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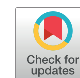
A systematic review and meta-analysis of the outcome of ileal pouch anal anastomosis in patients with obesity



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ABSTRACT

Background: Ileal-pouch anal anastomosis is used for treatment of different conditions, including mucosal ulcerative colitis and familial adenomatous polyposis. The present systematic review aimed to assess the literature for studies that compared the outcome of ileal-pouch anal anastomosis in patients with obesity versus patients with ideal weight.
Methods: A systematic literature search of electronic databases including PubMed, Scopus, Web of Science, and Cochrane library was performed and reported in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The main outcome measures were pouch failure, pouch complications, overall complications, operation time, blood loss, and hospital stay.
Results: This systematic review included 6 retrospective studies (3,460 patients). Out of the total number of patients, 19.8% had obesity or overweight. Patients with obesity were significantly less likely to have laparoscopic ileal-pouch anal anastomosis compared with patients with ideal body mass index (odds ratio = 0.436; $P = .017$). The weighted mean operation time and blood loss were significantly longer in the obesity group than the ideal weight group (weighted mean difference = 22.84; $P = .006$) and (weighted mean difference = 85.8; $P < .001$). The obesity group was associated with significantly higher odds of total complications (odds ratio = 2.27; $P < .001$), leak (odds ratio = 1.81; $P = .036$), and incisional hernia (odds ratio = 4.56; $P < .001$). The 2 groups had comparable rates of pouch failure, pouchitis, stricture, pelvic sepsis, wound infection, bowel obstruction, ileus, and venous thromboembolism. Male sex, longer operation time, and including inflammatory bowel disease patients only were significantly associated with higher complications in the obesity group.
Conclusion: Patients with obesity who undergo ileal-pouch anal anastomosis are more likely to have laparotomy rather than a laparoscopic procedure, have longer operation time, greater blood loss, higher overall complications, leak and incisional hernia, and longer hospital stay.
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Introduction

Ileal-pouch anal anastomosis (IPAA) is used to restore gastrointestinal continuity after proctocolectomy. Possible indications for IPAA include inflammatory bowel diseases (IBD), mucosal ulcerative colitis (MUC) and indeterminate colitis (IC), hereditary nonpolyposis colorectal cancer (HNPCC), familial adenomatous polyposis (FAP), and toxic megacolon.[1]

Overall, the outcomes of IPAA are good as revealed in a meta-analysis of 53 studies in which approximately 15,000 patients were assessed. de Zeeuw et al[2] reported pooled rates of pouch failure and pelvic sepsis equal to 3% and 7.5%, respectively, and observed a 2.5% reduction in the pouch failure rate when compared with studies published before 2000. The functional outcome of IPAA was satisfactory with a 24-hour defecation frequency of 5.9, which remained more or less stable over time.

However, there exist some challenging conditions that may compromise the technical, functional, and long-term outcomes of

Sameh Emile designed the study, collected the data, assessed the quality of the studies, conducted data analysis, and wrote the manuscript. Sualeh Khan contributed to data collection and interpretation and revision of the manuscript. Steven Wexner contributed to data interpretation and critically revised the manuscript.

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IPAA. The spectrum of these conditions include obesity, advanced age, anal sphincter dysfunction, history of obstetric complications, and radiation therapy.[3] Moreover, the indication for IPAA per se can factor in its outcome as patients with IC and Crohn's disease are more likely to experience pouch failure and complications than are patients with MUC.[4,5]

Obesity can adversely impact the outcome of IPAA. Although most patients with IBD are usually malnourished and underweight, the number of IBD patients who are overweight or obese is increasing.[6] The negative impact of obesity on the outcome of IPAA entails different aspects. A strong association between body mass index (BMI) and the ability to technically perform IPAA has been reported. The chance of an unsuccessful pouch increases from 2% at a BMI of 30kg/m^2 to 15% at a BMI of 40 kg/m^2.[7] Even when IPAA is successfully performed, obesity was found to increase the complexity of laparoscopic resections, blood loss, operative time, conversion rates, and readmission for infectious complications after IPAA.[8,9]

The present systematic review aimed to assess the current literature for studies that compared the outcome of IPAA in patients with obesity versus patients with ideal weight in terms of pouch success, pouch complications, overall complications, operations time, and hospital stay.

Methods

Registration

The protocol of this systematic review was registered in the International prospective register of systematic reviews, PROSPERO, under registration number, CRD42021248614. Formal ethics approval was not required for conducting this systematic review.

Search strategy

The guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses[10] have been followed when conducting and reporting the present systematic review. Two authors (S.E. and S.K.) independently performed a systematic search of the English literature. The main target of the literature search was studies that compared the outcome of IPAA in patients with obesity or overweight and patients with ideal weight.

The literature search included electronic databases such as PubMed, Scopus, Web of Science, and the Cochrane library. Published and ahead-of-publication studies dating from the inception of each database through April 2021 were screened. The PubMed function "related articles" was activated, and the reference section of each article found was manually searched to look for further eligible studies.

Upon screening of the preliminary records, we excluded duplicate reports and conference abstracts without a full text, after which the remaining articles were screened. An initial screening by title and abstract was performed and was followed by a full-text screening of the selected articles by 1 of 2 authors (S.E., S.K.) to check for eligibility. The senior author (S.D.W) reviewed the outcome of the article screening on a regular basis.

Search keywords

The keywords used in the search process included "obese," "obesity," "overweight," "body mass index," "BMI," "Ileal pouch," "IPAA," "anal anastomosis," "restorative proctocolectomy," "IBD," "inflammatory bowel disease," "ulcerative colitis," "UC," and "outcome". In addition, we used the following MeSH terms: pouch, IBDs, obesity, and outcome.

We used the following syntax combination for the literature search: (IPAA OR ileal pouch OR ileal pouch anal anastomosis OR restorative proctocolectomy) AND (obesity OR obese OR overweight) AND (outcome OR results).

Study selection

The studies deemed eligible for inclusion in this review had to be published in English and fulfilled the following Population, Intervention, Comparison, Outcomes, and Study criteria:

P (population*)*: patients who underwent IPAA for IBD, FAP, HNPCC, or toxic megacolon; I (intervention*)*: IPAA in patients with obesity defined as BMI equal to or greater than 30 kg/m^2 or overweight defined as BMI greater than 25 but less than 30 kg/m^2; C (comparator*)*: IPAA in patients with ideal body weight (BMI = 18–25 kg/m^2); O (outcome): pouch success, pouch complications, overall complications, operation time, and stay; and S (study design): controlled studies, whether prospective or retrospective series.

We excluded observational studies without a control group, studies that did not report the main outcomes of the review, studies entailing less than 10 patients in each arm, animal studies, editorials, case reports, reviews, and other meta-analyses.

Assessment of study quality and risk of bias

The methodological index for nonrandomized studies (MINORS)[11] was used independently by 2 authors (S.E., S.K.) for assessment of the quality of the studies. The maximum MINORs score for controlled studies is 24, and a score $\geq$20 indicated a low risk of bias. Any conflicts in the interpretation of the results were resolved by consensus and mutual agreement among the authors.

Data extraction

The following information was extracted from each study and entered into an Excel file template (Microsoft, Redmond, WA): authors, duration, country, and design of the study; total number of patients, indication for IPAA, 2- versus 3-stage procedure; number of patients, male: female ratio, age, and BMI in each group; the ability to successfully create the pouch; operative time in minutes and estimated blood loss in mL; pouch failure; and overall complications including pouch complications such as pouchitis, leak, and stricture and other complications such as bowel obstruction, ileus, pelvic sepsis, wound infection, incisional hernia, and venous thromboembolism.

Study outcomes

The primary outcome of this systematic review was pouch failure and complications in patients with obesity versus patients with ideal weight. Pouch failure was defined as the need to excise the ileal pouch for pouch dysfunction or intractable pouch-related complications and/or the need for permeant ileostomy. Secondary outcomes comprised overall complications, operative time, blood loss, and hospital stay.

Statistical analysis

Statistical analysis of data was performed using SPSS version 23 (IBM Corp, Chicago, IL). A meta-analysis was conducted using open-source, cross-platform software for advanced meta-analysis OpenMeta[Analyst], version 12.11.14 (Brown University, Providence, RI) and Cochrane Review Manger 5.4 (Cochrane Collaboration, London, United Kingdom). Differences between the 2 groups

with regards to pouch failure and complication rates were expressed as odds ratio (OR) with the 95% confidence interval (CI). Differences between the 2 groups with regards to operation time and blood loss were expressed as weighted mean difference (WMD). When the mean and SD of the required variables were not available, they were calculated from the median and normal range using online software tool[12] (http://vassarstats.net/median_range.html).

Statistical heterogeneity was determined by the P value of the Cochrane Q test and the inconsistency (I^2) statistics (low if I^2 <25%, moderate if I^2 = 25%–75%, and high if I^2 >75%). A fixed-effect model was used to pool data when no significant statistical heterogeneity was detected, and the binary random-effect model was used for pooling of data when significant ($P < .1$) statistical heterogeneity was observed. Sensitivity analysis of pouch failure and overall complications based on the publication year of the studies was conducted to explore the reasons for heterogeneity.

A random-effect meta-regression model was used weighing the studies by their within-study variance and the degree of heterogeneity. The heterogeneity between the studies was examined respective to differences in patients' age, sex, BMI, operative time, and blood loss. The statistical significance of each examined variable was determined using slope coefficient (SE) and P value.

Results

Patient and study characteristics

The initial literature search returned 133 relevant records. After exclusion of duplicates, 107 articles were screened by title/abstract which led to the exclusion of 97 irrelevant articles. The full text of the remaining 10 articles was reviewed, and 6 studies were finally included in the analysis (Fig 1).

This systematic review included 6 retrospective studies[13–18] published between 2001 and 2018. All studies were based in the United States, with the exception of 1 study from Japan.[13] The studies included a total of 3,460 patients, 57% of whom were male. Indications for IPAA included MUC (n = 2,545; 73.5%), FAP or HNPCC (n = 205; 5.9%), IC (n = 301; 8.7%), Crohn's disease (n = 76; 2.2%), and others/undefined (n = 333; 9.6%). IPAA was performed as a 2-stage procedure in 2,340 (67.6%) patients and as a 3-stage procedure in 1,120 (32.4%) patients. A summary of the characteristics of each study is shown in Table I. Two studies had low risk, and 4 had high risk of bias. The median MINORs score was 19 (range, 18–20) (Appendix Table S1).

Baseline data of patients with or without obesity

All studies defined obesity in a consistent manner as BMI ≥30 kg/m^2, whereas overweight was defined as BMI >25 and <30 kg/m.^{2} A total of 686 (19.8%) patients with obesity or overweight and 2,774 (80.2%) patients with ideal weight underwent IPAA. Both groups were comparable for sex (male:female ratio = 1.28:1 vs 1.32:1) and median age (43.7 vs 41 years). The mean BMI in the obesity group was significantly higher than in the ideal body weight group (33.7 ± 16.5 vs 23.5 ± 11.4 kg/m^2). A 3-stage procedure was performed in 173 (25.2%) patients in the obesity group versus 708 (25.5%) in the ideal weight group (Table II).

Operative and technical details

All patients in both groups underwent successful pouch creation. Canedo et al[16] excluded 5 patients in the obesity group from the analysis, because their ileal pouch could not reach the anus despite lengthening techniques. Four studies reported the approach of IPAA. IPAA was performed laparoscopically in 73 of 310 patients in the obesity group and in 482 of 1,072 patients in the

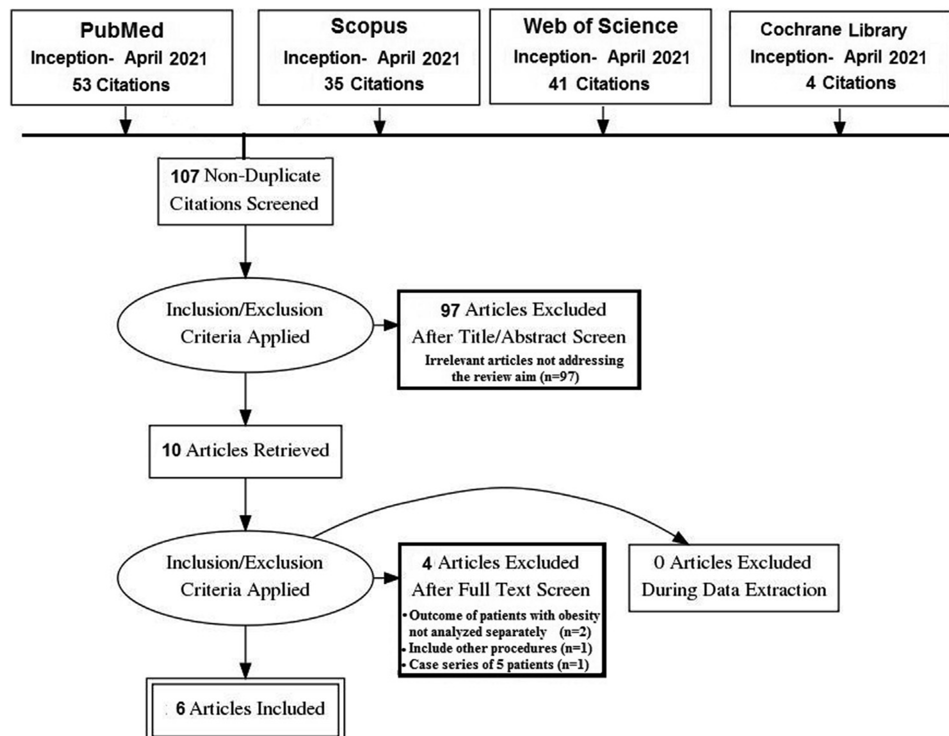

Fig 1. PRISMA flow chart illustrating the process of literature search and study selection. *PRISMA*, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table I
Patient and study characteristics

Study	Country	Duration	Type	Number	Male	Indication for IPAA
Horio et al. 2018[13]	Japan	April 2012–Aug 2015	Retrospective	165	107	MUC = 165
McKenna et al. 2017[14]	United States	Jan 2002–Aug 2013	Retrospective	909	540	MUC = 909
Klos et al. 2014[15]	United States	Jan 1990–April 2011	Retrospective	178	84	MUC = 142, HNPCC/FAP = 29, Crohn's = 4, IC = 1, other = 2
Canedo et al. 2010[16]	United States	1998–2008	Retrospective	130	67	MUC = 112, FAP = 16, Crohn's = 2
Kiran et al. 2008[17]	United States	NA	Retrospective	2,016	1,130	MUC = 1,163, Crohn's = 70, IC = 300, FAP = 152, cancer = 10
Efron et al. 2001[18]	United States	1988–1998	Retrospective	62	41	MUC = 54, FAP = 8

FAP, familial adenomatous polyposis; *HNPCC*, hereditary nonpolyposis colon cancer; *IC*, indeterminate colitis; *IPAA*, ileal pouch anal anastomosis; *MUC*, mucosal ulcerative colitis; *NA*, not available.

ideal weight group (23.5% vs 44.9%, respectively; $P < .0001$). Obese patients were significantly less likely to have undergone laparoscopic IPAA as compared with patients with ideal weight (OR = 0.436, 95% CI: 0.22–0.86; $P = .017$; $I^2 = 53.4\%$).

The weighted mean operative time in the obesity group was significantly longer than the ideal weight group (WMD = 22.84; 95% CI: 6.6–39.1; $P = .006$; $I^2 = 99\%$) (Fig 2). Similarly, the obesity group was associated with significantly higher blood loss (WMD = 85.8; 95% CI: 38.8–132.8; $P < .001$; $I^2 = 98.8\%$) (Fig 3, Table III).

Pouch failure and complications

The median follow-up duration was 50.7 (range, 18.5–60) months. The incidence of pouch failure was similar in the 2 groups (4.1% vs 5.5%) with an insignificant OR of 0.835 (95% CI: 0.5–1.38; $P = .48$; $I^2 = 0$) (Fig 4). Conversely, the obesity group was associated with significantly higher odds of total complications (83.1% vs 71.5%, OR = 2.27, 95% CI: 1.42–3.61; $P < .001$; $I^2 = 57.9\%$) (Fig 5, Table III).

Patients in the 2 groups had similar odds of pouch-related complications such as pouchitis and pouch stricture; however, there were significantly higher odds of anastomotic leak in the obesity group (OR = 1.81 [1.04–3.15]; $P = .036$). The number of each complication reported in the studies is shown in Appendix Table S2.

Regarding the other recorded complications, there were higher odds of incisional hernia in the obesity group as compared with the ideal weight group (OR = 4.56, 95% CI: 1.99–10.4; $P < .001$). The 2 groups had comparable rates of pelvic sepsis, wound infection, bowel obstruction, ileus, and venous thromboembolism (Table IV). The median hospital stay in the obesity group was 9.6 (range, 8.8–13.5) days vs 7.7 (range, 7.6–18) days in the ideal weight group.

Sensitivity analysis

Studies that were published on or after 2010 ($n = 4$) showed no significant difference in pouch failure (OR = 1.58, 95% CI: 0.43–5.8; $P = .48$; $I^2 = 0$), yet the overall complications were higher in patients with obesity (OR = 2.64, 95% CI: 1.2–5.84; $P = .01$; $I^2 = 70.6\%$).

Similarly, studies that were published before 2010 ($n = 2$) showed no significant difference in pouch failure (OR = 0.74, 95% CI: 0.43–1.29; $P = .29$; $I^2 = 0$); however, the overall complications were higher in patients with obesity (OR = 2.3, 95% CI: 1.47–3.59; $P < .001$; $I^2 = 0$).

Risk factors of complications after IPAA in patients with obesity and ideal weight patients

Meta-regression analysis of the risk factors of complications after IPAA in patients with obesity showed that male sex (SE = 0.002, 95% CI: 0.0001–0.003; $P = .03$), longer operative time (SE = −0.003, 95% CI: −0.005 to −0.002; $P < .001$), and including IBD patients only (SE = 0.321, 95% CI: 0.09–0.56; $P = .007$) were significant predictive factors of complications. Older age (SE = −0.095; $P = .06$) and greater blood loss (SE = 0.0001; $P = .95$) were not significantly associated with higher complications. In addition, an increase in BMI value was not proportionally associated with higher complication rates (SE = −0.005; $P = .96$).

In terms of patients with ideal body weight, longer operative time (SE = −0.006, 95% CI: −0.007 to −0.005; $P < .001$), greater blood loss (SE = −0.001, 95% CI: −0.002 to −0.0001; $P = .015$), and including IBD patients only (SE = 0.423, 95% CI: 0.12–0.73; $P = .006$) were significant predictive factors of complications. Male sex (SE = 0.0001; $P = .32$) and older age (SE = −0.006; $P = .81$) were not significantly associated with higher complications. Additionally, an increased BMI was not proportionally associated with higher complication rates (SE = −0.136; $P = .27$) (Table V).

Discussion

The present systematic review aimed to assess the impact of obesity on the outcome of IPAA. Over the span of 20 years, only 6 studies addressing the topic of this review were found. The small number of studies may be attributed to the fact that most patients who undergo IPAA have IBD, namely MUC, which is frequently associated with underweight and malnutrition, rather than obesity.[19] It was notable that the vast majority of the studies were

Table II
Baseline characteristics of patients in both groups

Study	Number		Male		Age (y)		Body mass index (kg/m^2)	
	Obesity	Ideal weight	Obesity	Ideal weight	Obesity	Ideal weight	Obesity	Ideal weight
Horio et al. 2018[13]	16	149	9 (56.2%)	98 (65.8%)	45	46	NA	NA
McKenna et al. 2017[14]	154	755	89 (57.8%)	451 (59.7%)	42.5	37.1	33	24.1
Klos et al. 2014[15]	75	103	32 (42.6%)	52 (50.5%)	42	40	35	24
Canedo et al. 2010[16]	65	65	34 (52.3%)	33 (50.7%)	47.08	48.9	34.3	22.4
Kiran et al. 2008[17]	345	1671	201 (58.3%)	929 (55.5%)	42.3	36.8	32.7	23.8
Efron et al. 2001[18]	31	31	21 (67.7%)	20 (64.5%)	45	42	33.7	23.2

NA, not available.

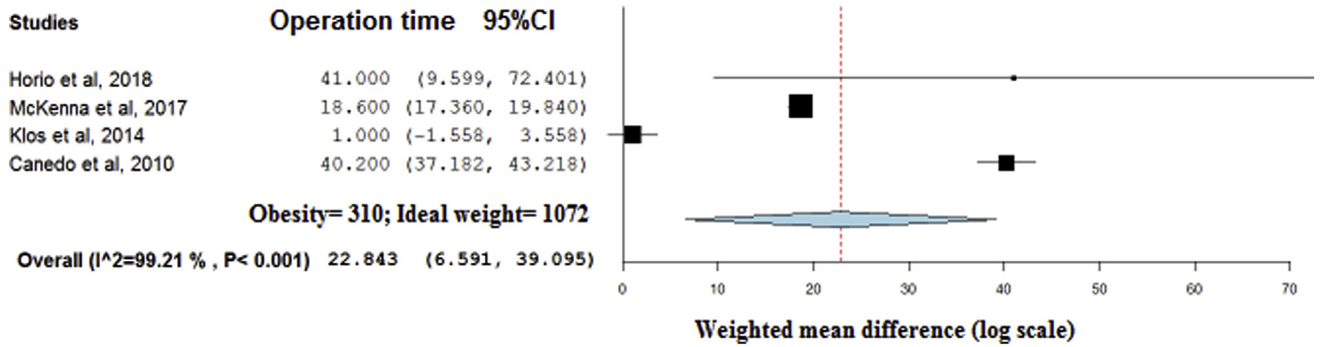

Fig 2. Forest plot representing the weighted mean difference in operation time, comparing patients with obesity and patients with ideal weight (patients with obesity = 310, patients with ideal weight = 1,072). *CI*, confidence interval.

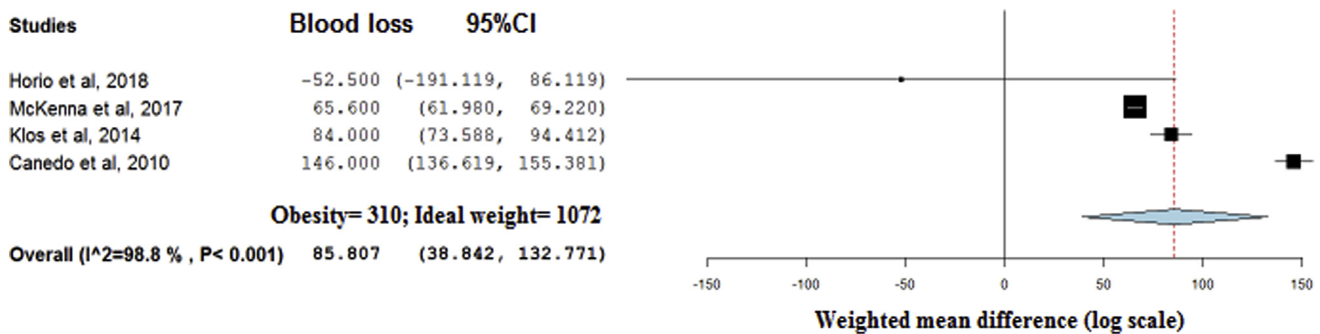

Fig 3. Forest plot representing the weighted mean difference in blood loss, comparing patients with obesity and patients with ideal weight (patients with obesity = 310, patients with ideal weight = 1,072). *CI*, confidence interval.

Table III
Outcome of patients in both groups

Study	Mean operation time		Mean blood loss		Pouch failure			Total complications		
	Obesity	Ideal weight	Obesity	Ideal weight	Obesity	Ideal weight	*P* value	Obesity	Ideal weight	*P* value
Horio et al. 2018[13]	291.5	250.5	452.5	505	NA	NA	-	8 (50%)	20 (13.4%)	.0008
McKenna et al. 2017[14]	288.7	270.1	271.2	205.6	NA	NA	-	84 (54.5%)	356 (47.1%)	.09
Klos et al. 2014[15]	227	226	375	291	4 (5.3%)	4 (3.9%)	.72	60 (80%)	66 (64%)	.03
Canedo et al. 2010[16]	244.6	204.4	348	202	1 (1.5%)	0	.99	74	59 (90.7%)	<.0001
Kiran et al. 2008	NA	NA	NA	NA	15 (4.3%)	100 (5.9%)	.9	327 (94.7%)	1470 (87.9%)	.006
Efron et al. 2001	229	196	423	539	1 (3.2%)	0	.99	17 (54.8%)	13 (41.9%)	.44

NA, not available.

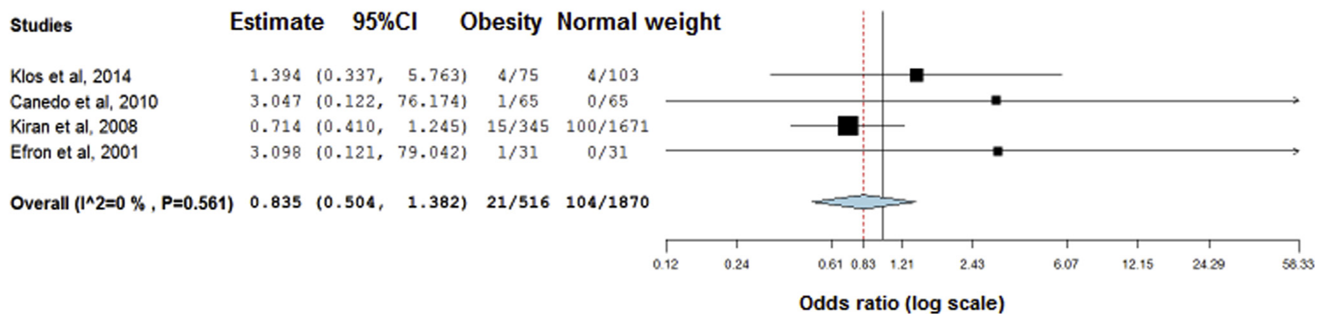

Fig 4. Forest plot representing the odds ratio of pouch failure, comparing patients with obesity and patients with ideal weight (patients with obesity = 516, patients with ideal weight = 1,870).

based in the United States. This may reflect an increased attention to the outcome of IPAA in challenging patients such as those with obesity, which has been considered a rising epidemic. The latest statistics from the Centers for Disease Control and Prevention imply that the prevalence of obesity in the United States has increased to 42.4%, of which 9% are considered severe obesity.[20]

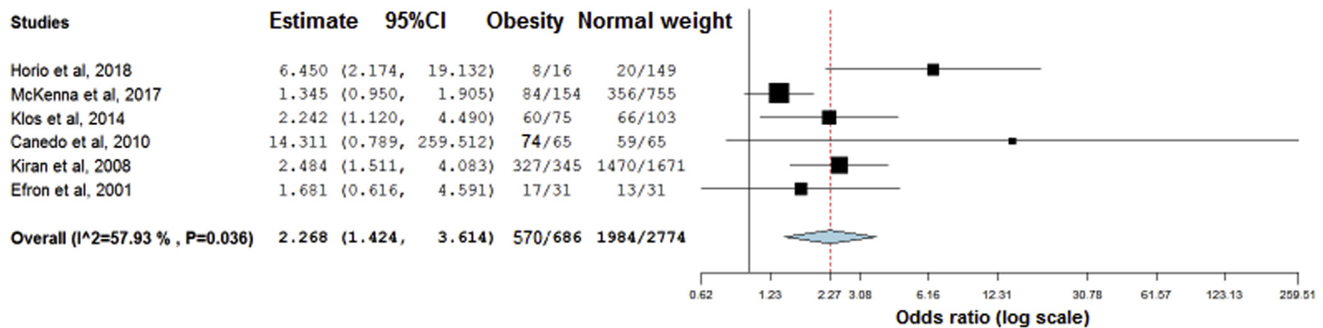

Fig 5. Forest plot representing the odds ratio of total complications, comparing patients with obesity and patients with ideal weight (patients with obesity = 686, patients with ideal weight = 2,774). *CI*, confidence interval.

Table IV
Odds ratio of total and individual complications

Parameter	Obesity (%)	Ideal weight (%)	OR (95% CI)	*P* value	I^2 (%)
Total complications	83.1	71.5	2.27(1.42–3.61)	<.001	57.9
Pouchitis	39.8	43.5	1.21 (0.79–1.87)	.38	57
Leak	8.7	3.6	1.81 (1.04–3.15)	.036	0
Stricture	16.5	20.5	1.89 (0.57–6.26)	.29	84.5
Pelvic sepsis	7.7	6.3	1.28 (0.78–2.12)	.33	26.3
Wound infection	15.4	8.8	1.5 (0.78–2.89)	.22	69.3
Bowel obstruction	17.3	21.5	0.8 (0.64–1)	.057	0
Ileus	11.6	7.9	1.31 (0.78–2.21)	.3	0
Incisional hernia	15.8	4	4.56 (1.99–10.4)	<.001	0
Venous thromboembolism	5.2	5.6	1.72 (0.39–7.73)	.47	37.1

CI, confidence interval; I^2, inconsistency index; *OR*, odds ratio.

Table V
Factors associated with higher complication rates in patients with obesity and patients with ideal weight

	Obesity group	Ideal weight group
Significant predictors of complications	Male sex (SE = 0.002, 95% CI: 0.0001–0.003; *P* = .03) Longer operative time (SE = −0.003, 95% CI: −0.005 to −0.002; *P* < .001) Including IBD patients only (SE = 0.321, 95% CI: 0.09–0.56; *P* = .007)	Greater blood loss (SE = −0.001, 95% CI: −0.002 to −0.0001; *P* = .015) Longer operation time (SE = −0.006, 95% CI: −0.007 to −0.005; *P* < .001) Including IBD patients only (SE = 0.423, 95% CI: 0.12–0.73; *P* = .006)
Nonsignificant predictors of complications	Greater blood loss (SE = 0.0001; *P* = .95) Older age (SE = −0.095; *P* = .06) Higher BMI value (SE = −0.005; *P* = .96)	Male sex (SE = 0.0001; *P* = .32) Older age (SE = −0.006; *P* = .81) Higher BMI value (SE = −0.136, *P* = .27).

BMI, body mass index; *IBD*, inflammatory bowel disease; *SE*, slope coefficient.

Five studies included patients with obesity, whereas 1 study[13] included patients with increased BMI defined as BMI >25 kg/m.[2] Overall, 20% of patients of this review had obesity or overweight. We were able to identify some technical and outcome differences between patients with obesity and ideal weight patients. The first technical aspect was the approach of IPAA. Patients with increased BMI were significantly less likely to have laparoscopic IPAA as compared with patients with ideal weight. Increased BMI has been linked to surgical difficulty in laparoscopy, which has been demonstrated by increased entry attempts, inability to identify key landmarks, and higher conversion rates.[21] Furthermore, the challenges of laparoscopy in patients with morbid obesity include the need to increase insufflation pressures to overcome the insufficient workspace, which may subsequently further compromise respiratory and hemodynamic function.[22] More than 75% of patients with obesity in this review had their IPAA performed by an open approach, and perhaps, this may explain the increased complication rate and hospital stay in this group.

The second technical aspect is the ability to successfully perform IPAA. Although an increased BMI is strongly associated with unsuccessful IPAA creation,[7] all patients in the present review had successful creation of IPAA. This is understandable because all studies excluded patients in whom IPAA was not created. Of note, Candeo et al[16] excluded 5 out of 70 obese patients with attempted IPAA, amounting to a failure rate of approximately 7%. It is known that obesity increases the technical difficulty of all procedures, especially those that require pelvic and perineal exposure. This is particularly true with IPAA because the bulky mesentery may hinder the formation of a J-pouch and limit its reach to the ileoanal anastomosis.

The operative time and estimated blood loss were significantly higher in the obesity group. The longer operative time in patients with obesity is expected because the increased adiposity tends to increase the complexity of the procedure, thus prolonging each step. The creation of a J-pouch, ensuring a tension-free anastomosis, may require additional steps such as the Kocher maneuver,

releasing the peritoneum around the superior mesenteric vessels, dividing the ileocolic pedicle, and creating a window in the ileal mesentery.[23] In addition, the construction of a loop ileostomy can be challenging and time consuming because of a shortened and fat mesentery and a thickened abdominal wall.[16] Obesity may also necessitate a more proximal ileostomy than would be created in a patient of ideal body weight. The more proximal stoma may result in high stoma output and thus prolong hospitalization until the output has been successfully decreased to an acceptable volume.

In our study, the 2 groups had similar rates of pouch failure, which was within the range (4%–5.5%) reported in the literature.[24] This fact indicates that increased BMI did not adversely impact the long-term survival of the pouch, although it did have an obvious impact on the overall complication rate. While obesity did not remarkably increase the rate of pouchitis and pouch stricture, it was associated with a significantly higher incidence of anastomotic leak. The incidence of leak in the obesity group was more than twice that in the ideal weight group (8.7% vs 3.6%), and both were within the range of leak after IPAA as reported by Gorgun and Remzi.[25]

All of the other complications were comparable between the 2 groups, except for incisional hernia which was 5 times more likely to develop in patients with obesity. This is partly explained by the higher rates of laparotomy in obese patients, as previously mentioned. In addition, obesity per se is a recognized risk factor for the development and recurrence of incisional hernia after repair.[26] It has been estimated that the risk of incisional hernia triples, at up to 39%, in patients with a BMI $>35 kg/m^2$ as compared with those with an ideal BMI owing to elevated intra-abdominal pressure and decreased abdominal wall resistance.[27,28]

An obesity paradox has been reported in the literature[29] in which patients who are overweight or obese experience lower crude and adjusted risks of serious morbidities and mortality after nonbariatric general surgery as compared with patients with ideal body weight. On the contrary, the present meta-analysis found patients with obesity have higher rates of overall complications and leak and similar rates of other complications compared with patients with ideal body weight.

The meta-regression analysis revealed that male patients, prolonged operative time, and including IBD patients only were significantly associated with more complications. Male sex has been linked to increased complications after IPAA, particularly septic complications and leak.[25] This can be attributed to the narrower android pelvis and shorter mesentery, which may place more tension on the anastomosis and compromise its blood supply.[30] Prolonged operative time has been associated with increased complications as the likelihood of complications increases by 14% for every 30 minutes of additional operating time.[31] Because patients with obesity already have increased operative time than do ideal weight patients, the higher incidence of overall complications is reasonable.

The important and noteworthy findings of the present meta-analysis can be summarized as follows. Firstly, although obesity does not negatively impact pouch survival, it is associated with higher overall complications, anastomotic leak, and incisional hernia. There was no significant difference in other individual complications between the obese and ideal weight groups. Secondly, the impact of obesity on pouch survival and complications did not change over the span of 20 years, during which time the included studies were published. Thirdly, obesity was associated with technical problems such as increased operative time and blood loss and a lower chance of a successful laparoscopic IPAA. Fourthly, male sex, longer operative time, and including IBD patients only were defined as risk factors for higher complications in obese patients.

To improve the outcome of patients with obesity, it can be advisable to lose excess weight before a planned IPAA. Weight loss can be achieved by dietary regimens and exercise programs. Moreover, bariatric surgery may have a useful role in select patients. Bollo et al[32] stated that several types of bariatric surgery can be considered in patients with FAP and morbid obesity and that their first choice is sleeve gastrectomy to decrease the technical complications and increase the success rate of the colon surgery. Furthermore, Lascano et al[33] have described an important benefit of using bariatric surgery before attempted IPAA in patients with obesity. They reported the case of a male patient with MUC who showed symptomatic improvement after losing more than 85% of excess weight after gastric bypass surgery, probably owing to a reduction of inflammatory markers after considerable weight loss.

It is important to note that the studies by Kiran et al[17] and McKenna et al[14] account for the majority of patients in this meta-analysis. However, the conclusions of the present meta-analysis add several important facets. Neither of the 2 studies reported the rate of incisional hernia after IPAA in patients with obesity, whereas we reported the OR of this complication, which was significantly higher in patients with obesity. Moreover, while the 2 studies reported significant differences in the individual complications of wound infection and bowel obstruction, the collective analysis did not find any significant differences between the 2 groups except for anastomotic leak. Finally, male sex, longer operative time, and including IBD patients only were identified as predictors of higher complications in patients with obesity.

The present systematic review has some limitations including the small number and retrospective nature of the studies included. The risk of bias was high in most of the studies owing to their retrospective, registry-based nature. In addition, although biologics may change the severity of disease at the time of surgery and affect complication rates, we could not assess their effect on the outcome of IPAA, as this was not explicitly reported in the included studies. The findings of this review may warrant conducting further prospective studies to assess the outcome of IPAA in patients with obesity after employing weight-reducing measures before surgery.

In conclusion, obese patients who undergo IPAA are more likely to require a laparotomy rather than a laparoscopic procedure, have longer operative time, greater blood loss, longer hospital stay, and higher overall complications, especially leak and incisional hernia, compared with ideal weight patients.

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Conflict of interest/Disclosure

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Supplementary Materials

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