Review Article

Metabolic surgery versus usual care effects on mortality among patients with obesity and type 2 diabetes: A systematic review and meta-analysis

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Although bariatric surgery is recommended for obesity treatment, there is an increasing trend toward comorbidity-related indications. The effects of bariatric surgery on mortality are inconsistent. This meta-analysis aimed to assess metabolic surgery versus usual care on mortality among patients with obesity and type 2 diabetes. we searched six databases for articles comparing bariatric surgery with usual care in terms of mortality. The terms used were bariatric surgery, metabolic surgery, lifestyles, usual care, gastric banding, bypass surgery, biliopancreatic diversion, gastric bypass, sleeve gastrectomy, and Roux-en-Y gastric bypass. The search engine was set for articles from inception up to June 2024. Out of the 1960 studies retrieved, 1810 were retained after the removal of duplication; from them, 75 full texts were eligible, and only 26 studies were included in the final meta-analysis. The study included 866,159 patients (167,152 patients who underwent bariatric surgery and 699,007 usual care patients) and 91,211 deaths. Mortality was lower among patients with bariatric surgery compared to usual care (3.1% vs. 12.6%), odds ratio = 0.43, 95% confidence interval (CI), 0.32–0.58, Chi-square = 1638.20, and $P < 0.001$, I^2 for heterogeneity = 99%, and the standard difference = 24. Mortality was higher in bariatric surgery in subgroup meta-analysis on patients with type 2 diabetes (2.6% versus 2.0%), odds ratio, 0.63, 95% CI, 0.42–0.95, Chi-square = 101.04, and $P = 0.03$ I^2 for heterogeneity = 95%, and the standard difference = 5. Bariatric surgery was associated with lower mortality in patients with obesity compared to usual care, but higher mortality in subgroup meta-analysis in type 2 diabetes. Larger, well-controlled trials are needed.

Key words: Bariatric surgery, mortality, obesity, type 2 diabetes, usual care

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INTRODUCTION

Obesity is a highly prevalent health problem and approaching a pandemic. Obesity is on the rise and tripled since 1975. The prevalence of obesity and overweight is 60% in Europe. The prevalence is 40% in the USA and the projection is one in two for 2030.[1,2] The disease is causing a lot of morbidity and mortality and caused four million deaths in 2016.[3] Obesity is associated with a wide range of diseases including cardiovascular disease, renal, metabolic-associated fatty liver disease, musculoskeletal, respiratory disease, malignancy, and mortality.[4] Mortality among patients with obesity is mainly due to macrovascular complications and obesity-related comorbidities including diabetes mellitus, high blood pressure, metabolic-associated steatohepatitis, and cancer.[5] The majority of patients with diabetes are overweight and 40% are obese (dia-obesity).[6] Although medical nutritional therapy is the cornerstone of diabetes management and tight glycemic control can prevent and delay microvascular complications. However, no effect was observed regarding macrovascular complications. In addition, oral hypoglycemic medications might cause life-threatening hypoglycemia.[7,8] Therefore, other measures to address mortality and macrovascular

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complications are crucial for obesity and diabetes management. Bariatric and metabolic surgery is a safe and effective measure for obesity; bariatric surgery is indicated for individuals with body mass index (BMI) >35 kg/m^2 and 30–34.9 kg/m^2 for patients with metabolic disease. The cutoff is lower for the Asian population, >27.5 kg/m^2.[9] Since 1991, healthcare providers, insurance bodies, and hospitals have used the National Institutes of Health consensus, the threshold was a BMI of >40 kg/m^2, or BMI >35 kg/m for normal patients and those with comorbidities, respectively.[10] The field of bariatric surgery is rapidly evolving, from the seventeen procedures, laparoscopic sleeve gastrectomy, followed by Roux-Y gastric bypass are currently the most popular with others losing their significance.[7,11] Bariatric surgery is not only a procedure for weight loss, extension to include patients with metabolic diseases is currently a hot topic worldwide.[12] Importantly, bariatric surgery effects on survival scare; few meta-analyses have assessed bariatric surgery effects on mortality, syn *et al*.[13] study was limited by searching only three databases and included only sixteen studies. Zhou *et al*. and Cardoso *et al*. included a few studies with limited events and concluded that bariatric surgery might reduce mortality.[14,15] van Veldhuisen *et al*.[16] focused on cardiovascular disease, while Wiggins *et al*.[17] missed important recently published studies. This is the largest meta-analysis to assess the effects of different bariatric surgeries on mortality. This meta-analysis aimed to assess metabolic surgery versus usual care effects on mortality among patients with obesity and type 2 diabetes.

METHODS

Eligibility criteria according to patient population, intervention, comparison, outcome, and study design (PICOS)

This study was conducted to assess the mortality among patients with and without type 2 diabetes undergoing different types of bariatric surgery and usual care.

Inclusion criteria

We included randomized controlled trials, prospective and retrospective studies, case–control, and cross-sectional studies from the first published up to June 2024. The studies must compare different types of bariatric surgery and usual care effect on mortality.

Exclusion criteria

Case reports, case series, experts' opinions, protocols without results, reviews, and editorials were excluded. We included the most recent study published by the same authors to avoid duplication of the results.

Outcome measures

The outcome measures

Bariatric surgery and usual care effect on mortality among obese patients with and without type 2 diabetes. We did not specify any type of bariatric surgery (all procedures were included).

Literature search and data extraction

The two authors searched PubMed MEDLINE, Web of Science, SCOPUS, EBSCO, Google Scholar, and Cochrane Library from the date of the first inception up to June 2024. The keywords including bariatric surgery, metabolic surgery, lifestyles, usual care, gastric banding, bypass surgery, biliopancreatic diversion, gastric bypass, sleeve gastrectomy, and Roux-en-Y gastric bypass were used. In addition, we screened the titles, abstracts, and references of the included studies for relevant articles. We identified 1960 studies and 1810 stands after the removal of duplication; from them, 75 full texts were eligible, and only 26 studies were included in the final meta-analysis. Twenty-five studies compared bariatric surgery and usual care among patients with obesity, and six studies compared bariatric surgery and usual care in patients with type 2 diabetes [Figure 1].

Data extraction

The author's name, year and country of publication, type of study, number of participants in bariatric surgery and control groups, age in years, female%, BMI, associated comorbidities, and the study duration we recorded in excel sheet [Table 1].

Risk of bias assessment

Newcastle Ottawa Scale risk of bias assessed the risk of bias of the included studies.[18] The scale assessed the studies in three domains: selection, comparability, and exposure. The studies scored from 7 to 9 on the Newcastle Ottawa Scale [Table 1].

Statistical analysis

The Review Manager version 5.4.1 (Oxford, United Kingdom) software from Cochrane Collaboration was used for data analysis. We pooled 25 studies of patients with obesity, and six studies investigated mortality among patients with type 2 diabetes. The odds ratio was calculated for the dichotomous data at 5% marginal error and 95% confidence interval (CI). The dichotomous date data was entered manually and the random effect was due to the substantial heterogeneity (99% when pooling 25 studies, and 95% is the type 2 diabetes subgroup meta-analysis). The I^2 was used to evaluate heterogeneity among studies (heterogeneity <25% was considered low, and >50% was considered substantial and the random effect was used). We generated Funnel plots to assess potential publication bias for meta-analysis containing ten or more studies. The Chi-square test, the weighted average effect size (Z), and the standard difference were applied. A subgroup meta-analysis was conducted to find the source of heterogeneity. $P < 0.05$ was considered statistically significant.

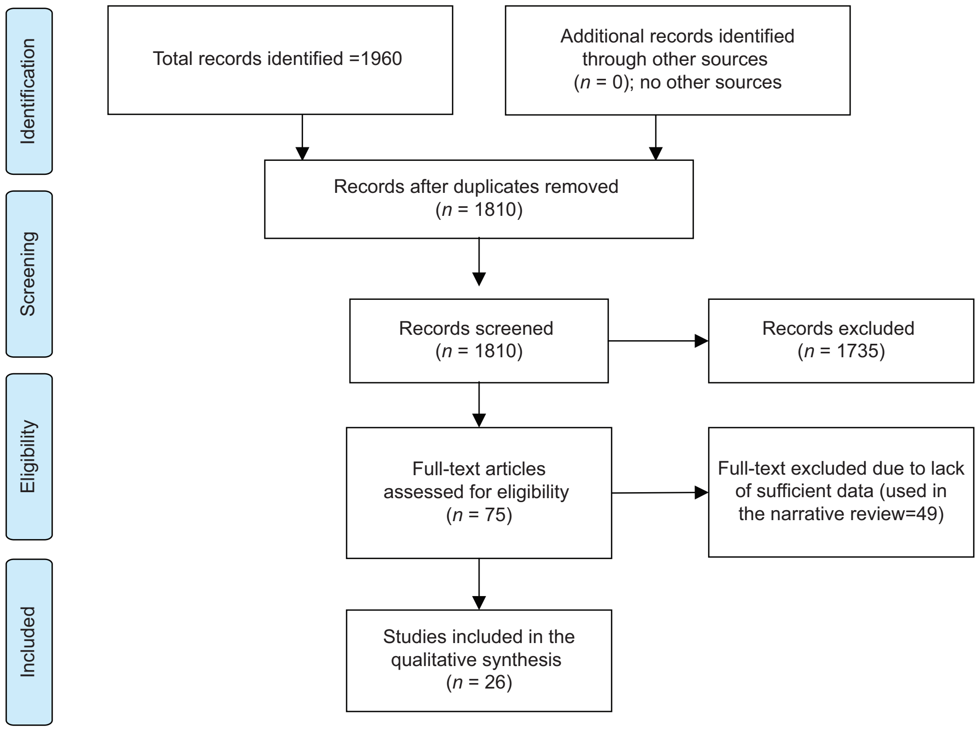

Figure 1: Studies comparing mortality among obese patients with and without diabetes mellitus (the PRISMA Chart)

Table 1: Newcastle Ottawa Scale risk of bias of the included studies

Author	Selection	Compatibility	Exposure	Total score
Aminian *et al*., 2020[19]	4	2	3	9
Ardissino *et al*., 2021[20]	3	2	2	7
Arterburn *et al*., 2015[21]	4	2	2	8
Batsis *et al*., 2007[22]	3	2	3	8
Carlsson *et al*., 2023[23]	3	2	3	8
Ceriani *et al*., 2019[24]	4	2	2	8
Davidson *et al*., 2016[25]	3	2	2	7
Dicker *et al*., 2021[26]	4	2	3	9
Douglas *et al*., 2015[27]	4	2	3	9
Doumouras *et al*., 2020[28]	4	2	3	9
Fisher *et al*., 2018[29]	4	2	3	9
Hung *et al*., 2021[30]	4	2	2	8
Johnson *et al*., 2013[31]	4	2	3	9
Kauppila *et al*., 2019[32]	3	2	3	8
Lent *et al*., 2017[33]	4	2	3	9
Liakopoulos *et al*., 2019[34]	3	2	2	9
Lundberg *et al*., 2023[35]	4	2	2	8
Moussa *et al*., 2020[36]	4	2	3	9
Pirlet *et al*., 2021[37]	4	2	2	8
Pontiroli, *et al*., 2018[38]	4	2	2	8
Rassen *et al*., 2021[39]	4	3	2	9
Reges *et al*., 2018[40]	4	2	3	9
Singh *et al*., 2020[41]	3	2	2	7
Sjöström L *et al*., 2012[42]	4	3	2	9
Thereaux *et al*., 2019[43]	4	2	2	8

In the present study, we identified 1960 studies and 1810 stands after the removal of duplication; from them, 75 full texts were eligible, and only 26 studies were included in the final meta-analysis.

Newcastle Ottawa Scale risk of bias assessed the risk of bias of the included studies.[18] The scale assessed the studies in three domains: selection, comparability, and exposure. The studies scored from 7 to 9 on the Newcastle Ottawa Scale [Table 1].

RESULTS

Characteristics of the study group

The study included 866,159 patients (167,152 patients who underwent bariatric surgery and 699,007 usual care patients) and 91,211 deaths. Six studies were prospective, eighteen retrospective, and one nested case–control study. Ten studies were conducted in Europe, nine were published in the USA, four in Asia, and two in Canada. Patients had type 2 diabetes in six studies, no diabetes in two studies, and mixed in seventeen studies [Table 2].

The participants age ranged from 32.27 ± 9.25 years to 59 years, the BMI ranged from 40 to 49.5 ± 8.9 years, study duration ranged from 2.6 to 32 years, and the rate of diabetes varied from 0% diabetes to 100%. Similarly, comorbidities were different in the included studies [Table 3].

Subgroup meta-analysis for heterogeneity

To investigate the source of heterogeneity, a subgroup meta-analysis was conducted in which the studies were removed one by one. In the obesity groups, Carlsson *et al*.[23]

Table 2: Mortality among patients on conventional treatment and bariatric surgery

Author	Country	Study type	Mortality in bariatric surgery (events/total)	Mortality in usual care (events/total)
Aminian *et al*., 2020[19]	USA	Retrospective	112/2287	1111/11,435
Ardissino *et al*., 2021[20]	UK	A nested propensity-matched cohort	14/593	35/593
Arterburn *et al*., 2015[21]	USA	Retrospective	263/2500	1277/7462
Batsis *et al*., 2007[22]	USA	Prospective	10/173	13/139
Carlsson *et al*., 2023[23]	Sweden	Prospective	594/2001	683/2031
Ceriani *et al*., 2019[24]	Italy	Retrospective	34/472	181/1405
Davidson *et al*., 2016[25]	USA	Retrospective	213/7925	321/7925
Dicker *et al*., 2021[26]	Israel	Retrospective	105/8385	600/25,155
Douglas *et al*., 2015[27]	UK	Retrospective	50/3774	51/3774
Doumouras *et al*., 2020[28]	Canada	Retrospective	197/13,679	340/13,679
Fisher *et al*., 2018[29]	USA	Retrospective	70/5301	622/14,934
Hung *et al*., 2021[30]	Taiwan	Retrospective	0/1436	2/1436
Johnson *et al*., 2013[31]	USA	Retrospective	41/2580	985/13,371
Kauppila *et al*., 2019[32]	Nordic countries	Retrospective	1784/49,977	75,345/494,842
Lent *et al*., 2017[33]	USA	Retrospective	91/2428	138/2428
Liakopoulos *et al*., 2019[34]	Sweden	Retrospective	183/5321	351/5321
Lundberg *et al*., 2023[35]	Sweden	Retrospective	505/28,204	1682/40,827
Moussa *et al*., 2020[36]	UK	Nested cohort	45/3701	182/3701
Pirlet *et al*., 2021[37]	Canada	Prospective	20/116	32/116
Pontiroli *et al*., 2018[38]	Italy	Retrospective	26/385	90/681
Rassen *et al*., 2021[39]	USA	Retrospective	13/343	22/556
Reges *et al*., 2018[40]	Israel	Retrospective	105/8385	583/25,155
Singh *et al*., 2020[41]	UK	Retrospective	90/5170	278/9995
Sjöström *et al*., 2012[42]	Sweden	Prospective	101/2010	129/2037
Thereaux *et al*., 2019[43]	France	Retrospective	586/10,000	1187/10,000

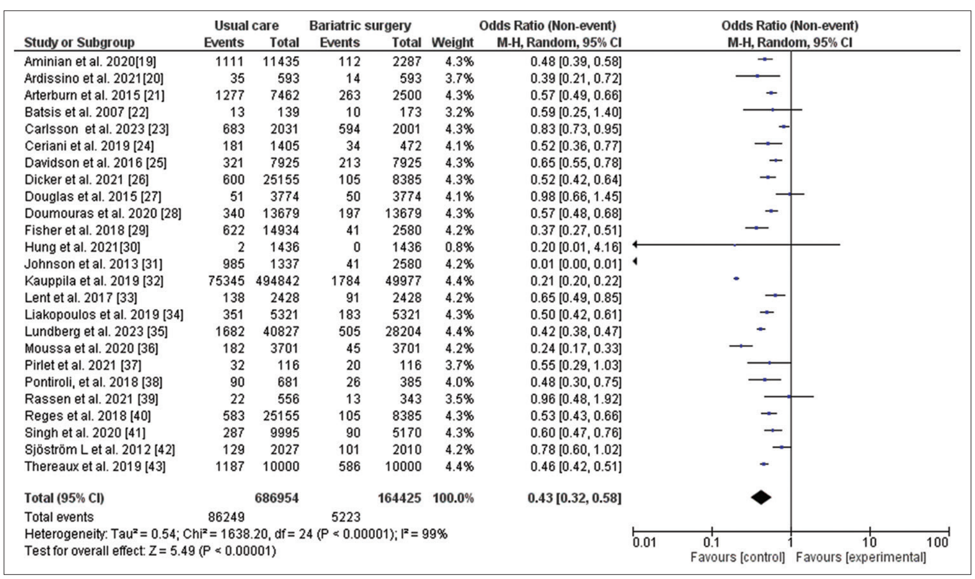

Figure 2: Forest plot of mortality among bariatric and usual care patients with obesity

showed 1% decrease, and Kauppila *et al*.[32] 11% decrease. All other references showed no effect on heterogeneity [Table 4].

In the diabetes group, Aminian *et al*.[19] increased the heterogeneity by 1%, Carlsson *et al*.[23] increased the heterogeneity by 1%, Doumouras *et al*.[28] increased the heterogeneity by 1%, Fisher *et al*.[29] showed no effect, Johnson *et al*.[31] decreased the heterogeneity by 13%, and Liakopoulos[34] increased the heterogeneity by 1% [Table 5].

Regarding mortality among patients with obesity, 25 studies were included[19-43] with 851,379 patients, and 91,472 deaths, the mortality was lower in bariatric surgery compared to usual care (3.1% versus 12.6%), Odds ratio, 043, 95%

Table 3: Basic characteristics of patients on conventional treatment and bariatric surgery

Author	Age/years	Females (%)	BMI	Duration/years	Comorbidities
Aminian *et al*., 2020[19]	52.5 versus 54.8	65.5 versus 64.2	45.1 versus 42.6	19 years, type 2 diabetes	Smoking, hypertension, and dyslipidemia are commoner in the intervention
Ardissino *et al*., 2021[20]	49.55 versus 49.63	65.1 versus 65.1	45.34 versus 45.14	42.7 months, diabetes, 18%, versus 19% on GLP-1	Matched for comorbidities
Arterburn *et al*., 2015[21]	52 versus 53	26 versus 26	47 versus 46	6.9 years, 55% diabetes in both arms	Hypertension, dyslipidemia, and fatty liver are commoner in the intervention
Batsis *et al*., 2007[22]	44.0±9.9 versus 43.4±11.2	80.2 versus 73	49.5±8.9 versus 44.0±5.7	13 years, 31% versus 25.2% diabetes	Obstructive sleep apnea is commoner among intervention
Carlsson *et al*., 2023[23]	47.2±5.9 versus 48.7±6.3	70.8 versus 70.9	42.4±4.5 versus 40.1±4.7	24 years, 17.2% versus 12.9% diabetes	Smoking, hypertension, and dyslipidemia are commoner in the intervention
Ceriani *et al*., 2019[24]	43.1±10.6 versus 43.5±12.5	75 versus 70.8	47.3±7.4 versus 46.8±3.78	12.1±3.4 years, 23.5% versus 27.4% diabetes	Cholesterol is higher among controls
Davidson *et al*., 2016[25]	39.5±10.5 versus 39.3±10.6	82.2 versus 82.2	45.3 versus 46.6	19 years, no diabetes	Matched
Dicker *et al*., 2021[26]	48 versus 48	61.4 versus 61.4	40.5 versus 40.6	4.2 years, 28.5% diabetes	Hypertension, and dyslipidemia, are commoner in the intervention
Douglas *et al*., 2015[31]	45±1.1 versus 45±1.1	80.5 versus 81.6	44.7±8.8 versus 42.1±6.5	3.4 years, 34% versus 33.4% diabetes	Smoking and coronary artery disease more in surgery
Doumouras *et al*., 2020[28]	Matched	Matched	Matched	4.9 years, all diabetes	Matched
Fisher *et al*., 2018[29]	50 versus 50	76 versus 75	44.7±6.9 versus 43.8±6.7	4.7 years, all diabetes	Hypertension, commoner in intervention
Hung *et al*., 2021[30]	32.39±8.63 versus 32.27±9.25	60.58 versus 60.45	Not mentioned	7 years, 5.15% versus 5.29% diabetes	Matched
Johnson *et al*., 2013[31]	47.5±10.6 versus 52.1±12.6	77 versus 67.4	Not mentioned	5 years, all diabetes	Dyslipidemia and sleep apnea are commoner among interventions, smoking, and COPD are commoner among controls
Kauppila *et al*., 2019[32]	42 years	75 versus 68	Matched	32 years, no diabetes	Matched
Lent *et al*., 2017[33]	48.2 versus 48.2	80 versus 80	46.1 versus 46.1%	5.8 years, 25.7% versus 25.7% diabetes	Smoking more in the intervention
Liakopoulos *et al*., 2019[34]	49±9.5 versus 47.1±11.5	60.5 versus 63.8	42±5.7 versus 40.9±7.3	9 years, patient with diabetes	Matched
Lundberg *et al*., 2023[35]	41.9 versus 41.9	72 versus 72	Obese versus normal weight	12 years, 8.4% versus 8.95% diabetes	Matched
Moussa *et al*., 2020[36]	36 versus 36	79.8 versus 79.8	40.3 versus 40.5	11.2 years, 25% versus 23.9 diabetes	Hypertension more among intervention
Pirlet *et al*., 2021[37]	52.9±7.2 versus 52.1±8.4	29 versus 26	42.0±6.1 versus 41.2±6.7	8.9 years, 49% versus 51% diabetes	Matched, intervention underwent revascularization
Pontiroli, *et al*., 2018[38]	39.2±10.4 versus 40.2±12.0	76 versus 75	40.1±4.5 versus 40.9±7.3	19.5±1.8 years, 13.5% versus 18.6% diabetes	Matched
Rassen *et al*., 2021[39]	58 versus 59	65 versus 65	43 versus 42	2.6 years 18.3% versus 16.8% diabetes	Matched
Reges *et al*., 2018[40]	46 versus 46	66 versus 66	40.6 versus 40.5	4 years, 28.5% versus 28.5% diabetes	Smoking, dyslipidemia, and hypertension are more in the intervention
Singh *et al*., 2020[41]	45·2±10·6 versus 45·3±10·5	80.4 versus 81.1	70.3% versus 67.8%>40	3.5 years, 22.7% versus 20.9% diabetes	Smoking more in controls and intervention had more obstructive sleep apnea
Sjöström L *et al*., 2012[42]	47.2±5.9 versus 48.7±6.2	72.7 versus 71	42.4±4.5 versus 40.1±4.7	22 years, 17.1% versus 13% diabetes	Smoking and metabolic comorbidities common in the intervention
Thereaux *et al*., 2019[43]	39.4±11.2 versus 39.4±11.2	60 versus 60>40	85% versus 85%>40	6 years, matched for diabetes	Controls with comorbidities excluded

BMI=Body mass index; COPD=Chronic obstructive pulmonary disease

CI, 0.32–0.158, Chi-square = 1638.20, and $P < 0.001$. Significant heterogeneity was found, I^2 for heterogeneity = 99%, standard difference = 24 [Figures 2 and 3].

Figure 3 shows a substantial heterogeneity of 99%, $P < 0.001$, heterogeneity $Tau^2 = 0.54$.

A subgroup meta-analysis among patients with type 2 diabetes who underwent bariatric surgery or usual care. Six studies were included[19,23,28,29,31,34] with 208,605 patients, and 4361 deaths, the mortality was higher in bariatric surgery group compared to usual care (2.0% versus 2.6%), odds ratio, 1.59, 95% CI, 1.06–02.41, Chi-square = 101.04,

Table 4: The effects of different studies on heterogeniety (all patients with obesity)

Reference	Effect on heterogeniety
Aminian *et al*., 2020[19]	No change
Ardissino *et al*., 2021[20]	No change
Arterburn *et al*., 2015[21]	No change
Batsis *et al*., 2007[22]	No change
Carlsson *et al*., 2023[23]	1% decreased
Ceriani *et al*., 2019[24]	No change
Davidson *et al*., 2016[25]	No change
Dicker *et al*., 2021[26]	No change
Douglas *et al*., 2015[27]	No change
Doumouras *et al*., 2020[28]	No change
Fisher *et al*., 2018[29]	No change
Hung *et al*., 2021[30]	No change
Johnson *et al*., 2013[31]	No change
Kauppila *et al*., 2019[32]	11% decrease
Lent *et al*., 2017[33]	No change
Liakopoulos *et al*., 2019[34]	No change
Lundberg *et al*., 2023[35]	No change
Moussa *et al*., 2020[36]	No change
Pirlet *et al*., 2021[37]	No change
Pontiroli *et al*., 2018[38]	No change
Rassen *et al*., 2021[39]	No change
Reges *et al*., 2018[40]	No change
Singh *et al*., 2020[41]	No change
Sjöström *et al*., 2012[42]	No change
Thereaux *et al*., 2019[43]	No change

Table 5: The effects of different studies on heterogeniety (all patients with type 2 diabetes)

Reference	Effect on heterogeniety
Aminian *et al*., 2020[19]	1% increase
Carlsson *et al*., 2023[23]	1% increase
Doumouras *et al*., 2020[28]	1% increase
Fisher *et al*., 2018[29]	No change
Johnson *et al*., 2013[31]	13% decrease
Liakopoulos *et al*., 2019[34]	1% increase

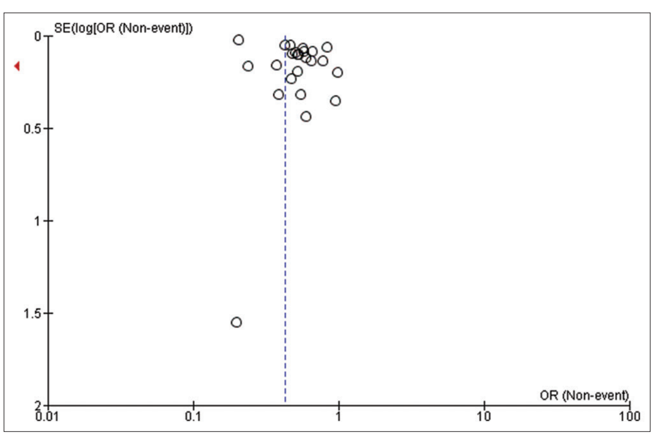

Figure 3: Funnel plot of mortality among bariatric and usual care patients with obesity

and $P = 0.03$. Significant heterogeneity was found, I^2 for heterogeneity = 95%, standard difference = 5 [Figures 4 and 5].

Figure 5 shows a substantial heterogeneity of 95%, $P < 0.001$, heterogeneity $Tau^2 = 0.25$.

DISCUSSION

This is the largest meta-analysis to assess the association between bariatric/metabolic surgery and all-cause mortality. The study pooled 25 cohorts and found that bariatric surgery was associated with all-cause mortality reduction (3.1% versus 12.6%), odds ratio, 043, 95% CI, 0.32-0.158, Chi-square = 1638.20, and $P < 0.001$. The findings showed a minimal effect size raising questions about its clinical significance, particularly given the large sample size. A sub-analysis among patients with type 2 diabetes showed higher mortality in bariatric surgery group compared to usual care (2.0% versus 2.6%), odds ratio, 1.59, 95% CI, 1.06–02.41, Chi-square = 101.04, and $P = 0.03$. Syn *et al*.[13] included sixteen studies and found a higher survival rate among patients who underwent bariatric surgery in line with this study. However, our findings in patients with type 2 diabetes reported higher mortality in bariatric surgery, plausible explanations could be the small number of included studies, and differences in basic characters of the patients with diabetes. Other studies included few studies and showed inconsistent results.[14,15] van Veldhuisen *et al*.[16] assessed mortality as a secondary endpoint, while Wiggins *et al*.[17] missed important recently published studies. A meta-analysis published by Hussain *et al*. concluded the same findings of low mortality among bariatric surgery arm. However, their study was limited by including only two studies and they searched only PubMed, MEDLINE.[44] Despite the proven efficacy of bariatric surgery, and the recent recommendations to lower the cutoff for bariatric surgery, few who qualify for receive it. It is estimated that only 1% of the American population who are eligible receive bariatric surgery.[45,46] Plausible explanations might be inaccessibility or fear of surgical complications. A practical solution is endoscopic surgeries that can fill the current treatment gap for the failure of lifestyle and drug therapy. Endoscopic bariatric surgery had fewer side effects compared to invasive methods and showed more weight reduction compared to lifestyles and usual care.[9] Mortality reduction among bariatric surgery is mainly due to the effects on cardiovascular mortality.[47] Other mechanisms are increased serum acetate levels and reduced inflammatory markers observed among patients who underwent bariatric surgery; acetate is involved in protein and lipid metabolism and energy production. Acetate acts through the hypothalamus and is involved in appetite reduction. In addition, acetate increased hepatic absorption of lipids, decreased hyperglycemia, and

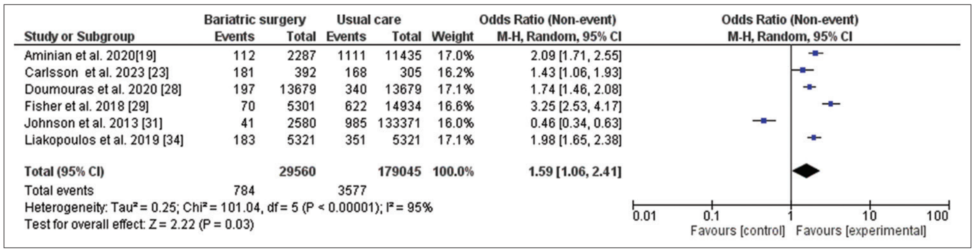

Figure 4: Mortality among bariatric surgery and usual care patients with type 2 diabetes

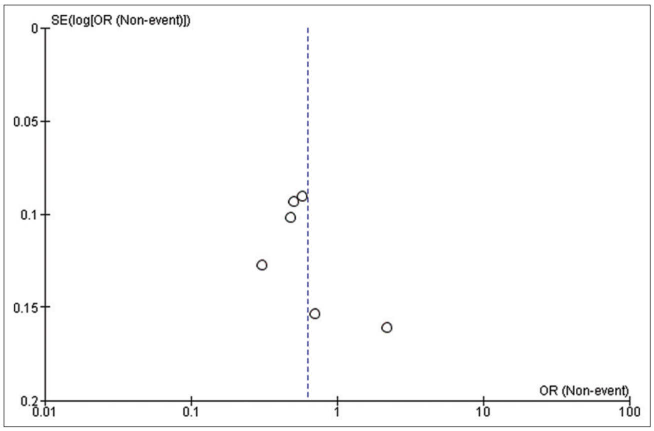

Figure 5: Mortality among bariatric surgery and usual care patients with type 2 diabetes (Funnel Plot)

blocks endogenous lipolysis.[48,49] Other mechanisms are delayed gastric emptying, change in eating behavior, gut microbiota regulation, and effects on gut hormones.[50,51] In light of the increasing rate of obesity and the rapidly expanding metabolic surgery, the current meta-analysis provided an up-to-date information to support physicians and patients' decisions. There is a high need for facilitating access to bariatric surgery.[52] Importantly, evidence is contradicting regarding the effects of nonsurgical weight loss on mortality, between decrease,[53] no change,[54] or decrease.[55] Obesity treatment including lifestyle measures is not enough for meaningful weight loss, and few drugs are available for weight reduction.[56,57] Therefore, losing weight to live longer is justifiable.[58] In the present study, the mean age was 45 years among both bariatric surgery and usual care patients. An interesting study found no mortality reduction among young bariatric surgery patients in contrast to their counterparts.[59] A plausible explanation might be the higher rate of external suicide observed among young patients with bariatric surgery compared to usual care patients. Bariatric surgery association with suicide and self harm mortality was documented in previous studies, by Neovius et al. Hung et al. and Güzel et al. reported an increasing risk in the surgical group compared to usual care.[34,60-62] Younger age group and history of suicidal ideation before surgery were the major determinants of suicide following bariatric surgery.[63] In the present study, participants were morbidly obese and with comorbidities, the results imply that bariatric surgery uptake was low. Comorbidities-oriented bariatric surgery is needed and research on the effects of bariatric surgery on comorbidities and mortality is needed among people with lower BMI.

Strengths and limitations

The study limitations were a substantial portion of the included studies are retrospective, which might introduce biases related to confounding and reverse causality. In addition, the high heterogeneity observed is a major limitation.

CONCLUSION

Bariatric surgery is associated with more mortality reduction compared to usual care among patients with and without type 2 diabetes, the results were significant after addressing the observed heterogeneity. Bariatric surgery indications need to be extended to involve mortality reduction. Randomized trials are needed to better inform the community regarding this important issue.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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