-I: a tool for non-randomised studies of interventions

Section	Question	Answer
Overall bias	Risk of bias judgement	High *(Confounding expected, all known important confounding domains appropriately measured and controlled for (age at index date, sex, smoking status, presence of type 2 diabetes, histological NAFLD activity score, and histological liver fibrosis stage). Assignments of intervention status were determined retrospectively. Nonsurgical intervention was not defined. There was no pre-registered protocol or statistical analysis plan.)*
Overall bias	Directness	Directly applicable

Booth, 2014

Bibliographic Reference	Booth, Helen; Khan, Omar; Prevost, Toby; Reddy, Marcus; Dregan, Alex; Charlton, Judith; Ashworth, Mark; Rudisill, Caroline; Littlejohns, Peter; Gulliford, Martin C; Incidence of type 2 diabetes after bariatric surgery: population-based matched cohort study.; The lancet. Diabetes & endocrinology; 2014; vol. 2 (no. 12); 963-8

Study details

Secondary publication of another included	

study- see primary study for details	
Study type	Retrospective cohort study
Study location	UK
Study setting	UK primary care clinical practice database
Study dates	Jan 1, 2002, and April 30, 2014
Sources of funding	UK National Institute for Health Research.
Inclusion criteria	Without diabetes
Exclusion criteria	Exclusion: participants who had bariatric surgery less than 1 year after the start of the electronic health record, because this record might have indicated a procedure undertaken before their registration at the family practice. We also excluded patients younger than 20 years at the index date, those with either no BMI record before surgery or a last recorded BMI value less than 30 kg/m², individuals with a record for gastric band removal before the index date, and patients with diabetes diagnosed on or before the index date.

Intervention(s)	laparoscopic gastric banding, gastric bypass, or sleeve gastrectomy
Comparator	No Surgery
Outcome measures	Type 2 Diabetes
Number of participants	n=4334
Duration of follow-up	Median 2.8 years, Maximum 7 years
Loss to follow-up	
Methods of analysis	time-to-event framework, using a Cox proportional hazards model to assess diabetes

Study arms

Bariatric Surgery (N = 2167)

Non Surgical (N = 2167)

Characteristics

Arm-level characteristics

Characteristic	Bariatric Surgery (N = 2167)	Non Surgical (N = 2167)
% Female Custom value	84%	87%
Mean age (SD) Mean (SD)	44.4 (10.1)	44.6 (14.1)

Characteristic	Bariatric Surgery (N = 2167)	Non Surgical (N = 2167)
Smoking status Custom value	17% current smoker	18% current smoker
BMI Mean (SD)	43 (8.1)	43.2 (8.6)
Comorbidities Custom value	CHD 3%	CHD 3%
Comorbidities Custom value	treatment for hypertension 42%	treatment for hypertension 24%
Comorbidities Custom value	Stroke 1%	Stroke 1%

Critical appraisal - GDT Crit App - ROBINS-I: a tool for non-randomised studies of interventions

Section	Question	Answer
Overall bias	Risk of bias judgement	Moderate *(Observational study. Important confounders appear adequately controlled, but possible confounding by unmeasured variables remains.)*
Overall bias	Directness	Directly applicable

Douglas, 2015

Bibliographic Reference	Douglas, Ian J; Bhaskaran, Krishnan; Batterham, Rachel L; Smeeth, Liam; Bariatric Surgery in the United Kingdom: A Cohort Study of Weight Loss and Clinical Outcomes in Routine Clinical Care.; PLoS medicine; 2015; vol. 12 (no. 12); e1001925

Study details

Secondary publication of another included study- see primary study for details	
Study location	UK
Study setting	CPRD database
Study dates	CPRD database entries for bariatric surgery up until 31 Dec 2014
Sources of funding	IJD is funded by a Medical Research Council Fellowship (G0802403/1). LS is funded by a Wellcome Trust Fellowship. RLB is funded by the Rosetrees Trust. KB holds a Sir Henry Dale
Inclusion criteria	Inclusion: Patients were included if they had a code indicating bariatric surgery
Exclusion criteria	Exclusion: Patients were excluded if they previously had a record indicating reversal of bariatric surgery (e.g., gastric band removal).

Intervention(s)	Gastric band 1,829 (47.1%) Gastric bypass 1,421 (36.6%) Sleeve gastrectomy 613 (15.8%) Duodenal switch (0.1%) Gastric stapling 6 (0.2%) Stomach partition (not elsewhere classified) 5 (0.1%) Mason vertical banded gastroplasty (0.1%)
Comparator	No Surgery
Outcome measures	Weight (kg) BMI (kg/m2) All cause mortality Cardiovascular event Cancer Obstructive sleep apnoea Type 2 Diabetes
Number of participants	n=7764

Duration of follow-up	Mean - 3.4 years
Loss to follow-up	
Methods of analysis	Cox regression was used to determine the hazard ratio (HR) for each event. For all analyses, the highest and lowest 5% propensity score bands were excluded (trimming) since patients treated contrary to extreme scores can introduce bias if important information about their health status is missing [16]. A sensitivity analysis was done without trimming. For each analysis, all individuals with a history of the specific outcome were excluded. We ensured that the proportional hazards assumption was met for all analyses.

Study arms

Bariatric (N = 3882)

No surgery (N = 3882)

Characteristics

Arm-level characteristics

Characteristic	Bariatric (N = 3882)	No surgery (N = 3882)
% Female	80.5%	81.6%

Characteristic	Bariatric (N = 3882)	No surgery (N = 3882)
Custom value		
Mean age (SD) Mean (SD)	45 (11)	45 (11)
Smoking status Custom value	Current smoker 14.5%	Current smoker 13.7%
BMI (kg/m2) Mean (SD)	44.7 (8.8)	42.1 (6.5)
Comorbidities Custom value	T2DM 34%	T2DM 33.4%
Comorbidities Custom value	Hypertension 33.8%	Hypertension 34.1%
Comorbidities Custom value	CVD 1.4%	CVD 1%

Critical appraisal - GDT Crit App - ROBINS-I: a tool for non-randomised studies of interventions

Section	Question	Answer
Overall bias	Risk of bias judgement	Moderate *(Confounding expected, all known important confounding domains appropriately measured and controlled for (matching by age, gender, general practice, and calendar period; comorbidities were covariates). Selection into the study may have been related to intervention and outcome; and the authors used appropriate methods to adjust for the selection*

Section	Question	Answer
		bias (propensity scores were used). Assignments of intervention status were determined retrospectively. No information is reported on whether there is deviation from the intended intervention. There was no pre-registered protocol or statistical analysis plan.)
Overall bias	Directness	Directly applicable

Doumouras, 2020

Bibliographic Reference	Doumouras, Aristithes G; Hong, Dennis; Lee, Yung; Tarride, Jean-Eric; Paterson, J Michael; Anvari, Mehran; Association Between Bariatric Surgery and All-Cause Mortality: A Population-Based Matched Cohort Study in a Universal Health Care System.; Annals of internal medicine; 2020; vol. 173 (no. 9); 694-703

Study details

Secondary publication of another included study- see primary study for details	
Other publications associated with this study included in review	
Trial registration number and/or trial name	
Study type	Retrospective cohort study

Study location	Canada
Study setting	Surgical centres within the Ontario Bariatric Network
Study dates	January 2010 - December 2016
Sources of funding	ICES - funded by Ontario Ministry of Health and Long-Term Care
Inclusion criteria	BMI 35 kg/m2 or higher Inclusion: All patients who underwent primary bariatric surgery in the Ontario Bariatric Network
Exclusion criteria	Exclusion: Control group: Non Ontario residents, Age >70 years, BMI <35kg/m2, history of cancer within 2 years, active substance use disorder, accessed palliative care, pregnancy, previous organ transplantation, active cardiac disease or revascularisation procedure within 6 months, severe liver disease with ascites within 1 year.
Intervention(s)	Gastric Bypass Sleeve Gastrectomy
Comparator	No Surgery
Outcome measures	All cause mortality
Number of participants	n = 27 358
Duration of follow-up	4.89 years median
Loss to follow-up	not stated
Methods of analysis	Nearest greedy neighbour matching 1:1 on age, sex, BMI, diabetes status and duration. Multivariable regression analysis with potential demographic, socioeconomic and clinical confounders

Study arms

Bariatric Surgery (N = 13679)

No surgery (N = 13679)

Characteristics

Arm-level characteristics

Characteristic	Bariatric Surgery (N = 13679)	No surgery (N = 13679)
% Female Custom value	81.9%	81.9%
Mean age (SD) Mean (SD)	45.23 (10.89)	45.49 (11.63)
Smoking status Custom value	8.2%	9.1%
BMI (kg/m2) Mean (SD)	47.21 (8.01)	46.7 (8.44)
Comorbidities Custom value	Diabetes 26.7%	Diabetes 26.7%
Comorbidities Custom value	Cardiac disease 3.2%	2.8%

Characteristic	Bariatric Surgery (N = 13679)	No surgery (N = 13679)
Comorbidities Custom value	Hypertension 15%	Hypertension 7.7%
Comorbidities Custom value	Sleep apnoea 3.9%	Sleep apnoea 1.9%

Critical appraisal - GDT Crit App - ROBINS-I: a tool for non-randomised studies of interventions

Section	Question	Answer
Overall bias	Risk of bias judgement	Moderate *(Bias expected due to unknown confounders and not enough information on co-interventions across groups)*
Overall bias	Directness	Directly applicable

Jamaly, 2019, Carlsson 2020

Bibliographic Reference	Jamaly, Shabbar; Carlsson, Lena; Peltonen, Markku; Jacobson, Peter; Karason, Kristjan; Surgical obesity treatment and the risk of heart failure.; European heart journal; 2019; vol. 40 (no. 26); 2131-2138

Study details

Other publications associated with this study included in review	Carlsson, Lena M S, Sjoholm, Kajsa, Jacobson, Peter et al. (2020) Life Expectancy after Bariatric Surgery in the Swedish Obese Subjects Study. The New England journal of medicine 383(16): 1535-1543

Trial registration number and/or trial name	NCT01479452
Study type	Prospective cohort study
Study location	Sweden
Study setting	Surgical departments and primary healthcare centres
Study dates	1987 to 2016
Sources of funding	National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health and the Swedish Heart-Lung Foundation.
Inclusion criteria	Aged between 37 and 60 years BMI of 34 kg/m2 or more for men and 38 kg/m2 or more for women
Exclusion criteria	Exclusion: History of earlier surgery for gastric or duodenal ulcer Earlier bariatric surgery Gastric ulcer during the past 6months Ongoing malignancy Active malignancy during the past 5 years Myocardial infarction during the past 6months Bulimic eating pattern

	Drug or alcohol abuse Psychiatric or cooperative problems contraindicating bariatric surgery Other contraindicating conditions (such as chronic glucocorticoid or anti-inflammatory treatment)
Intervention(s)	Bariatric surgery - vertical banded gastroplasty (68%), gastric banding (19%), and gastric bypass (13%). After bariatric surgery, the recommended daily nutritional supplementation included oral doses of multivitamin and mineral supplements, vitamin B12, and a combination of calcium and vitamin D3. If laboratory findings indicated deficiencies of iron or folate, a replacement therapy was introduced.
Comparator	Standard nonsurgical obesity treatment from primary health care centres. No attempt was made to standardize the conventional treatment, which ranged from sophisticated lifestyle intervention and behaviour modification to, in some practices, no treatment at all.
Outcome measures	BMI (kg/m2) Adverse events Heart failure
Number of participants	Jamaly 2019 analysis: n=4033 - *14 participants from 4047 participants in the SOS study were excluded due to history of heart failure at baseline.* Carlsson 2020 analysis: n=4047 (surgery n=2007, control n=2040)
Duration of follow-up	The two study groups underwent identical examinations at the participating surgical departments and primary health care centres both at baseline and during follow-up at 0.5, 1, 2, 3, 4, 6, 8, 10, 15, and 20 years. Participants were followed until the first-time principal diagnosis of heart failure, death or 31 December 2016. There was a median follow-up of 22 (IQR 18-24) years for the outcome of incidence of heart failure.
Loss to follow-up	Persons who had a follow-up time of <1 year (n=39) or for whom a weight measurement at the 1-year follow-up was not available (n= 371) were excluded from these analyses.

Methods of analysis	A matched control group of 2037 participants was created using an automatic matching program and 18 matching variables (sex, age, weight, height, waist-hip ratio, blood pressure, serum cholesterol and triglycerides, smoking, diabetes, menopause, four psychosocial variables associated with risk for death, and personality traits related to treatment preferences). The matching was not performed on an individual basis (i.e. subject by subject); instead the matching algorithm selected controls in such a way that the current mean values of the matching variables in the control group moved as much as possible in the direction of the current mean values in the surgery group. Data are presented as mean values with standard deviations or as percentages. Baseline comparisons between treatment groups used t-tests for continuous variables and a logistic-regression model for dichotomous variables. The differences in changes in BMI and in self-reported medication use between the surgery and control groups were analysed with multilevel mixed-effects regression models. The observations were considered nested within the individuals, and the statistical tests and confidence intervals were thus calculated controlling for the repeated measurements. Test for treatment by time interactions were conducted to evaluate between-group differences in changes. Cumulative incidence of heart failure was estimated with competing risks regression models, in which deaths without heart failure were treated as competing events. Persons without heart failure who emigrated, altered their obesity intervention, withdrew their consent or were alive at the end of follow-up were treated as censored observations. Univariable and multivariable models were applied to obtain relative risk estimates expressed as sub-hazard ratios. The treatment effect in the surgery group compared with the control group was evaluated in a primary unadjusted analysis with a single covariate for treatment group (surgery or control) and in a secondary analysis that was adjusted for preselected baseline risk factors considered traditional for heart failure. After pooling data from the two study groups, patients were divided into quartiles of weight change occurring during the first year of follow-up. The quartiles ranged from weight gain (Quartile 1) to the greatest weight loss (Quartile 4). The association of weight change and heart failure risk was studied: in a primary model with Quartile 1 as reference; in a secondary model adjusted for surgical intervention; and in a tertiary model adjusted for surgical intervention and selected baseline characteristics.

	The consistency of the treatment effect with respect to the main outcome was assessed in several subgroups defined by baseline characteristics. Homogeneity was evaluated with test of interaction between the indicator for treatment and baseline variables using competing-risks regression models. Continuous variables were dichotomized by a median split to illustrate the effects, but the interaction test was based on the original continuous variable. No adjustment for multiple testing was performed. All statistical tests were two-tailed and P-values of <0.05 were considered statistically significant.

Study arms

Bariatric surgery (N = 2003)

Usual care (N = 2030)

Characteristics

Arm-level characteristics

Characteristic	Bariatric surgery (N = 2003)	Usual care (N = 2030)
% Female Sample size	% = 70.8	% = 71.2
Mean age (SD) Mean (SD)	47.2 (5.9)	48.7 (6.3)
Smoking status Sample size	% = 25.8	% = 20.9
BMI (kg/m2)	42.4 (4.5)	40.1 (4.7)

Characteristic	Bariatric surgery (N = 2003)	Usual care (N = 2030)
Mean (SD)		
Weight (kg) Mean (SD)	121 (17)	115 (17)
Hypertension Sample size	% = 78.4	% = 63.7
Diabetes Sample size	% = 17.2	% = 12.7

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Section	Question	Answer
Overall bias	Risk of bias judgement	High *(Due to likely variations in co-interventions across the study groups and observational design, which is susceptible to unmeasured confounding.)*
Overall bias	Directness	Directly applicable

Moussa, 2020

Bibliographic Reference	Moussa, Osama; Ardissino, Maddalena; Heaton, Tobias; Tang, Alice; Khan, Omar; Ziprin, Paul; Darzi, Ara; Collins, Peter; Purkayastha, Sanjay; Effect of bariatric surgery on long-term cardiovascular outcomes: a nationwide nested cohort study.; European heart journal; 2020; vol. 41 (no. 28); 2660-2667

Study details

Trial registration number and/or trial name	Not reported
Study type	Retrospective cohort study
Study location	UK
Study setting	General practice surgeries
Study dates	Data collected from 1987 onwards
Sources of funding	NIHR Imperial Biomedical Research Centre
Inclusion criteria	BMI >30kg/m2 Obesity
Exclusion criteria	Lost to follow-up within 12 months from index date for reasons other than fatal event Not eligible for bariatric surgery BMI less than 35 kg/m2 Major adverse cardiovascular event prior to index date Missing age, BMI, or gender data
Intervention(s)	Bariatric surgery
Comparator	No bariatric surgery
Outcome measures	Weight (kg) Composite of fatal or non-fatal myocardial infarction and fatal or non-fatal acute ischaemic stroke

	Heart failure Fatal or non-fatal myocardial infarction Fatal or non-fatal ischaemic stroke
Number of participants	n=7402
Duration of follow-up	Average length of follow-up was 140.7 months (SD = 79.9 months)
Loss to follow-up	Not reported
Methods of analysis	Baseline demographic, clinical, and treatment factors were compared across cohorts using Pearson's v2 test for categorical variables and Mann–Whitney U test for continuous data. Weight and BMI change across follow-up time, and rates of resolution of diabetes, were also compared across cohorts. This was done using Wilcoxon rank-sum test and v2 test. The Mann–Whitney U test was chosen as the data were not normally distributed on Kolmogorov–Smirnov test. Cox proportional hazards model was used to analyse time to event data adjusting for multiple covariates for both primary and secondary endpoints. Factors adjusted for in the Cox proportional hazards model include HTN, hyperlipidaemia, DM, smoking, alcohol use, cocaine use, exercise, and use of medications, such as BB, CCB, ACE-i or ARBs, statins, aspirin, and HRT. The interaction of gender, diabetes, and BMI category with bariatric surgery on the primary endpoint was tested using Cox proportional hazards model with interaction terms. The interaction effects of predefined variables were tested using a Cox proportional hazards model with interaction terms. The cumulative event rates by bariatric surgery type were also assessed by means of a Kaplan–Meier analysis, and the relative rates across groups compared using a log rank function. The number of interventions needed to prevent a single cardiovascular event over 11.2 years [and therefore the number needed to treat (NNT)] was calculated as the reciprocal of the absolute risk reduction between the surgery and control cohorts. All P-values reported are two sided; statistical significance was considered when P<0.05.
Additional comments	Data for the study were extracted from the Clinical Practice Research Datalink (CPRD) database, which involves 674 General Practice surgeries in the UK.

Study arms

Bariatric sugery (N = 3701)

No bariatric surgery (N = 3701)

Characteristics

Arm-level characteristics

Characteristic	Bariatric sugery (N = 3701)	No bariatric surgery (N = 3701)
% Female Calculated by analyst from percentage of males reported in the study Sample size	% = 79.8	% = 79.8
Mean age (SD) Median and IQR as mean and SD not reported Median (IQR)	36 (29 to 44)	36 (29 to 44)
Smoking status Smoking Sample size	n = 1369 ; % = 37	n = 1354 ; % = 36.6
BMI Median (IQR)	40.5 (37.1 to 45.5)	40.3 (36.6 to 43.9)
0 on Charlson comorbidity index Sample size	n = 1762 ; % = 47.6	n = 1695 ; % = 45.8

Characteristic	Bariatric sugery (N = 3701)	No bariatric surgery (N = 3701)
1 on Charlson comorbidity index Sample size	n = 1177 ; % = 31.8	n = 1197 ; % = 32.3
2 on Charlson comorbidity index Sample size	n = 464 ; % = 12.5	n = 436 ; % = 11.8
3 on Charlson comorbidity index Sample size	n = 177 ; % = 4.8	n = 211 ; % = 5.7
4 on Charlson comorbidity index Sample size	n = 74 ; % = 2	n = 80 ; % = 2.2
5+ on Charlson comorbidity index Sample size	n = 40 ; % = 1.1	n = 66 ; % = 1.7
Index weight (kg) Mean (SD)	125 (33)	109 (27)
Hypertension Sample size	n = 1928 ; % = 52.1	n = 1822 ; % = 49.2
Hyperlipidaemia Sample size	n = 50 ; % = 1.4	n = 39 ; % = 1.1
Diabetes Sample size	n = 922 ; % = 25	n = 881 ; % = 23.9

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Section	Question	Answer
Overall bias	Risk of bias judgement	High *(Due to not formally matching groups for obesity-related comorbidities and it being unclear how many people who had bariatric surgery were excluded due to limited follow-up.)*
Overall bias	Directness	Directly applicable

Appendix F – Forest plots

Obesity with no specific comorbidity

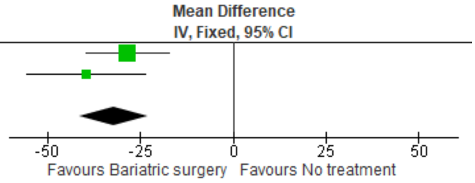
Bariatric surgery vs no treatment

RCT data

Figure 1: Weight (kg) (Better indicated by lower values)

	Bariatric surgery			No treatment				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Aguiar 2014	-28.48	17.06	16	0	23.13	36	66.6%	-28.48 [-39.75, -17.21]
Freitas 2018	-37.8	17.82	55	1.8	29.05	14	33.4%	-39.60 [-55.53, -23.67]
Total (95% CI)			**71**			**50**	**100.0%**	**-32.19 [-41.39, -22.99]**

Heterogeneity: Chi² = 1.25, df = 1 (P = 0.26); I² = 20%
Test for overall effect: Z = 6.86 (P < 0.00001)

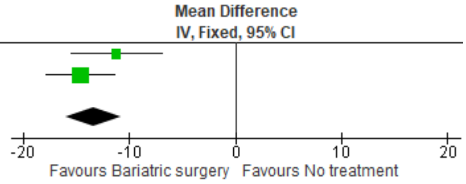


Aguiar 2014 (3 months follow-up); Freitas 2018 (6 months follow-up)

Figure 2: Body mass index (BMI) (kg/m^2) (Better indicated by lower values)

	Bariatric surgery			No treatment				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Aguiar 2014	-11.24	7.8	16	0	6.13	36	35.8%	-11.24 [-15.55, -6.93]
Freitas 2018	-14.1	5.94	55	0.5	5.37	14	64.2%	-14.60 [-17.82, -11.38]
Total (95% CI)			**71**			**50**	**100.0%**	**-13.40 [-15.98, -10.82]**

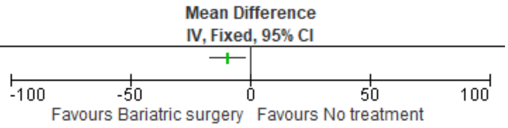
Heterogeneity: Chi² = 1.50, df = 1 (P = 0.22); I² = 33%
Test for overall effect: Z = 10.17 (P < 0.00001)



Aguiar 2014 (3 months follow-up); Freitas 2018 (6 months follow-up)

Figure 3: Apnoea-hypopnoea index (AHI) score (Better indicated by lower values)

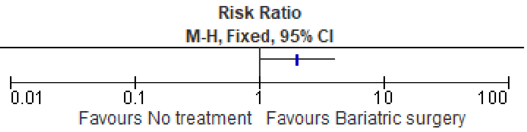
	Bariatric surgery			No treatment			Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	IV, Fixed, 95% CI
Aguiar 2014	-9.39	13.43	16	0	9.14	36	-9.39 [-16.62, -2.16]



3 months follow-up; AHI: apnoea-hypopnoea index

Figure 4: AHI < 5 (Better indicated by higher value)

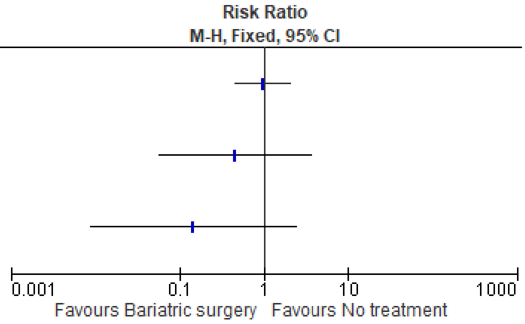
	Bariatric surgery		No treatment		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Aguiar 2014	9	16	10	36	2.02 [1.02, 4.00]



3 months follow-up; AHI: apnoea-hypopnoea index

Figure 5: AHI severity (better indicated by lower values)

	Bariatric surgery		No treatment		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
1.5.1 AHI 5<15					
Aguiar 2014	6	16	14	36	0.96 [0.45, 2.05]
1.5.2 AHI 15<30					
Aguiar 2014	1	16	5	36	0.45 [0.06, 3.55]
1.5.3 AHI ≥ 30					
Aguiar 2014	0	16	7	36	0.15 [0.01, 2.40]



3 months follow-up; AHI: apnoea-hypopnoea index

Bariatric surgery vs no surgery

Observational data

Figure 6: Type 2 diabetes incidence (2.8 years) (Better indicated by lower values): BMI subgroup

Study or Subgroup	log[Hazard Ratio]	SE	Bariatric Surgery Total	No Surgery Total	Weight	Hazard Ratio IV, Fixed, 95% CI
1.1.1 BMI 30-34.9 kg/m2						
Booth 2014	-0.94161	0.652534	339	332	100.0%	0.39 [0.11, 1.40]
Subtotal (95% CI)			**339**	**332**	**100.0%**	**0.39 [0.11, 1.40]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.44 (P = 0.15)						
1.1.2 BMI 35-39.9 kg/m2						
Booth 2014	-1.42711636	0.35890654	535	551	100.0%	0.24 [0.12, 0.48]
Subtotal (95% CI)			**535**	**551**	**100.0%**	**0.24 [0.12, 0.48]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 3.98 (P < 0.0001)						
1.1.3 BMI >= 40 kg/m2						
Booth 2014	-1.89711999	0.26062532	1293	1284	100.0%	0.15 [0.09, 0.25]
Subtotal (95% CI)			**1293**	**1284**	**100.0%**	**0.15 [0.09, 0.25]**
Heterogeneity: Not applicable						
Test for overall effect: Z = 7.28 (P < 0.00001)						

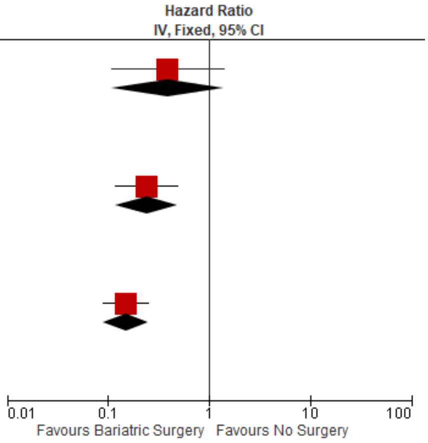
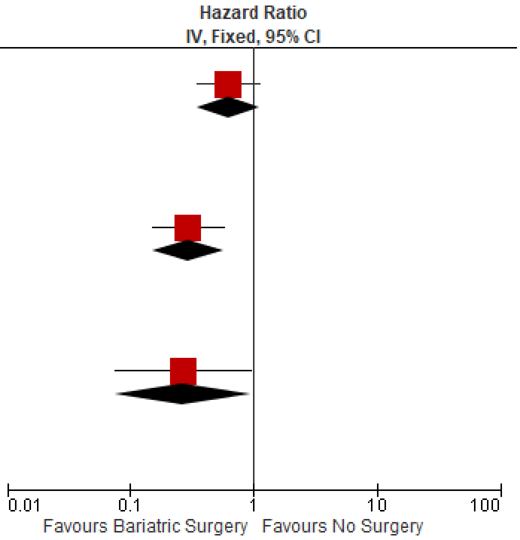


Figure 7: Major adverse cardiovascular events (MACE) 11 years (Better indicated by lower values): BMI subgroup

Study or Subgroup	log[Hazard Ratio]	SE	Weight	Hazard Ratio IV, Fixed, 95% CI
1.2.1 BMI 35-40 kg/m2				
Moussa 2020	-0.47481519	0.29919844	100.0%	0.62 [0.35, 1.12]
Subtotal (95% CI)			**100.0%**	**0.62 [0.35, 1.12]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 1.59 (P = 0.11)				
1.2.2 BMI 40-50 kg/m2				
Moussa 2020	-1.23100148	0.34011356	100.0%	0.29 [0.15, 0.57]
Subtotal (95% CI)			**100.0%**	**0.29 [0.15, 0.57]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 3.62 (P = 0.0003)				
1.2.3 BMI >50 kg/m2				
Moussa 2020	-1.32425897	0.65112166	100.0%	0.27 [0.07, 0.95]
Subtotal (95% CI)			**100.0%**	**0.27 [0.07, 0.95]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 2.03 (P = 0.04)				



Test for subgroup differences: Chi² = 3.36, df = 2 (P = 0.19), I² = 40.4%

Figure 8: Heart Failure (median follow up 22 years; Better indicated by lower values): BMI subgroup

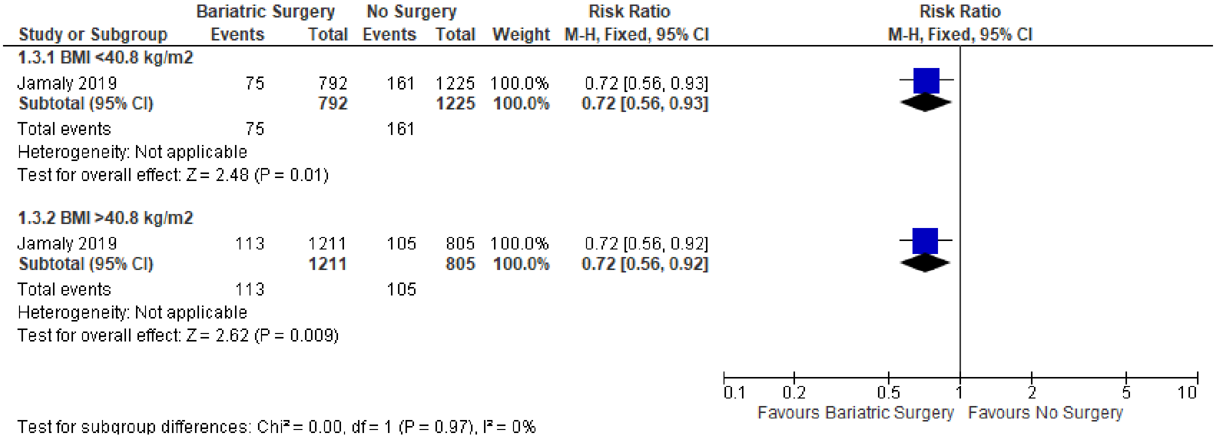
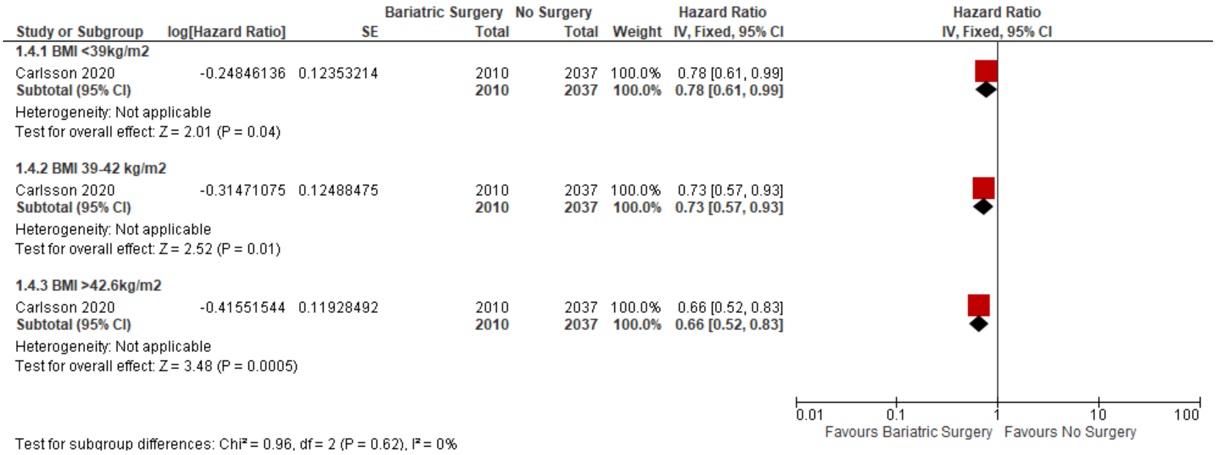
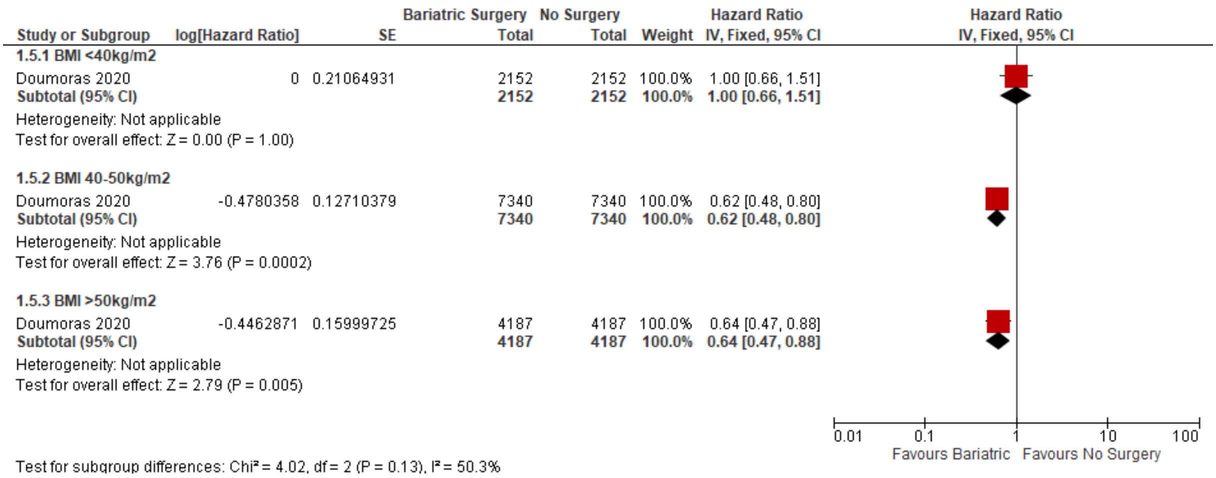


Figure 9: Overall mortality (median follow up 19 years; Better indicated by lower values): BMI subgroup



**Total population numbers for whole cohort, not each BMI subgroup

Figure 10: Overall mortality (median follow up 4.84 years) BMI subgroup



Bariatric surgery vs non-surgical intervention

RCT data

Figure 11: Weight (kg) (Better indicated by lower values)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Non-surgical intervention Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
2.1.1 At 12 months							
O'Brien 2006	-18.7	5.99	40	-9.5	6.13	40	-9.20 [-11.86, -6.54]
2.1.2 At 2 years							
O'Brien 2006	-20.5	5.85	40	-5.3	4.22	40	-15.20 [-17.44, -12.96]

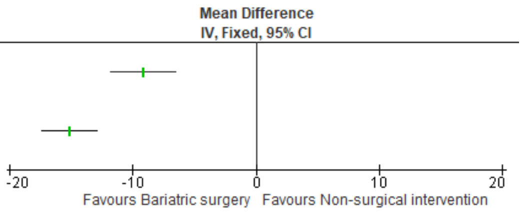
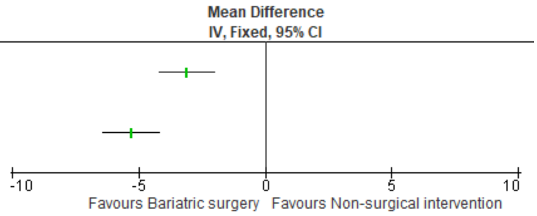


Figure 12: BMI (kg/m^2) (Better indicated by lower values)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Non-surgical intervention Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
2.2.1 At 12 months							
O'Brien 2006	-6.7	2.43	40	-3.6	2.58	40	-3.10 [-4.20, -2.00]
2.2.2 At 2 years							
O'Brien 2006	-7.3	2.43	40	-2	2.67	40	-5.30 [-6.42, -4.18]



Obesity with obstructive sleep apnoea

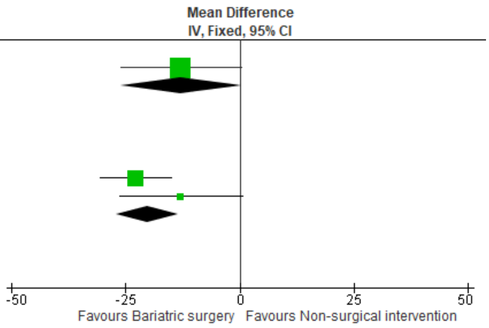
Bariatric surgery vs non-surgical intervention

RCT data

Figure 13: Weight (kg)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Non-surgical intervention Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
3.1.1 At 12 months								
Feigel-Guiller 2015	-19.5	23.74	26	-6.6	26.78	30	100.0%	-12.90 [-26.13, 0.33]
Subtotal (95% CI)			**26**			**30**	**100.0%**	**-12.90 [-26.13, 0.33]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.91 (P = 0.06)								
3.1.2 At longest follow-up								
Dixon 2012	-27.8	18.4785	30	-5.1	11.5156	30	75.0%	-22.70 [-30.49, -14.91]
Feigel-Guiller 2015	-19.4	22.76	21	-6.5	22.36	22	25.0%	-12.90 [-26.39, 0.59]
Subtotal (95% CI)			**51**			**52**	**100.0%**	**-20.25 [-27.00, -13.50]**
Heterogeneity: Chi² = 1.52, df = 1 (P = 0.22); I² = 34%								
Test for overall effect: Z = 5.88 (P < 0.00001)								

Test for subgroup differences: Chi² = 0.94, df = 1 (P = 0.33), I² = 0%



Longest follow-up (Dixon 2012 [2 years]; Feigel-Guiller 2015 [10 years])

Figure 14: BMI (kg/m^2)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Non-surgical intervention Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
3.2.1 At 12 months							
Feigel-Guiller 2015	-7.3	9.2	26	-2.7	9.66	30	-4.60 [-9.55, 0.35]
3.2.2 At 10 years							
Feigel-Guiller 2015	-7.8	8.71	21	-1	8.07	22	-6.80 [-11.82, -1.78]

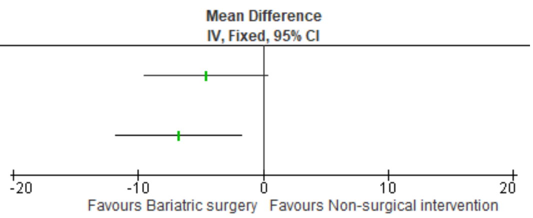
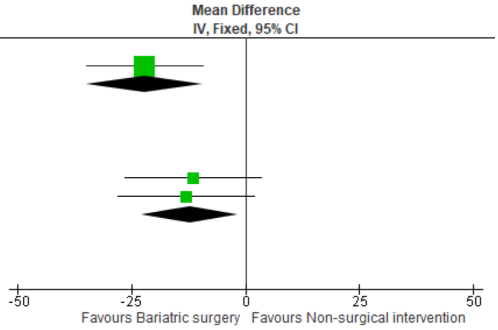


Figure 15: AHI score (better indicated by lower values)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Non-surgical intervention Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
3.3.1 At 12 months								
Feigel-Guiller 2015	-25	23.67	26	-2.9	25.15	30	100.0%	-22.10 [-34.90, -9.30]
Subtotal (95% CI)			**26**			**30**	**100.0%**	**-22.10 [-34.90, -9.30]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 3.38 (P = 0.0007)								
3.3.2 At longest follow-up								
Dixon 2012	-25.5	30.262	30	-14	28.6551	30	49.9%	-11.50 [-26.41, 3.41]
Feigel-Guiller 2015	-15.8	24.37	22	-2.8	27.16	24	50.1%	-13.00 [-27.89, 1.89]
Subtotal (95% CI)			**52**			**54**	**100.0%**	**-12.25 [-22.79, -1.71]**
Heterogeneity: Chi² = 0.02, df = 1 (P = 0.89); I² = 0%								
Test for overall effect: Z = 2.28 (P = 0.02)								

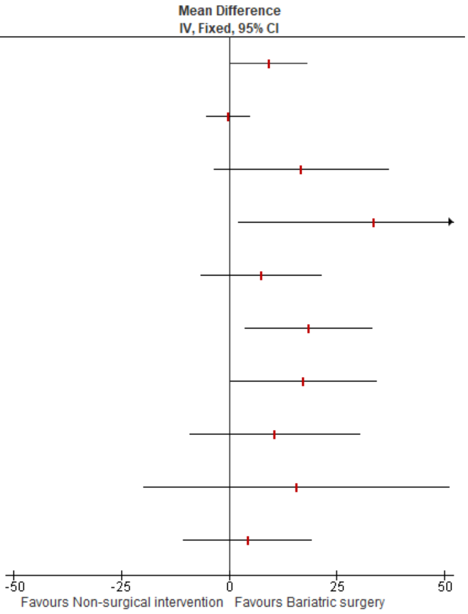


Test for subgroup differences: Chi² = 1.36, df = 1 (P = 0.24), I² = 26.2%

Longest follow-up (Dixon 2012 [2 years]; Feigel-Guiller 2015 [10 years]); AHI: apnoea-hypopnoea index

Figure 16: Health related quality of life (SF-36) at 2 years (better indicated by higher values; range of scale: 0 to 100)

Study or Subgroup	Mean Difference	SE	Bariatric surgery Total	Non-surgical intervention Total	Mean Difference IV, Fixed, 95% CI
3.4.1 Physical component summary					
Dixon 2012	9.3	4.4899	30	30	9.30 [0.50, 18.10]
3.4.2 Mental component summary					
Dixon 2012	-0.3	2.5511	30	30	-0.30 [-5.30, 4.70]
3.4.3 Physical function					
Dixon 2012	16.8	10.3063	30	30	16.80 [-3.40, 37.00]
3.4.4 Role-Physical					
Dixon 2012	33.5	15.9697	30	30	33.50 [2.20, 64.80]
3.4.5 Body pain					
Dixon 2012	7.4	7.092	30	30	7.40 [-6.50, 21.30]
3.4.6 General health					
Dixon 2012	18.4	7.5512	30	30	18.40 [3.60, 33.20]
3.4.7 Vitality					
Dixon 2012	17.3	8.6226	30	30	17.30 [0.40, 34.20]
3.4.8 Social function					
Dixon 2012	10.6	10.0512	30	30	10.60 [-9.10, 30.30]
3.4.9 Role emotional					
Dixon 2012	15.6	18.0105	30	30	15.60 [-19.70, 50.90]
3.4.10 Mental health					
Dixon 2012	4.3	7.5512	30	30	4.30 [-10.50, 19.10]



Bariatric surgery vs standard care (continuous positive airway pressure)

RCT data

Figure 17: Weight (kg)

Study or Subgroup	Bariatric surgery Mean	SD	Total	Standard care Mean	SD	Total	Mean Difference IV, Fixed, 95% CI
5.1.1 At 9 months							
Bakker 2018	-8.7	17.48	25	-5.1	14.93	18	-3.60 [-13.32, 6.12]
5.1.2 At 18 months							
Bakker 2018	-9.3	17.48	24	-4.8	16.05	16	-4.50 [-15.02, 6.02]

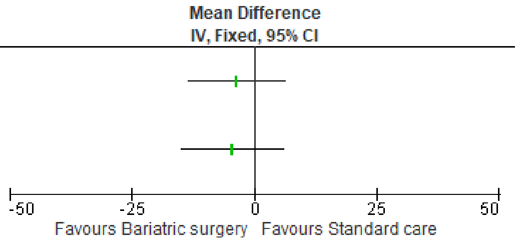


Figure 18: BMI (kg/m²)

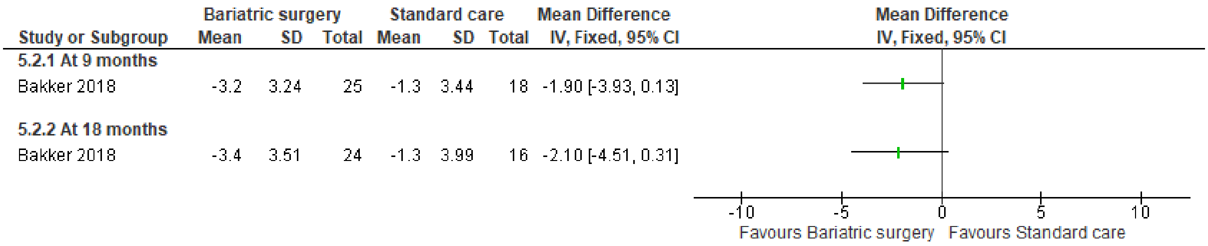
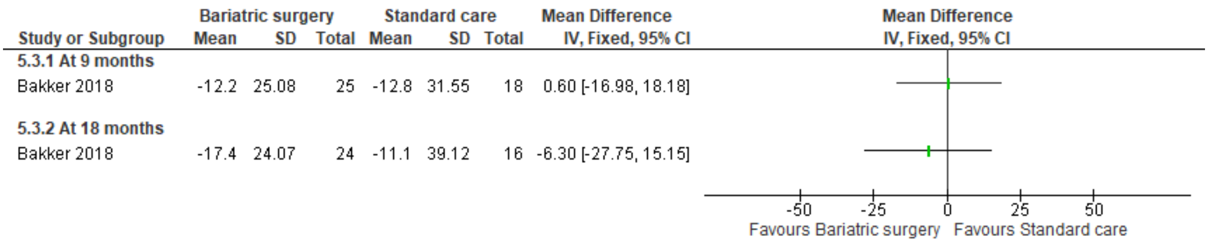


Figure 19: AHI (events per hour) off continuous positive airway pressure treatment



Bariatric surgery vs no surgery

Observational data

Figure 20: Discontinuation of positive airway pressure (PAP) 6 months – 1 year

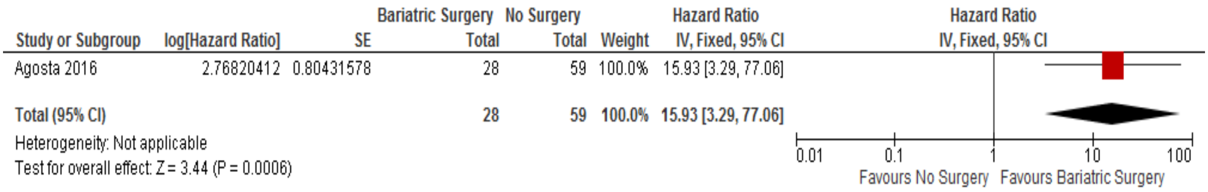
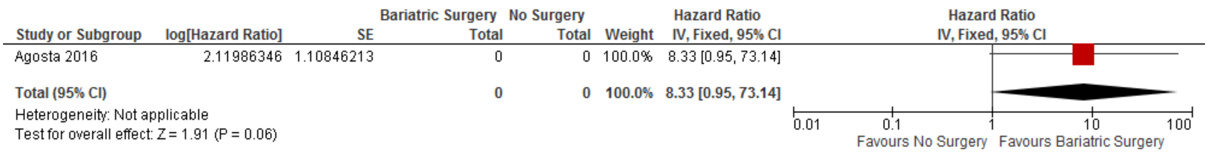


Figure 21: Discontinuation of positive airway pressure (PAP) 1-2 years

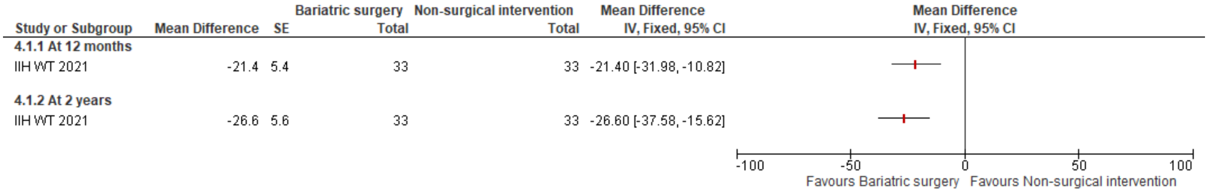


Obesity with idiopathic intracranial hypertension

Bariatric surgery vs non-surgical intervention

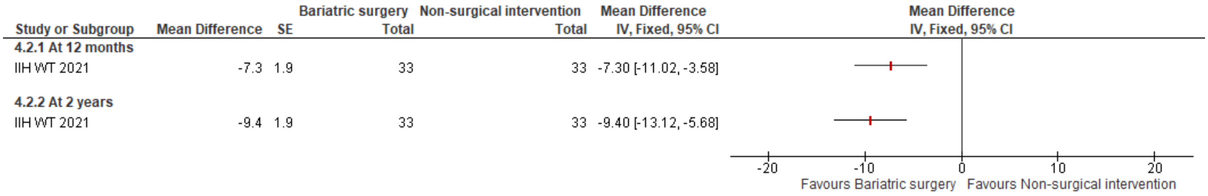
RCT data

Figure 22: Weight (kg)



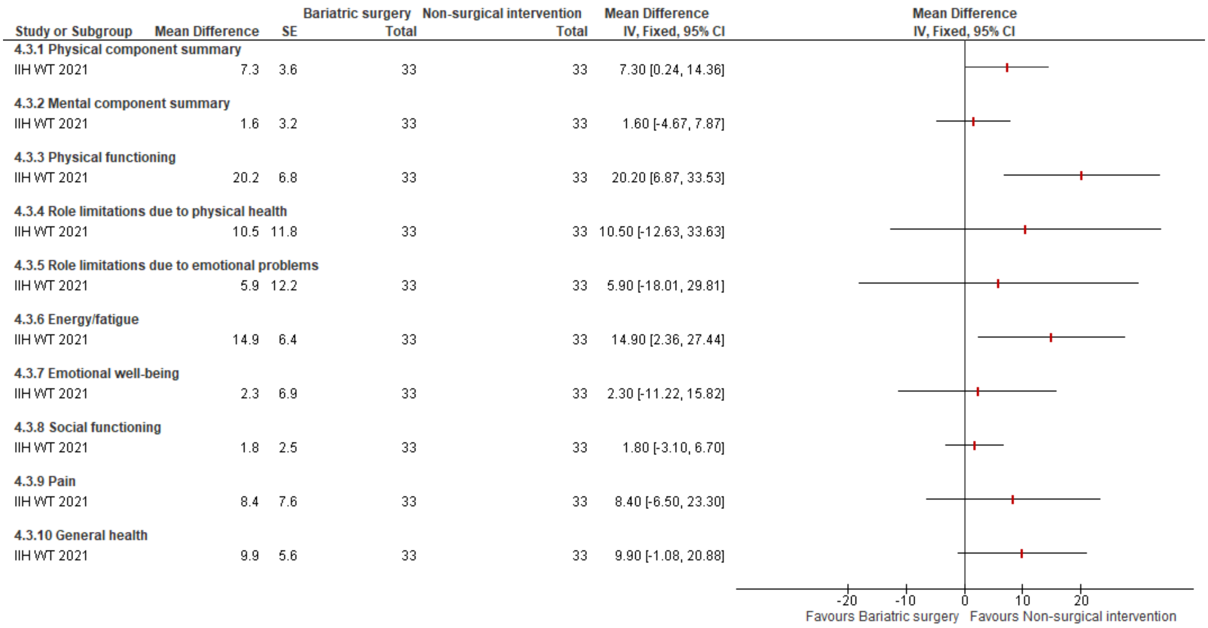
IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 23: BMI (kg/m^2)



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

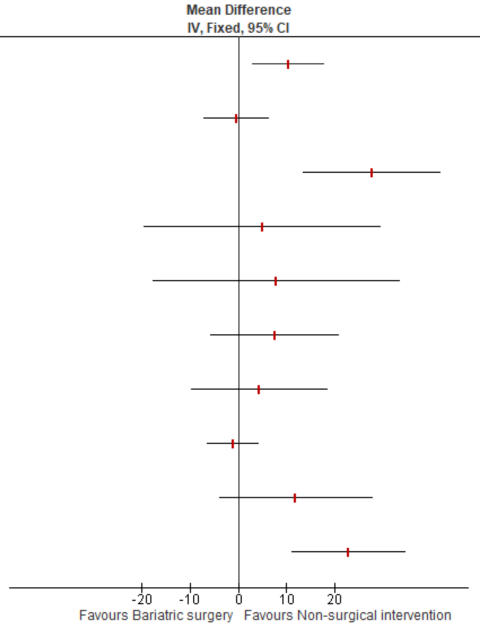
Figure 24: Health related quality of life (SF-36) at 12 months (better indicated by higher values; range of scale: 0 to 100)



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 25: Health related quality of life (SF-36) at 2 years (better indicated by higher values; range of scale: 0 to 100)

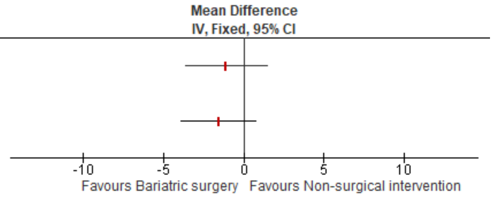
Study or Subgroup	Mean Difference	SE	Bariatric surgery Total	Non-surgical intervention Total	Mean Difference IV, Fixed, 95% CI
4.4.1 Physical component summary					
IIH WT 2021	10.4	3.8	33	33	10.40 [2.95, 17.85]
4.4.2 Mental component summary					
IIH WT 2021	-0.5	3.4	33	33	-0.50 [-7.16, 6.16]
4.4.3 Physical functioning					
IIH WT 2021	27.7	7.2	33	33	27.70 [13.59, 41.81]
4.4.4 Role limitations due to physical health					
IIH WT 2021	5	12.5	33	33	5.00 [-19.50, 29.50]
4.4.5 Role limitations due to emotional problems					
IIH WT 2021	7.9	13.1	33	33	7.90 [-17.78, 33.58]
4.4.6 Energy/fatigue					
IIH WT 2021	7.5	6.8	33	33	7.50 [-5.83, 20.83]
4.4.7 Emotional well-being					
IIH WT 2021	4.3	7.2	33	33	4.30 [-9.81, 18.41]
4.4.8 Social functioning					
IIH WT 2021	-1.1	2.7	33	33	-1.10 [-6.39, 4.19]
4.4.9 Pain					
IIH WT 2021	11.9	8.1	33	33	11.90 [-3.98, 27.78]
4.4.10 General health					
IIH WT 2021	22.8	6	33	33	22.80 [11.04, 34.56]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 26: Hospital anxiety and depression scores (HADS) at 12 months (better indicated by lower values; range of scale: 0 to 21)

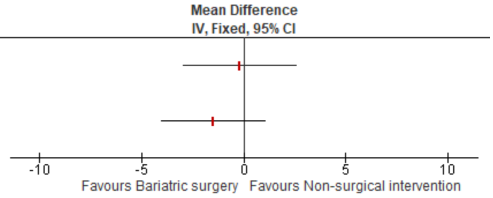
Study or Subgroup	Mean Difference	SE	Bariatric surgery Total	Non-surgical intervention Total	Mean Difference IV, Fixed, 95% CI
4.5.1 HADS - anxiety					
IIH WT 2021	-1.1	1.3	33	33	-1.10 [-3.65, 1.45]
4.5.2 HADS - depression					
IIH WT 2021	-1.6	1.2	33	33	-1.60 [-3.95, 0.75]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 27: Hospital anxiety and depression scores (HADS) at 2 years (better indicated by lower values; range of scale: 0 to 21)

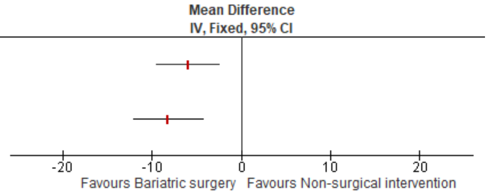
Study or Subgroup	Mean Difference	SE	Bariatric surgery Total	Non-surgical intervention Total	Mean Difference IV, Fixed, 95% CI
4.6.1 HADS - anxiety					
IIH WT 2021	-0.2	1.4	33	33	-0.20 [-2.94, 2.54]
4.6.2 HADS - depression					
IIH WT 2021	-1.5	1.3	33	33	-1.50 [-4.05, 1.05]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 28: Intracranial pressure (cm CFS)

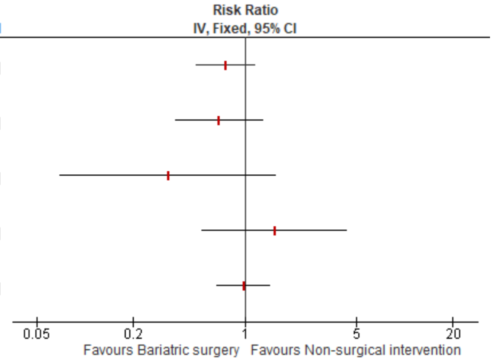
Study or Subgroup	Mean Difference	SE	Bariatric surgery Total	Non-surgical intervention Total	Mean Difference IV, Fixed, 95% CI
4.7.1 At 12 months					
IIH WT 2021	-6	1.8	33	33	-6.00 [-9.53, -2.47]
4.7.2 At 2 years					
IIH WT 2021	-8.2	2	33	33	-8.20 [-12.12, -4.28]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 29: Idiopathic intracranial hypertension symptoms at 12 months

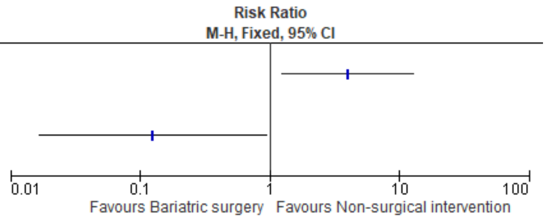
Study or Subgroup	log[Risk Ratio]	SE	Bariatric surgery Total	Non-surgical intervention Total	Risk Ratio IV, Fixed, 95% CI
4.8.1 Pulsatile tinnitus					
IIH WT 2021	-0.2744	0.2136	30	29	0.76 [0.50, 1.16]
4.8.2 Visual loss					
IIH WT 2021	-0.3711	0.318	30	29	0.69 [0.37, 1.29]
4.8.3 Diplopia					
IIH WT 2021	-1.1087	0.7911	30	29	0.33 [0.07, 1.56]
4.8.4 Visual obscurations					
IIH WT 2021	0.4253	0.5314	30	29	1.53 [0.54, 4.34]
4.8.5 Headache					
IIH WT 2021	-0.0202	0.194	30	39	0.98 [0.67, 1.43]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 30: Serious adverse events

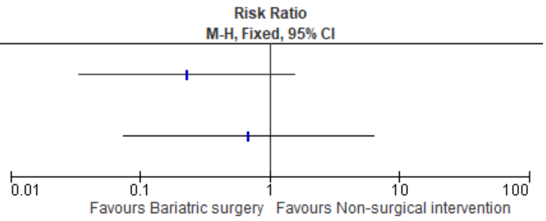
Study or Subgroup	Bariatric surgery Events	Bariatric surgery Total	Non-surgical intervention Events	Non-surgical intervention Total	Risk Ratio M-H, Fixed, 95% CI
4.9.1 At 0 to 12 months					
IIH WT 2021	12	33	3	33	4.00 [1.24, 12.88]
4.9.2 At 12 months to 2 years					
IIH WT 2021	1	33	8	33	0.13 [0.02, 0.94]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Mollan 2021

Figure 31: Diagnosis of obstructive sleep apnoea at 12 months (only women)

Study or Subgroup	Bariatric surgery Events	Bariatric surgery Total	Non-surgical intervention Events	Non-surgical intervention Total	Risk Ratio M-H, Fixed, 95% CI
4.10.1 By American Academy of Sleep Medicine criteria					
IIH WT 2021	1	8	6	11	0.23 [0.03, 1.55]
4.10.2 By apnoea/hypopnoea index (score 15 or more)					
IIH WT 2021	1	8	2	11	0.69 [0.07, 6.34]



IIH WT: Idiopathic Intracranial Hypertension Weight Trial; reported by Yiangou 2021

Obesity with hypertension

Bariatric surgery vs standard care (medical treatment for hypertension)

RCT data

Figure 32: Weight (Kg)

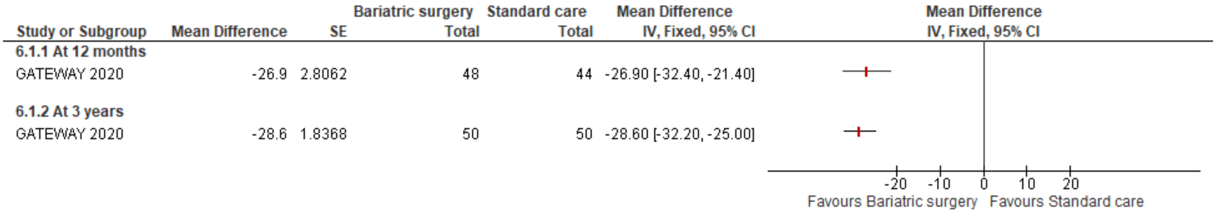


Figure 33: BMI (Kg/m2)

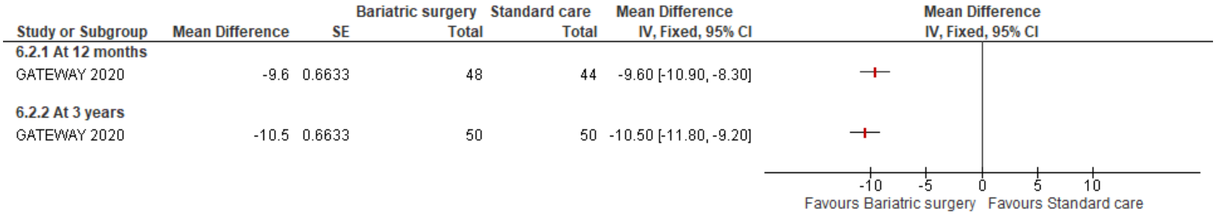


Figure 34: Reduction of ≥30% of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg

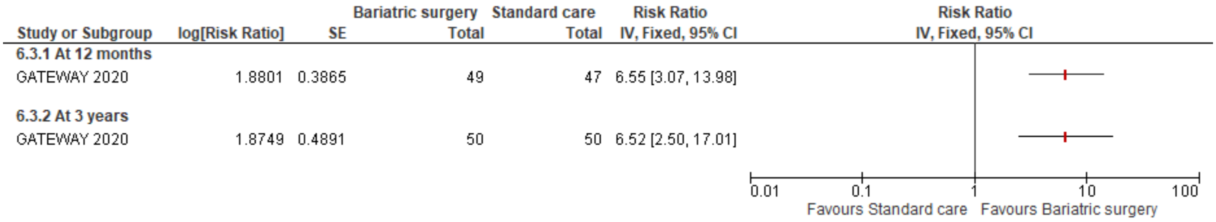


Figure 35: Resistant hypertension (Better indicated by lower value)

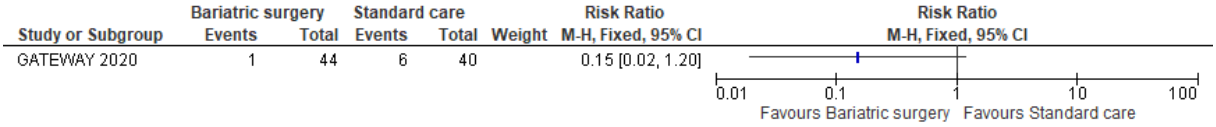
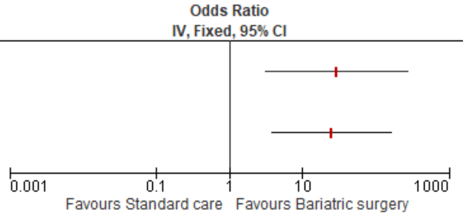


Figure 36: Obstructive sleep apnoea

Study or Subgroup	log[Odds Ratio]	SE	Bariatric surgery Total	Standard care Total	Odds Ratio IV, Fixed, 95% CI
6.6.1 Obstructive sleep apnoea vs no obstructive sleep apnoea					
GATEWAY 2020	3.3722	1.1336	24	13	29.14 [3.16, 268.81]
6.6.2 Obstructive sleep apnoea vs no or mild obstructive sleep apnoea					
GATEWAY 2020	3.2088	0.9521	24	13	24.75 [3.83, 159.95]



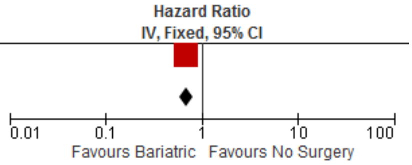
Bariatric surgery vs no surgery

Observational data

Figure 37: Overall mortality – median follow up 19 years

Study or Subgroup	log[Hazard Ratio]	SE	Bariatric Total	No Surgery Total	Weight	Hazard Ratio IV, Fixed, 95% CI
Carlsson 2020	-0.37106368	0.08084482	2010	2037	100.0%	0.69 [0.59, 0.81]
Total (95% CI)			**2010**	**2037**	**100.0%**	**0.69 [0.59, 0.81]**

Heterogeneity: Not applicable
Test for overall effect: Z = 4.59 (P < 0.00001)



Obesity with cardiovascular disease

Bariatric surgery vs no surgery

Observational data

Figure 38: MACE (observational – systematic review)

Study or Subgroup	Bariatric surgery Events	Bariatric surgery Total	No surgery Events	No surgery Total	Weight	Risk Ratio M-H, Random, 95% CI
Aminian 2019 (Sutanto SR)	385	2287	3243	11435	12.8%	0.59 [0.54, 0.65]
Batsis 2007 (Sutanto SR)	6	197	9	163	2.5%	0.55 [0.20, 1.52]
Doumoras 2021 (Sutanto SR)	151	1319	259	1319	11.6%	0.58 [0.48, 0.70]
Hung 2020 (Sutanto SR)	10	1436	57	1436	4.7%	0.18 [0.09, 0.34]
Moussa 2020 (Sutanto SR)	82	3701	275	3701	10.7%	0.30 [0.23, 0.38]
Naslund 2021 (Sutanto SR)	95	509	184	509	11.1%	0.52 [0.42, 0.64]
Nguyen 2020 (Sutanto SR)	3376	50296	228763	1650647	13.2%	0.48 [0.47, 0.50]
Pirlet 2020 (Sutanto SR)	37	116	50	116	9.0%	0.74 [0.53, 1.04]
Sjostrom 2012 (Sutanto SR)	199	2010	234	2037	11.7%	0.86 [0.72, 1.03]
Stenberg 2020 (Sutanto SR)	379	11863	1125	26199	12.6%	0.74 [0.66, 0.83]
Total (95% CI)		**73734**		**1697562**	**100.0%**	**0.55 [0.46, 0.65]**
Total events	4720		234199			

Heterogeneity: Tau² = 0.06; Chi² = 130.26, df = 9 (P < 0.00001); I² = 93%
Test for overall effect: Z = 6.65 (P < 0.00001)

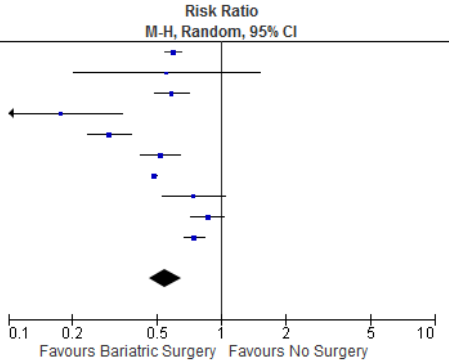


Figure 39: MACE (observational – systematic review)- Funnel plot

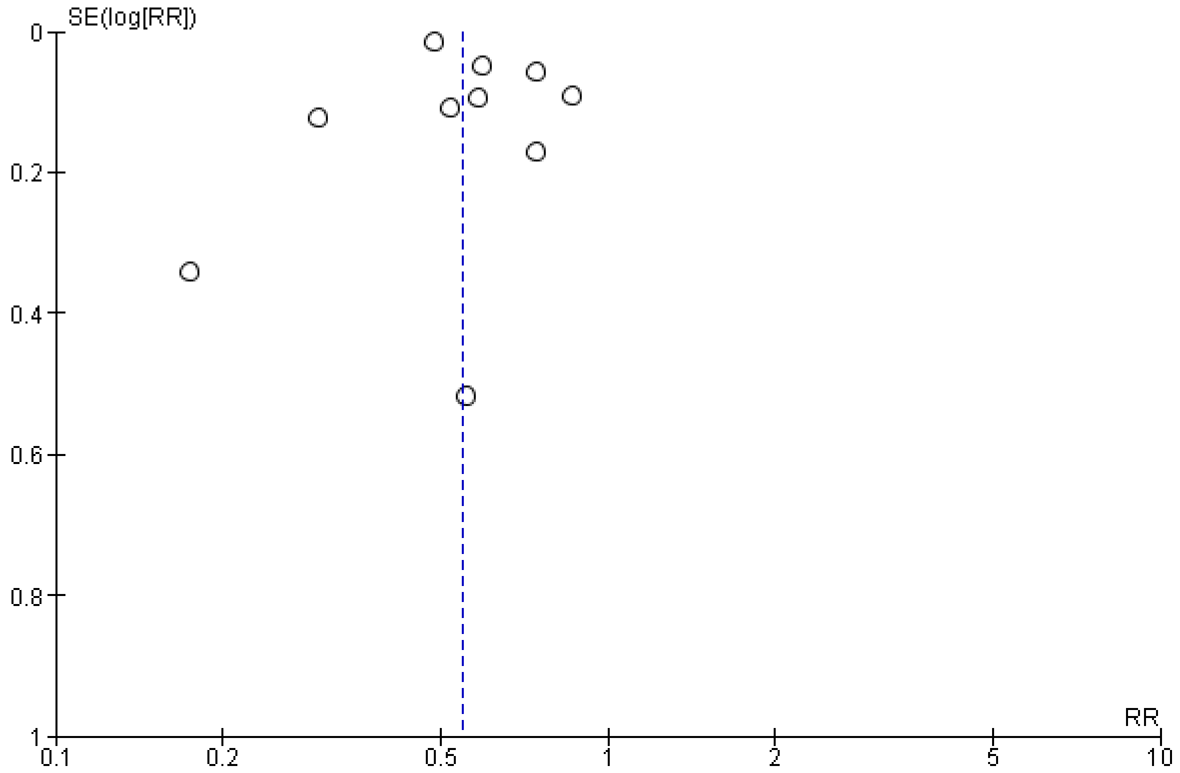


Figure 40: Myocardial infarction

Study or Subgroup	log[Hazard Ratio]	SE	Bariatric Total	No surgery Total	Weight	Hazard Ratio IV, Fixed, 95% CI
Douglas 2015	-1.2039728	0.56888122	53	40	100.0%	0.30 [0.10, 0.91]
Total (95% CI)			**53**	**40**	**100.0%**	**0.30 [0.10, 0.91]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.12 (P = 0.03)

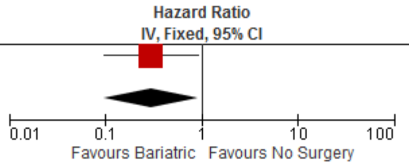


Figure 41: Stroke

Study or Subgroup	log[Hazard Ratio]	SE	Bariatric Total	No surgery Total	Weight	Hazard Ratio IV, Fixed, 95% CI
Douglas 2015	0.0295588	0.44596638	53	40	100.0%	1.03 [0.43, 2.47]
Total (95% CI)			**53**	**40**	**100.0%**	**1.03 [0.43, 2.47]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.07 (P = 0.95)

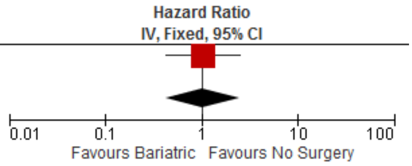


Figure 42: Hypertension

Study or Subgroup	log[Hazard Ratio]	SE	Bariatric Total	No surgery Total	Weight	Hazard Ratio IV, Fixed, 95% CI
Douglas 2015	-1.71479843	0.79708294	53	40	100.0%	0.18 [0.04, 0.86]
Total (95% CI)			**53**	**40**	**100.0%**	**0.18 [0.04, 0.86]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.15 (P = 0.03)

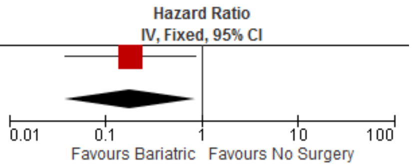


Figure 43: Type 2 Diabetes

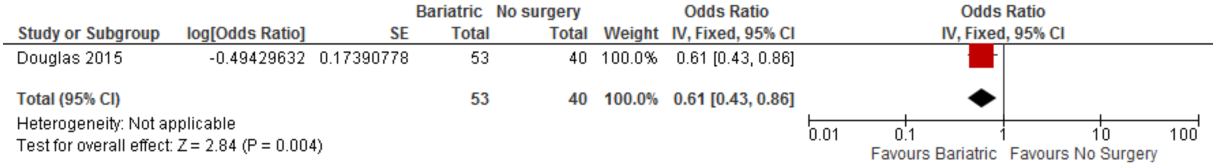


Figure 44: Non-alcoholic fatty liver disease

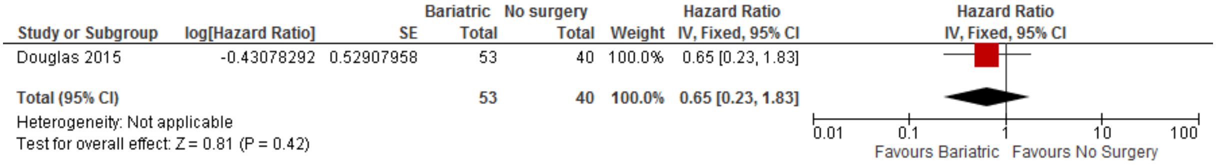


Figure 45: Obstructive sleep apnoea

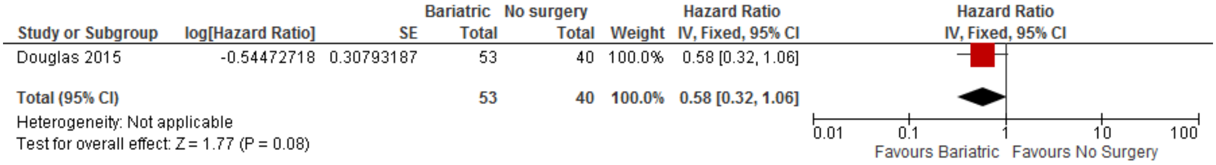
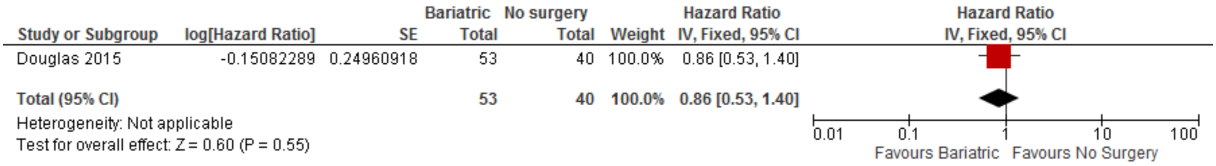


Figure 46: Mortality



Obesity with non-alcoholic fatty liver disease (NAFLD)

Bariatric surgery vs no surgery

Observational data

Figure 47: Major adverse liver outcome 10 years

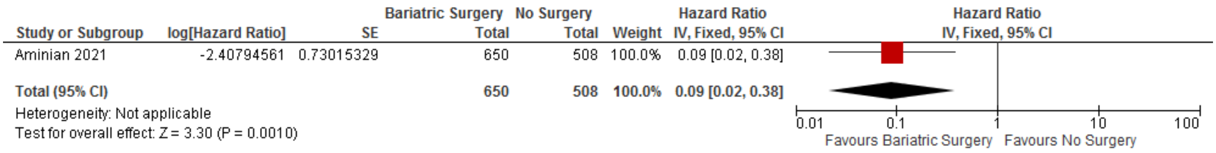
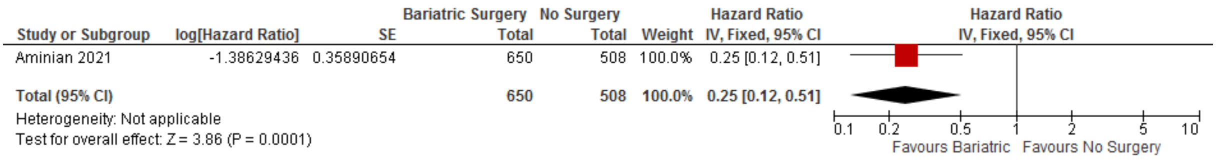


Figure 48: MACE 10 years



Appendix G – GRADE profiles

Obesity with no specific comorbidity

Table 22: Bariatric surgery vs no treatment

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	No treatment	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 13.05] (follow-up 6 months[1]; Better indicated by lower values)												
2[2]	randomised trials	very serious[3]	no serious inconsistency	no serious indirectness	no serious imprecision	none	71	50	-	MD 32.19 lower (41.39 to 22.99 lower)	⊕⊕OO LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 2.88] (follow-up 6 months[1]; Better indicated by lower values)												
2[2]	randomised trials	very serious[3]	no serious inconsistency	no serious indirectness	no serious imprecision	none	71	50	-	MD 13.4 lower (15.98 to 10.82 lower)	⊕⊕OO LOW	CRITICAL[4]
AHI score [MID +/- 4.57] (follow-up 3 months; Better indicated by lower values)												
1[5]	randomised trials	serious[6]	no serious inconsistency	no serious indirectness	serious[7]	none	16	36	-	MD 9.39 lower (16.62 to 2.16 lower)	⊕⊕OO LOW	CRITICAL[4]
AHI <5 [MID 0.8 to 1.25] (follow-up 3 months)												
1[5]	randomised trials	serious[6]	no serious inconsistency	no serious indirectness	serious[7]	none	9/16 (56.3%)	27.8%	RR 2.03 (1.02 to 4)	29 more per 100 (from 1 more to 83 more)	⊕⊕OO LOW	CRITICAL[4]
AHI severity - AHI 5<15 [MID 0.8 to 1.25] (follow-up 3 months)												
1[5]	randomised trials	serious[6]	no serious inconsistency	no serious indirectness	very serious[8]	none	6/16 (37.5%)	38.9%	RR 0.96 (0.45 to 2.05)	2 fewer per 100 (from 21 fewer to 41 more)	⊕OOO VERY LOW	CRITICAL[4]

AHI severity - AHI 15<30 [MID 0.8 to 1.25] (follow-up 3 months)											
1[5]	randomised trials	serious[6]	no serious inconsistency	no serious indirectness	very serious[8]	none	1/16 (6.3%)	13.9%	RR 0.45 (0.06 to 3.55)	8 fewer per 100 (from 13 fewer to 35 more)	⊕OOO VERY LOW	CRITICAL[4]
AHI severity - AHI ≥30 [MID 0.8 to 1.25] (follow-up 3 months)											
1[5]	randomised trials	serious[6]	no serious inconsistency	no serious indirectness	very serious[8]	none	0/16 (0%)	19.4%	RR 0.15 (0.01 to 2.4)	16 fewer per 100 (from 19 fewer to 27 more)	⊕OOO VERY LOW	CRITICAL[4]

[1] Aguiar 2014 (3 months follow-up); Freitas 2018 (6 months follow-up)
[2] Aguiar 2014; Freitas 2018
[3] >33.3% of the weight in meta-analysis came from studies at high risk of bias
[4] Primary outcome in protocol
[5] Aguiar 2014
[6] Study at moderate risk of bias
[7] 95% CI crossed one line of the calculated MID
[8] Confidence intervals cross 2 clinical decision thresholds (0.8, 1.25)

Bariatric surgery vs no surgery

Table 23: Data stratified by BMI

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Bariatric Surgery**	**No Surgery**	**Relative (95% CI)**	**Absolute**		
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years) - BMI 30-34.9 kg/m2												
1[1]	Observational study (assessed using ROBINS-I)	serious[2]	no serious inconsistency[3]	no serious indirectness	very serious[4]	none	0/339 (0%)	8.2%	HR 0.39 (0.11 to 1.4)	49 fewer per 1000 (from 73 fewer to 31 more)	⊕OOO VERY LOW	CRITICAL
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years) - BMI 35-39.9 kg/m2												
1[1]	Observational study (assessed using ROBINS-I)	serious[2]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	0/535 (0%)	8.1%[5]	HR 0.24 (0.12 to 0.48)	61 fewer per 1000 (from 41 fewer to 71 fewer)	⊕⊕⊕O MODERATE	CRITICAL
Type 2 diabetes incidence [MID 0.8 to 1.25] (2.8 years) - BMI >= 40 kg/m2												
1[1]	Observational study (assessed using ROBINS-I)	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	0/1293 (0%)	8.1%[5]	HR 0.15 (0.09 to 0.25)	68 fewer per 1000 (from 60 fewer to 73 fewer)	⊕⊕⊕O MODERATE	CRITICAL
MACE [MID 0.8 to 1.25] (11 years) - BMI 35-40 kg/m2												
1[6]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	serious[8]	none	0/1764 (0%)	2.5%[5]	HR 0.62 (0.35 to 1.12)	9 fewer per 1000 (from 16 fewer to 3 more)	⊕OOO VERY LOW	CRITICAL
MACE [MID 0.8 to 1.25] (11 years) - BMI 40-50 kg/m2												
1[6]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	0/1513 (0%)	2.5%[5]	HR 0.29 (0.15 to 0.57)	18 fewer per 1000 (from 11 fewer to 21 fewer)	⊕⊕OO LOW	CRITICAL
MACE [MID 0.8 to 1.25] (11 years) - BMI >50 kg/m2												

1[6]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	serious[8]	none	0/424 (0%)	2.5%[5]	HR 0.27 (0.07 to 0.95)	18 fewer per 1000 (from 1 fewer to 23 fewer)	⊕OOO VERY LOW	CRITICAL
Heart Failure [MID 0.8 to 1.25] - median follow up 22 years - BMI <40.8 kg/m2												
1[9]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	serious[8]	none	75/792 (9.5%)	161/1225 (13.1%)	RR 0.72 (0.56 to 0.93)	37 fewer per 1000 (from 9 fewer to 58 fewer)	⊕OOO VERY LOW	CRITICAL
Heart Failure [MID 0.8 to 1.25] - median follow up 22 years - BMI >40.8 kg/m2												
1[9]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	serious[8]	none	113/1211 (9.3%)	105/805 (13%)	RR 0.72 (0.56 to 0.92)	37 fewer per 1000 (from 10 fewer to 57 fewer)	⊕OOO VERY LOW	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 19 years – BMI <39kg/m^2												
1[10]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	489/2010[5] (24%)	28%[5]	HR 0.78 (0.61-0.99)		⊕⊕OO LOW	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 19 years – BMI 39-42kg/m^2												
1[10]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	489/2010[5] (24%)	28%[5]	HR 0.73 (0.57-0.93)		⊕⊕OO LOW	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 19 years – BMI >42.6kg/m^2												
1[10]	Observational study (assessed using ROBINS-I)	very serious[7]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	489/2010[5] (24%)	28%[5]	HR 0.66 (0.52-0.83)		⊕⊕OO LOW	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 4.84 years - BMI <40kg/m^2												
1[11]	Observational study (assessed using ROBINS-I)	Serious[12]	no serious inconsistency[3]	no serious indirectness	serious[13]	None	42/2152 (2%)	49/2152 (2.3%)	HR 1.00 (0.66-1.51)		⊕⊕OO LOW	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 4.84 years – BMI 40-50kg/m^2												

1[11]	Observational study (assessed using ROBINS-I)	Serious[12]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	93/7340 (1.3%)	186/7340 (2.5%)	HR 0.62 (0.48-0.80)		⊕⊕⊕O MODERATE	CRITICAL
Overall mortality [MID: Line of no effect] – median follow up 4.84 years – BMI >50kg/m[2]												
1[11]	Observational study (assessed using ROBINS-I)	Serious[12]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	62/4187 (1.5%)	105/4187 (2.5%)	HR 0.64 (0.57-0.82)		⊕⊕⊕O MODERATE	CRITICAL

[1] Booth 2014
[2] Study at moderate risk of bias.
[3] Single study, so assessment of inconsistency not possible.
[4] Confidence intervals cross 2 clinical decision thresholds (0.8, 1.25)
[5] Baseline risk estimated from events in whole population (not stratified by BMI)
[6] Moussa 2020
[7] Study at high risk of bias
[8] Confidence intervals cross 1 clinical decision threshold (0.8, 1.25)
[9] Jamaly 2019
[10] Jamaly 2019 (Carlsson 2020 post hoc analysis)
[11] Doumoras 2020
[12] Study at moderate risk of bias
[13] Confidence intervals cross line of no effect (clinical decision threshold for mortality outcome).

Table 24: Bariatric surgery vs non-surgical intervention

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Non-surgical intervention for obesity	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 3.06] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	40	40	-	MD 9.20 lower (11.86 to 6.54 lower)	⊕⊕⊕O MODERATE	CRITICAL[3]
Weight (kg) [MID +/- 2.11] (follow-up 2 years; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	40	40	-	MD 15.2 lower (17.44 to 12.96 lower)	⊕⊕⊕O MODERATE	CRITICAL[3]
BMI (kg/m²) [MID +/- 1.29] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	40	40	-	MD 3.1 lower (4.2 to 2 lower)	⊕⊕⊕O MODERATE	CRITICAL[3]
BMI (kg/m²) [MID +/- 1.33] (follow-up 2 years; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	40	40	-	MD 5.3 lower (6.42 to 4.18 lower)	⊕⊕⊕O MODERATE	CRITICAL[3]

[1] O'Brien 2006
[2] Study at moderate risk of bias
[3] Primary outcome in protocol

Obesity with obstructive sleep apnoea

Table 25: Bariatric surgery vs non-surgical intervention

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Non-surgical intervention for obesity	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 13.39] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	26	30	-	MD 12.9 lower (26.13 lower to 0.33 higher)[5]	⊕OOO VERY LOW	CRITICAL[4]
Weight (kg) [MID +/- 8.47] (follow-up 10 years[6]; Better indicated by lower values)												
2[7]	randomised trials	serious[8]	serious[9]	no serious indirectness	no serious imprecision	none	51	52	-	MD 20.25 lower (27 to 13.5 lower)[5]	⊕⊕OO LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 4.53] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	26	30	-	MD 4.6 lower (9.55 lower to 0.35 higher)[5]	⊕OOO VERY LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 4.03] (follow-up 10 years; Better indicated by lower values)												
1[1]	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	21	22	-	MD 6.8 lower (11.82 to 1.78 lower)[5]	⊕OOO VERY LOW	CRITICAL[4]
AHI score [MID +/- 12.57] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	26	30	-	MD 22.1 lower (34.9 to 9.3 lower)	⊕OOO VERY LOW	CRITICAL[4]
AHI score [MID +/- 13.95] (follow-up 10 years[6]; Better indicated by lower values)												
2[7]	randomised trials	very serious[10]	no serious inconsistency	no serious indirectness	serious[3]	none	52	54	-	MD 12.25 lower (22.79 to 1.71 lower)[5]	⊕OOO VERY LOW	CRITICAL[4]
Health related quality of life (SF-36) - Physical component summary [MID +/- 8.69] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												

1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 9.3 higher (0.5 to 18.1 higher)[5,13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Mental component summary [MID +/- 4.94] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 0.3 lower (5.3 lower to 4.7 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Physical function [MID +/- 19.96] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 16.8 higher (3.4 lower to 37 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role-Physical [MID +/- 30.92] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 33.5 higher (2.2 to 64.8 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Body pain [MID +/- 13.73] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 7.4 higher (6.5 lower to 21.3 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - General health [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 18.4 higher (3.6 to 33.2 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Vitality [MID +/- 16.70] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 17.3 higher (0.4 to 34.2 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Social function [MID +/- 19.46] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 10.6 higher (9.1 lower to 30.3 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role emotional [MID +/- 34.87] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												

1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 15.6 higher (19.7 lower to 50.9 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Mental health [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 4.3 higher (10.5 lower to 19.1 higher)[13]	⊕⊕OO LOW	CRITICAL[4]
Depression (Beck Depression Inventory) [MID +/- 5.82] (follow-up 2 years; range of scores: 0-63; Better indicated by lower values)												
1[11]	randomised trials	serious[12]	no serious inconsistency	no serious indirectness	serious[3]	none	30	30	-	MD 1.80 lower (7.7 lower to 4.1 higher)[13]	⊕⊕OO LOW	CRITICAL[4]

[1] Feigel-Guiller 2015
[2] Study at high risk of bias
[3] 95% CI crossed one line of the calculated MID
[4] Primary outcome in protocol
[5] Dixon 2012 - Longitudinal Analysis With Multiple Imputation for Missing Data; Standard deviations calculated using Review Manager calculator
[6] Longest follow-up (Dixon 2012 [2 years]; Feigel-Guiller 2015 [10 years])
[7] Dixon 2012; Feigel-Guiller 2015
[8] >33.3% of the weight in meta-analysis came from studies at moderate risk of bias
[9] I2 was between 33.3% and 66.7%
[10] >33.3% of the weight in meta-analysis came from studies at high risk of bias
[11] Dixon 2012
[12] Study at moderate risk of bias
[13] Dixon 2012 - Standard deviations calculated using Review Manager calculator

Table 26: Bariatric surgery vs standard of care (continuous positive airway pressure)

Quality assessment	No of patients	Effect	Quality	Importance

No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Standard of care	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 7.46] (follow-up 9 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	25	18	-	MD 3.6 lower (13.32 lower to 6.12 higher)	⊕⊕OO LOW	CRITICAL[4]
Weight (kg) [MID +/- 8.02] (follow-up 18 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	24	16	-	MD 4.5 lower (15.02 lower to 6.02 higher)	⊕⊕OO LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 1.72] (follow-up 9 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	25	18	-	MD 1.9 lower (3.93 lower to 0.13 higher)	⊕⊕OO LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 1.99] (follow-up 18 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	24	16	-	MD 2.1 lower (4.51 lower to 0.31 higher)	⊕⊕OO LOW	CRITICAL[4]
AHI (events per hour) off continuous positive airway pressure treatment [MID +/- 15.77] (follow-up 9 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[5]	none	25	18	-	MD 0.6 higher (16.98 lower to 18.18 higher)	⊕OOO VERY LOW	CRITICAL[4]
AHI (events per hour) off continuous positive airway pressure treatment [MID +/- 19.56] (follow-up 18 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	24	16	-	MD 6.3 lower (27.75 lower to 15.15 higher)	⊕⊕OO LOW	CRITICAL[4]

[1] Bakker 2018
[2] Study at moderate risk of bias
[3] 95% CI crossed one line of the calculated MID
[4] Primary outcome in protocol
[5] 95% CI crossed both lines of the calculated MID

Table 27: Bariatric surgery vs no surgery

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Lifestyle intervention - Sleep apnoea population	Relative (95% CI)	Absolute		
Discontinuation of positive airway pressure (PAP) [MID 0.8 to 1.25] 6 months - 1 year												
1[1]	Observational study (assessed using ROBINS-I)	very serious[2]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	-	0.02%[4]	HR 15.93 (3.29 to 77.06)	3 more per 1000 (from 0 more to 15 more)	⊕⊕OO LOW	CRITICAL
Discontinuation of positive airway pressure (PAP) [MID 0.8 to 1.25] 12 months - 2 year												
1[1]	Observational study (assessed using ROBINS-I)	very serious[2]	no serious inconsistency	no serious indirectness	serious[5]	none	-	0.04%[4]	HR 8.33 (0.95 to 73.25)	3 more per 1000 (from 0 fewer to 28 more)	⊕OOO VERY LOW	CRITICAL

[1] Agosta 2016
[2] Study at high risk of bias.
[3] Single study, so assessment of inconsistency not possible.
[4] Risk in control arm estimated from Kaplan Meier curve
[5] Confidence intervals cross 1 clinical decision threshold (0.8, 1.25)

Obesity with idiopathic intracranial hypertension

Table 28: Bariatric surgery vs non-surgical intervention

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Non-surgical intervention for obesity	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 10.96] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 21.4 lower (31.98 to 10.82 lower)[5]	⊕⊕OO LOW	CRITICAL[4]
Weight (kg) [MID +/-11.47] (follow-up 2 years; Better indicated by lower values)												
1	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	33	33	-	MD 26.6 lower (37.58 to 15.62 lower)[5]	⊕⊕⊕O MODERATE	CRITICAL[4]
BMI (kg/m²) [MID +/- 3.86] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 7.3 lower (11.02 to 3.58 lower)[5]	⊕⊕OO LOW	CRITICAL[4]
BMI (kg/m²) [MID +/- 3.86] (follow-up 2 years; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	33	33	-	MD 9.4 lower (13.12 to 5.68 lower)[5]	⊕⊕⊕O MODERATE	CRITICAL[4]
Health related quality of life (SF-36) - Physical component summary [MID +/- 7.31] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 7.3 higher (0.24 to 14.36 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Mental component summary [MID +/- 6.5] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.6 higher (4.67 lower to 7.87 higher)[5]	⊕⊕OO LOW	CRITICAL[4]

Health related quality of life (SF-36) - Physical functioning [MID +/- 13.81] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 20.2 higher (6.87 to 33.53 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role limitations due to physical health [MID +/- 23.96] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 10.5 higher (12.63 lower to 33.63 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role limitations due to emotional problems [MID +/- 24.78] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 5.9 higher (18.01 lower to 29.81 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Energy/fatigue [MID +/- 13.00] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 14.9 higher (2.36 to 27.44 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Emotional well-being [MID +/- 14.01] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 2.3 higher (11.22 lower to 15.82 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Social functioning [MID +/- 5.07] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.8 higher (3.1 lower to 6.7 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Pain [MID +/- 15.43] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 8.4 higher (6.5 lower to 23.3 higher)[5]	⊕⊕OO LOW	CRITICAL[4]

Health related quality of life (SF-36) - General health [MID +/- 11.37] (follow-up 12 months; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 9.9 higher (1.08 lower to 20.88 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Physical component summary [MID +/- 7.72] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 10.4 higher (2.95 to 17.85 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Mental component summary [MID +/- 6.90] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 0.5 lower (7.16 lower to 6.16 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Physical functioning [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 27.7 higher (13.59 to 41.81 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role limitations due to physical health [MID +/- 25.39] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 5 higher (19.5 lower to 29.5 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Role limitations due to emotional problems [MID +/- 26.60] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 7.9 higher (17.78 lower to 33.58 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Energy/fatigue [MID +/- 13.81] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 7.5 higher (5.83 lower to 20.83 higher)[5]	⊕⊕OO LOW	CRITICAL[4]

Health related quality of life (SF-36) - Emotional well-being [MID +/- 14.62] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 4.3 higher (9.81 lower to 18.41 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Social functioning [MID +/- 5.48] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.1 lower (6.39 lower to 4.19 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - Pain [MID +/- 16.45] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 11.9 higher (3.98 lower to 27.78 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Health related quality of life (SF-36) - General health [MID +/- 12.18] (follow-up 2 years; range of scores: 0-100; Better indicated by higher values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 22.8 higher (11.04 to 34.56 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Hospital anxiety and depression scores (HADS) - HADS - anxiety [MID +/- 2.64] (follow-up 12 months; range of scores: 0-21; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.1 lower (3.65 lower to 1.45 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Hospital anxiety and depression scores (HADS) - HADS - depression [MID +/- 2.43] (follow-up 12 months; range of scores: 0-21; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.6 lower (3.95 lower to 0.75 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Hospital anxiety and depression scores (HADS) - HADS - anxiety [MID +/- 2.84] (follow-up 2 years; range of scores: 0-21; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 0.2 lower (2.94 lower to 2.54 higher)[5]	⊕⊕OO LOW	CRITICAL[4]

Hospital anxiety and depression scores (HADS) at 2 years - HADS - depression [MID +/- 2.64] (follow-up 2 years; range of scores: 0-21; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 1.5 lower (4.05 lower to 1.05 higher)[5]	⊕⊕OO LOW	CRITICAL[4]
Intracranial pressure (cm CFS) [MID +/- 3.65] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	33	33	-	MD 6 lower (9.53 to 2.47 lower)[5]	⊕⊕OO LOW	CRITICAL[4]
Intracranial pressure (cm CFS) [MID +/- 4.06] (follow-up 2 years; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	33	33	-	MD 8.2 lower (12.12 to 4.28 lower)[5]	⊕⊕⊕O MODERATE	CRITICAL[4]
Idiopathic intracranial hypertension symptoms - Pulsatile tinnitus [MID 0.8 to 1.25] (follow-up 12 months)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	14/30 (46.7%)	18/29 (62.1%)	RR 0.76 (0.5 to 1.16)	15 fewer per 100 (from 31 fewer to 10 more)	⊕⊕OO LOW	CRITICAL[4]
Idiopathic intracranial hypertension symptoms - Visual loss [MID 0.8 to 1.25] (follow-up 12 months)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	10/30 (33.3%)	14/29 (48.3%)	RR 0.69 (0.37 to 1.29)	15 fewer per 100 (from 30 fewer to 14 more)	⊕OOO VERY LOW	CRITICAL[4]
Idiopathic intracranial hypertension symptoms - Diplopia [MID 0.80 to 1.25] (follow-up 12 months)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	4/30 (13.3%)	4/29 (13.8%)	RR 0.33 (0.07 to 1.56)	9 fewer per 100 (from 13 fewer to 8 more)	⊕OOO VERY LOW	CRITICAL[4]
Idiopathic intracranial hypertension symptoms - Visual obscurations [MID 0.80 to 1.25] (follow-up 12 months)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	7/30 (23.3%)	4/29 (13.8%)	RR 1.53 (0.54 to 4.34)	7 more per 100 (from 6 fewer to 46 more)	⊕OOO VERY LOW	CRITICAL[4]
Idiopathic intracranial hypertension symptoms - Headache [MID 0.80 to 1.25] (follow-up 12 months)												

1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	22/30 (73.3%)	23/39 (59%)	RR 0.98 (0.67 to 1.43)	1 fewer per 100 (from 19 fewer to 25 more)	⊕OOO VERY LOW	CRITICAL[4]
Serious adverse events - 0 to 12 months [MID 0.80 to 1.25]												
1[1]	randomised trials	serious[2]	no serious inconsistency	serious[7]	serious[3]	none	12/33 (36.4%)[8]	3/33 (9.1%)[8]	RR 4 (1.24 to 12.88)	27 more per 100 (from 2 more to 100 more)	⊕OOO VERY LOW	IMPORTANT[9]
Serious adverse events - 12 months to 2 years [MID 0.80 to 1.25]												
1[1]	randomised trials	serious[2]	no serious inconsistency	serious[7]	serious[3]	none	1/33 (3%)[8]	8/33 (24.2%)[8]	RR 0.13 (0.02 to 0.94)	21 fewer per 100 (from 1 fewer to 24 fewer)	⊕OOO VERY LOW	IMPORTANT[9]
Diagnosis of obstructive sleep apnoea (only women) - By American Academy of Sleep Medicine criteria [MID 0.80 to 1.25] (follow-up 12 months)												
1[10]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	1/8 (12.5%)	6/11 (54.5%)	RR 0.23 (0.03 to 1.55)	42 fewer per 100 (from 53 fewer to 30 more)	⊕OOO VERY LOW	CRITICAL[4]
Diagnosis of obstructive sleep apnoea (only women) - By apnoea/hypopnoea index (score 15 or more) [MID 0.80 to 1.25] (follow-up 12 months)												
1[10]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	very serious[6]	none	1/8 (12.5%)	2/11 (18.2%)	RR 0.69 (0.07 to 6.34)	6 fewer per 100 (from 17 fewer to 97 more)	⊕OOO VERY LOW	CRITICAL[4]

[1] Idiopathic Intracranial Hypertension Weight Trial (IIH WT) reported by Mollan 2021
[2] Study at moderate risk of bias
[3] 95% CI crossed one line of the calculated MID/ clinical decision threshold (0.8, 1.25)
[4] Primary outcome in protocol
[5] Hierarchical regression analysis; Standard deviations calculated using Review Manager calculator
[6] 95% CI crossed both lines of the clinical decision threshold (0.8, 1.25)
[7] Definition does not match the protocol (protocol defines serious adverse events according to the European medicine agency definition while study presented adverse events according to the medical dictionary for regulatory activities preferred term.)
[8] Total number of participants were not reported. Randomised number of participants were used for totals
[9] Secondary outcome in protocol
[10] Idiopathic Intracranial Hypertension Weight Trial (IIH WT) reported by Yiangou 2021

Obesity with hypertension

Table 29: Bariatric surgery vs standard of care (medical treatment for hypertension)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	Standard of care	Relative (95% CI)	Absolute		
Weight (kg) [MID +/- 6.72] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	48	44	-	MD 26.9 lower (32.4 to 21.4 lower)[3]	⊕⊕⊕O MODERATE	CRITICAL
Weight (kg) [MID +/- 4.59] (follow-up 3 years; Better indicated by lower values)												
1[4]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	50	50	-	MD 28.6 lower (32.2 to 25 lower)[3]	⊕⊕⊕O MODERATE	CRITICAL
BMI (kg/m²) [MID +/- 1.58] (follow-up 12 months; Better indicated by lower values)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	48	44	-	MD 9.6 lower (10.9 to 8.3 lower)[3]	⊕⊕⊕O MODERATE	CRITICAL
BMI (kg/m²) [MID +/- 1.65] (follow-up 3 years; Better indicated by lower values)												
1[4]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	50	50	-	MD 10.5 lower (11.8 to 9.2 lower)[3]	⊕⊕⊕O MODERATE	CRITICAL
Reduction of ≥30% of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg [MID 0.8 to 1.25] (follow-up 12 months)												
1[1]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	41/49 (83.7%)	6/47 (12.8%)	RR 6.55 (3.07 to 13.98)[5]	71 more per 100 (from 26 more to 100 more)	⊕⊕⊕O MODERATE	CRITICAL
Reduction of ≥30% of the total number of antihypertensive medications while maintaining office systolic and diastolic blood pressure <140 mm Hg and <90 mm Hg [MID 0.8 to 1.25] (follow-up 3 years)												

1[4]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	27/50 (54%)	4/50 (8%)	RR 6.52 (2.5 to 17.01)[5]	44 more per 100 (from 12 more to 100 more)	⊕⊕⊕O MODERATE	CRITICAL
Resistant hypertension [MID 0.80 to 1.25] (follow-up 3 years)												
1[4]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	serious[6]	none	1/44 (2.3%)	6/40 (15%)	RR 0.15 (0.02 to 1.2)	13 fewer per 100 (from 15 fewer to 3 more)	⊕⊕OO LOW	CRITICAL
Obstructive sleep apnoea - Obstructive sleep apnoea vs no obstructive sleep apnoea [MID 0.8 to 1.25] (follow-up 3 years)												
1[7]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	17/24 (70.8%)	1/13 (7.7%)	OR 29.14 (3.16 to 268.73)[8]	63 more per 100 (from 13 more to 88 more)	⊕⊕⊕O MODERATE	CRITICAL
Obstructive sleep apnoea - Obstructive sleep apnoea vs no or mild obstructive sleep apnoea [MID 0.8 to 1.25] (follow-up 3 years)												
1[7]	randomised trials	serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	22/24 (91.7%)	4/13 (30.8%)	OR 24.75 (3.83 to 159.92)[8]	61 more per 100 (from 32 more to 68 more)	⊕⊕⊕O MODERATE	CRITICAL

[1] GATEWAY 2020 reported by Schiavon 2018
[2] Study at moderate risk of bias
[3] Standard deviations calculated using Review Manager calculator
[4] GATEWAY 2020 reported by Schiavon 2020
[5] Multiple imputation analysis
[6] 95% CI crossed one line of the clinical decision threshold (0.8, 1.25)
[7] GATEWAY 2020 reported by Furlan 2021
[8] Logistic regression with the patient as random effects and interaction between group and visit (baseline and 3 years) as fixed effects

Table 30: Bariatric surgery vs no surgery

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	**Design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Bariatric surgery**	**Standard of care**	**Relative (95% CI)**	**Absolute**		
Overall mortality [MID: Line of no effect]												
1[1]	Observational study (assessed using ROBINS-I)	Very serious[2]	no serious inconsistency[3]	no serious indirectness	no serious	none	489/2010[4] (24%)	28%[5]	HR 0.69 (0.59-0.81)		⊕⊕OO LOW	CRITICAL

[1] Jamaly 2019 (Carlsson 2020 post hoc analysis)

[2] Study at high risk of bias
[3] Single study, so assessment of inconsistency not possible.
[4] Baseline risk estimated from events in whole population (not stratified by hypertension)

Obesity with cardiovascular disease

Table 31: Bariatric surgery vs no surgery

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric surgery	No Surgery	Relative (95% CI)	Absolute		
MACE (composite of cardiovascular death, non-fatal stroke and non-fatal myocardial infarction) [MID 0.8 to 1.25], latest timepoint in study												
10[1]	observational studies (data from systematic review not assessed using ROBINS-I)	no serious risk of bias[2]	very serious[3]	no serious indirectness	no serious imprecision	none	4720/73734 (6.4%)	13.8%	RR 0.55 (0.46 to 0.65)	62 fewer per 1000 (from 48 fewer to 75 fewer)	⊕OOO VERY LOW	CRITICAL
Myocardial infarction [MID 0.8 to 1.25] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	serious[7]	none	-	0.5%[8]	HR 0.30 (0.1 to 0.91)	3 fewer per 1000 (from 0 fewer to 4 fewer)	⊕⊕OO LOW	CRITICAL
Stroke [MID 0.8 to 1.25] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	very serious[9]	none	-	0.5%[8]	HR 1.03 (0.43 to 2.47)	0 more per 1000 (from 3 fewer to 7 more)	⊕OOO VERY LOW	CRITICAL
Hypertension [MID 0.8 to 1.25] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	serious[7]	none	-	8.8%[8]	HR 0.18 (0.04 to 0.86)	72 fewer per 1000 (from 12 fewer to 84 fewer)	⊕⊕OO LOW	CRITICAL
Type 2 diabetes [MID 0.8 to 1.25] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	serious[7]	none	-	6.6%[8]	HR 0.61 (0.43 to 0.86)	25 fewer per 1000 (from 9 fewer to 37 fewer)	⊕⊕OO LOW	CRITICAL
NAFLD [MID 0.8 to 1.25] (4 years)												

1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	very serious[9]	none	-	0.5%[8]	HR 0.65 (0.23 to 1.83)	2 fewer per 1000 (from 4 fewer to 4 more)	⊕OOO VERY LOW	CRITICAL
Obstructive sleep apnoea [MID 0.8 to 1.25] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	serious[7]	none	-	2%[8]	HR 0.58 (0.32 to 1.06)	8 fewer per 1000 (from 14 fewer to 1 more)	⊕⊕OO LOW	CRITICAL
Mortality [MID: Line of no effect] (4 years)												
1[4]	Observational study (assessed using ROBINS-I)	serious[5]	no serious inconsistency[6]	no serious indirectness	serious[10]	none		1.4%[8]	RR 0.58 (0.32 to 1.06)	6 fewer per 1000 (from 10 fewer to 1 more)	⊕⊕OO LOW	IMPORTANT

[1] Sutanto 2021 systematic review
[2] Quality assessment conducted as part of systematic review used newcastle ottawa scale. <33% of studies judged as moderate or high risk of bias using this scale.
[3] I2 >33.3%
[4] Douglas 2015
[5] Study at moderate risk of bias
[6] Single study, so assessment of inconsistency not possible.
[7] Confidence intervals cross 1 clinical decision threshold (0.8, 1.25)
[8] Control event rate not reported for population with pre existing CVD: taken from overall event rate for general bariatric surgery population.
[9] Confidence intervals cross 2 clinical decision thresholds (0.8, 1.25)
[10] Confidence intervals cross line of no effect (clinical decision threshold for mortality outcome)

Obesity with non-alcoholic fatty liver disease (NAFLD)

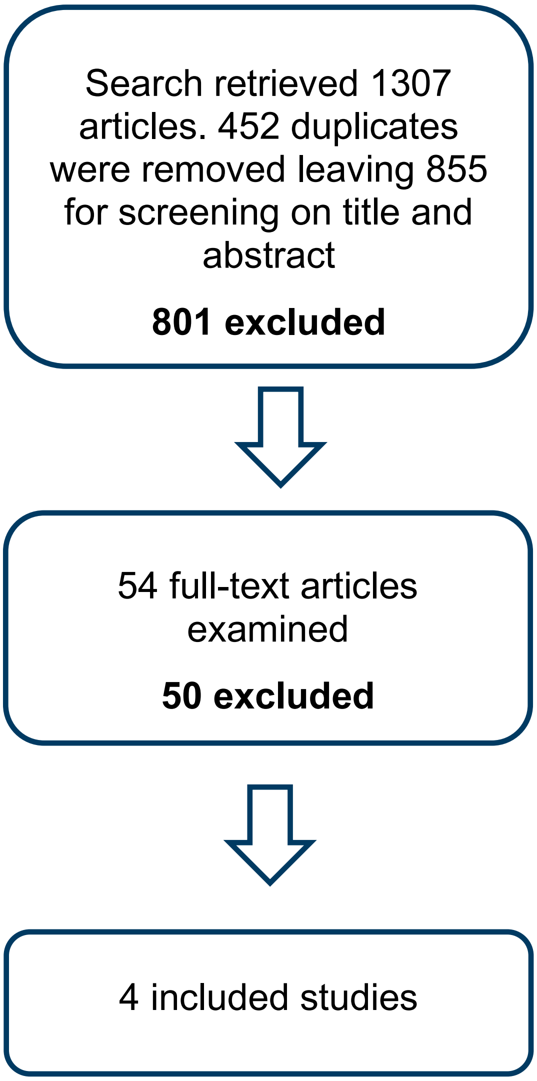
Table 32: Bariatric surgery vs no surgery

Quality assessment	No of patients	Effect	Quality	Importance

No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Bariatric Surgery	No surgery	Relative (95% CI)	Absolute		
Major adverse liver outcome [MID 0.8 to 1.25] (10 years)												
1[1]	Observational study (assessed using ROBINS-I)	very serious[2]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	-	10.7%[4]	HR 0.09 (0.02 to 0.38)	97 fewer per 1000 (from 65 fewer to 105 fewer)	⊕⊕OO LOW	CRITICAL
MACE [MID 0.8 to 1.25] (10 years)												
1[1]	Observational study (assessed using ROBINS-I)	very serious[2]	no serious inconsistency[3]	no serious indirectness	no serious imprecision	none	-	16.3%	HR 0.25 (0.12 to 0.51)	119 fewer per 1000 (from 76 fewer to 142 fewer)	⊕⊕OO LOW	CRITICAL

[1] Aminian 2021
[2] Study at serious risk of bias.
[3] Single study, so assessment of inconsistency not possible.
[4] Number of events in control arm not reported - baseline risk estimated as reported cumulative risk in control arm at 10 years.

Appendix H – Economic evidence study selection



Appendix I – Economic evidence tables

Table 1: Avenell at al. (2018)

Avenell et al. (2018). Bariatric surgery, lifestyle interventions and orlistat for severe obesity: the REBALANCE mixed-methods systematic review and economic evaluation.[1]	
Study details	**Analysis:** UKHF microsimulation model **Approach to analysis:** The simulation consisted of two modules. The first module calculated the predictions of risk factor trends over time based on data from rolling cross-sectional studies. The second module performed the microsimulation of a virtual population, generated with demographic characteristics matching those of the observed data. The health trajectory of each individual from the population was simulated over time allowing them to contract, survive or die from a set of diseases or injuries related to the analysed risk factors. **BMI related complications considered:** CHD, stroke, hypertension, type 2 diabetes mellitus, knee osteoarthritis and BMI-related cancers, including breast, colorectal, endometrial, oesophageal, pancreatic and renal. **Time horizon:** 30 years **Discounting:** 1.5% **Setting:** UK National Health Service
Interventions	**Intervention 1:** No intervention **Intervention 2:** Very low calorie diet component added to a weight management program **Intervention 3:** Roux-en-Y gastric bypass
Population	**Population: A**dult population (aged ≥ 18 years) with a BMI of ≥ 35 kg/m2 in 2016
Data sources	**Baseline/natural history:** Body mass index data were extracted from the HSE using the UK Data Service database. Data was from 2003-2014. **Incidence of long-term conditions:** Incidence, prevalence and mortality data for the BMI related complications considered were identified from searches of published literature. Incidence and mortality data for cancers in the model were from the Office for National Statistics. **Effectiveness:** Body mass index drop calculated using a meta-analyses of RCTs. **Resource use & Costs:** Only direct health-care costs of obesity-related diseases were included. These were obtained from health-care expenditure data from the published literature. Authors included cods for hospital visits (both inpatient and outpatient), primary care and medication. Interventions were costed using a component costing approach and data available from the Look AHEAD study. **QoL:** EQ-5D-based utilities for the health states incorporated in the model were obtained from the literature. For those with multiple health conditions, the authors made an independence assumption and applied a multiplicative utility.
Base-case results	

Intervention	Absolute		Incremental		
	Costs (£)	QALYs	Costs (£)	QALYs	ICER (£)
No intervention	£2,898 (£m/100k population)	1,135,676 (per 100k Population)	-	-	-
RYGB surgery	£4,319 (£m/100k population)	1,276,038 (per 100k	£1,421 (£m/100k population)	140,362 (per 100K population)	£10,126

Avenell et al. (2018). Bariatric surgery, lifestyle interventions and orlistat for severe obesity: the REBALANCE mixed-methods systematic review and economic evaluation.[1]	
	Population)
Sensitivity analyses	**Deterministic:** Sensitivity analyses varied the weight regain assumption for weight management programmes, varied the discount rate for costs and QALYs from the base-case value of 1.5% and varied the time horizon over which the interventions were analysed. **Probabilistic:** Not reported. Does not appear a PSA was performed.
Comments	**Source of funding:** National Institute for Health Research (NIHR) **Limitations:** Minor limitations (Table 6)

Table 2: Galvain et al. (2021)

Galvain et al. (2021). Cost-effectiveness of bariatric and metabolic surgery, and implications of COVID-19 in the United Kingdom.[3]	
Study details	**Analysis:** Cost utility analysis **Approach to analysis:** A Markov model was used. 30 day mortality rates were assigned to the surgery arm. Bariatric and metabolic surgery (BMS) and conventional treatment led to changes in BMI, blood pressure, lipid ratio, and rate of T2D remission accordingly. BMI affected the probability of transitioning to T2D. Age, sex, BP, LR, and T2D status affected the risk of stroke and MI, based on Framingham risk equations. Patients could occupy a diabetes health state, and transition between T2D and remission on an ongoing basis. Patients could occupy and transition between mutually exclusive health states (stroke, MI, cancer) **BMI related complications considered:** T2D, Stroke, MI, Cancer **Time horizon:** Lifetime **Discounting:** 3.5% **Setting:** UK National Health Service
Interventions	**Intervention 1:** Bariatric and metabolic surgery (BMS) **Intervention 2:** Conventional treatment (behaviour change strategies to increase patients' physical activity or decrease inactivity, improve eating behaviour and the quality of the person's diet, and reduce energy intake)
Population	**Population:** Group A (BMI>= 40kg/m2): Mean age: 46.45 Group B (BMI>= 35kg/m2): Mean age: 51.74
Data sources	**Baseline/natural history:** From an audit of patients who underwent BMS in the Bristol area. **Incidence of long-term conditions:** CPRD **Effectiveness:** Sourced via a wide range of sources from the literature. **Resource use & Costs:** Derived from NHS Reference costs, CPRD related studies, National Stroke registry and other UK based sources and cost-effectiveness studies. **QoL:** Baseline utility sourced from Lee et al who reported results for a large UK population stratified by BMI groups. Disutility from surgery was assumed to be the same as hernia repair. Disutility from diabetes from from Sullivan et al which provided a catalogue of eq-5D scores for the UK based on the analysis of the US based Medical Expenditure Panel Survey (2000-03) and the application of community based UK preferences to this analysis. Disutility from stroke and MI from UK based study.
Base-case results	(see table below)

	Intervention	Absolute		Incremental		
		Costs (£)	QALYs	Costs (£)	QALYs	ICER (£)
Group A	Conventional treatment	£51,519	7.81	-	-	-

Galvain et al. (2021). Cost-effectiveness of bariatric and metabolic surgery, and implications of COVID-19 in the United Kingdom.[3]	
	<table><tr><td></td><td>BMS</td><td>£46,691</td><td>12.02</td><td>-£4,828</td><td>4.21</td><td>Dominated</td></tr><tr><td rowspan="2">Group B</td><td>Conventional treatment</td><td>£67,085</td><td>7.03</td><td>-</td><td>-</td><td>-</td></tr><tr><td>BMS</td><td>£59,258</td><td>9.30</td><td>-£7,827</td><td>2.27</td><td>Dominated</td></tr></table>
Sensitivity analyses	**Deterministic:** Sensitivity analyses were performed to look at the impact of covid, delayed surgery and endoscopy on results. Covid and delayed surgery both resulted in an increase in the NMB for groups A and B. **Probabilistic:** In the PSA, BMS was associated with cost savings in all simulations for both groups and generated higher QALYs in 99.9% and 100% of simulations in Group A and Group B,
Comments	**Source of funding:** National Institute for Health Research (NIHR) **Limitations:** Minor limitations (Table 6)

Table 3: Gulliford et al. (2016)

Gulliford et al. (2016). Costs and outcomes of increasing access to bariatric surgery for obesity: cohort study and cost-effectiveness analysis using electronic health records.[4]	
Study details	**Analysis:** Cost utility analysis **Approach to analysis:** A probabilistic Markov model was used. Health states were stratified by status of depression, BMI category, gender and age. Participants could transition between BMI categories. Intervention effects were applied to diabetes, CHD, Stroke, Cancer and Depression. **BMI related complications considered:** Complications considered included diabetes mellitus, CHD, stroke and cancer. Each state was further subdivided into 'depressed' and 'not depressed'. **Time horizon:** 100 years **Discounting:** 3.5% **Setting:** UK National Health Service
Interventions	**Intervention 1:** Bariatric surgery **Intervention 2:** No surgery
Population	**Population:** Adults >=20 years; Mean age: 46; Females: 50%; BMI>40 kg/m2
Data sources	**Baseline/natural history:** Baseline population was sourced from the CPRD **Incidence of long-term conditions:** CPRD **Effectiveness:** Relative risks for depression and diabetes were sourced from CPRD analysis. Relative risks of Stroke, CHD and Cancer were sourced from the Swedish Obese Subjects trial. **Resource use & Costs:** Cost of Bariatric surgery was based on NHS tariff information. Unit costs of healthcare based on PSSRU, prescription costs from RESIP UK. **QoL:** All utility values were sourced from Sullivan et al which provided a catalogue of eq-5D scores for the UK based on the analysis of the US based Medical Expenditure Panel Survey (2000-03) and the application of community based UK preferences to this analysis.
Base-case results	<table><tr><th rowspan="2">Intervention</th><th colspan="2">Absolute</th><th colspan="3">Incremental</th></tr><tr><th>Costs (£)</th><th>QALYs</th><th>Costs (£)</th><th>QALYs</th><th>ICER (£)</th></tr></table>

Gulliford et al. (2016). Costs and outcomes of increasing access to bariatric surgery for obesity: cohort study and cost-effectiveness analysis using electronic health records.[4]	
	<table><tr><td>Bariatric surgery</td><td>£67,250</td><td>14.509</td><td>-</td><td>-</td><td>-</td></tr><tr><td>No Bariatric surgery</td><td>£51,990</td><td>12.367</td><td>£15,260</td><td>2.142</td><td>£7,129</td></tr></table>
Sensitivity analyses	**Deterministic:** Sensitivity analyses were performed to look at the cost-effectiveness of Bariatric surgery for different age categories, genders, BMI groups, and categories of deprivation (defined by IMD groups). Sensitivity analyses was also performed by varying the cost of Bariatric surgery, discount rates, assuming diminishing intervention effects. Results did not vary significantly across gender, age, and deprivation categories. ICERs increased marginally when considering a population with BMI of 35-39 kg/m2. Results were very sensitive to changes in costs of procedure, and decline in intervention effects over time. **Probabilistic:** A PSA was performed with 95% Cis included for all projected results.
Comments	**Source of funding:** National Institute for Health Research (NIHR) **Limitations:** Minor limitations (Table 6)

Table 4: Harrison et al. (2021)

Harrison et al. (2021). Long-term cost-effectiveness of interventions for obesity: A mendelian randomisation study.[5]	
Study details	**Analysis:** Cost utility analysis **Approach to analysis:** Mendelian randomisation – Genetic information used as an instrumental variable to reduce the risk of bias through confounding and reverse causation. Costs and QALYs calculated using observational data from UK Biobank. **BMI related complications considered:** Cancer, cardiovascular disease, stroke, type 2 diabetes **Time horizon:** 20 years **Discounting:** 3.5% **Perspective:** UK National Health Service
Interventions	**Intervention 1:** No intervention **Intervention 2:** Laparoscopic bariatric surgery
Population	**Population:** Adults aged 40 to 69 years with a BMI above 35 kg/m^2 **Characteristics:** Individuals with data recorded in UK Biobank – main analyses restricted to unrelated individuals of white British ancestry living in England or Wales at recruitment, with a measured BMI value
Data sources	**Baseline/natural history:** UK Biobank observational data **Incidence of long-term conditions:** UK Biobank observational data **Effectiveness:** UK Biobank observational data used to calculate the costs and QALYs for people who received laparoscopic bariatric surgery compared with those who did not. **Resource use & costs:** Medical data for hospital episode statistics and primary care has been linked to UK Biobank participants using EMIS Health and TPP software systems. Primary care costs estimated between recruitment and 31 March 2017 by summing the cost of prescribed drugs and appointments at a GP practice. Prescribed drugs estimated using the NHS drug tariff November 2019 version. Secondary care costs estimated by converting procedure and diagnosis ICD-10 code into healthcare resource groups using HES data for England and Patient Episode Database for Wales. Total healthcare costs calculated by combining the average primary and secondary care healthcare costs for each person.

Harrison et al. (2021). Long-term cost-effectiveness of interventions for obesity: A mendelian randomisation study.[5]	
	QoL: Disutility of all 240 ICD-9 coded health conditions estimates with multiple regression (age, sex, ethnicity, education level, income and number of comorbid health conditions as covariates). The results of this regression were then used to code each of the 240 health conditions for each participant in the UK Biobank daily from recruitment to 31 March 2017. Health-related quality of life was then predicted by multiplying the value of each covariate against the coefficient of disutility for that variable and summing across all covariables and the constant. The authors then averaged predicted health-related quality of life between recruitment and the end of follow-up to estimate each participant's quality-adjusted life years per year of follow-up. Assumed that bariatric surgery has no impact on QALYs, therefore any impact on QoL is observed from a reduction in BMI and comorbidities.

Base-case results

	Absolute		Incremental		
	Costs - £ (95% CI)	**QALYs (95% CI)**	**Costs - £ (95% CI)**	**QALYs (95% CI)**	**ICER (£/QALY)**
No intervention	NR	NR	-	-	-
Laparoscopic bariatric surgery	NR	NR	-£5,096 (-£3,459 to -£6,852)	0.92 (0.66 to 1.17)	Dominant

Sensitivity analyses	**Deterministic:** Sensitivity analysis undertaken to test the mendelian randomisation assumption of no pleiotropy, stratifying the main analysis by age group, accounting for prediction uncertainty in QALYs and testing whether decision analytic simulation models incorporate enough health conditions to accurately estimate the effect of BMI on QALYs. The final sensitivity analysis found a substantial difference between models only using a limited number of health conditions (cancer, cardiovascular disease, cerebrovascular disease, and type 2 diabetes) and the full model. However, as BMI should have affected more health conditions than just cancer, cardiovascular disease, stroke and type 2 diabetes, the results from the base case analysis was considered to be more convincing. **Probabilistic:** NR
Comments	**Source of funding:** The Medical Research Council (MRC) and the University of Bristol support the MRC Integrative Epidemiology Unit. This work was part of a project entitled 'social and economic consequences of health: causal inference methods and longitudinal intergenerational data', which is part of the Health Foundation's Social and Economic Value of Health Programme. **Limitations:** Minor limitations (Table 6)

Table 5: Applicability checklist

Study	1.1 Is the study population appropriate for the review question?	1.2 Are the interventions appropriate for the review question?	1.3 Is the system in which the study was conducted sufficiently similar to the current UK context?	1.4 Is the perspective for costs appropriate for the review question?	1.5 Is the perspective for outcomes appropriate for the review question?	1.6 Are all future costs and outcomes discounted appropriately?	1.7 Are QALYs, derived using NICE's preferred methods, or an appropriate social care-related equivalent used as an outcome?	1.8 Overall judgement
Avenell et al. (2018)	Yes	Yes	Yes	Yes (UK based study with an NHS perspective)	Yes (UK based study with an NHS perspective)	Partly (Discounted at 1.5%)	Yes (EQ-5D scores have been used)	Directly applicable
Galvain et al. (2021)	Yes	Yes	Yes (UK based study with an NHS perspective)	Yes (UK based study with an NHS perspective)	Yes (UK based study with an NHS perspective)	Yes (Discounted at 3.5%)	Yes (EQ-5D scores have been used)	Partially applicable
Gulliford et al. (2016)	Yes	No (Conventional treatment is the comparison arm)	Yes (UK based study with an NHS perspective)	Yes (UK based study with an NHS perspective)	Yes (UK based study with an NHS perspective)	Yes (Discounted at 3.5%)	Yes (EQ-5D scores have been used)	Directly applicable
Harrison et al. (2021)[1]	Partly (main analyses restricted to unrelated individuals of white British ancestry living in England or Wales, UK Biobank noted as not representative of the UK population as participants tend to be wealthier and healthier than the UK as a whole)	Yes	Yes	Yes	Yes	Yes	Partly (QALYs only reported for 31% of participants, multiple imputation by chained equations to predict QALYs for remaining 69% of the cohort)	Partially applicable

Table 6: Limitations checklist

Study	2.1 Does the model structure adequately reflect the nature of the topic under evaluation?	2.2 Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?	2.3 Are all important and relevant outcomes included?	2.4 Are the estimates of baseline outcomes from the best available source?	2.5 Are the estimates of relative intervention effects from the best available source?	2.6 Are all important and relevant costs included?	2.7 Are the estimates of resource use from the best available source?	2.8 Are the unit costs of resources from the best available source?	2.9 Is an appropriate incremental analysis presented or can it be calculated from the data?	2.10 Are all important parameters whose values are uncertain subjected to appropriate sensitivity analysis?	2.11 Has no potential financial conflict of interest been declared?	2.12 Overall assessment
Avenell et al. (2018)	Yes	Partly (results are presented over a 30 year time horizon)	Yes	Yes (Sourced from systematic review of the literature)	Yes (Obtained from systematic literature review)	Yes	Yes	Yes (UK specific sources have been used)	Yes	Partly (Appropriate deterministic analysis has been performed but probabilistic sensitivity analysis was not performed)	Yes	Minor limitations
Galvain et al. (2021)	Yes	Yes (100 years)	Yes (Not all CVD events have been considered)	Partly (Informed by the CPRD dataset)	Partly (Not identified via a systematic review with appropriate evidence synthesis methods)	Yes	Yes (UK specific sources have been used)	Yes (UK specific sources have been used)	Yes	Yes (Appropriate deterministic and probabilistic sensitivity analysis has been performed)	Yes	Minor limitations
Gulliford et al. (2016)	Yes	Yes (Lifetime)	Yes (Not all CVD events have been considered. Depression	Partly (Sourced from audit data)	Partly (Not identified via a systematic review with appropriate evidence	Partly (Depression costs have not been included)	Yes (UK specific sources have been used)	Yes (UK specific sources have been used)	Yes	Yes (Appropriate deterministic and probabilistic sensitivity	No (Funded by Johnson & Johnson)	Minor limitations

Study	2.1 Does the model structure adequately reflect the nature of the topic under evaluation?	2.2 Is the time horizon sufficiently long to reflect all important differences in costs and outcomes?	2.3 Are all important and relevant outcomes included?	2.4 Are the estimates of baseline outcomes from the best available source?	2.5 Are the estimates of relative intervention effects from the best available source?	2.6 Are all important and relevant costs included?	2.7 Are the estimates of resource use from the best available source?	2.8 Are the unit costs of resources from the best available source?	2.9 Is an appropriate incremental analysis presented or can it be calculated from the data?	2.10 Are all important parameters whose values are uncertain subjected to appropriate sensitivity analysis?	2.11 Has no potential financial conflict of interest been declared?	2.12 Overall assessment
			has not been considered)		synthesis methods. Intervention effects have been sourced from various hand picked studies from the literature.)					analysis has been performed)		
Harrison et al. (2021)[1]	Yes	Partly (results are presented over a 20 year time horizon)	Yes	Yes	Yes	Partly (costs for emergency care, outpatient appointments, private healthcare, diagnostic tests were excluded)	Yes	Yes	Yes	Yes	Yes	Minor limitations

Appendix J – Health economic model

No economic analysis was conducted for this review question.

1 # Appendix K – Excluded studies

2 ## Clinical studies

Study	Reason for exclusion
Acquafresca, Pablo A, Palermo, Mariano, Rogula, Tomasz et al. (2015) Early surgical complications after gastric by-pass: a literature review. Arquivos brasileiros de cirurgia digestiva : ABCD = Brazilian archives of digestive surgery 28(1): 74-80	- Review article but not a systematic review
Adams, Ted D, Davidson, Lance E, Litwin, Sheldon E et al. (2017) Weight and Metabolic Outcomes 12 Years after Gastric Bypass. The New England journal of medicine 377(12): 1143-1155	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Adegbola, Samuel; Tayeh, Salim; Agrawal, Sanjay (2014) Systematic review of laparoscopic adjustable gastric banding in patients with body mass index <=35 kg/m2. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 10(1): 155-60	- Not a relevant study design *No meta-analysis*
Agarwal, Lokesh, Sahu, Ankit Kumar, Baksi, Aditya et al. (2021) Safety of metabolic and bariatric surgery in obese patients with liver cirrhosis: a systematic review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 17(3): 525-537	- Not an SR of comparative observational studies
Aggarwal, Ravi, Harling, Leanne, Efthimiou, Evangelos et al. (2016) The Effects of Bariatric Surgery on Cardiac Structure and Function: a Systematic Review of Cardiac Imaging Outcomes. Obesity surgery 26(5): 1030-40	- Not an SR of comparative observational studies
Aguiar, Magda, Frew, Emma, Mollan, Susan P et al. (2021) The Health Economic Evaluation of Bariatric Surgery Versus a Community Weight Management Intervention Analysis from the Idiopathic Intracranial Hypertension Weight Trial (IIH:WT). Life (Basel, Switzerland) 11(5)	- Not a relevant study design *Health economics study*
Ahlin, S, Peltonen, M, Sjoholm, K et al. (2020) Fracture risk after three bariatric surgery procedures in Swedish obese subjects: up to 26 years follow-up of a controlled intervention study. Journal of internal medicine 287(5): 546-557	- Outcome reported does not match that specified in protocol

Study	Reason for exclusion
Ahmed, Saleem, Pouwels, Sjaak, Parmar, Chetan et al. (2021) Outcomes of Bariatric Surgery in Patients with Liver Cirrhosis: a Systematic Review. Obesity surgery 31(5): 2255-2267	- Not an SR of comparative observational studies
Ahnis, Anne, Figura, Andrea, Hofmann, Tobias et al. (2015) Surgically and conservatively treated obese patients differ in psychological factors, regardless of body mass index or obesity-related co-morbidities: a comparison between groups and an analysis of predictors. PloS one 10(2): e0117460	- Not a relevant study design *Cross sectional analysis of baseline psychological characteristics in both groups*
Akhter, Zainab, Rankin, Judith, Ceulemans, Dries et al. (2019) Pregnancy after bariatric surgery and adverse perinatal outcomes: A systematic review and meta-analysis. PLoS medicine 16(8): e1002866	- SR not of a subgroup of interest
Al Khalifa, Khalid, Al Ansari, Ahmed, Alsayed, Abdul Rahim et al. (2013) The impact of sleeve gastrectomy on hyperlipidemia: a systematic review. Journal of obesity 2013: 643530	- Not a relevant study design *No meta-analysis*
Al-Nimr, Rima Itani, Hakeem, Rubina, Moreschi, Julie M et al. (2019) Effects of Bariatric Surgery on Maternal and Infant Outcomes of Pregnancy-An Evidence Analysis Center Systematic Review. Journal of the Academy of Nutrition and Dietetics 119(11): 1921-1943	- Not a relevant study design *No meta-analysis*
Aleassa, Essa M, Khorgami, Zhamak, Kindel, Tammy L et al. (2019) Impact of bariatric surgery on heart failure mortality. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(7): 1189-1196	- Not a relevant study design
Aleman, Rene, Lo Menzo, Emanuele, Szomstein, Samuel et al. (2020) Efficiency and risks of one-anastomosis gastric bypass. Annals of translational medicine 8(suppl1): 7	- Review article but not a systematic review
Alibhai, Kameela, Churchill, Isabella, Vause, Tannys et al. (2022) The impact of bariatric surgery on assisted reproductive technology outcomes: a systematic review protocol. Systematic reviews 11(1): 1	- Study protocol and baseline characteristics

Study	Reason for exclusion
Alsumali, Adnan, Al-Hawag, Ali, Bairdain, Sigrid et al. (2018) The impact of bariatric surgery on pulmonary function: a meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 14(2): 225-236	- Not an SR of comparative observational studies *Included uncontrolled studies*
Amundsen, Tina; Strommen, Magnus; Martins, Catia (2017) Suboptimal Weight Loss and Weight Regain after Gastric Bypass Surgery-Postoperative Status of Energy Intake, Eating Behavior, Physical Activity, and Psychometrics. Obesity surgery 27(5): 1316-1323	- Comparator in study does not match that specified in protocol
Andersen, John Roger, Aasprang, Anny, Karlsen, Tor-Ivar et al. (2015) Health-related quality of life after bariatric surgery: a systematic review of prospective long-term studies. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 11(2): 466-73	- Not a relevant study design *No meta-analysis was reported*
Anonymous (2019) Correction to: Effects of Bariatric Surgery in Obese Patients With Hypertension: The GATEWAY Randomized Trial (Gastric Bypass to Treat Obese Patients With Steady Hypertension). Circulation 140(14): e718	- Study included a comorbidity that is not a subgroup of interest
Anvari, Sama, Lee, Yung, Lam, Megan et al. (2022) Effect of Bariatric Surgery on Natriuretic Peptide Levels: A Systematic Review and Meta-Analysis. Cardiology in review 30(1): 8-15	- SR not of a subgroup of interest
Arhi, Chanpreet Singh, Dudley, Roise, Moussa, Osama et al. (2021) The Complex Association Between Bariatric Surgery and Depression: a National Nested-Control Study. Obesity Surgery 31(5): 1994-2001	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Arterburn, David E, Johnson, Eric, Coleman, Karen J et al. (2021) Weight Outcomes of Sleeve Gastrectomy and Gastric Bypass Compared to Nonsurgical Treatment. Annals of surgery 274(6): e1269-e1276	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Arterburn, David E, Olsen, Maren K, Smith, Valerie A et al. (2015) Association between bariatric surgery and long-term survival. JAMA 313(1): 62-70	- Study included people with type 2 diabetes *>50% of people with T2D*

Study	Reason for exclusion
Ashrafian, Hutan, Toma, Tania, Rowland, Simon P et al. (2015) Bariatric Surgery or Non-Surgical Weight Loss for Obstructive Sleep Apnoea? A Systematic Review and Comparison of Meta-analyses. Obesity surgery 25(7): 1239-50	- Not an SR of comparative observational studies
Athanasiadis, Dimitrios I, Martin, Anna, Kapsampelis, Panagiotis et al. (2021) Factors associated with weight regain post-bariatric surgery: a systematic review. Surgical endoscopy 35(8): 4069-4084	- Not an SR of comparative observational studies
Auclair, Audrey, Biertho, Laurent, Marceau, Simon et al. (2017) Bariatric Surgery-Induced Resolution of Hypertension and Obstructive Sleep Apnea: Impact of Modulation of Body Fat, Ectopic Fat, Autonomic Nervous Activity, Inflammatory and Adipokine Profiles. Obesity surgery 27(12): 3156-3164	- Comparator in study does not match that specified in protocol
Avenell, Alison, Robertson, Clare, Skea, Zoe et al. (2020) Corrigendum: Bariatric surgery, lifestyle interventions and orlistat for severe obesity: the REBALANCE mixed-methods systematic review and economic evaluation. Health technology assessment (Winchester, England) 22(68): 247-250	- Systematic review of RCTs, references checked
Baheeg, Mohamad, Tag El-Din, Mohamed, Labib, Mohamed Fathy et al. (2021) Long-term durability of weight loss after bariatric surgery; a retrospective study. International Journal of Surgery Open 28: 37-40	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Baldwin, Dustin; Chennakesavalu, Mohansrinivas; Gangemi, Antonio (2019) Systematic review and meta-analysis of Roux-en-Y gastric bypass against laparoscopic sleeve gastrectomy for amelioration of NAFLD using four criteria. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(12): 2123-2130	- Not an SR of comparative observational studies
Benaiges, David, Climent, Elisenda, Goday, Albert et al. (2019) Bariatric surgery and hypertension: Implications and perspectives after the GATEWAY randomized trial. Cardiovascular Diagnosis and Therapy 9(1): 100-103	- Editorial only
Benjamim, Cicero Jonas R, Pontes, Yasmim Mota de M, de Sousa Junior, Francisco	- Data not reported in an extractable format

Study	Reason for exclusion
Welington et al. (2021) Does bariatric surgery improve cardiac autonomic modulation assessed by heart rate variability? A systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 17(8): 1497-1509	
Benotti, Peter N, Wood, G Craig, Carey, David J et al. (2017) Gastric Bypass Surgery Produces a Durable Reduction in Cardiovascular Disease Risk Factors and Reduces the Long-Term Risks of Congestive Heart Failure. Journal of the American Heart Association 6(5)	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Berger, Sebastian, Meyre, Pascal, Blum, Steffen et al. (2018) Bariatric surgery among patients with heart failure: a systematic review and meta-analysis. Open heart 5(2): e000910	- SR not of a subgroup of interest
Berney, Maxime, Vakilzadeh, Nima, Maillard, Marc et al. (2021) Bariatric Surgery Induces a Differential Effect on Plasma Aldosterone in Comparison to Dietary Advice Alone. Frontiers in endocrinology 12: 745045	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Bolignano, Davide and Zoccali, Carmine (2013) Effects of weight loss on renal function in obese CKD patients: a systematic review. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association 28suppl4: iv82-98	- Not an SR of comparative observational studies
Bower, Guy, Toma, Tania, Harling, Leanne et al. (2015) Bariatric Surgery and Non-Alcoholic Fatty Liver Disease: a Systematic Review of Liver Biochemistry and Histology. Obesity surgery 25(12): 2280-9	- Not an SR of comparative observational studies
Brown, Andrew M, Yang, Jie, Zhang, Xiaoyue et al. (2020) Bariatric Surgery Lowers the Risk of Major Cardiovascular Events. Annals of surgery	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *no adjustment/matching on BMI*
Buchwald, H; Buchwald, J N; McGlennon, T W (2014) Systematic review and meta-analysis of medium-term outcomes after banded Roux-en-Y gastric bypass. Obesity surgery 24(9): 1536-51	- Not an SR of comparative observational studies
Canetti, Laura, Elizur, Yoel, Karni, Yair et al. (2013) Health-related quality of life changes and	- Study does not contain a relevant intervention

Study	Reason for exclusion
weight reduction after bariatric surgery vs. a weight-loss program. The Israel journal of psychiatry and related sciences 50(3): 194-200	*Majority of participants had intervention not listed in protocol*
Cardoso, Luis, Rodrigues, Dircea, Gomes, Leonor et al. (2017) Short- and long-term mortality after bariatric surgery: A systematic review and meta-analysis. Diabetes, obesity & metabolism 19(9): 1223-1232	- SR not of a subgroup of interest
Carlsson, Lena M S, Sjoholm, Kajsa, Karlsson, Cecilia et al. (2017) Long-term incidence of microvascular disease after bariatric surgery or usual care in patients with obesity, stratified by baseline glycaemic status: a post-hoc analysis of participants from the Swedish Obese Subjects study. The lancet. Diabetes & endocrinology 5(4): 271-279	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Ceriani, Valerio, Sarro, Giuliano, Micheletto, Giancarlo et al. (2019) Long-term mortality in obese subjects undergoing malabsorptive surgery (biliopancreatic diversion and biliointestinal bypass) versus medical treatment. International journal of obesity (2005) 43(6): 1147-1153	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Challapalli, Jothika, Maynes, Elizabeth J, O'Malley, Thomas J et al. (2020) Sleeve Gastrectomy in Patients with Continuous-Flow Left Ventricular Assist Devices: a Systematic Review and Meta-Analysis. Obesity surgery 30(11): 4437-4445	- Comparator in study does not match that specified in protocol
Chang, Catherine, Chang, Steven, Poles, Jillian et al. (2021) The Impact of Bariatric Surgery Compared to Metformin Therapy on Pregnancy Outcomes in Patients with Polycystic Ovarian Syndrome: a Systematic Review and Meta-analysis. Journal of gastrointestinal surgery : official journal of the Society for Surgery of the Alimentary Tract 25(2): 378-386	- Not an SR of comparative observational studies
Chang, S-H, Freeman, N L B, Lee, J A et al. (2018) Early major complications after bariatric surgery in the USA, 2003-2014: a systematic review and meta-analysis. Obesity reviews : an official journal of the International Association for the Study of Obesity 19(4): 529-537	- Not an SR of comparative observational studies
Chatzistergiou, T Konstantinos, Zervaki, D Styliani, Derouich, Mohamed et al. (2021)	- Not an SR of comparative observational studies

Study	Reason for exclusion
Laparoscopic sleeve gastrectomy and pregnancy outcomes: A systematic review. European journal of obstetrics, gynecology, and reproductive biology 256: 339-347	
Chaves Pereira de Holanda, Narriane, de Lima Carlos, Ingrid, Chaves de Holanda Limeira, Caio et al. (2022) Fracture Risk After Bariatric Surgery: A Systematic Literature Review and Meta-Analysis. Endocrine practice : official journal of the American College of Endocrinology and the American Association of Clinical Endocrinologists 28(1): 58-69	- SR not of a subgroup of interest
Chen, Jian-Han, Wei, Yu-Feng, Chen, Chung-Yen et al. (2021) Decreased Long-Term Respiratory Infection Risk After Bariatric Surgery: a Comprehensive National Cohort Study. Obesity surgery 31(2): 499-507	- Outcome reported does not match that specified in protocol
Chen, Yufei, Chen, Lijia, Ye, Lingxia et al. (2021) Association of Metabolic Syndrome With Prevalence of Obstructive Sleep Apnea and Remission After Sleeve Gastrectomy. Frontiers in physiology 12: 650260	- Comparator in study does not match that specified in protocol
Cheng, Ji, Gao, Jinbo, Shuai, Xiaoming et al. (2016) The comprehensive summary of surgical versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomized controlled trials. Oncotarget 7(26): 39216-39230	- Systematic review of RCTs, references checked
Clapp, Benjamin, Wynn, Matthew, Martyn, Colin et al. (2018) Long term (7 or more years) outcomes of the sleeve gastrectomy: a meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 14(6): 741-747	- Not an SR of comparative observational studies
Coblijn, Usha K, Goucham, Amin B, Lagarde, Sjoerd M et al. (2014) Development of ulcer disease after Roux-en-Y gastric bypass, incidence, risk factors, and patient presentation: a systematic review. Obesity surgery 24(2): 299-309	- Not an SR of comparative observational studies
Cohen, Ricardo V., Petry, Tarissa Beatrice Zanata, Aboud, Cristina Mamedio et al. (2021) Renoprotective effects of the combination of empagliflozin and liraglutide compared with roux-en-y gastric bypass in early-stage diabetic	- Study included people with type 2 diabetes

Study	Reason for exclusion
kidney disease: A post hoc analysis of the microvascular outcomes after metabolic surgery (moms) randomized controlled clinical trial. Diabetes Care 44(10): e177-e179	
Cohen, Ricardo; Sforza, Noelia S; Clemente, Romina G (2021) Impact of Metabolic Surgery on Type 2 Diabetes Mellitus, Cardiovascular Risk Factors, and Mortality: A Review. Current hypertension reviews 17(2): 159-169	- Review article but not a systematic review
Colquitt, Jill L, Pickett, Karen, Loveman, Emma et al. (2014) Surgery for weight loss in adults. The Cochrane database of systematic reviews: cd003641	- Systematic review of RCTs, references checked
Conley, Marguerite M, McFarlane, Catherine M, Johnson, David W et al. (2021) Interventions for weight loss in people with chronic kidney disease who are overweight or obese. The Cochrane database of systematic reviews 3: cd013119	- Systematic review of RCTs, references checked
Consalvo, Vincenzo; Canero, Antonio; Salsano, Vincenzo (2017) Bariatric Surgery and Infertility: A Prospective Study. Surgical technology international 31: 327-330	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Cornejo-Pareja, Isabel, Molina-Vega, Maria, Gomez-Perez, Ana Maria et al. (2021) Factors Related to Weight Loss Maintenance in the Medium-Long Term after Bariatric Surgery: A Review. Journal of clinical medicine 10(8)	- Review article but not a systematic review *Quantitative data on wrong comparison - surgery vs surgery*
Cosentino, Claudia, Marchetti, Cristiano, Monami, Matteo et al. (2021) Efficacy and effects of bariatric surgery in the treatment of obesity: Network meta-analysis of randomized controlled trials. Nutrition, metabolism, and cardiovascular diseases : NMCD 31(10): 2815-2824	- Systematic review of RCTs, references checked
Courcoulas, Anita P, Johnson, Eric, Arterburn, David E et al. (2021) Reduction in Long-term Mortality after Sleeve Gastrectomy and Gastric Bypass Compared to Non-surgical Patients with Severe Obesity. Annals of surgery	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Currie, Andrew C, Askari, Alan, Fangueiro, Ana et al. (2021) Network Meta-Analysis of Metabolic Surgery Procedures for the Treatment of	- Comparator in study does not match that specified in protocol

Study	Reason for exclusion
Obesity and Diabetes. Obesity surgery 31(10): 4528-4541	
Cuspidi, Cesare, Rescaldani, Marta, Tadic, Marijana et al. (2014) Effects of bariatric surgery on cardiac structure and function: a systematic review and meta-analysis. American journal of hypertension 27(2): 146-56	- Not an SR of comparative observational studies
Dash, Satya, Everett, Karl, Jackson, Timothy et al. (2021) Cardiorenal outcomes in eligible patients referred for bariatric surgery. Obesity (Silver Spring, Md.) 29(12): 2035-2043	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
daSilva-deAbreu, Adrian, Alhafez, Bader Aldeen, Curbelo-Pena, Yuhamy et al. (2021) Bariatric Surgery in Patients with Obesity and Ventricular Assist Devices Considered for Heart Transplantation: Systematic Review and Individual Participant Data Meta-analysis. Journal of cardiac failure 27(3): 338-348	- Not an SR of comparative observational studies *Case series included in analysis*
Dawson, Alison J, Sathyapalan, Thozhukat, Sedman, Peter et al. (2014) Insulin resistance and cardiovascular risk marker evaluation in morbid obesity 12 months after bariatric surgery compared to weight-matched controls. Obesity surgery 24(3): 349-58	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
de Barros, Fernando and Cardoso Faleiro Uba, Pedro Henrique (2021) Liver transplantation and bariatric surgery: a new surgical reality: a systematic review of the best time for bariatric surgery. Updates in surgery 73(5): 1615-1622	- Not an SR of comparative observational studies
de Miranda Neto, Antonio Afonso, de Moura, Diogo Turiani Hourneaux, Ribeiro, Igor Braga et al. (2020) Efficacy and Safety of Endoscopic Sleeve Gastroplasty at Mid Term in the Management of Overweight and Obese Patients: a Systematic Review and Meta-Analysis. Obesity surgery 30(5): 1971-1987	- Study does not contain a relevant intervention
de Sousa, Alan Robson Trigueiro, Freitas Junior, Wilson Rodrigues, Perez, Eduardo Araujo et al. (2021) Surgery for Obesity and Weight-Related Diseases Changes the Inflammatory Profile in Women with Severe Obesity: a Randomized Controlled Clinical Trial. Obesity surgery 31(12): 5224-5236	- Secondary publication of an included study that does not provide any additional relevant information

Study	Reason for exclusion
Di Lorenzo, Nicola, Antoniou, Stavros A, Batterham, Rachel L et al. (2020) Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO and ESPCOP. Surgical endoscopy 34(6): 2332-2358	- Systematic review of RCTs references checked
Dicker, Dror, Greenland, Philip, Leibowitz, Morton et al. (2021) All-Cause Mortality of Patients With and Without Diabetes Following Bariatric Surgery: Comparison to Non-surgical Matched Patients. Obesity surgery 31(2): 755-762	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Dix, Clare F; Bauer, Judith D; Wright, Olivia R L (2017) A Systematic Review: Vitamin D Status and Sleeve Gastrectomy. Obesity surgery 27(1): 215-225	- Not an SR of comparative observational studies
Dixon, J, Schachter, L, O'brien, P et al. (2012) Surgical versus conventional therapy for weight loss treatment of obstructive sleep apnea: a randomized controlled trial. Sleep and biological rhythms 10: 40-41	- Conference abstract
Dixon, John, Schachter, Linda M, O'Brien, Paul E. et al. (2012) Surgical Versus Conventional Therapy For Weight Loss Treatment Of Obstructive Sleep Apnea: A Randomized Controlled Trial. B108. DIAGNOSTIC AND THERAPEUTIC APPROACHES IN SLEEP APNEA na(na): na-na	- Conference abstract
Dixon, John, Strauss, Boyd Josef Gimnicher, Laurie, Cheryl et al. (2007) Changes in body composition with weight loss: obese subjects randomized to surgical and medical programs. Obesity (Silver Spring, Md.) 15(5): 1187-1198	- Secondary publication of an included study that does not provide any additional relevant information
Dolan, Russell D, Baker, Jason, Harer, Kimberly et al. (2021) Small Intestinal Bacterial Overgrowth: Clinical Presentation in Patients with Roux-en-Y Gastric Bypass. Obesity surgery 31(2): 564-569	- Outcome reported does not match that specified in protocol
Domenech-Ximenos, Blanca, Cuba, Victor, Daunis-I-Estadella, Pepus et al. (2020) Bariatric Surgery-Induced Changes in Intima-Media Thickness and Cardiovascular Risk Factors in Class 3 Obesity: A 3-Year Follow-Up Study. Obesity (Silver Spring, Md.) 28(9): 1663-1670	- Does not contain relevant control group *Healthy control group used*

Study	Reason for exclusion
Doumouras, Aristithes G, Wong, Jorge A, Paterson, J Michael et al. (2021) Bariatric Surgery and Cardiovascular Outcomes in Patients With Obesity and Cardiovascular Disease:: A Population-Based Retrospective Cohort Study. Circulation 143(15): 1468-1480	- Study included people with type 2 diabetes *>50% population with type 2 diabetes*
Driscoll, Shannon, Gregory, Deborah M, Fardy, John M et al. (2016) Long-term health-related quality of life in bariatric surgery patients: A systematic review and meta-analysis. Obesity (Silver Spring, Md.) 24(1): 60-70	- SR not of a subgroup of interest
Due-Petersson, Rasmus, Poulsen, Inge Marie, Hedback, Nora et al. (2020) Effect and safety of endoscopic sleeve gastroplasty for treating obesity - a systematic review. Danish medical journal 67(11)	- Study does not contain a relevant intervention
Ebell, Mark H (2017) Bariatric Surgery Improves Quality of Life and Results in More Weight Loss Than Intensive Medical Therapy. American family physician 95(12): 805	- Study included people with type 2 diabetes
Elzouki, Abdel-Naser, Waheed, Muhammad-Aamir, Suwileh, Salah et al. (2022) Evolution of gastroesophageal reflux disease symptoms after bariatric surgery: A dose-response meta-analysis. Surgery open science 7: 46-51	- Comparator in study does not match that specified in protocol
Emile, Sameh Hany, Mahdy, Tarek, Schou, Carl et al. (2021) Systematic review of the outcome of single-anastomosis sleeve ileal (SASI) bypass in treatment of morbid obesity with proportion meta-analysis of improvement in diabetes mellitus. International journal of surgery (London, England) 92: 106024	- Study does not contain a relevant intervention
Enani, Ghada, Bilgic, Elif, Lebedeva, Ekaterina et al. (2020) The incidence of iron deficiency anemia post-Roux-en-Y gastric bypass and sleeve gastrectomy: a systematic review. Surgical endoscopy 34(7): 3002-3010	- Comparator in study does not match that specified in protocol *Unable to tell of control group used for all studies and not presented as separate analysis*
Fakhry, Tannous K, Mhaskar, Rahul, Schwitalla, Theresa et al. (2019) Bariatric surgery improves nonalcoholic fatty liver disease: a contemporary systematic review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(3): 502-511	- Not an SR of comparative observational studies *Includes uncontrolled studies*

Study	Reason for exclusion
Faulconbridge, Lucy F, Wadden, Thomas A, Thomas, John G et al. (2013) Changes in depression and quality of life in obese individuals with binge eating disorder: bariatric surgery versus lifestyle modification. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 9(5): 790-6	- Not a subgroup of interest from protocol
Fermont, Jilles M, Blazeby, Jane M, Rogers, Chris A et al. (2017) The EQ-5D-5L is a valid approach to measure health related quality of life in patients undergoing bariatric surgery. PloS one 12(12): e0189190	- Comparator in study does not match that specified in protocol *This was a three-arm RCT comparing 3 types of bariatric surgery:laparoscopic Roux-en-Y gastric bypassadjustable gastric band surgerylaparoscopic sleeve gastrectomy*
Fink, Jodok, Seifert, Gabriel, Bluher, Matthias et al. (2022) Obesity Surgery-Weight Loss, Metabolic Changes, Oncological Effects, and Follow-up. Deutsches Arzteblatt international	- Study not reported in English
Fredheim, Jan Magnus, Rollheim, Jan, Sandbu, Rune et al. (2013) Obstructive sleep apnea after weight loss: a clinical trial comparing gastric bypass and intensive lifestyle intervention. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine 9(5): 427-32	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Friedrich, Asja E, Damms-Machado, Antje, Meile, Tobias et al. (2013) Laparoscopic sleeve gastrectomy compared to a multidisciplinary weight loss program for obesity--effects on body composition and protein status. Obesity surgery 23(12): 1957-65	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Galazis, Nicolas, Docheva, Nikolina, Simillis, Constantinos et al. (2014) Maternal and neonatal outcomes in women undergoing bariatric surgery: a systematic review and meta-analysis. European journal of obstetrics, gynecology, and reproductive biology 181: 45-53	- SR not of a subgroup of interest
Georgiadou, Despoina, Sergentanis, Theodoros N, Nixon, Alexander et al. (2014) Efficacy and safety of laparoscopic mini gastric bypass. A systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 10(5): 984-91	- Not a relevant study design *No meta-analysis*

Study	**Reason for exclusion**
Gill, Hartej, Kang, Simratdeep, Lee, Yena et al. (2019) The long-term effect of bariatric surgery on depression and anxiety. Journal of affective disorders 246: 886-894	- Not a relevant study design *No meta-analysis*
Gill, Richdeep S, Al-Adra, David P, Birch, Daniel et al. (2011) Robotic-assisted bariatric surgery: a systematic review. The international journal of medical robotics + computer assisted surgery : MRCAS 7(3): 249-55	- Not a relevant study design *No meta-analysis*
Giordano, S and Victorzon, M (2018) Laparoscopic Roux-En-Y Gastric Bypass in Elderly Patients (60 Years or Older): A Meta-Analysis of Comparative Studies. Scandinavian journal of surgery : SJS : official organ for the Finnish Surgical Society and the Scandinavian Surgical Society 107(1): 6-13	- Comparator in study does not match that specified in protocol
Giordano, Salvatore and Salminen, Paulina (2020) Laparoscopic Sleeve Gastrectomy Is Safe for Patients Over 60 Years of Age: A Meta-Analysis of Comparative Studies. Journal of laparoendoscopic & advanced surgical techniques. Part A 30(1): 12-19	- Comparator in study does not match that specified in protocol *compares with < 60 who had surgery*
Giordano, Salvatore and Victorzon, Mikael (2015) Bariatric surgery in elderly patients: a systematic review. Clinical interventions in aging 10: 1627-35	- Not an SR of comparative observational studies
Giske, Liv, Lauvrak, Vigdis, Elvsaas, Ida-Kristin Orjasaeter et al. (2014) No title provided.	- Article could not be retrieved
Glina, Felipe Placco Araujo, de Freitas Barboza, Julia Walter, Nunes, Victor Moises et al. (2017) What Is the Impact of Bariatric Surgery on Erectile Function? A Systematic Review and Meta-Analysis. Sexual medicine reviews 5(3): 393-402	- Not an SR of comparative observational studies *Included uncontrolled studies*
Gloy, Viktoria L, Briel, Matthias, Bhatt, Deepak L et al. (2013) Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. BMJ (Clinical research ed.) 347: f5934	- Systematic review of RCTs references checked
Goldman, Randi H, Missmer, Stacey A, Robinson, Malcolm K et al. (2016) Reproductive Outcomes Differ Following Roux-en-Y Gastric	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
Bypass and Adjustable Gastric Band Compared with Those of an Obese Non-Surgical Group. Obesity surgery 26(11): 2581-2589	*Didn't adjust for obesity related comorbidity*
Graham, Carolyn, Switzer, Noah, Reso, Artan et al. (2019) Sleeve gastrectomy and hypertension: a systematic review of long-term outcomes. Surgical endoscopy 33(9): 3001-3007	- Not an SR of comparative observational studies
Gribsholt, Sigrid Bjerge, Thomsen, Reimar Wernich, Svensson, Elisabeth et al. (2017) Overall and cause-specific mortality after Roux-en-Y gastric bypass surgery: A nationwide cohort study. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 13(4): 581-587	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *BMI data missing*
Grzegorczyk-Martin, V, Freour, T, De Bantel Finet, A et al. (2020) IVF outcomes in patients with a history of bariatric surgery: a multicenter retrospective cohort study. Human reproduction (Oxford, England) 35(12): 2755-2762	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Gu, Alex, Cohen, Jordan S, Malahias, Michael-Alexander et al. (2019) The Effect of Bariatric Surgery Prior to Lower-Extremity Total Joint Arthroplasty: A Systematic Review. HSS journal : the musculoskeletal journal of Hospital for Special Surgery 15(2): 190-200	- Not a relevant study design *Meta-analysis was not conducted*
Gu, Lihu, Chen, Bangsheng, Du, Nannan et al. (2019) Relationship Between Bariatric Surgery and Gastroesophageal Reflux Disease: a Systematic Review and Meta-analysis. Obesity surgery 29(12): 4105-4113	- Comparator in study does not match that specified in protocol
Guggino, Jessica, Coumes, Sandrine, Wion, Nelly et al. (2020) Effectiveness and Safety of Bariatric Surgery in Patients with End-Stage Chronic Kidney Disease or Kidney Transplant. Obesity 28(12): 2290-2304	- Comparator in study does not match that specified in protocol *Most studies in analysis had no control*
Guidry, Christopher A, Davies, Stephen W, Sawyer, Robert G et al. (2015) Gastric bypass improves survival compared with propensity-matched controls: a cohort study with over 10-year follow-up. American journal of surgery 209(3): 463-7	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Guiho, Mylene, Lacaze, Laurence, Thibault, Ronan et al. (2020) Nutritional complications of	- Study not reported in English

Study	Reason for exclusion
obesity surgery: Prevalence, prevention, treatment. A systematic review. Nutrition Clinique et Metabolisme 34(4): 263-280	
Guirat, Ahmed, Bachner, Ioan, Guenzi, Martino et al. (2014) What is the role of the sleeve gastrectomy in the surgical treatment of morbid obesity?. European Surgery - Acta Chirurgica Austriaca 46(5): 181-188	- Not a relevant study design *No meta-analysis*
Gulliford, Martin C, Charlton, Judith, Booth, Helen P et al. (2016) No title provided.	- Not a relevant study design *HE analysis*
Ha, Jane, Kwon, Yeongkeun, Kwon, Jin-Won et al. (2021) Micronutrient status in bariatric surgery patients receiving postoperative supplementation per guidelines: Insights from a systematic review and meta-analysis of longitudinal studies. Obesity reviews : an official journal of the International Association for the Study of Obesity 22(7): e13249	- Not an SR of comparative observational studies
Hachem, Aleeya and Brennan, Leah (2016) Quality of Life Outcomes of Bariatric Surgery: A Systematic Review. Obesity surgery 26(2): 395-409	- Not a relevant study design *Meta-analysis was not conducted*
Haghighat, Neda, Ashtari-Larky, Damoon, Aghakhani, Ladan et al. (2021) How Does Fat Mass Change in the First Year After Bariatric Surgery? A Systemic Review and Meta-Analysis. Obesity surgery 31(8): 3799-3821	- Not an SR of comparative observational studies
Haghighat, Neda, Kazemi, Asma, Asbaghi, Omid et al. (2021) Long-term effect of bariatric surgery on body composition in patients with morbid obesity: A systematic review and meta-analysis. Clinical nutrition (Edinburgh, Scotland) 40(4): 1755-1766	- Not an SR of comparative observational studies
Hagstrom, Hannes, Ekstedt, Mattias, Olbers, Torsten et al. (2021) Bariatric Surgery Versus Standard Obesity Treatment and the Risk of Severe Liver Disease: Data From the Swedish Obese Subjects Study. Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association 19(12): 2675-2676e2	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Han, Hedong, Chen, Lihong, Wang, Meng et al. (2019) Benefits of bariatric surgery in patients	- Not a relevant study design

Study	Reason for exclusion
with acute ischemic stroke-a national population-based study. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(11): 1934-1942	*Case-control design*
Handley, Joel D, Baruah, Bedanta P, Williams, David M et al. (2015) Bariatric surgery as a treatment for idiopathic intracranial hypertension: a systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 11(6): 1396-403	- Not an SR of comparative observational studies *Included case reports*
Hasan, Bashar, Nayfeh, Tarek, Alzuabi, Muayad et al. (2020) Weight Loss and Serum Lipids in Overweight and Obese Adults: A Systematic Review and Meta-Analysis. The Journal of clinical endocrinology and metabolism 105(12)	- Systematic review of RCTs references checked
Hassanian, Mazen, Al-Mulhim, Amnah, Al-Sabhan, Atheer et al. (2014) The effect of bariatric surgeries on nonalcoholic fatty liver disease. Saudi journal of gastroenterology : official journal of the Saudi Gastroenterology Association 20(5): 270-8	- Review article but not a systematic review
Hassinger, Taryn E., Mehaffey, J. Hunter, Johnston, Lily E. et al. (2018) Roux-en-Y gastric bypass is safe in elderly patients: a propensity-score matched analysis. Surgery for Obesity and Related Diseases 14(8): 1133-1138	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Hedjoudje, Abdellah, Abu Dayyeh, Barham K, Cheskin, Lawrence J et al. (2020) Efficacy and Safety of Endoscopic Sleeve Gastroplasty: A Systematic Review and Meta-Analysis. Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association 18(5): 1043-1053e4	- Study does not contain a relevant intervention
Herder, Christian, Peltonen, Markku, Svensson, Per-Arne et al. (2014) Adiponectin and bariatric surgery: associations with diabetes and cardiovascular disease in the Swedish Obese Subjects Study. Diabetes care 37(5): 1401-9	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Herpertz, Stephan, Muller, Astrid, Burgmer, Ramona et al. (2015) Health-related quality of life and psychological functioning 9 years after restrictive surgical treatment for obesity. Surgery	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *BMI not included in matching or adjustment*

Study	Reason for exclusion
for obesity and related diseases : official journal of the American Society for Bariatric Surgery 11(6): 1361-70	
Himbert, Caroline, Ose, Jennifer, Delphan, Mahmoud et al. (2017) A systematic review of the interrelation between diet- and surgery-induced weight loss and vitamin D status. Nutrition research (New York, N.Y.) 38: 13-26	- Not a relevant study design *No meta-analysis*
Hjorth, Stephan, Naslund, Ingmar, Andersson-Assarsson, Johanna C et al. (2019) Reoperations After Bariatric Surgery in 26 Years of Follow-up of the Swedish Obese Subjects Study. JAMA surgery 154(4): 319-326	- Secondary publication of an included study that does not provide any additional relevant information
Hossain, Naveed; Arhi, Chanpreet; Borg, Cynthia-Michelle (2021) Is Bariatric Surgery Better than Nonsurgical Weight Loss for Improving Asthma Control? A Systematic Review. Obesity surgery 31(4): 1810-1832	- Comparator in study does not match that specified in protocol
Hsieh, Meng-Fan, Chen, Jian-Han, Su, Yu-Chieh et al. (2021) The Increasing Possibility of Pregnancy Postbariatric Surgery: a Comprehensive National Cohort Study in Asian Population. Obesity surgery 31(3): 1022-1029	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *BMI not included*
Hsieh, Taulee, Zurita, Luis, Grover, Harpreet et al. (2014) 10-year outcomes of the vertical transected gastric bypass for obesity: a systematic review. Obesity surgery 24(3): 456-61	- Not an SR of comparative observational studies
Huang, Hongyan, Lu, Jun, Dai, Xiaojiang et al. (2021) Improvement of Renal Function After Bariatric Surgery: a Systematic Review and Meta-analysis. Obesity surgery 31(10): 4470-4484	- Not an SR of comparative observational studies
Hung, Shao-Lun, Chen, Chung-Yen, Chin, Wei-Leng et al. (2021) The long-term risk of cardiovascular events in patients following bariatric surgery compared to a non-surgical population with obesity and the general population: a comprehensive national cohort study. Langenbeck's archives of surgery 406(1): 189-196	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *BMI not included*
Hussain, Abdulzahra and El-Hasani, Shamsi (2013) Bariatric emergencies: current evidence	- Not a relevant study design *No meta-analysis*

Study	Reason for exclusion
and strategies of management. World journal of emergency surgery : WJES 8(1): 58	
Iannelli, Antonio, Bulsei, Julie, Debs, Tarek et al. (2022) Clinical and Economic Impact of Previous Bariatric Surgery on Liver Transplantation: a Nationwide, Population-Based Retrospective Study. Obesity surgery 32(1): 55-63	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Ighani Arani, Perna, Wretenberg, Per, Ottosson, Johan et al. (2020) Bariatric surgery prior to total knee arthroplasty is not associated with lower risk of revision: a register-based study of 441 patients. Acta Orthopaedica 92(1): 97-101	- Outcome reported does not match that specified in protocol
Jabbour, Georges and Salman, Ahmad (2021) Bariatric Surgery in Adults with Obesity: the Impact on Performance, Metabolism, and Health Indices. Obesity surgery 31(4): 1767-1789	- Not an SR of comparative observational studies *before and after*
Jager, Pia, Wolicki, Annina, Spohnholz, Johannes et al. (2020) Review: Sex-Specific Aspects in the Bariatric Treatment of Severely Obese Women. International journal of environmental research and public health 17(8)	- Review article but not a systematic review
Jakobsen, Gunn Signe, Smastuen, Milada Cvancarova, Sandbu, Rune et al. (2018) Association of Bariatric Surgery vs Medical Obesity Treatment With Long-term Medical Complications and Obesity-Related Comorbidities. JAMA 319(3): 291-301	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Jamaly, Shabbar, Carlsson, Lena, Peltonen, Markku et al. (2016) Bariatric Surgery and the Risk of New-Onset Atrial Fibrillation in Swedish Obese Subjects. Journal of the American College of Cardiology 68(23): 2497-2504	- Study does not contain a relevant outcome
Jamialahmadi, Tannaz, Reiner, Zeljko, Alidadi, Mona et al. (2021) Impact of Bariatric Surgery on Pulse Wave Velocity as a Measure of Arterial Stiffness: a Systematic Review and Meta-analysis. Obesity surgery 31(10): 4461-4469	- SR not of a subgroup of interest
Jan, Ahmad; Narwaria, Mahendra; Mahawar, Kamal K (2015) A Systematic Review of Bariatric Surgery in Patients with Liver Cirrhosis. Obesity surgery 25(8): 1518-26	- Not an SR of comparative observational studies

Study	Reason for exclusion
Jans, Goele, Guelinckx, Isabelle, Voets, Willy et al. (2014) Vitamin K1 monitoring in pregnancies after bariatric surgery: a prospective cohort study. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 10(5): 885-90	- Population excluded in protocol *Analysis of pregnant women - not pregnancy as an outcome*
Jaruvongvanich, Veeravich, Wongjarupong, Nicha, Vantanasiri, Kornpong et al. (2020) Midterm Outcome of Laparoscopic Sleeve Gastrectomy in Asians: a Systematic Review and Meta-analysis. Obesity surgery 30(4): 1459-1467	- Not a relevant study design *SR of descriptive studies not comparative observational*
Johansson, Kari, Svensson, Per-Arne, Soderling, Jonas et al. (2021) Long-term risk of anaemia after bariatric surgery: results from the Swedish Obese Subjects study. The lancet. Diabetes & endocrinology 9(8): 515-524	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Johnson, LK, Andersen, LF, Hofsø, D et al. (2013) Dietary changes in obese patients undergoing gastric bypass or lifestyle intervention: a clinical trial. British journal of nutrition 110(1): 127-134	- Outcome reported does not match that specified in protocol
Jorgenson, Margaret R, Gracon, Adam S, Hanlon, Bret et al. (2021) Pre-transplant bariatric surgery is associated with increased fungal infection after liver transplant. Transplant infectious disease : an official journal of the Transplantation Society 23(2): e13484	- Outcome reported does not match that specified in protocol
Julien, Cassandre A, Lavoie, Kim L, Ribeiro, Paula A B et al. (2021) Behavioral weight management interventions in metabolic and bariatric surgery: A systematic review and meta-analysis investigating optimal delivery timing. Obesity reviews : an official journal of the International Association for the Study of Obesity 22(4): e13168	- Study does not contain a relevant intervention
Jumbe, Sandra, Bartlett, Claire, Jumbe, Samantha L et al. (2016) The effectiveness of bariatric surgery on long term psychosocial quality of life - A systematic review. Obesity research & clinical practice 10(3): 225-42	- Not a relevant study design *No meta-analysis*
Jung, Sung Hoon, Yoon, Jai Hoon, Choi, Hyuk Soon et al. (2020) Comparative efficacy of bariatric endoscopic procedures in the treatment of morbid obesity: a systematic review and	- Comparator in study does not match that specified in protocol

Study	Reason for exclusion
network meta-analysis. Endoscopy 52(11): 940-954	
Juodeikis, Zygimantas and Brimas, Gintautas (2017) Long-term results after sleeve gastrectomy: A systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 13(4): 693-699	- Not a relevant study design *No meta-analysis*
Kakazu, Maximiliano Tamae, Soghier, Israa, Afshar, Majid et al. (2020) Weight Loss Interventions as Treatment of Obesity Hypoventilation Syndrome. A Systematic Review. Annals of the American Thoracic Society 17(4): 492-502	- SR not of a subgroup of interest
Kalani, A, Bami, H, Tiboni, M et al. (2017) The effect of bariatric surgery on serum 25-OH vitamin D levels: a systematic review and meta-analysis. Obesity science & practice 3(3): 319-332	- Study does not contain a relevant outcome
Kalyvas, Aristotelis, Neromyliotis, Eleftherios, Koutsarnakis, Christos et al. (2021) A systematic review of surgical treatments of idiopathic intracranial hypertension (IIH). Neurosurgical review 44(2): 773-792	- Not an SR of comparative observational studies *Case series and case report for bariatric studies*
Kang, Jenny H and Le, Quang A (2017) Effectiveness of bariatric surgical procedures: A systematic review and network meta-analysis of randomized controlled trials. Medicine 96(46): e8632	- Comparator in study does not match that specified in protocol
Kardassis, Dimitris, Grote, Ludger, Sjostrom, Lars et al. (2013) Sleep apnea modifies the long-term impact of surgically induced weight loss on cardiac function and inflammation. Obesity (Silver Spring, Md.) 21(4): 698-704	- Secondary publication of an included study that does not provide any additional relevant information
Karlsen, TI, Lund, RS, Røislien, J et al. (2013) Health related quality of life after gastric bypass or intensive lifestyle intervention: a controlled clinical study. Health and quality of life outcomes 11: 17	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Kauppila, Joonas H, Tao, Wenjing, Santoni, Giola et al. (2019) Effects of Obesity Surgery on Overall and Disease-Specific Mortality in a 5-Country Population-Based Study. Gastroenterology 157(1): 119-127e1	- Comparator in study does not match that specified in protocol

Study	Reason for exclusion
Keleidari, Behrouz, Dehkordi, Mohsen Mahmoudieh, Shahraki, Masoud Sayadi et al. (2021) Bile reflux after one anastomosis gastric bypass surgery: A review study. Annals of medicine and surgery (2012) 64: 102248	- Not an SR of comparative observational studies
Keleidari, Behrouz, Mahmoudieh, Mohsen, Shahabi, Shahab et al. (2019) Hepatic failure after bariatric surgery: A systematic review. Hepatitis Monthly 19(1): e86078	- Not a relevant study design *No meta-analysis*
Kent, David, Stanley, Jeffrey, Aurora, R Nisha et al. (2021) Referral of adults with obstructive sleep apnea for surgical consultation: an American Academy of Sleep Medicine systematic review, meta-analysis, and GRADE assessment. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine 17(12): 2507-2531	- Outcome reported does not match that specified in protocol
Kent, David, Stanley, Jeffrey, Aurora, R Nisha et al. (2021) Referral of adults with obstructive sleep apnea for surgical consultation: an American Academy of Sleep Medicine clinical practice guideline. Journal of clinical sleep medicine : JCSM : official publication of the American Academy of Sleep Medicine 17(12): 2499-2505	- Not a relevant study design *Guideline not an SR*
Kermansaravi, Mohammad, Davarpanah Jazi, Amir Hossein, Shahabi Shahmiri, Shahab et al. (2021) Revision procedures after initial Roux-en-Y gastric bypass, treatment of weight regain: a systematic review and meta-analysis. Updates in surgery 73(2): 663-678	- Study does not contain a relevant intervention
Khalooeifard, Razieh, Adebayo, Oladimeji, Rahmani, Jamal et al. (2021) Health Effect of Bariatric Surgery on Patients with Asthma: A Systematic Review and Meta-Analysis. Bariatric Surgical Practice and Patient Care 16(1): 2-9	- Not an SR of comparative observational studies
Khosravi-Largani, Matin, Nojomi, Marzieh, Aghili, Rokhsareh et al. (2019) Evaluation of all Types of Metabolic Bariatric Surgery and its Consequences: a Systematic Review and Meta-Analysis. Obesity surgery 29(2): 651-690	- Not an SR of comparative observational studies
Kolotkin, Ronette L, Kim, Jaewhan, Davidson, Lance E et al. (2018) 12-year trajectory of health-related quality of life in gastric bypass patients versus comparison groups. Surgery for	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
obesity and related diseases : official journal of the American Society for Bariatric Surgery 14(9): 1359-1365	*no adjustment for obesity related comorbidity*
Koppe, Uwe, Nitsch, Dorothea, Mansfield, Kathryn E et al. (2018) Long-term effects of bariatric surgery on acute kidney injury: a propensity-matched cohort in the UK Clinical Practice Research Datalink. BMJ open 8(5): e020371	- Outcome reported does not match that specified in protocol
Koschker, Ann-Cathrin, Warrings, Bodo, Morbach, Caroline et al. (2022) Cardio-psycho-metabolic outcomes of bariatric surgery: design and baseline of the WAS trial. Endocrine connections	- Study protocol and baseline characteristics
Kristensson, Felipe M, Andersson-Assarsson, Johanna C, Svensson, Per-Arne et al. (2020) Effects of Bariatric Surgery in Early- and Adult-Onset Obesity in the Prospective Controlled Swedish Obese Subjects Study. Diabetes care 43(4): 860-866	- Study included a comorbidity that is not a subgroup of interest *Only reports results stratified by self reported BMI at age 20*
Kulovitz, Michelle G, Kolkmeyer, Deborah, Conn, Carole A et al. (2014) Medical weight loss versus bariatric surgery: does method affect body composition and weight maintenance after 15% reduction in body weight?. Nutrition (Burbank, Los Angeles County, Calif.) 30(1): 49-54	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Kumar, Parveen, Hamza, Numan, Madhok, Brijesh et al. (2016) Copper Deficiency after Gastric Bypass for Morbid Obesity: a Systematic Review. Obesity surgery 26(6): 1335-42	- Not an SR of comparative observational studies
Kwak, Minyoung, Mehaffey, J Hunter, Hawkins, Robert B et al. (2020) Bariatric surgery is associated with reduction in non-alcoholic steatohepatitis and hepatocellular carcinoma: A propensity matched analysis. American journal of surgery 219(3): 504-507	- Review article but not a systematic review
Kwok, Chun Shing, Pradhan, Ashish, Khan, Muhammad A et al. (2014) Bariatric surgery and its impact on cardiovascular disease and mortality: a systematic review and meta-analysis. International journal of cardiology 173(1): 20-8	- SR not of a subgroup of interest

Study	Reason for exclusion
Kwong, Wilson; Tomlinson, George; Feig, Denice S (2018) Maternal and neonatal outcomes after bariatric surgery; a systematic review and meta-analysis: do the benefits outweigh the risks?. American journal of obstetrics and gynecology 218(6): 573-580	- SR not of a subgroup of interest
Lazzati, Andrea, Iannelli, Antonio, Schneck, Anne-Sophie et al. (2015) Bariatric surgery and liver transplantation: a systematic review a new frontier for bariatric surgery. Obesity surgery 25(1): 134-42	- Not an SR of comparative observational studies
Lee, Yung, Anvari, Sama, Chu, Megan M et al. (2022) Improvement of kidney function in patients with chronic kidney disease and severe obesity after bariatric surgery: A systematic review and meta-analysis. Nephrology (Carlton, Vic.) 27(1): 44-56	- Not an SR of comparative observational studies *Contains mix of studies in analysis*
Lee, Yung, Anvari, Sama, Sam Soon, Melissa et al. (2022) Bariatric Surgery as a Bridge to Heart Transplantation in Morbidly Obese Patients: A Systematic Review and Meta-Analysis. Cardiology in review 30(1): 1-7	- Not an SR of comparative observational studies
Lee, Yung, Doumouras, Aristithes G, Yu, James et al. (2019) Complete Resolution of Nonalcoholic Fatty Liver Disease After Bariatric Surgery: A Systematic Review and Meta-analysis. Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association 17(6): 1040-1060e11	- Not an SR of comparative observational studies
Lee, Yung, Raveendran, Lucshman, Lovrics, Olivia et al. (2021) The role of bariatric surgery on kidney transplantation: A systematic review and meta-analysis. Canadian Urological Association journal = Journal de l'Association des urologues du Canada 15(10): e553-e562	- Not an SR of comparative observational studies *Contains non-comparative studies in analysis*
Lee, Yung, Tian, Chenchen, Lovrics, Olivia et al. (2020) Bariatric surgery before, during, and after liver transplantation: a systematic review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 16(9): 1336-1347	- Not an SR of comparative observational studies
Lent, Michelle R, Benotti, Peter N, Mirshahi, Tooraj et al. (2017) All-Cause and Specific-Cause Mortality Risk After Roux-en-Y Gastric	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)

Study	Reason for exclusion
Bypass in Patients With and Without Diabetes. Diabetes care 40(10): 1379-1385	
Lewis, Carrie-Anne, de Jersey, Susan, Hopkins, George et al. (2018) Does Bariatric Surgery Cause Vitamin A, B1, C or E Deficiency? A Systematic Review. Obesity surgery 28(11): 3640-3657	- Not a relevant study design *No meta-analysis*
Lewis, Carrie-Anne, de Jersey, Susan, Seymour, Matthew et al. (2020) Iron, Vitamin B12, Folate and Copper Deficiency After Bariatric Surgery and the Impact on Anaemia: a Systematic Review. Obesity surgery 30(11): 4542-4591	- Not an SR of comparative observational studies
Li, Peiwen, Ma, Bin, Gong, Shulei et al. (2020) Efficacy and safety of endoscopic sleeve gastroplasty for obesity patients: a meta-analysis. Surgical endoscopy 34(3): 1253-1260	- Study does not contain a relevant intervention
Lim, Gregory B. (2018) Obesity: Bariatric surgery helps BP control. Nature Reviews Cardiology 15(1): 6	- Review article but not a systematic review
Lim, Russell B C; Zhang, Melvyn W B; Ho, Roger C M (2018) Prevalence of All-Cause Mortality and Suicide among Bariatric Surgery Cohorts: A Meta-Analysis. International journal of environmental research and public health 15(7)	- Not an SR of comparative observational studies
Lindekilde, N, Gladstone, B P, Lubeck, M et al. (2015) The impact of bariatric surgery on quality of life: a systematic review and meta-analysis. Obesity reviews : an official journal of the International Association for the Study of Obesity 16(8): 639-51	- Not an SR of comparative observational studies *Included uncontrolled studies*
Liu, De-Feng, Ma, Zheng-Ye, Zhang, Cai-Shun et al. (2021) The effects of bariatric surgery on dyslipidemia and insulin resistance in overweight patients with or without type 2 diabetes: a systematic review and network meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 17(9): 1655-1672	- Systematic review of RCTs, references checked
Lopez-Lopez, Victor, Ruiz-Manzanera, Juan Jose, Eshmuminov, Dilmurodjon et al. (2021) Are We Ready for Bariatric Surgery in a Liver	- Not an SR of comparative observational studies

Study	Reason for exclusion
Transplant Program? A Meta-Analysis. Obesity surgery 31(3): 1214-1222	
Lu, Chia-Wen, Chang, Yu-Kang, Lee, Yi-Hsuan et al. (2018) Increased risk for major depressive disorder in severely obese patients after bariatric surgery - a 12-year nationwide cohort study. Annals of medicine 50(7): 605-612	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *Used propensity score matching and regression but no adjustment for baseline BMI*
Lupoli, Roberta, Lembo, Erminia, Rainone, Carmen et al. (2022) Rate of post-bariatric hypoglycemia using continuous glucose monitoring: A meta-analysis of literature studies. Nutrition, metabolism, and cardiovascular diseases : NMCD 32(1): 32-39	- SR not of a subgroup of interest
Lv, Bo; Xing, Chuan; He, Bing (2022) Effects of bariatric surgery on the menstruation- and reproductive-related hormones of women with obesity without polycystic ovary syndrome: a systematic review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 18(1): 148-160	- Not an SR of comparative observational studies *before and after studies*
Lynch, Kevin T, Mehaffey, J Hunter, Hawkins, Robert B et al. (2019) Bariatric surgery reduces incidence of atrial fibrillation: a propensity score-matched analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(2): 279-285	- Outcome reported does not match that specified in protocol
Maciejewski, Matthew L, Arterburn, David E, Van Scoyoc, Lynn et al. (2016) Bariatric Surgery and Long-term Durability of Weight Loss. JAMA surgery 151(11): 1046-1055	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Madhulika, Pallikonda S. and Gonzalez-Tova, Juan U. (2017) Hypocalcemia and vitamin d deficiency in patients post-bariatric surgery: A systematic review. World Journal of Laparoscopic Surgery 10(3): 108-111	- Not an SR of comparative observational studies
Mahawar, Kamal K, Bhasker, Aparna Govil, Bindal, Vivek et al. (2017) Zinc Deficiency after Gastric Bypass for Morbid Obesity: a Systematic Review. Obesity surgery 27(2): 522-529	- Not a relevant study design *No meta-analysis*
Major, Piotr, Malczak, Piotr, Wysocki, Michal et al. (2018) Bariatric patients' nutritional status as	- Not a relevant study design

Study	Reason for exclusion
a risk factor for postoperative complications, prolonged length of hospital stay and hospital readmission: A retrospective cohort study. International journal of surgery (London, England) 56: 210-214	*Case control - both groups had surgery*
Mala, Tom (2014) Postprandial hyperinsulinemic hypoglycemia after gastric bypass surgical treatment. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 10(6): 1220-5	- Not a relevant study design *No meta-analysis*
Manfield, James H, Yu, Kenny K-H, Efthimiou, Evangelos et al. (2017) Bariatric Surgery or Non-surgical Weight Loss for Idiopathic Intracranial Hypertension? A Systematic Review and Comparison of Meta-analyses. Obesity surgery 27(2): 513-521	- Not an SR of comparative observational studies *Analysis did not compare intervention with comparator*
Maniscalco, Mauro, Zamparelli, Alessandro Sanduzzi, Molino, Antonio et al. (2017) Long-term effect of weight loss induced by bariatric surgery on asthma control and health related quality of life in asthmatic patients with severe obesity: A pilot study. Respiratory Medicine 130: 69-74	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Marczuk, Pawel, Kubisa, Michal J, Swiech, Michal et al. (2019) Effectiveness and Safety of Roux-en-Y Gastric Bypass in Elderly Patients-Systematic Review and Meta-analysis. Obesity surgery 29(2): 361-368	- Not an SR of comparative observational studies *Included uncontrolled studies*
Merlotti, C; Morabito, A; Pontiroli, A E (2014) Prevention of type 2 diabetes; a systematic review and meta-analysis of different intervention strategies. Diabetes, obesity & metabolism 16(8): 719-27	- SR not of a subgroup of interest
Merlotti, Claudia, Morabito, Alberto, Ceriani, Valerio et al. (2014) Prevention of type 2 diabetes in obese at-risk subjects: a systematic review and meta-analysis. Acta diabetologica 51(5): 853-63	- SR not of a subgroup of interest
Merola, Joseph, Selezneva, Liudmila, Perkins, Ryan et al. (2020) Cerebrospinal fluid diversion versus bariatric surgery in the management of idiopathic intracranial hypertension. British journal of neurosurgery 34(1): 9-12	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
Michaels, Alex D, Mehaffey, J Hunter, Hawkins, Robert B et al. (2020) Bariatric surgery reduces long-term rates of cardiac events and need for coronary revascularization: a propensity-matched analysis. Surgical endoscopy 34(6): 2638-2643	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *Used propensity score matching, but not for sex*
Miedziaszczyk, Milosz; Ciabach, Patrycja; Szalek, Edyta (2021) The Effects of Bariatric Surgery and Gastrectomy on the Absorption of Drugs, Vitamins, and Mineral Elements. Pharmaceutics 13(12)	- Data not reported in an extractable format
Migliore, Enrica, Brunani, Amelia, Ciccone, Giovannino et al. (2021) Effect of Bariatric Surgery on Survival and Hospitalizations in Patients with Severe Obesity. A Retrospective Cohort Study. Nutrients 13(9)	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Milone, Marco, De Placido, Giuseppe, Musella, Mario et al. (2016) Incidence of Successful Pregnancy After Weight Loss Interventions in Infertile Women: a Systematic Review and Meta-Analysis of the Literature. Obesity surgery 26(2): 443-51	- Not an SR of comparative observational studies *Included uncontrolled studies*
Mirijello, Antonio, D'Angelo, Cristina, Ferrulli, Anna et al. (2015) Social phobia and quality of life in morbidly obese patients before and after bariatric surgery. Journal of Affective Disorders 179: 95-100	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *obesity related comorbidity missing from model*
Mocanu, Valentin, Nasralla, Awrad, Dang, Jerry et al. (2019) Ongoing Inconsistencies in Weight Loss Reporting Following Bariatric Surgery: a Systematic Review. Obesity surgery 29(4): 1375-1387	- Not a relevant study design *No meta-analysis*
Moly, K.T. (2021) Quality of life after bariatric surgery. Medico-Legal Update 21(1): 606-612	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Monteiro, Fabiane, Ponce, Diego A N, Silva, Humberto et al. (2017) Physical Function, Quality of Life, and Energy Expenditure During Activities of Daily Living in Obese, Post-Bariatric Surgery, and Healthy Subjects. Obesity surgery 27(8): 2138-2144	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Moussa, Osama, Ardissino, Maddalena, Tang, Alice et al. (2021) Long-term cerebrovascular	- Outcome reported does not match that specified in protocol

Study	Reason for exclusion
outcomes after bariatric surgery: A nationwide cohort study. Clinical neurology and neurosurgery 203: 106560	
Moxthe, Luz Cilis, Sauls, Rachel, Ruiz, Michelle et al. (2020) Effects of Bariatric Surgeries on Male and Female Fertility: A Systematic Review. Journal of reproduction & infertility 21(2): 71-86	- Not a relevant study design *Qualitative synthesis not meta-analysis*
Muller, Astrid, Hase, Carolin, Pommnitz, Melanie et al. (2019) Depression and Suicide After Bariatric Surgery. Current psychiatry reports 21(9): 84	- Editorial only
Naslund, Erik, Stenberg, Erik, Hofmann, Robin et al. (2021) Association of Metabolic Surgery With Major Adverse Cardiovascular Outcomes in Patients With Previous Myocardial Infarction and Severe Obesity: A Nationwide Cohort Study. Circulation 143(15): 1458-1467	- More recent systematic review included that covers the same topic *Study included in SR include*
Nguyen, Tran, Alzahrani, Talal, Mandler, Ari et al. (2021) Relation of Bariatric Surgery to Inpatient Cardiovascular Outcomes (from the National Inpatient Sample). The American journal of cardiology 144: 143-147	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Nielsen, Joan Bach, Pedersen, Ane Matilde, Gribsholt, Sigrid Bjerge et al. (2016) Prevalence, severity, and predictors of symptoms of dumping and hypoglycemia after Roux-en-Y gastric bypass. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 12(8): 1562-1568	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
O'Brien, Paul E, Brennan, Leah, Laurie, Cheryl et al. (2013) Intensive medical weight loss or laparoscopic adjustable gastric banding in the treatment of mild to moderate obesity: long-term follow-up of a prospective randomised trial. Obesity surgery 23(9): 1345-53	- Not a relevant study design *O'Brien 2013 stated that "the follow-up beyond 2 years was structured as a community program rather than the more prescribed program of the RCT".*
O'Brien, Paul E, Hindle, Annemarie, Brennan, Leah et al. (2019) Long-Term Outcomes After Bariatric Surgery: a Systematic Review and Meta-analysis of Weight Loss at 10 or More Years for All Bariatric Procedures and a Single-Centre Review of 20-Year Outcomes After Adjustable Gastric Banding. Obesity surgery 29(1): 3-14	- Not an SR of comparative observational studies *Included uncontrolled studies*

Study	Reason for exclusion
Oliver, Abigail, Hooper, Suzie, Lau, Rosalind et al. (2021) Effect of a multidisciplinary rehabilitation program for patients receiving weight management interventions on eating behaviours and health-related quality of life. Obesity research & clinical practice 15(3): 268-274	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Orandi, Babak J, Purvis, Joshua W, Cannon, Robert M et al. (2020) Bariatric surgery to achieve transplant in end-stage organ disease patients: A systematic review and meta-analysis. American journal of surgery 220(3): 566-579	- Not an SR of comparative observational studies
Ospanov, Oral, Akilzhanova, Ainur, Buchwald, J N et al. (2021) Stapleless vs Stapled Gastric Bypass vs Hypocaloric Diet: a Three-Arm Randomized Controlled Trial of Body Mass Evolution with Secondary Outcomes for Telomere Length and Metabolic Syndrome Changes. Obesity surgery 31(7): 3165-3176	- Study included people with type 2 diabetes
Ottridge, Ryan, Mollan, Susan P, Botfield, Hannah et al. (2017) Randomised controlled trial of bariatric surgery versus a community weight loss programme for the sustained treatment of idiopathic intracranial hypertension: the Idiopathic Intracranial Hypertension Weight Trial (IIH:WT) protocol. BMJ open 7(9): e017426	- Study protocol only
Outmani, Loubna, Kimenai, Hendrikus J A N, Roodnat, Joke I et al. (2021) Clinical outcome of kidney transplantation after bariatric surgery: A single-center, retrospective cohort study. Clinical transplantation 35(3): e14208	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *Used propensity score matching but not accross all required parameters.*
Ovrebo, B, Strommen, M, Kulseng, B et al. (2017) Bariatric surgery versus lifestyle interventions for severe obesity: 5-year changes in body weight, risk factors and comorbidities. Clinical obesity 7(3): 183-190	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Owen, Jonathan G; Yazdi, Farshid; Reisin, Efrain (2018) Bariatric Surgery and Hypertension. American Journal of Hypertension 31(1): 11-17	- Article could not be retrieved
Padwal, Raj S, Rueda-Clausen, Christian F, Sharma, Arya M et al. (2014) Weight loss and outcomes in wait-listed, medically managed,	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
and surgically treated patients enrolled in a population-based Bariatric program: prospective cohort study. Medical care 52(3): 208-15	*obesity related comorbidity not adjusted for*
Palamuthusingam, D, Singh, A, Palamuthusingam, P et al. (2021) Postoperative outcomes after bariatric surgery in patients on chronic dialysis: A systematic review and meta-analysis. Obesity research & clinical practice 15(5): 473-484	- Comparator in study does not match that specified in protocol
Panagiotou, Orestis A, Markozannes, Georgios, Adam, Gaelen P et al. (2018) Comparative Effectiveness and Safety of Bariatric Procedures in Medicare-Eligible Patients: A Systematic Review. JAMA surgery 153(11): e183326	- SR not of a subgroup of interest
Panunzi, Simona, Maltese, Sabina, De Gaetano, Andrea et al. (2021) Comparative efficacy of different weight loss treatments on knee osteoarthritis: A network meta-analysis. Obesity reviews : an official journal of the International Association for the Study of Obesity 22(8): e13230	- Study included a comorbidity that is not a subgroup of interest
Park, Chan Hyuk, Nam, Seung-Joo, Choi, Hyuk Soon et al. (2019) Comparative Efficacy of Bariatric Surgery in the Treatment of Morbid Obesity and Diabetes Mellitus: a Systematic Review and Network Meta-Analysis. Obesity surgery 29(7): 2180-2190	- SR not of a subgroup of interest
Park, Do Joong, An, Sena, Park, Young Suk et al. (2021) Bariatric surgery versus medical therapy in Korean obese patients: prospective multicenter nonrandomized controlled trial (KOBESS trial). Annals of surgical treatment and research 101(4): 197-205	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Park, Ji Yeon, Heo, Yoonseok, Kim, Yong Jin et al. (2019) Long-term effect of bariatric surgery versus conventional therapy in obese Korean patients: a multicenter retrospective cohort study. Annals of surgical treatment and research 96(6): 283-289	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Parmar, Chetan D, Efeotor, O, Ali, A et al. (2019) Primary Banded Sleeve Gastrectomy: a Systematic Review. Obesity surgery 29(2): 698-704	- Not a relevant study design *No meta-analysis*

Study	Reason for exclusion
Parmar, Chetan D; Zakeri, Roxanna; Mahawar, Kamal (2020) A Systematic Review of One Anastomosis/Mini Gastric Bypass as a Metabolic Operation for Patients with Body Mass Index <= 35 kg/m2. Obesity surgery 30(2): 725-735	- Not an SR of comparative observational studies
Patkar, Anuprita, Fegelman, Elliott, R Kashyap, Sangeeta et al. (2017) Assessing the real-world effect of laparoscopic bariatric surgery on the management of obesity-related comorbidities: A retrospective matched cohort study using a US Claims Database. Diabetes, obesity & metabolism 19(2): 181-188	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *Age not matched/adjusted for*
Persson, Christina E, Bjorck, Lena, Lagergren, Jesper et al. (2017) Risk of Heart Failure in Obese Patients With and Without Bariatric Surgery in Sweden-A Registry-Based Study. Journal of cardiac failure 23(7): 530-537	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Peterson, Kim, Anderson, Johanna, Boundy, Erin et al. (2017) Rapid Evidence Review of Bariatric Surgery in Super Obesity (BMI >= 50 kg/m2). Journal of general internal medicine 32(suppl1): 56-64	- Not a relevant study design *No meta-analysis*
Petrick, Anthony T, Kuhn, Jason E, Parker, David M et al. (2019) Bariatric surgery is safe and effective in Medicare patients regardless of age: an analysis of primary gastric bypass and sleeve gastrectomy outcomes. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(10): 1704-1711	- Comparator in study does not match that specified in protocol
Petroni, Renata, Di Mauro, Michele, Altorio, Settimio F et al. (2017) The role of bariatric surgery for improvement of hypertension in obese patients: a retrospective study. Journal of cardiovascular medicine (Hagerstown, Md.) 18(3): 152-158	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Piche, Marie-Eve, Clavel, Marie-Annick, Auclair, Audrey et al. (2021) Early benefits of bariatric surgery on subclinical cardiac function: Contribution of visceral fat mobilization. Metabolism: clinical and experimental 119: 154773	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Piper, Rory J, Kalyvas, Aristotelis V, Young, Adam M H et al. (2015) Interventions for	- Not a relevant study design

Study	Reason for exclusion
idiopathic intracranial hypertension. The Cochrane database of systematic reviews: cd003434	*No meta-analysis*
Pirlet, Charles, Voisine, Pierre, Poirier, Paul et al. (2020) Outcomes in Patients with Obesity and Coronary Artery Disease with and Without Bariatric Surgery. Obesity surgery 30(6): 2085-2092	- More recent systematic review included that covers the same topic *Study included in SR include*
Pontiroli, Antonio E; Ceriani, Valerio; Tagliabue, Elena (2020) Compared with Controls, Bariatric Surgery Prevents Long-Term Mortality in Persons with Obesity Only Above Median Age of Cohorts: a Systematic Review and Meta-Analysis. Obesity surgery 30(7): 2487-2496	- SR not of a subgroup of interest
Pontiroli, Antonio E, Ceriani, Valerio, Tagliabue, Elena et al. (2020) Bariatric surgery, compared to medical treatment, reduces morbidity at all ages but does not reduce mortality in patients aged < 43 years, especially if diabetes mellitus is present: a post hoc analysis of two retrospective cohort studies. Acta diabetologica 57(3): 323-333	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Pontiroli, Antonio E, Merlotti, Claudia, Veronelli, Annamaria et al. (2013) Effect of weight loss on sympatho-vagal balance in subjects with grade-3 obesity: restrictive surgery versus hypocaloric diet. Acta diabetologica 50(6): 843-50	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Pontiroli, Antonio E, Zakaria, Ahmed S, Fanchini, Marco et al. (2018) A 23-year study of mortality and development of co-morbidities in patients with obesity undergoing bariatric surgery (laparoscopic gastric banding) in comparison with medical treatment of obesity. Cardiovascular diabetology 17(1): 161	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Pupier, Emilie, Monsaingeon-Henry, Maud, Poullenot, Florian et al. (2018) Malnutrition After Bariatric Surgery Requiring Artificial Nutrition Supplies. Obesity Surgery 28(6): 1803-1805	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Puzziferri, Nancy, Roshek, Thomas B 3rd, Mayo, Helen G et al. (2014) Long-term follow-up after bariatric surgery: a systematic review. JAMA 312(9): 934-42	- Not an SR of comparative observational studies *Included case series*
Qumseya, Bashar J, Qumsiyeh, Yazan, Ponniah, Sandeep A et al. (2021) Barrett's	- Not an SR of comparative observational studies

Study	Reason for exclusion
esophagus after sleeve gastrectomy: a systematic review and meta-analysis. Gastrointestinal endoscopy 93(2): 343-352e2	
Rasmussen-Torvik, Laura J, Reges, Orna, Greenland, Philip et al. (2019) All-Cause Mortality Following Bariatric Surgery in Smokers and Non-smokers. Obesity surgery 29(12): 3854-3859	- Not a subgroup of interest from protocol
Reges, Orna, Greenland, Philip, Dicker, Dror et al. (2018) Association of Bariatric Surgery Using Laparoscopic Banding, Roux-en-Y Gastric Bypass, or Laparoscopic Sleeve Gastrectomy vs Usual Care Obesity Management With All-Cause Mortality. JAMA 319(3): 279-290	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Ricci, Cristian, Gaeta, Maddalena, Rausa, Emanuele et al. (2015) Long-term effects of bariatric surgery on type II diabetes, hypertension and hyperlipidemia: a meta-analysis and meta-regression study with 5-year follow-up. Obesity surgery 25(3): 397-405	- Not an SR of comparative observational studies *Includes uncontrolled studies*
Ricci, Cristian, Gaeta, Maddalena, Rausa, Emanuele et al. (2014) Early impact of bariatric surgery on type II diabetes, hypertension, and hyperlipidemia: a systematic review, meta-analysis and meta-regression on 6,587 patients. Obesity surgery 24(4): 522-8	- Not an SR of comparative observational studies *Included uncontrolled studies*
Rives-Lange, Claire, Rassy, Natalie, Carette, Claire et al. (2022) Seventy years of bariatric surgery: A systematic mapping review of randomized controlled trials. Obesity reviews : an official journal of the International Association for the Study of Obesity: e13420	- Systematic review of RCTs references checked
Robertson, A G N, Wiggins, T, Robertson, F P et al. (2021) Perioperative mortality in bariatric surgery: meta-analysis. The British journal of surgery 108(8): 892-897	- Not an SR of comparative observational studies *Included uncontrolled studies*
Romero Funes, David, Gutierrez Blanco, David, Botero-Fonnegra, Cristina et al. (2022) Bariatric surgery decreases the number of future hospital admissions for diastolic heart failure in subjects with severe obesity: a retrospective analysis of the US National Inpatient Sample database. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 18(1): 1-8	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *BMI not in model*

Study	Reason for exclusion
Roos, Nathalie, Neovius, Martin, Cnattingius, Sven et al. (2013) Perinatal outcomes after bariatric surgery: nationwide population based matched cohort study. BMJ (Clinical research ed.) 347: f6460	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Rosenblatt, Alberto; Faintuch, Joel; Cecconello, Ivan (2013) Sexual hormones and erectile function more than 6 years after bariatric surgery. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 9(5): 636-40	- Outcome reported does not match that specified in protocol
Roth, Jonathan; Constantini, Shlomi; Kesler, Anat (2015) Over-drainage and persistent shunt-dependency in patients with idiopathic intracranial hypertension treated with shunts and bariatric surgery. Surgical neurology international 6(suppl27): 655-60	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Rottenstreich, Amihai, Elazary, Ram, Goldenshluger, Ariela et al. (2019) Maternal nutritional status and related pregnancy outcomes following bariatric surgery: A systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(2): 324-332	- Not a relevant study design *No meta-analysis*
Rustgi, Vinod K, Li, You, Gupta, Kapil et al. (2021) Bariatric Surgery Reduces Cancer Risk in Adults With Nonalcoholic Fatty Liver Disease and Severe Obesity. Gastroenterology 161(1): 171-184e10	- Study does not contain a relevant outcome
Saad, R K, Ghezzawi, M, Habli, D et al. (2022) Fracture risk following bariatric surgery: a systematic review and meta-analysis. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA	- SR not of a subgroup of interest
Salehi, Marzieh, Vella, Adrian, McLaughlin, Tracey et al. (2018) Hypoglycemia After Gastric Bypass Surgery: Current Concepts and Controversies. The Journal of clinical endocrinology and metabolism 103(8): 2815-2826	- Review article but not a systematic review
Sanches, Elijah E, Topal, Besir, de Jongh, Frank W et al. (2021) Effects of Bariatric	- SR not of a subgroup of interest

Study	Reason for exclusion
Surgery on Heart Rhythm Disorders: a Systematic Review and Meta-Analysis. Obesity surgery 31(5): 2278-2290	
Sanchis, Pilar, Frances, Carla, Nicolau, Joana et al. (2015) Cardiovascular risk profile in Mediterranean patients submitted to bariatric surgery and intensive lifestyle intervention: impact of both interventions after 1 year of follow-up. Obesity surgery 25(1): 97-108	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Schenkelaars, Nicole, Rousian, Melek, Hoek, Jeffrey et al. (2021) Preconceptional maternal weight loss and hypertensive disorders in pregnancy: a systematic review and meta-analysis. European journal of clinical nutrition 75(12): 1684-1697	- Not an SR of comparative observational studies
Schiavo, Luigi, Scalera, Giuseppe, Pilone, Vincenzo et al. (2017) Fat mass, fat-free mass, and resting metabolic rate in weight-stable sleeve gastrectomy patients compared with weight-stable nonoperated patients. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 13(10): 1692-1699	- Does not contain a population of people that match population listed in protocol *healthy controls used*
Schiavon, Carlos Aurelio, Ikeoka, Dimas Tadahiro, de Sousa, Marcio Goncalves et al. (2014) Effects of gastric bypass surgery in patients with hypertension: rationale and design for a randomised controlled trial (GATEWAY study). BMJ open 4(9): e005702	- Study included a comorbidity that is not a subgroup of interest
Schröder, W and Bruns, C (2017) Bariatric surgery versus medical therapy in the treatment of obesity. Der Chirurg; Zeitschrift fur alle Gebiete der operativen Medizen 88(5): 449-450	- Study not reported in English
Shai, Daniel, Shoham-Vardi, Ilana, Amsalem, Doron et al. (2014) Pregnancy outcome of patients following bariatric surgery as compared with obese women: a population-based study. The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians 27(3): 275-8	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Sharples, Alistair J and Mahawar, Kamal (2020) Systematic Review and Meta-Analysis of	- Comparator in study does not match that specified in protocol

Study	Reason for exclusion
Randomised Controlled Trials Comparing Long-Term Outcomes of Roux-En-Y Gastric Bypass and Sleeve Gastrectomy. Obesity surgery 30(2): 664-672	
Sharpton, Suzanne R, Terrault, Norah A, Tavakol, Mehdi M et al. (2021) Sleeve gastrectomy prior to liver transplantation is superior to medical weight loss in reducing posttransplant metabolic complications. American journal of transplantation : official journal of the American Society of Transplantation and the American Society of Transplant Surgeons 21(10): 3324-3332	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Sheetz, Kyle H, Gerhardinger, Laura, Dimick, Justin B et al. (2020) Bariatric Surgery and Long-term Survival in Patients With Obesity and End-stage Kidney Disease. JAMA surgery 155(7): 581-588	- Study included people with type 2 diabetes *>50%*
Shen, Xiaojun, Zhang, Xin, Bi, Jianwei et al. (2015) Long-term complications requiring reoperations after laparoscopic adjustable gastric banding: a systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 11(4): 956-64	- Not a relevant study design *No meta-analysis*
Sheridan, William, Da Silva, Ana Sofia, Leca, Bianca M et al. (2021) Weight loss with bariatric surgery or behaviour modification and the impact on female obesity-related urine incontinence: A comprehensive systematic review and meta-analysis. Clinical obesity 11(4): e12450	- Not an SR of comparative observational studies
Shuai, Xiaoming, Tao, Kaixiong, Mori, Masayuki et al. (2015) Bariatric surgery for metabolic syndrome in obesity. Metabolic syndrome and related disorders 13(4): 149-60	- Review article but not a systematic review
Singh, P, Subramanian, A, Adderley, N et al. (2020) Impact of bariatric surgery on cardiovascular outcomes and mortality: a population-based cohort study. The British journal of surgery 107(4): 432-442	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Singh, Shailendra, Hourneaux de Moura, Diogo Turiani, Khan, Ahmad et al. (2020) Safety and efficacy of endoscopic sleeve gastroplasty worldwide for treatment of obesity: a systematic	- Study does not contain a relevant intervention

Study	Reason for exclusion
review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 16(2): 340-351	
Sjoholm, Kajsa, Jacobson, Peter, Taube, Magdalena et al. (2021) Long-term incidence of hypoglycaemia-related events after bariatric surgery or usual care in the Swedish Obese Subjects study: A register-based analysis. Diabetes, obesity & metabolism 23(8): 1917-1925	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Snoek, Katinka M, Steegers-Theunissen, Regine P M, Hazebroek, Eric J et al. (2021) The effects of bariatric surgery on periconception maternal health: a systematic review and meta-analysis. Human reproduction update 27(6): 1030-1055	- Not an SR of comparative observational studies
Sohouli, Mohammad Hassan, Baniasadi, Mansoureh, Nabavizadeh, Raheleh et al. (2022) Trends in insulin-like growth factor-1 levels after bariatric surgery: a systematic review and meta-analysis. International journal of obesity (2005)	- Not an SR of comparative observational studies
Speck, Rebecca M, Bond, Dale S, Sarwer, David B et al. (2014) A systematic review of musculoskeletal pain among bariatric surgery patients: implications for physical activity and exercise. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 10(1): 161-70	- Not a relevant study design *No meta-analysis*
Spinos, Dimitrios, Skarentzos, Konstantinos, Esagian, Stepan M et al. (2021) The Effectiveness of Single-Anastomosis Duodenoileal Bypass with Sleeve Gastrectomy/One Anastomosis Duodenal Switch (SADI-S/OADS): an Updated Systematic Review. Obesity surgery 31(4): 1790-1800	- Not an SR of comparative observational studies
Spirou, Dean; Raman, Jayanthi; Smith, Evelyn (2020) Psychological outcomes following surgical and endoscopic bariatric procedures: A systematic review. Obesity reviews : an official journal of the International Association for the Study of Obesity 21(6): e12998	- Not a relevant study design *Qualitative synthesis not meta-analysis*
Stefanova, Irena, Currie, Andrew C, Newton, Richard C et al. (2020) A Meta-analysis of the	- Not an SR of comparative observational studies

Study	Reason for exclusion
Impact of Bariatric Surgery on Back Pain. Obesity surgery 30(8): 3201-3207	
Stein, J, Stier, C, Raab, H et al. (2014) Review article: The nutritional and pharmacological consequences of obesity surgery. Alimentary pharmacology & therapeutics 40(6): 582-609	- Review article but not a systematic review
Stenberg, Erik, Cao, Yang, Marsk, Richard et al. (2020) Association between metabolic surgery and cardiovascular outcome in patients with hypertension: A nationwide matched cohort study. PLoS medicine 17(9): e1003307	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Stone, Gregory; Samaan, Jamil S; Samakar, Kamran (2021) Racial disparities in complications and mortality after bariatric surgery: A systematic review. American journal of surgery	- Not an SR of comparative observational studies
Sun, Warren Y. L., Switzer, Noah J., Dang, Jerry T. et al. (2020) Idiopathic intracranial hypertension and bariatric surgery: a systematic review. Canadian journal of surgery. Journal canadien de chirurgie 63(2): e123-e128	- Not an SR of comparative observational studies
Sundstrom, Johan, Bruze, Gustaf, Ottosson, Johan et al. (2017) Weight Loss and Heart Failure: A Nationwide Study of Gastric Bypass Surgery Versus Intensive Lifestyle Treatment. Circulation 135(17): 1577-1585	- Observational study on general obesity population with no analysis based on subgroups of interest (see protocol deviation for details)
Syn, Nicholas L, Cummings, David E, Wang, Louis Z et al. (2021) Association of metabolic-bariatric surgery with long-term survival in adults with and without diabetes: a one-stage meta-analysis of matched cohort and prospective controlled studies with 174 772 participants. Lancet (London, England) 397(10287): 1830-1841	- SR not of a subgroup of interest
Szmulewicz, Alejandro, Wanis, Kerollos N, Gripper, Ashley et al. (2019) Mental health quality of life after bariatric surgery: A systematic review and meta-analysis of randomized clinical trials. Clinical obesity 9(1): e12290	- Systematic review of RCTs, references checked
Tandon, Ashutosh, Akbari, Khalid, Gillies, Richard et al. (2021) Meta-Analysis of Gastrointestinal Quality of Life after Laparoscopic Sleeve Gastrectomy or Laparoscopic Roux-en-Y Gastric Bypass.	- Not an SR of comparative observational studies

Study	Reason for exclusion
Bariatric Surgical Practice and Patient Care 16(2): 78-84	
Tayyem, R M; Atkinson, J M; Martin, C R (2014) Development and validation of a new bariatric-specific health-related quality of life instrument "bariatric and obesity-specific survey (BOSS)". Journal of postgraduate medicine 60(4): 357-61	- Study does not contain a relevant outcome *Study analysing the validity of a HRQOL tool*
Thereaux, J, Lesuffleur, T, Czernichow, S et al. (2019) Multicentre cohort study of antihypertensive and lipid-lowering therapy cessation after bariatric surgery. The British journal of surgery 106(3): 286-295	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *No adjustment for comorbidities*
Thereaux, Jeremie, Lesuffleur, Thomas, Czernichow, Sebastien et al. (2019) Long-term adverse events after sleeve gastrectomy or gastric bypass: a 7-year nationwide, observational, population-based, cohort study. The lancet. Diabetes & endocrinology 7(10): 786-795	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *No adjustment for comorbidity*
Tofield, A. (2016) Bariatric surgery vs. Lifestyle changes. European Heart Journal 37(32): 2514	- Review article but not a systematic review
Tur, Juan Jesus, Escudero, Antonio Jorge, Alos, Maria Micaela et al. (2013) One year weight loss in the TRAMOMTANA study. A randomized controlled trial. Clinical endocrinology 79(6): 791-9	- Not a relevant study design *Surgical group was not randomised and not adjusted for*
Upala, Sikarin; Thavaraputta, Subhanudh; Sanguankeo, Anawin (2019) Improvement in pulmonary function in asthmatic patients after bariatric surgery: a systematic review and meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 15(5): 794-803	- Data not reported in an extractable format *Meta-analysis is of before and after comparison*
Vallois, Antoine; Menahem, Benjamin; Alves, Arnaud (2020) Is Laparoscopic Bariatric Surgery Safe and Effective in Patients over 60 Years of Age?" an Updated Systematic Review and Meta-Analysis. Obesity surgery 30(12): 5059-5070	- Not an SR of comparative observational studies
van Huisstede, Astrid, Rudolphus, Arjan, Castro Cabezas, Manuel et al. (2015) Effect of bariatric surgery on asthma control, lung function and bronchial and systemic inflammation in morbidly	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
obese subjects with asthma. Thorax 70(7): 659-67	
van Olst, N, van Rijswijk, A S, Mikdad, S et al. (2021) Long-term Emergency Department Visits and Readmissions After Laparoscopic Roux-en-Y Gastric Bypass: a Systematic Review. Obesity surgery 31(6): 2380-2390	- Not a relevant study design *Qualitative synthesis not meta-analysis*
van Rijswijk, Anne-Sophie, van Olst, Nienke, Schats, Winnie et al. (2021) What Is Weight Loss After Bariatric Surgery Expressed in Percentage Total Weight Loss (%TWL)? A Systematic Review. Obesity surgery 31(8): 3833-3847	- Not an SR of comparative observational studies
Vangoitsenhoven, Roman, Frederiks, Pascal, Gijbels, Brecht et al. (2016) Long-term effects of gastric bypass surgery on psychosocial well-being and eating behavior: not all that glitters is gold. Acta clinica Belgica 71(6): 395-402	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Vilallonga, Ramon, Sanchez-Cordero, Sergi, Umpierrez Mayor, Nicolas et al. (2021) GERD after Bariatric Surgery. Can We Expect Endoscopic Findings?. Medicina (Kaunas, Lithuania) 57(5)	- Not an SR of comparative observational studies
Vitiello, Antonio, Angrisani, Luigi, Santonicola, Antonella et al. (2019) Bariatric Surgery Versus Lifestyle Intervention in Class I Obesity: 7-10-Year Results of a Retrospective Study. World journal of surgery 43(3): 758-762	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Wan, Qianyi, Zhao, Rui, Chen, Yi et al. (2021) Comparison of the incidence of cholelithiasis after sleeve gastrectomy and Roux-en-Y gastric bypass: a meta-analysis. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 17(6): 1198-1205	- Does not contain relevant control group
Wang, Laicheng, Lin, Meihua, Yu, Jianjian et al. (2021) The Impact of Bariatric Surgery Versus Non-Surgical Treatment on Blood Pressure: Systematic Review and Meta-Analysis. Obesity surgery 31(11): 4970-4984	- Systematic review of RCTs references checked
Wang, Yao, Yi, Xiaoyan, Li, Qifu et al. (2016) The Effectiveness and Safety of Sleeve Gastrectomy in the Obese Elderly Patients: a	- Comparator in study does not match that specified in protocol *Comparator younger cohort*

Study	Reason for exclusion
Systematic Review and Meta-Analysis. Obesity surgery 26(12): 3023-3030	
Wang, Yong, Song, Ying-Han, Chen, Jing et al. (2019) Roux-en-Y Gastric Bypass Versus Sleeve Gastrectomy for Super Super Obese and Super Obese: Systematic Review and Meta-analysis of Weight Results, Comorbidity Resolution. Obesity surgery 29(6): 1954-1964	- Comparator in study does not match that specified in protocol
Wang, Zhengdong, Gu, Dezhi, Pan, Cheng et al. (2021) Comparative observation on the effect of laparoscopic sleeve gastrectomy and routine weight loss in the treatment of obesity and the improvement of blood pressure. Panminerva medica	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Wei, Yihui, Wu, Tingting, Tong, Daniel K H et al. (2020) Improvement in patient-reported outcomes in Chinese adults after bariatric surgery: 1-year follow-up of a prospective cohort. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 16(10): 1563-1572	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *Used propensity score matching but did not adjust for comorbidities*
Wei, Yong; Chen, Quanbing; Qian, Wenhui (2018) Effect of Bariatric Surgery on Semen Parameters: A Systematic Review and Meta-Analysis. Medical science monitor basic research 24: 188-197	- Not an SR of comparative observational studies *Not all prospective studies in subgroup analysis had control group*
Weng, Ting-Chia, Chang, Chia-Hsuin, Dong, Yaa-Hui et al. (2015) Anaemia and related nutrient deficiencies after Roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. BMJ open 5(7): e006964	- Not an SR of comparative observational studies *Before and after comparison*
Wiggins, Tom, Guidozzi, Nadia, Welbourn, Richard et al. (2020) Association of bariatric surgery with all-cause mortality and incidence of obesity-related disease at a population level: A systematic review and meta-analysis. PLoS medicine 17(7): e1003206	- SR not of a subgroup of interest
Wilhelm, Sheila M; Young, Jamie; Kale-Pradhan, Pramodini B (2014) Effect of bariatric surgery on hypertension: a meta-analysis. The Annals of pharmacotherapy 48(6): 674-82	- SR subgroup of interest but mixed study design
Wirth, Keith M, Sheka, Adam C, Kizy, Scott et al. (2020) Bariatric Surgery is Associated With Decreased Progression of Nonalcoholic Fatty	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
Liver Disease to Cirrhosis: A Retrospective Cohort Analysis. Annals of surgery 272(1): 32-39	
Wong, Ai-Ming, Barnes, Hayley N, Joosten, Simon A et al. (2018) The effect of surgical weight loss on obstructive sleep apnoea: A systematic review and meta-analysis. Sleep medicine reviews 42: 85-99	- Not an SR of comparative observational studies *Included uncontrolled studies*
Xiang, Anny H, Trigo, Enrique, Martinez, Mayra et al. (2018) Impact of Gastric Banding Versus Metformin on beta-Cell Function in Adults With Impaired Glucose Tolerance or Mild Type 2 Diabetes. Diabetes care 41(12): 2544-2551	- Study included a comorbidity that is not a subgroup of interest
Yang (2019) Correction to: Letter by Yang et al regarding article, "Effects of bariatric surgery in obese patients with hypertension: The GATEWAY randomized trial (Gastric bypass to treat obese patients with steady hypertension)" (Circulation (2018) 138 (1488-1489) DOI: 10.1161/CIRCULATIONAHA.118.035120). Circulation 139(2): e3	- Correction of a letter to editor
Yeo, Danson, Yeo, Charleen, Low, Tze Yi et al. (2019) Outcomes After Metabolic Surgery in Asians-a Meta-analysis. Obesity surgery 29(1): 114-126	- Comparator in study does not match that specified in protocol *Surgery vs surgery in analysis*
Yeung, Kai Tai Derek, Penney, Nicholas, Ashrafian, Leanne et al. (2020) Does Sleeve Gastrectomy Expose the Distal Esophagus to Severe Reflux?: A Systematic Review and Meta-analysis. Annals of surgery 271(2): 257-265	- Not an SR of comparative observational studies
Yi, Xiao-yan, Li, Qi-fu, Zhang, Jun et al. (2015) A meta-analysis of maternal and fetal outcomes of pregnancy after bariatric surgery. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics 130(1): 3-9	- SR not of a subgroup of interest
Yu, Elaine W, Bouxsein, Mary L, Putman, Melissa S et al. (2015) Two-year changes in bone density after Roux-en-Y gastric bypass surgery. The Journal of clinical endocrinology and metabolism 100(4): 1452-9	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)

Study	Reason for exclusion
Yu, Elaine W, Bouxsein, Mary L, Roy, Adam E et al. (2014) Bone loss after bariatric surgery: discordant results between DXA and QCT bone density. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 29(3): 542-50	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Yuan, Hongtao, Medina-Inojosa, Jose R, Lopez-Jimenez, Francisco et al. (2021) The Long-Term Impact of Bariatric Surgery on Development of Atrial Fibrillation and Cardiovascular Events in Obese Patients: An Historical Cohort Study. Frontiers in cardiovascular medicine 8: 647118	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Yuan, William, Yu, Kun-Hsing, Palmer, Nathan et al. (2019) Evaluation of the association of bariatric surgery with subsequent depression. International journal of obesity (2005) 43(12): 2528-2535	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Zakaria, Ahmed S, Rossetti, Luca, Cristina, Maurizio et al. (2016) Effects of gastric banding on glucose tolerance, cardiovascular and renal function, and diabetic complications: a 13-year study of the morbidly obese. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 12(3): 587-595	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity)
Zeng, C, Lane, N E, Li, X et al. (2021) Association between bariatric surgery with long-term analgesic prescription and all-cause mortality among patients with osteoarthritis: a general population-based cohort study. Osteoarthritis and cartilage 29(10): 1412-1417	- Study included a comorbidity that is not a subgroup of interest
Zeng, Tianshu; Cai, Yuli; Chen, Lulu (2017) The Effectiveness of Bariatric Surgery for Chinese Obesity in 2 Years: A Meta-Analysis and Systematic Review. Journal of investigative surgery : the official journal of the Academy of Surgical Research 30(5): 332-341	- Not an SR of comparative observational studies *Included uncontrolled studies*
Zhang, Qingyu, Dong, Jinlei, Zhou, Dongsheng et al. (2020) Comparative risk of fracture for bariatric procedures in patients with obesity: A systematic review and Bayesian network meta-analysis. International journal of surgery (London, England) 75: 13-23	- SR not of a subgroup of interest
Zhang, Yuxiang, Wang, Wenyue, Yang, Chengcan et al. (2019) Improvement in	- Not an SR of comparative observational studies

Study	Reason for exclusion
Nocturnal Hypoxemia in Obese Patients with Obstructive Sleep Apnea after Bariatric Surgery: a Meta-Analysis. Obesity surgery 29(2): 601-608	
Zhang, Zhengchao, Miao, Lele, Ren, Zhijian et al. (2021) Robotic bariatric surgery for the obesity: a systematic review and meta-analysis. Surgical endoscopy 35(6): 2440-2456	- Inadequate adjustment/matching (study must use method set out in NICE TSD 17 to adjust for minimum of age, BMI sex and comorbidity) *No adjustment for baseline BMI*
Zhao, Jasmine, Samaan, Jamil S, Abboud, Yazan et al. (2021) Racial disparities in bariatric surgery postoperative weight loss and co-morbidity resolution: a systematic review. Surgery for obesity and related diseases : official journal of the American Society for Bariatric Surgery 17(10): 1799-1823	- Not an SR of comparative observational studies
Zhou, Xu, Yu, Jiajie, Li, Ling et al. (2016) Effects of Bariatric Surgery on Mortality, Cardiovascular Events, and Cancer Outcomes in Obese Patients: Systematic Review and Meta-analysis. Obesity surgery 26(11): 2590-2601	- SR not of a subgroup of interest
Zilberstein, Bruno; Santo, Marco Aurelio; Carvalho, Marnay Helbo (2019) CRITICAL ANALYSIS OF SURGICAL TREATMENT TECHNIQUES OF MORBID OBESITY. Arquivos brasileiros de cirurgia digestiva : ABCD = Brazilian archives of digestive surgery 32(3): e1450	- Not an SR of comparative observational studies

Economic studies

Study	Reason for exclusion
Ademi Z, Tomonaga Y, van Stiphout J, Glinz D, Gloy V, Raatz H, Bucher HC, Schwenkglenks M. Adaptation of cost-effectiveness analyses to a single country: the case of bariatric surgery for obesity and overweight. Swiss medical weekly. 2018;148:w14626.	- Review of cost-effectiveness studies
Aguiar M, Frew E, Mollan SP, Mitchell JL, Ottridge RS, Alimajstorovic Z, Yiangou A, Singhal R, Tahrani AA, Sinclair AJ. The health economic evaluation of Bariatric surgery versus a community weight management intervention analysis from the idiopathic intracranial hypertension weight trial (IIH: WT). Life. 2021 May;11(5):409.	- Inappropriate population as this focused on females with active idiopathic intracranial hypertension with papilloedema.

Study	Reason for exclusion
Aleassa EM, Brethauer S, Aminian A, Augustin T. Cost-effectiveness of enhanced recovery pathway in bariatric surgery: it is not all about length of stay. Surgery for Obesity and Related Diseases. 2019 Apr 1;15(4):602-7.	- Not a cost-utility study. No QALYs.
Alsumali A, Eguale T, Bairdain S, Samnaliev M. Cost-effectiveness analysis of bariatric surgery for morbid obesity. Obesity surgery. 2018 Aug;28(8):2203-14.	- Not a UK study
An S, Park HY, Oh SH, Heo Y, Park S, Jeon SM, Kwon JW. Cost-effectiveness of Bariatric Surgery for People with Morbid Obesity in South Korea. Obesity Surgery. 2020 Jan;30(1):256-66.	- Not a UK study
Assumpção, R.P., Bahia, L.R., da Rosa, M.Q.M., Correia, M.G., da Silva, E.N., Zubiaurre, P.R., Mottin, C.C. and Vianna, D.A., 2019. Cost-utility of gastric bypass surgery compared to clinical treatment for severely obese with and without diabetes in the perspective of the Brazilian Public Health System. Obesity Surgery, 29(10), pp.3202-3211.	- Not a UK study
Bairdain S, Samnaliev M. Cost-effectiveness of adolescent bariatric surgery. Cureus. 2015 Feb 4;7(2).	- Not a UK study
Basharic FA, OlyaeeManesh A, Raei B, Goudarzi R, Zozani MA, Ezzatabadi MR. Cost-effectiveness of laparoscopic sleeve gastrectomy and laparoscopic Roux-en-Y gastric bypass in two hospitals of Tehran city in 2014. Medical journal of the Islamic Republic of Iran. 2017;31:22.	- Not a cost-utility study. Effectiveness was measured as change in mean BMI.
Bailey JG, Hayden JA, Davis PJ, Liu RY, Haardt D, Ellsmere J. Robotic versus laparoscopic Roux-en-Y gastric bypass (RYGB) in obese adults ages 18 to 65 years: a systematic review and economic analysis. Surgical endoscopy. 2014 Feb;28(2):414-26.	- Not a cost-utility study. No QALYs, only costs presented.
Borisenko, O., V. Lukyanov, and A. R. Ahmed. "Cost–utility analysis of bariatric surgery." Journal of British Surgery 105.10 (2018): 1328-1337.	- Not a UK study
Borisenko O, Adam D, Funch-Jensen P, Ahmed AR, Zhang R, Colpan Z, Hedenbro J. Bariatric surgery can lead to net cost savings to health care systems: results from a comprehensive European decision analytic model. Obesity surgery. 2015 Sep;25(9):1559-68.	- Not a UK study
Borisenko O, Lukyanov V, Debergh I, Dillemans B. Cost-effectiveness analysis of bariatric	- Not a UK study

Study	Reason for exclusion
surgery for morbid obesity in Belgium. Journal of Medical Economics. 2018 Apr 3;21(4):365-73.	
Borisenko O, Lukyanov V, Johnsen SP, Funch-Jensen P. Cost analysis of bariatric surgery in Denmark made with a decision-analytic model. Dan Med J. 2017 Aug 1;64(8):A5401.	- Not a UK study
Borisenko O, Mann O, Duprée A. Cost-utility analysis of bariatric surgery compared with conventional medical management in Germany: a decision analytic modeling. BMC surgery. 2017 Dec;17(1):1-9.	- Not a UK study
Boyers D, Retat L, Jacobsen E, Avenell A, Aveyard P, Corbould E, Jaccard A, Cooper D, Robertson C, Aceves-Martins M, Xu B. Cost-effectiveness of bariatric surgery and non-surgical weight management programmes for adults with severe obesity: a decision analysis model. International Journal of Obesity. 2021 Oct;45(10):2179-90.	- Not a UK study
Castilla I, Mar J, Valcárcel-Nazco C, Arrospide A, Ramos-Goñi JM. Cost–utility analysis of gastric bypass for severely obese patients in Spain. Obesity surgery. 2014 Dec;24(12):2061-8.	- Not a UK study
Choudhury RA, Murayama KM, Neylan CJ, Savulionyte G, Glick HA, Williams NN, Dempsey DT, Dumon KR. Re-examining the BMI threshold for bariatric surgery in the USA. Journal of Gastrointestinal Surgery. 2014 Dec;18(12):2074-9.	- Not a UK study
Cohen RV, Luque A, Junqueira S, Ribeiro RA, Le Roux CW. What is the impact on the healthcare system if access to bariatric surgery is delayed?. Surgery for Obesity and Related Diseases. 2017 Sep 1;13(9):1619-27.	- Not a UK study
Elliot L, Frew E, Mollan SP, Mitchell JL, Yiangou A, Alimajstorovic Z, Ottridge RS, Wakerley BR, Thaller M, Grech O, Singhal R. Cost-effectiveness of bariatric surgery versus community weight management to treat obesity-related idiopathic intracranial hypertension: Evidence from a single-payer healthcare system. Surgery for Obesity and Related Diseases. 2021 Jul 1;17(7):1310-6.	- Inappropriate population as this focused on females with active idiopathic intracranial hypertension.
Gil-Rojas Y, Garzón A, Lasalvia P, Hernández F, Castañeda-Cardona C, Rosselli D. Cost-effectiveness of bariatric surgery compared with nonsurgical treatment in people with obesity and comorbidity in Colombia. Value in Health Regional Issues. 2019 Dec 1;20:79-85.	- Not a UK study

Study	Reason for exclusion
Giske L, Stoinska-Schneider A, Hjelmesæth J, Mala T, Arentz-Hansen EH, Elvsaas IK, Desser AS, Hafstad EV, Juvet LK, Fure B. Fedmekirurgi ved diabetes type 2 og kroppsmasseindeks under 35-fullstendig metodevurdering.	- Not a cost-utility study. Only costs presented.
Gulliford MC, Charlton J, Prevost T, Booth H, Fildes A, Ashworth M, Littlejohns P, Reddy M, Khan O, Rudisill C. Costs and outcomes of increasing access to bariatric surgery: cohort study and cost-effectiveness analysis using electronic health records. Value in Health. 2017 Jan 1;20(1):85-92.	- A longer more comprehensive version of this economic evaluation is published in full, therefore the more comprehensive version was included instead of this version.
Gulliford MC, Charlton J, Booth HP, Fildes A, Khan O, Reddy M, Ashworth M, Littlejohns P, Prevost AT, Rudisill C. Costs and outcomes of increasing access to bariatric surgery for obesity: cohort study and cost-effectiveness analysis using electronic health records. Health Services and Delivery Research. 2016 May 1;4(17):1-20.	- This is a duplicate publication that has already been included.
James R, Salton RI, Byrnes JM, Scuffham PA. Cost-utility analysis for bariatric surgery compared with usual care for the treatment of obesity in Australia. Surgery for Obesity and Related Diseases. 2017 Dec 1;13(12):2012-20.	- Not a UK study
Karim MA, Clifton E, Ahmed J, Mackay GW, Ali A. Economic evaluation of bariatric surgery to combat morbid obesity: A study from the W est of S cotland. Asian Journal of Endoscopic Surgery. 2013 Aug;6(3):197-202.	- Not a cost-utility study. No QALYs.
Kim DD, Arterburn DE, Sullivan SD, Basu A. Economic value of greater access to bariatric procedures for patients with severe obesity and diabetes. Medical Care. 2018 Jul 1;56(7):583-8.	- Not a UK study
Klebanoff MJ, Chhatwal J, Nudel JD, Corey KE, Kaplan LM, Hur C. Cost-effectiveness of bariatric surgery in adolescents with obesity. JAMA surgery. 2017 Feb 1;152(2):136-41.	- Out of scope as this focused on bariatric surgery among adolescents.
Klebanoff MJ, Corey KE, Chhatwal J, Kaplan LM, Chung RT, Hur C. Bariatric surgery for nonalcoholic steatohepatitis: a clinical and cost-effectiveness analysis. Hepatology. 2017 Apr;65(4):1156-64.	- Not a UK study
Klebanoff MJ, Corey KE, Samur S, Choi JG, Kaplan LM, Chhatwal J, Hur C. Cost-effectiveness analysis of bariatric surgery for patients with nonalcoholic steatohepatitis cirrhosis. JAMA network open. 2019 Feb 1;2(2):e190047-.	- Inappropriate population as this focused on people with non-alcoholic steatohepatitis cirrhosis.

Study	Reason for exclusion
Lester EL, Padwal RS, Birch DW, Sharma AM, So H, Ye F, Klarenbach SW. The real-world cost-effectiveness of bariatric surgery for the treatment of severe obesity: a cost–utility analysis. Canadian Medical Association Open Access Journal. 2021 Apr 1;9(2):E673-9.	- Not a UK study
Li M, Zeng N, Liu Y, Yan W, Zhang S, Wu L, Liu S, Wang J, Zhao X, Han J, Kang J. The Choice of Gastric Bypass or Sleeve Gastrectomy for Patients Stratified by Diabetes Duration and Body Mass Index (BMI) level: Results from a National Registry and Meta-analysis. Obesity Surgery. 2021 Sep;31(9):3975-89.	- Inappropriate population as this focused exclusively on people with type 2 diabetes.
Louwagie P, Neyt M, Dossche D, Camberlin C, ten Geuzendam B, Van den Heede K, Van Brabandt H. Bariatric surgery: an HTA report on the efficacy, safety and cost-effectiveness.	- No de novo modelling.
Lucchese M, Borisenko O, Mantovani LG, Cortesi PA, Cesana G, Adam D, Burdukova E, Lukyanov V, Di Lorenzo N. Cost-utility analysis of bariatric surgery in Italy: results of decision-analytic modelling. Obesity Facts. 2017;10(3):261-72.	- Not a UK study
Mital S, Nguyen HV. Incremental cost-effectiveness of aspiration therapy vs bariatric surgery and no treatment for morbid obesity. Official journal of the American College of Gastroenterology| ACG. 2019 Sep 1;114(9):1470-7.	- Not a UK study
McGlone ER, Carey I, Veličković V, Chana P, Mahawar K, Batterham RL, Hopkins J, Walton P, Kinsman R, Byrne J, Somers S. Bariatric surgery for patients with type 2 diabetes mellitus requiring insulin: Clinical outcome and cost-effectiveness analyses. PLoS medicine. 2020 Dec 7;17(12):e1003228.	- Inappropriate population as this focused exclusively on people with type 2 diabetes.
McLawhorn AS, Southren D, Wang YC, Marx RG, Dodwell ER. Cost-effectiveness of bariatric surgery prior to total knee arthroplasty in the morbidly obese: a computer model-based evaluation. JBJS. 2016 Jan 20;98(2):e6.	- Inappropriate population as this focused exclusively on people who go on to receive a total knee arthroplasty.
Panca M, Viner RM, White B, Pandya T, Melo H, Adamo M, Batterham R, Christie D, Kinra S, Morris S. Cost-effectiveness of bariatric surgery in adolescents with severe obesity in the UK. Clinical obesity. 2018 Apr;8(2):105-13.	- Out of scope as this focused on bariatric surgery among adolescents.
Paranjape CS, Gentry RD, Regan CM. Cost-effectiveness of bariatric surgery prior to posterior lumbar decompression and fusion in an obese population with degenerative	- Not a UK study

Study	Reason for exclusion
spondylolisthesis. Spine. 2021 Jul 15;46(14):950-7.	
Rognoni C, Armeni P, Tarricone R, Donin G. Cost–benefit Analysis in Health Care: The Case of Bariatric Surgery Compared With Diet. Clinical therapeutics. 2020 Jan 1;42(1):60-75.	- Not a UK study
Sanchez-Santos, R., Padin, E.M., Adam, D., Borisenko, O., Fernandez, S.E., Dacosta, E.C., Fernández, S.G., Vazquez, J.T., de Adana, J.C.R. and de la Cruz Vigo, F., 2018. Bariatric surgery versus conservative management for morbidly obese patients in Spain: a cost-effectiveness analysis. Expert Review of Pharmacoeconomics & Outcomes Research, 18(3), pp.305-314.	- Not a UK study
Song HJ, Kwon JW, Kim YJ, Oh SH, Heo Y, Han SM. Bariatric surgery for the treatment of severely obese patients in South Korea—is it cost effective?. Obesity surgery. 2013 Dec;23(12):2058-67.	- Not a UK study
Tang Q, Sun Z, Zhang N, Xu G, Song P, Xu L, Tang W. Cost-effectiveness of bariatric surgery for type 2 diabetes mellitus: a randomized controlled trial in China. Medicine. 2016 May;95(20).	- Inappropriate population as this focused exclusively on people with type 2 diabetes.
Tu Y, Wang L, Wei L, Xu Y, Han X, Han J, Yu H, Zheng C, Bao Y, Jia W. Cost-utility of laparoscopic Roux-en-Y gastric bypass in Chinese patients with type 2 diabetes and obesity with a BMI≥ 27.5 kg/m2: a multi-center study with a 4-year follow-up of surgical cohort. Obesity Surgery. 2019 Dec;29(12):3978-86.	- Inappropriate population as this focused exclusively on people with type 2 diabetes.
Viratanapanu I, Romyen C, Chaivanijchaya K, Sornphiphatphong S, Kattipatanapong W, Techagumpuch A, Kitisin K, Pungpapong SU, Tharavej C, Navicharern P, Boonchayaanant P. Cost-effectiveness evaluation of bariatric surgery for morbidly obese with diabetes patients in Thailand. Journal of Obesity. 2019 Feb 3;2019.	- Not a UK study
Walter E, Langer FB, Beckerhinn P, Hoffer F, Prager G. Impact of metabolic surgery on cost and long-term health outcome: a cost-effectiveness approach. Surgery for Obesity and Related Diseases. 2022 Feb 1;18(2):260-70.	- Not a UK study
Wan B, Fang N, Guan W, Ding H, Wang Y, Ge X, Liang H, Li X, Zhan Y. Cost-effectiveness of bariatric surgery versus medication therapy for obese patients with type 2 diabetes in China: a Markov analysis. Journal of Diabetes Research. 2019 Dec 20;2019.	- Inappropriate population as this focused exclusively on people with type 2 diabetes.

Study	Reason for exclusion
Wang B, Wong ES, Alfonso-Cristancho R, He H, Flum DR, Arterburn DE, Garrison LP, Sullivan SD. Cost-effectiveness of bariatric surgical procedures for the treatment of severe obesity. The European Journal of Health Economics. 2014 Apr;15(3):253-63.	- Not a UK study
Warren JA, Ewing JA, Hale AL, Blackhurst DW, Bour ES, Scott JD. Cost-effectiveness of bariatric surgery: increasing the economic viability of the most effective treatment for type II diabetes mellitus. The American Surgeon. 2015 Aug;81(8):807-11.	- Not a cost-utility study. No QALYs, only costs presented.
Wentworth JM, Dalziel KM, O'Brien PE, Burton P, Shaba F, Clarke PM, Laiteerapong N, Brown WA. Cost-effectiveness of gastric band surgery for overweight but not obese adults with type 2 diabetes in the US. Journal of Diabetes and its Complications. 2017 Jul 1;31(7):1139-44.	- Inappropriate population as this focused exclusively on people with type 2 diabetes.
Zanela OO, Cabra HA, Meléndez G, Anaya P, Rupprecht F. Economic evaluation of bariatric surgery in Mexico using discrete event simulation. Value in Health Regional Issues. 2012 Dec 1;1(2):172-9.	- Not a cost-utility study. Results were presented as ‘return on investment’.

Appendix L – Research recommendations – full details

Research recommendation 1

What is the effectiveness and cost effectiveness of bariatric surgery in achieving weight loss and improving treatment outcomes in people who are unable to receive treatment for other health conditions (such as, joint replacement surgery or fertility treatment) because they are living with obesity?

Why this is important

In this review, evidence on effectiveness and cost effectiveness of bariatric surgery across different subpopulations was used to inform the appropriate referral criteria for bariatric surgery. No evidence on the effectiveness of bariatric surgery was identified in people who are unable to receive treatment because of their obesity. This can include people who may require kidney transplant, fertility treatment and hip or joint replacement surgery. They also noted that based on current referral criteria, people in this group may find it difficult to get referred to bariatric surgery.

The committee noted that in practice, people are often urged to lose weight before receiving treatments for other conditions, however as no evidence was identified in this subpopulation, the committee highlighted the importance of further research in this group. The committee also noted that robust, longitudinal evidence is also required to show how surgery may impact the outcome of other treatments received after bariatric surgery.

Rationale for research recommendation

Importance to ‘patients’ or the population	People are often urged to lose weight before receiving other treatments for conditions such as kidney transplant and fertility treatment. If robust evidence is identified on the effectiveness of bariatric surgery in achieving weight loss outcomes and improvement in treatment outcomes, people who may currently find it difficult to receive bariatric surgery may benefit as it means they are able to receive their desired treatment which can improve their quality of life.
Relevance to NICE guidance	People who are unable to receive treatment because of their obesity cannot currently receive bariatric surgery based on existing recommendations. New recommendations were developed to highlight examples of conditions that can be improved due to weight loss, but further research is required in people who are unable to receive treatment because of their obesity.
Relevance to the NHS	People who may have previously been denied assessment for bariatric surgery can be considered in the future if further research is identified.
National priorities	High
Current evidence base	Minimal long-term data
Equality considerations	None known

Modified PICO table

Population	People living with obesity who are unable to receive treatment because they are living with obesity for example, kidney transplant, fertility treatment, hip/ joint replacement. Subgroups: People from minority ethnic groups: • Black African/ Caribbean • Asian (South Asian, Chinese, any other Asian background) • Other ethnic groups (Arab, any other ethnic group) • Multiple/mixed ethnic group
Intervention	**Bariatric Surgery including:** • Roux-en-Y gastric bypass • Mini gastric bypass / one-anastomosis gastric bypass • Sleeve gastrectomy • Gastric band • Biliopancreatic diversion (with duodenal switch)
Comparator	• No treatment • Standard care • Non-surgical intervention for obesity

Outcome	• Measures of weight change (including change in weight or BMI)
	• Intervention outcomes such as:
	  ○ success rate of intervention received after bariatric surgery.
	  ○ Improvement in condition (e.g., improvement in fertility outcomes)
	• Health related quality of life
	• Mortality (perioperative and at the latest time point in the study)
	• Adverse events
	• Revision rates (reversal or conversions to normal or other procedures)

Study design	Observational study
Timeframe	Long term
Additional information	None

Research recommendation 2

What is the effectiveness and cost effectiveness of bariatric surgery in achieving weight loss and maintaining a healthier weight in adults from minority ethnic family backgrounds who are living with obesity?

Why this is important

People from minority ethnic family backgrounds are affected by obesity related comorbidities at lower BMI levels because they have higher central adiposity at the same BMI than people with other family backgrounds. In this review, evidence on effectiveness and cost effectiveness of bariatric surgery across different subpopulations was used to inform the appropriate referral criteria for bariatric surgery. However, no evidence for the effectiveness of bariatric surgery in people of different family backgrounds was identified.

Based on their understanding of current clinical practice, the committee stated that assessment for bariatric surgery can be considered in people of South Asian, Chinese, other Asian, Middle Eastern, Black African or African-Caribbean family background at a lower BMI (reduced by 2.5 kg/m^2). However, the committee stated that robust, longitudinal evidence is needed for the use of lower BMI thresholds (reduced by 2.5 kg/m^2) and also to see if there are other more appropriate BMI thresholds for bariatric surgery in this population.

Rationale for research recommendation

Importance to 'patients' or the population	No evidence identified on the effectiveness of bariatric surgery in people from minority ethnic family backgrounds. Further research is required to identify appropriate BMI thresholds for bariatric surgery in this population.
Relevance to NICE guidance	People from minority ethnic family backgrounds are affected by obesity related comorbidities at lower BMI levels. Further research is needed to draft stronger recommendations for these population groups.
Relevance to the NHS	The outcome would affect the number of people offered referral for assessment for bariatric surgery.
National priorities	High
Current evidence base	Minimal long-term data
Equality considerations	As people from minority ethnic family backgrounds are affected by obesity related comorbidities at a lower BMI threshold, it is important to identify if lower BMI thresholds should be recommended for BAME groups. BAME groups are frequently underrepresented in clinical trials and therefore it is important to promote further research in this population.

Modified PICO table

Population	People from minority ethnic groups: • Black African/ Caribbean • Asian (South Asian, Chinese, any other Asian background)

	• Other ethnic groups (Arab, any other ethnic group) • Multiple/mixed ethnic group Subgroups: • Different BMI thresholds (e.g., BMI thresholds for people from white family backgrounds lowered by 2.5 kg/m^2 or more) • Comorbidities including: ○ Non-alcoholic fatty liver disease ○ Sleep apnoea ○ Severe Asthma ○ Cardiovascular disease ○ Idiopathic intracranial hypertension ○ Depression/anxiety
Intervention	**Bariatric Surgery including:** • Roux-en-Y gastric bypass • Mini gastric bypass / one-anastomosis gastric bypass • Sleeve gastrectomy • Gastric band • Biliopancreatic diversion (with duodenal switch)
Comparator	• No treatment • Standard care • Non-surgical intervention for obesity
Outcome	• Measures of weight change (including change in weight or BMI) • Health related quality of life • Mortality (perioperative and at the latest time point in the study) • Adverse events • Revision rates (reversal or conversions to normal or other procedures)
Study design	Observational study
Timeframe	Long term
Additional information	Subgroup analysis by BMI categories, if possible.