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ORIGINAL ARTICLE

Is the recurrence rate higher in obese patients undergoing inguinal hernia surgery?

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Abstract

Purpose This study aimed to evaluate whether obese patients undergoing inguinal hernia repair surgery have a higher recurrence rate and compare the clinical outcomes of obese and non-obese patients.

Materials and methods The databases of PubMed, EMBASE, and Cochrane Library were used to search for eligible studies from inception to November 1, 2024. Mean difference (MD), Odds ratios (OR) and 95% confidence intervals (Cl) were pooled up to analyze. The Newcastle-Ottawa Scale (NOS) scores were used to evaluate the quality of the included studies. This study was performed with Stata (V.16.0) software.

Results A total of nine studies involving 56,833 patients were included in this study. By comparing the baseline information, we found that the obese group had Fewer older (MD=-0.08, I^2=62.41%, 95%CI=-0.16 to -0.00, P=0.04), higher BMI (MD=2.45, I^2=93.67%, 95%CI=2.08 to 2.81, P<0.01), more hypertension patients (OR=1.32, I^2=32.96%, 95%CI=1.02 to 1.67, P=0.04), more BPH (OR=0.68, I^2=0.00%, 95%CI=0.49 to 0.94, P=0.02) and more local anesthesia (OR=0.82, I^2=14.73%, 95%CI=0.79 to 0.86, P<0.01) than the none-obese group. In terms of postoperative outcomes, We found that the obese group had higher recurrence rate (OR=1.27, I^2=21.89%, 95%CI=1.10 to 1.47, P<0.01), more wound infection (OR=1.43, I^2=0.00%, 95%CI=1.20 to 1.69, P<0.01), and more overall complications (OR=1.12, I^2=28.20%, 95%CI=1.05 to 1.20, P<0.01).

Conclusion Compared with the non-obese group, the obese group has a higher recurrence rate, more wound infections, and overall more complications.

Keywords Inguinal hernia repair surgery · Obese · Recurrence · Complications

Introduction

It is estimated that over 20 million patients worldwide undergo selective inguinal hernia repair surgery annually [1, 2]. According to relevant research reports, approximately 27% of men and 3% of women suffer from inguinal hernia in their lifetime [3, 4]. Due to the risk of developing incarcerated or strangulated hernias, most hernias require surgical treatment.

According to the World Health Organization (WHO), with the improvement of the economy and living standards, the global obesity rate has doubled since 1975 [5]. Although obesity is typically defined as a weight exceeding 120% of the ideal weight, most authoritative institutions choose body mass index (BMI) to define obesity [6–8]. Obesity is a high-risk factor for hypercholesterolemia, hypertension, type 2 diabetes, coronary heart disease, and stroke [9–11]. In addition, obesity is considered as a risk factor for poor postoperative prognosis [12–14].

The relationship between weight and inguinal hernia is complex. Theoretically, obesity increases the incidence rate of inguinal hernia by increasing abdominal pressure [15]. Nevertheless, most studies have revealed that obese patients have a lower risk of developing inguinal hernia [16–18]. For recurrence, Attaar M [5] et al. believe that obese patients are

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more prone to recurrence after undergoing inguinal hernia surgery. However, other studies have shown that there is no significant statistical significance between obese patients and recurrence compared to non-obese patients [19, 20]. Thus, the current study aimed to investigate whether obese patients undergoing inguinal hernia repair surgery have a higher recurrence rate and compare the clinical outcomes of obese and non-obese patients.

Materials and methods

This study was conducted by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [21].

Search strategy

PubMed, EMBASE, and Cochrane Library were searched from inception to October 31, 2024. The following keywords related to groin hernia were used for the search: "groin hernia" OR "inguinal hernia" OR "femoral hernia" OR "indirect inguinal hernia" OR "direct inguinal hernia". As for BMI, the search strategy was "obese" OR "obesity" OR "BMI" OR "body mass index" OR "adiposity" OR "overweight". Then, we combined these items with "AND". The search was limited to title and abstract. The language available was English. And two authors performed the search independently.

Inclusion and exclusion criteria

The studies were included in this study if they met the following criteria: (1) Patients with inguinal hernia who underwent hernia repair surgery were included; (2) The comparison between the obese group and the non-obese group was reported; (3) Postoperative complications were reported; The exclusion criteria of this study were as follows: (1) Conferences, reviews, letters, comments, or case reports, duplicated publication data; (2) Insufficient data for analysis. All disagreements about inclusion and exclusion were solved by group discussion.

Study selection

Two authors searched the database independently. First, after removing the duplicate records, and then the titles and abstracts were screened. Second, the full texts were evaluated for eligibility based on the inclusion and exclusion criteria. The final judgment was made after the group discussion.

Definition

Postoperative complications of this study were classified according to the Clavien-Dindo classification and severe postoperative complications were defined as grades≥III [22].

Data extraction

The data of this study were extracted as follows: (1) Studies' information included the publication year, the first author's name, country, sample size, study design; (2) Patients' baseline information including age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) grade, hypertension, diabetes, lung disease, benign prostate hyperplasia (BPH), cardiac disease, smoking, anesthesia type, hernia type and previous prostatectomy; (3) Postoperative complications included operative time, postoperative hospital stay, skin-to-skin time, 30-d Morbidity, recurrence, surgical-site infection, urinary retention, seroma, wound hematoma, scrotal seroma, peritoneal injury, Intraoperative complication and overall complications.

Quality assessment

The Newcastle-Ottawa Scale (NOS), which had a score ranging from zero to nine points, was used to assess the quality of the enrolled studies [23]. A study with a score of nine points was considered high quality, a study with a score of seven to eight points was considered medium quality, and a study with six or fewer was considered low quality.

Statistical analysis

Mean differences (MDs) and 95% confidence intervals (CIs) were calculated for continuous variables. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the postoperative complications. Statistical heterogeneity was assessed by using the value of I^2 and the result of the chi-squared test. If $I^2 > 50\%$, it was considered high heterogeneity, the random effect model was used and $p < 0.1$ was considered statistically significant [24]. The random effect model was used in this article. Funnel plots and Egger tests were also used to observe the heterogeneity of studies and publication bias. This study was performed with Stata (V.16.0).

Results

Study selection

A total of 1619 studies were identified in the database, including 522 studies in PubMed, 974 studies in Embase, and 123 studies in the Cochrane Library. After removing duplicate studies and unqualified study types, 1348 were left for record screening. After browsing the titles and abstracts, 52 studies were left for full-text scanning. Finally, nine studies [5, 18–20, 25–29] were included in the current study (Fig. 1).

Characteristics of the included studies

A total of nine studies were included in this study. These studies were published from 2010 to 2024 and the study period was from 2003 to 2022, including nine retrospective studies. More specific information and the NOS scores are shown in Table 1.

Baseline information between the obese group and the non-obese group

By comparing the baseline information, we found that there were no significant differences in sex (OR=-0.08, I^2=89.46%, 95%CI=-0.16 to 1.82, P=0.04), ASA grade (≥3) (OR=1.10, I^2=0.00%, 95%CI=0.91 to 1.34, P=0.33), diabetes (OR=1.43, I^2=64.20%, 95%CI=0.99 to 2.08, P=0.06), lung disease (OR=0.78, I^2=74.66%, 95%CI=0.47 to 1.28, P=0.32), cardiac disease (OR=1.47, I^2=3.64%, 95%CI=0.91 to 2.37, P=0.12), smoking (OR=1.08, I^2=42.33%, 95%CI=0.94 to 1.24, P=0.26), general & regional anesthesia (OR=1.66, I^2=65.95%, 95%CI=0.78 to 1.50, P=0.63), bilateral hernia (OR=0.88, I^2=40.68%, 95%CI=0.65 to 1.18, P=0.39), unilateral hernia (OR=1.32, I^2=48.65%, 95%CI=0.92 to 1.89, P=0.13), direct hernia (OR=0.82, I^2=40.12%, 95%CI=0.63 to 1.08, P=0.16), indirect hernia (OR=1.02, I^2=0.00%, 95%CI=0.83 to 1.26, P=0.83), recurrent hernia (OR=1.13, I^2=0.00%, 95%CI=0.73 to 1.74, P=0.58), femoral hernia (OR=0.77, I^2=0.00%, 95%CI=0.37 to 1.62, P=0.49), complex hernia

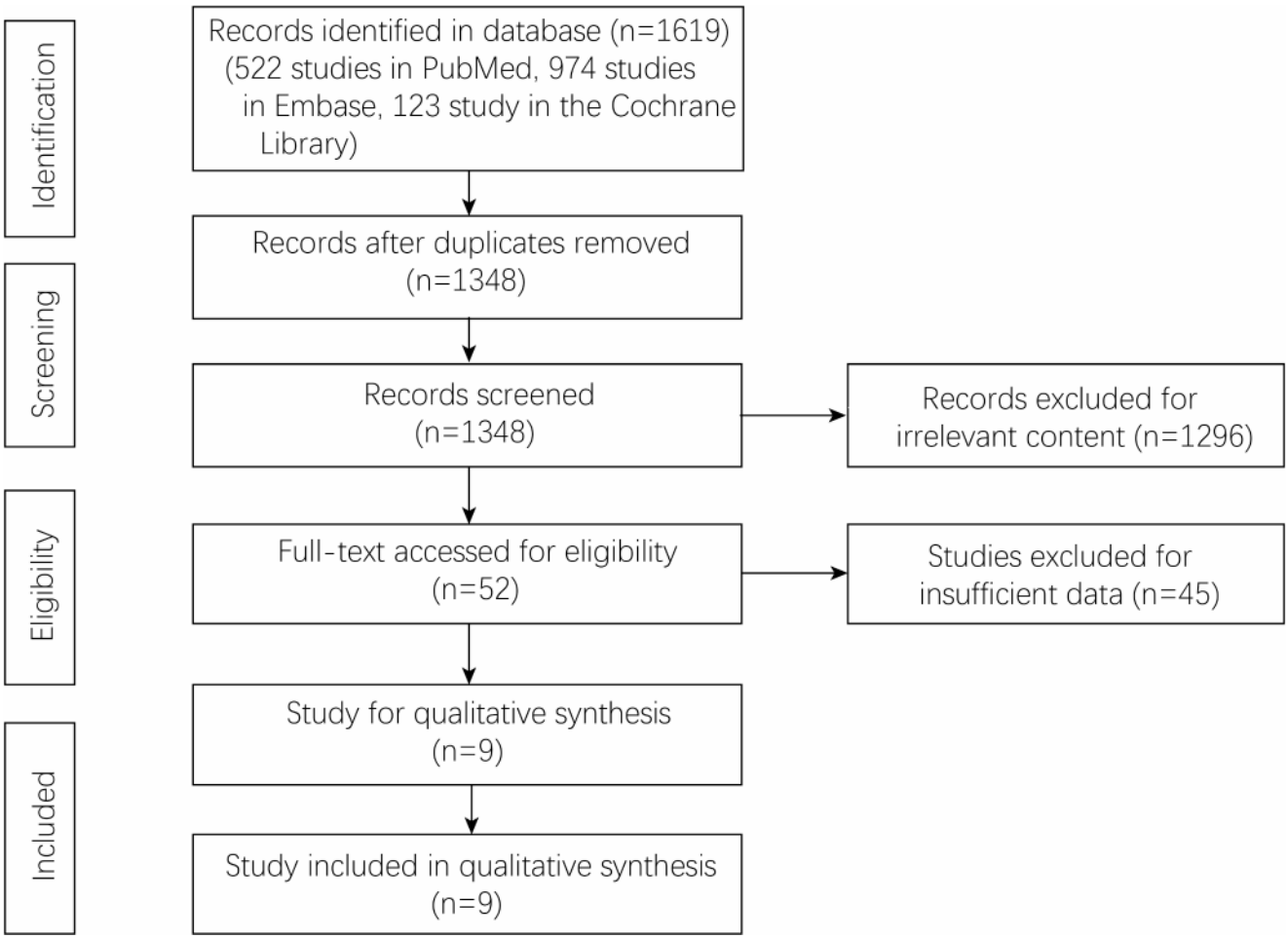

Fig. 1 Flowchart of study selection

Table 1 Baseline characteristics of included studies

Author	Year	Country	Study date	Study type	Sample size		NOS
					Obese	Non-Obese	
Attaar M	2024	America	2010–2021	Retrospective	835	4740	8
Pararas N	2023	Greece	2017–2022	Retrospective	39	70	6
Tee WQ	2023	China	2014–2021	Retrospective	57	60	7
Huerta S	2021	America	2005–2020	Retrospective	300	300	8
Kudsi OY	2021	America	2013–2020	Retrospective	131	262	8
Wakasugi M	2019	Japan	2016–2018	Retrospective	152	49	6
Park CY	2011	Korea	2001–2009	Retrospective	344	275	7
Rosemar A	2010	Sweden	2003–2007	Retrospective	22,387	26,707	8
Reid TD	2008	England	Unrecorded	Retrospective	90	35	7

Abbreviations: NOS, Newcastle-Ottawa Scales

Table 2 Summary of characteristics between the obese group and the non-obese group

Characteristics	Studies	Participants (Obese/Non-Obese)	Odds Ratio/Mean Difference (95% CI)	Model	Heterogeneity
Age (year)	8	24,175/32,541	-0.08 [-0.16, -0.00]; $P=0.04$	RE	$I^2=62.41\%$; $P=0.01$
Sex, male	8	22,780/29,136	1.15 [0.73, 1.82]; $P=0.55$	RE	$I^2=89.46\%$; $P<0.01$
BMI (kg/m2)	8	1788/5744	2.45 [2.08, 2.81]; $P<0.01$*	RE	$I^2=93.67\%$; $P<0.01$
ASA, ≥3	4	973/4478	1.10 [0.91, 1.34]; $P=0.33$	FE	$I^2=0.00\%$; $P=0.53$
Hypertension	3	243/270	1.32[1.02, 1.67]; $P=0.04$*	FE	$I^2=32.96\%$; $P=0.22$
Diabetes	5	216/454	1.43[0.99, 2.08]; $P=0.06$	RE	$I^2=64.20\%$; $P=0.02$
Lung disease	4	113/268	0.78[0.47, 1.28]; $P=0.32$	RE	$I^2=74.66\%$; $P=0.01$
BPH	2	77/98	0.68[0.49, 0.94]; $P=0.02$*	FE	$I^2=0.00\%$; $P=0.85$
Cardiac disease	2	131/97	1.47[0.91, 2.37]; $P=0.12$	FE	$I^2=3.64\%$; $P=0.31$
Smoking	4	419/1810	1.08[0.94, 1.24]; $P=0.26$	FE	$I^2=42.33\%$; $P=0.16$
Anesthesia type					
Local	4	5259/7031	0.82[0.79, 0.86]; $P<0.01$*	FE	$I^2=14.73\%$; $P=0.32$
General & regional	2	17,619/20,058	1.66[0.78, 1.50]; $P=0.63$	RE	$I^2=65.95\%$; $P=0.09$
Hernia type					
Bilateral	5	89/168	0.88 [0.65, 1.18]; $P=0.39$	FE	$I^2=40.68\%$; $P=0.15$
Unilateral	3	467/555	1.32 [0.92, 1.89]; $P=0.13$	FE	$I^2=48.65\%$; $P=0.14$
Direct	4	133/208	0.82 [0.63, 1.08]; $P=0.16$	FE	$I^2=40.12\%$; $P=0.17$
Indirect	5	593/674	1.02 [0.83, 1.26]; $P=0.83$	FE	$I^2=0.00\%$; $P=0.87$
Recurrent	3	41/57	1.13 [0.73, 1.74]; $P=0.58$	FE	$I^2=0.00\%$; $P=0.70$
Femoral	4	13/20	0.77 [0.37, 1.62]; $P=0.49$	FE	$I^2=0.00\%$; $P=0.65$
Complex	2	37/75	1.01 [0.64, 1.60]; $P=0.98$	FE	$I^2=0.00\%$; $P=0.74$
Scrotal component	2	58/67	1.25 [0.85, 1.84]; $P=0.25$	FE	$I^2=0.00\%$; $P=0.89$
Pantaloon	2	46/43	1.07 [0.68, 1.67]; $P=0.78$	FE	$I^2=0.00\%$; $P=0.89$
Surgical approaches					
Laparoscopic	2	/	/	/	/
Open	2	20,913/25,535	0.97 [0.81, 1.17]; $P=0.78$	RE	$I^2=53.62\%$; $P=0.78$
Previous prostatectomy	3	78/89	1.28 [0.57, 2.87]; $P=0.54$	RE	$I^2=65.18\%$; $P=0.06$

Abbreviations: BMI, Body Mass Index; ASA, American Society of Anesthesiologists; BPH, Benign Prostate Hyperplasia; CI, Confidence Intervals

(OR = 1.01, I^2=0.00%, 95%CI = 0.64 to 1.60, $P=0.98$), scrotal component hernia (OR = 1.25, I^2=0.00%, 95%CI = 0.85 to 1.84, $P=0.25$), pantaloont hernia (OR = 1.07, I^2=0.00%, 95%CI = 0.68 to 1.67, $P=0.78$), surgical approaches (OR = 0.97, I^2=53.62%, 95%CI = 0.81 to 1.17, $P=0.78$) and previous prostatectomy (OR = 1.28, I^2=65.18%, 95%CI = 0.57 to 2.87, $P=0.54$). We found that the obese group had Fewer older (MD=-0.08, I^2=62.41%, 95%CI=-0.16 to -0.00, $P=0.04$), higher BMI (MD = 2.45, I^2=93.67%, 95%CI = 2.08 to 2.81, $P<0.01$), more hypertension patients (OR = 1.32, I^2=32.96%, 95%CI = 1.02 to 1.67, $P=0.04$), more BPH (OR = 0.68, I^2=0.00%, 95%CI = 0.49 to 0.94, $P=0.02$) and more local anesthesia (OR = 0.82, I^2=14.73%, 95%CI = 0.79 to 0.86, $P<0.01$) than the None-obese group. (Table 2)

Operative and postoperative complications between the obese group and the non-obese group

We found that the obese group had a higher recurrence rate (OR = 1.27, I^2=21.89%, 95%CI = 1.10 to 1.47, P < 0.01), more wound infection (OR = 1.43, I^2=0.00%, 95%CI = 1.20 to 1.69, P < 0.01), and more overall complications (OR = 1.12, I^2=28.20%, 95%CI = 1.05 to 1.20, P < 0.01). However, there were no significant differences in operative time (MD = 0.12, I^2=80.86%, 95%CI=-0.13 to 0.38, P = 0.34), postoperative hospital stay (MD=-1.21, I^2=99.65%, 95%CI=-2.73 to 0.31, P = 0.12), skin-to-skin time (OR = 0.33, I^2=88.26%, 95%CI=-0.05 to 0.72, P = 0.09), 30-d Morbidity (OR = 1.02, I^2=53.81%, 95%CI = 0.64 to 1.63, P = 0.93), urinary retention (OR = 0.66, I^2=0.00%, 95%CI = 0.40 to 1.10, P = 0.11), seroma (OR = 1.133, I^2=0.00%, 95%CI = 0.90 to 1.42, P = 0.28), wound hematoma (OR = 1.06, I^2=0.00%, 95%CI = 0.96 to 1.18, P = 0.23), scrotal seroma (OR = 1.88, I^2=0.00%, 95%CI = 0.81 to 4.39, P = 0.14), peritoneal injury (OR = 0.78, I^2=53.71%, 95%CI = 0.33 to 1.84, P = 0.57) and intraoperative complication (OR = 1.78, I^2=29.53%, 95%CI = 0.63 to 5.00, P = 0.57). (Table 3)

Comparing recurrence between the obese group and the non-obese group

Seven studies [5, 18–20, 25–27] reported the recurrence. We found that the obese group had higher recurrence than the non-obese group. (OR = 1.27, I^2=21.89%, 95%CI = 1.10 to 1.47, P < 0.01). (Fig. 2)

Comparing wound infection between the obese group and the non-obese group

Seven studies [5, 18–20, 25–27] reported the wound infection. We found that the obese group had a higher infection rate than the non-obese group. (OR = 1.43, I^2=0.00%, 95%CI = 1.20 to 1.69, P < 0.01). (Fig. 3)

Comparing overall complications between the obese group and the non-obese group

Five studies [18, 19, 25, 26, 29] reported the overall complications. We found that the obese group had more overall complications than the non-obese group. (OR = 1.12, I^2=28.20%, 95%CI = 1.05 to 1.20, P < 0.01) (Fig. 4).

Publication bias

Publication bias for the included studies was based on a visual inspection of the symmetrical funnel plot. We developed a funnel plot to reflect the heterogeneity of recurrence for the included studies. (Fig. 5)

Discussion

A total of nine studies involving 56,833 patients who underwent inguinal hernia surgery were included in this study. By comparing operative and postoperative outcomes between the obese group and the non-obese group, we found that the obese group had a higher recurrence rate, more wound infection, and more overall complications than the non-obese group.

Obesity is a global health crisis, leading to type 2 diabetes, cardiovascular disease, and a high-risk factor for multiple cancers [30]. Therefore, surgeons will continuously treat obese patients. It has been reported inguinal hernia usually occurs in elderly and frail men [15]. In addition, in cases with a family history of inguinal hernia, the probability of developing inguinal hernia is 8 times higher than in normal individuals [26]. Long-term repeated heavy lifting, chronic cough, chronic obstructive pulmonary disease, obesity, and

Table 3 Operative and postoperative complications the obese group and the non-obese group

Characteristics	Studies	Participants (Obese/Non-Obese)	Odds Ratio/Mean Difference (95% CI)	Heterogeneity
Operative time (min)	5	789/857	0.12[-0.13, 0.38]; P = 0.34	I^2=80.86%; P < 0.01
Postoperative hospital stay	5	1575/5445	-1.21 [-2.73, 0.31]; P = 0.12	I^2=99.65%; P < 0.01
Skin-to-skin time	2	431/562	0.33 [-0.05, 0.72]; P = 0.09	I^2=88.26%; P < 0.01
30-d Morbidity	2	258/215	1.02 [0.64, 1.63]; P = 0.93	I^2=53.81%; P = 0.14
Recurrence	7	359/462	1.27 [1.10, 1.47]; P < 0.01*	I^2=21.89%; P = 0.26
Wound infection	7	290/259	1.43 [1.20, 1.69]; P < 0.01*	I^2=0.00%; P = 0.62
Urinary retention	4	19/128	0.66 [0.40, 1.10]; P = 0.11	I^2=0.00%; P = 0.87
Seroma	5	106/493	1.13 [0.90, 1.42]; P = 0.28	I^2=0.00%; P = 0.91
Wound hematoma	7	737/741	1.06 [0.96, 1.18]; P = 0.23	I^2=0.00%; P = 0.57
Scrotal seroma	2	18/8	1.88 [0.81, 4.39]; P = 0.14	I^2=0.00%; P = 0.96
Peritoneal injury	2	22/53	0.78 [0.33, 1.84]; P = 0.57	I^2=53.71%; P = 0.57
Intraoperative complication	2	16-Jun	1.78 [0.63, 5.00]; P = 0.27	I^2=29.53%; P = 0.23
Overall complications	5	1825/1952	1.12 [1.05, 1.20]; P = < 0.01*	I^2=28.20%, P = 0.23

Abbreviations: CI, confidence intervals

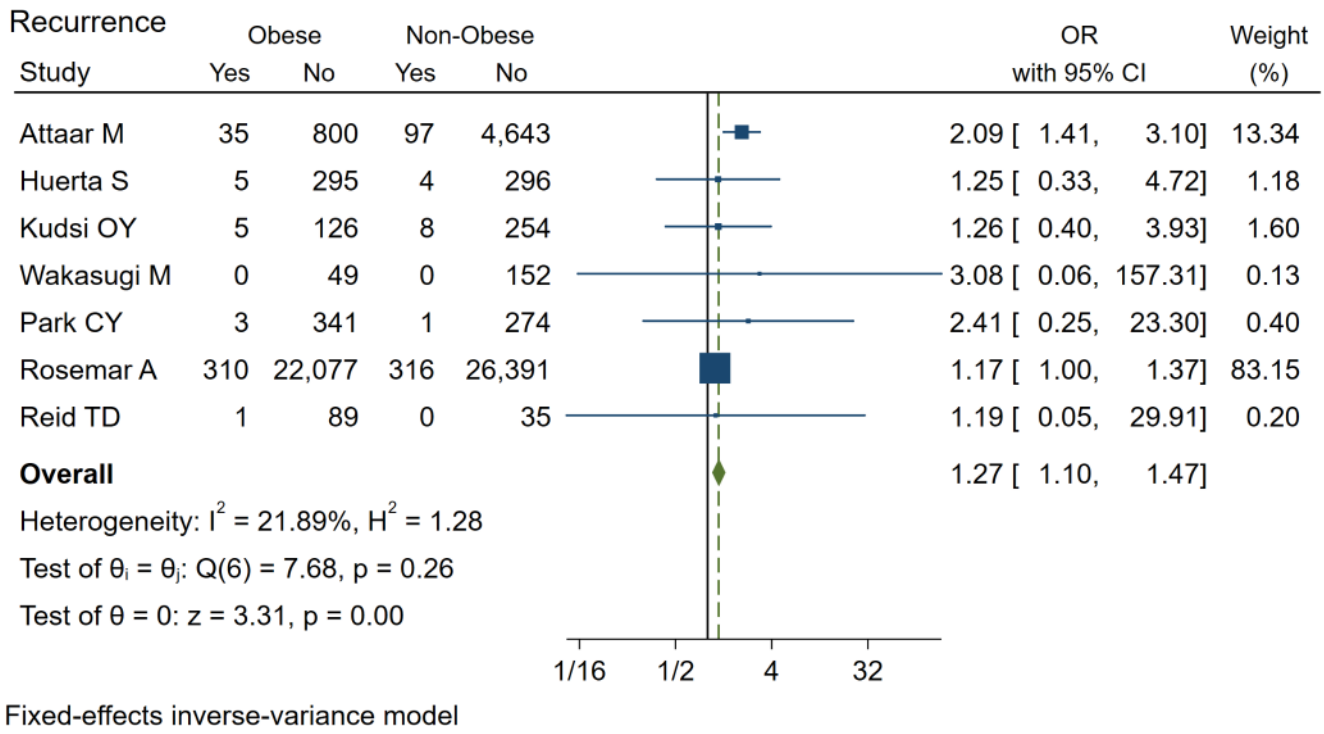

Fig. 2 Comparing recurrence between the obese group and the non-obese group

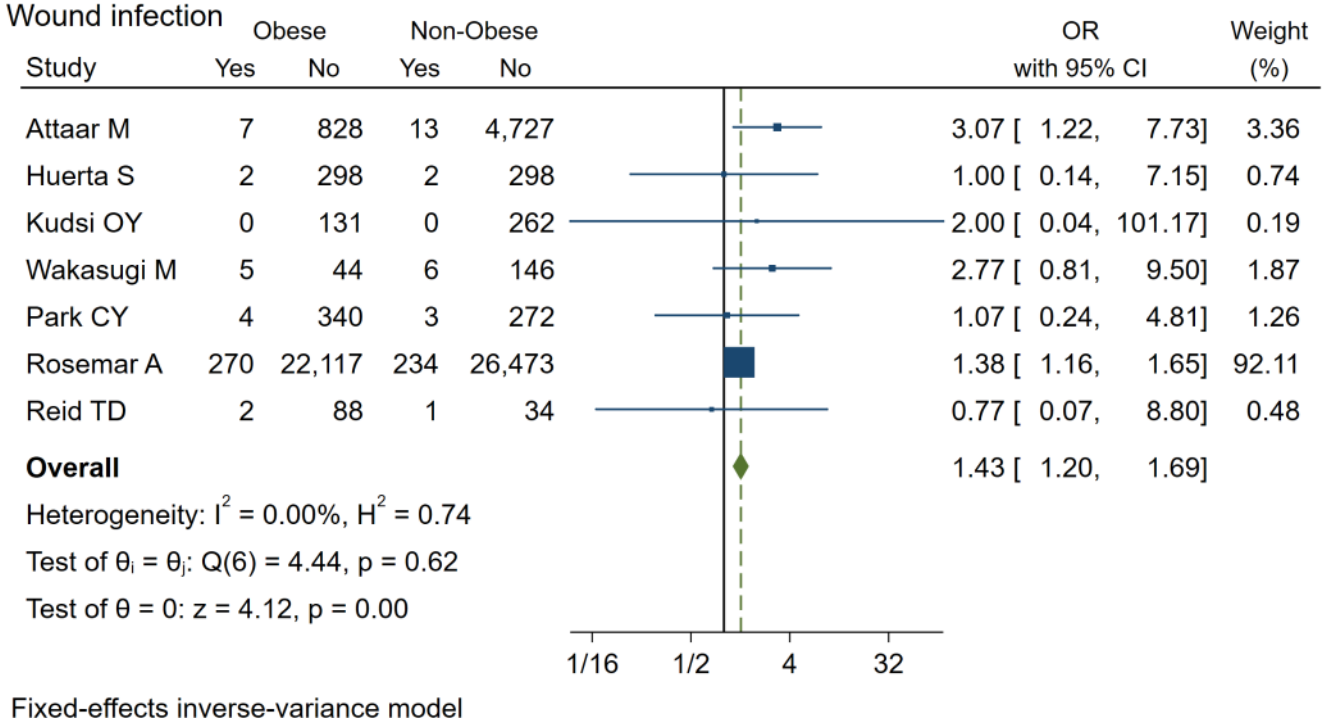

Fig. 3 Comparing wound infection between the obese group and the non-obese group

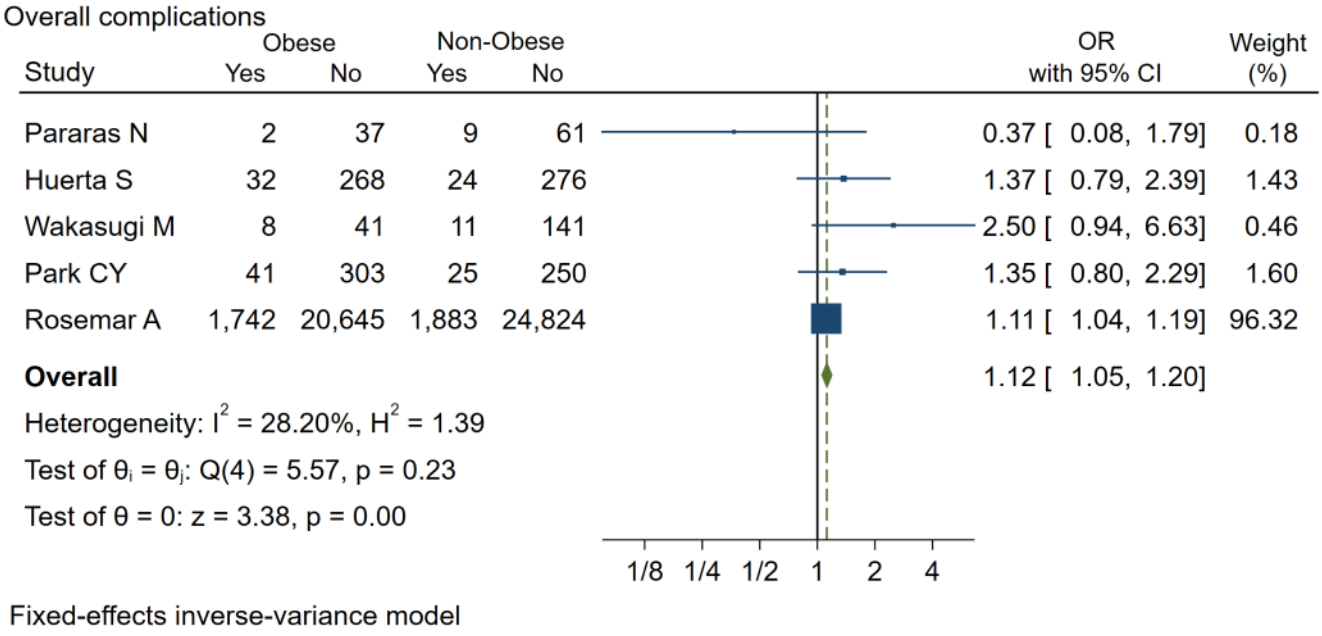

Fig. 4 Comparing overall complications between the obese group and the non-obese group

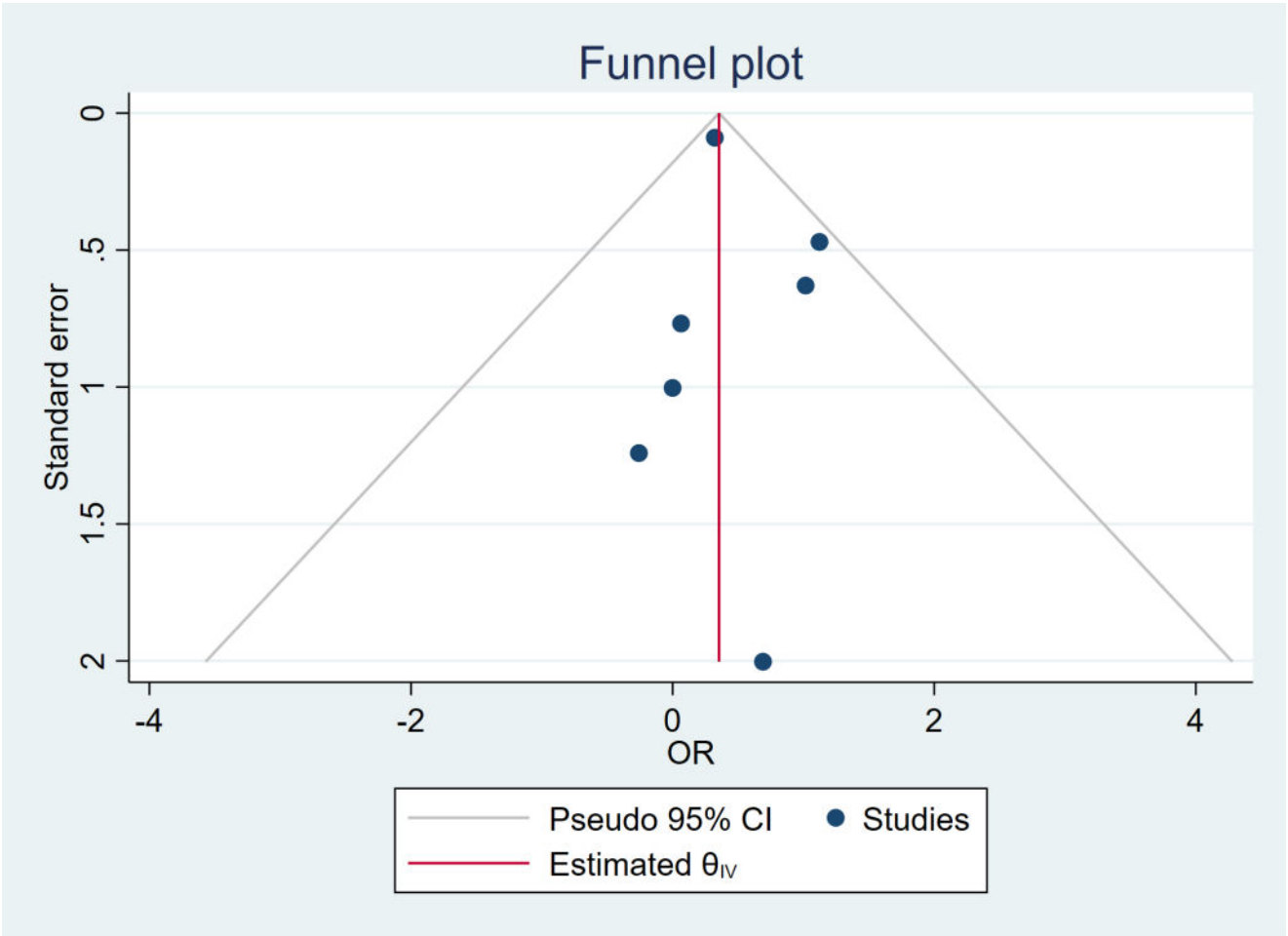

Fig. 5 Funnel plot of readmission

constipation can all cause an increase in intra-abdominal pressure, which are risk factors for inguinal hernia [31]. One of the most common indicators used to determine the success of inguinal hernia repair is the recurrence rate.

In recent years, quite a few studies have reported the postoperative outcomes of hernia repair in obese and non-obese patients. However, there is no clear consensus on the recurrence rate between obese and non-obese patients. Wakasugi M [25] et al. retrospectively collected data from patients who underwent inguinal hernia surgery, divided patients into obese and non-obese groups, and analyzed. In terms of recurrence rate, no significant statistical significance was found between the two groups. Similarly, Kudsi OY [20] et al. Kudsi used a 1:2 propensity score matching to compare the postoperative outcomes of obese and non-obese patients and had the same opinion. However, Attaar M [5] et al. held the opposite view. Their research suggests that obese patients have a higher recurrence rate after undergoing hernia repair surgery. Therefore, the purpose of this study aimed to evaluate whether obese patients undergoing inguinal hernia repair surgery have a higher recurrence rate and compare the clinical outcomes of obese and non-obese patients.

In our study, we found that we found that the obese group had a higher recurrence rate by comparing the obese group and the non-obese group. The main reason might be that obesity leads to chronic weakness of abdominal wall muscle tissue and the pressure on the reconstructed abdominal muscles increases [32]. In addition, we also found that obese patients are more prone to wound infection and have more overall complications. The reason might be that excessive adipose tissue can obstruct the field of view, and anatomical abnormalities and obstructed tissue planes make dissection more difficult, requiring the separation of more tissues [33]. Interestingly, we found that the obese group received more local anesthesia than the none-obese group. The main reason might be that the increased deposition of cervical adipose tissue in obese patients, which could cause airway stenosis and elevate the risks associated with general anesthesia [32]. Additionally, obese patients had a higher risk of aspiration and acute upper airway obstruction during the perioperative period [34]. Consequently, we speculated that surgeons and anesthesiologists were more likely to opt for local anesthesia in obese patients with inguinal hernia.

To the best of our knowledge, this study is the first pooling up analysis to assess the recurrence rate between obese and non-obese patients. However, some limitations existed in this study. First, just nine articles were included in the study, which was relatively small. Second, all included studies were retrospective studies. Third, we lacked long-term follow-up after hernia repair surgery. Therefore, comprehensive, prospective, large sample size and high-quality randomized controlled trials should be conducted to further confirm our results in the future.

In conclusion, compared with the non-obese group, the obese group has a higher recurrence rate, more wound infections, and overall more complications. For patients with pathological obesity who do not have an urgent inguinal hernia, we recommend weight loss before hernia repair surgery. However, treatment decisions should be individualized based on the patients overall health, preferences, and the specific details of the hernia. Additionally, surgeons are required to pay more attention to perioperative management for obese patients.

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Author contributions Data extraction, Zi-Wei Li, Ming Song, Jun Liu, Bin Jiang, and Wei Hu; quality assessments, Zi-Wei Li and Xin Zheng; data analysis, Zi-Wei Li and Xin Zheng; writing-origin draft, Zi-Wei Li; writing-review and editing, Zi-Wei Li, Xin Zheng. All authors read and approved the final manuscript.

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Data availability All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare that they have no competing interests.

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