Systematic Review

A Meta-analysis of the Efficacy of Different Surgical Methods in the Treatment of Uterine Prolapse

Ann. Ital. Chir., 2024 95, 3: 257–274
https://doi.org/10.62713/aic.3385

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AIM: The management of uterine prolapse poses a significant clinical challenge, with surgical intervention often necessary for symptom relief and restoration of pelvic floor function. However, the optimal surgical approach for uterine prolapse remains uncertain, prompting a comprehensive meta-analysis to compare the efficacy of various surgical methods. This study aims to assess the effectiveness of different surgical methods for treating uterine prolapse.

METHODS: We used computer search to retrieve relevant literature to compare the therapeutic effects of different surgical methods for treating uterine prolapse. The search was conducted in the Web of Science and PubMed databases, and articles published until October 2023 were obtained. We employed random effects and fixed effects models and performed a meta-analysis using the R software.

RESULTS: This study included 40 standard papers covering 25,896 patients with uterine prolapse. We used random and fixed effects models to conduct a meta-analysis of hysterectomy and uterine fixation procedures. The findings indicated that different surgical approaches had no significant impact on surgical success rates (I^2 = 69%, $p < 0.01$; risk ratio (RR) (95% confidence intervals (CI)): 1.00 [0.98; 1.03]) or postoperative adverse reactions (I^2 = 54%, $p < 0.01$; RR (95% CI), 1.10 [0.83; 1.45]). However, the durations of the surgical procedure for hysterectomy (I^2 = 91%, $p < 0.01$; standardized mean difference (SMD) (95% CI), 0.78 [0.49; 1.07]), surgical blood loss (I^2 = 97%, $p < 0.01$, SMD (95% CI): 1.14 [0.21; 2.07]), and intraoperative adverse reactions (I^2 = 0%, p = 0.61, RR (95% CI): 1.37 [1.10; 1.71]) were statistically significant between hysterectomy and uterine fixation procedures. Additionally, publication bias and sensitivity tests showed no publication bias in this meta-analysis and no literature causing significant sensitivity.

CONCLUSIONS: In the treatment of uterine prolapse, both hysterectomy and uterine fixation are similar in terms of surgical success rates and postoperative adverse reactions. However, hysterectomy is associated with longer duration of the surgical procedure, increased blood loss and higher incidence of intraoperative adverse reactions compared to uterine fixation.

Keywords: surgical methods; uterine prolapse; efficacy; meta-analysis

Introduction

Uterine prolapse (UP) is an anatomical anomaly in the female reproductive system. It is characterized by weakening pelvic floor support structures, leading to descent, sliding, or downward displacement of the uterus and/or cervix, along with adjacent organs such as the bladder and/or rectum [1, 2]. The causes of UP are diverse and include factors such as pregnancy, childbirth, congenital or acquired connective tissue disorders, pelvic nerve weakness or aging, menopause, and factors associated with prolonged elevated intra-abdominal pressure. These factors may involve a history of multiple pregnancies, difficult deliveries, prolonged labor, insufficient postpartum rest, or engagement in heavy physical labor [3]. With the growth of the elderly population, the incidence of UP is increasing. Concurrently, physiological and psychological issues resulting from UP, such as urinary incontinence, sexual intercourse pain, and other symptoms, substantially affect the quality of life of many females. With increases in health awareness, UP has received greater attention [4, 5]. Surgery is one of the main approaches for treating UP. However, there is still no consensus among clinicians regarding the most effective surgical method, requiring further research and evaluation [6].

Meta-analysis is a statistical approach aimed at synthesizing independent findings from related studies [7]. Its primary objective is to amalgamate data from multiple studies, explore heterogeneity, and, when applicable, generate a single effect estimate to summarize the overall effect in the research field. As a widely utilized statistical method, meta-analysis aids in integrating all relevant studies and investigating consistency and divergence among individual studies, thereby yielding statistically analyzed results that are closer to real-world scenarios [8]. Through meta-analysis, researchers can obtain more reliable conclusions, avoiding excessive reliance on individual study outcomes and gaining a better understanding of the overall situation in the relevant field. Meta-analysis has widespread applications in the fields of medicine and the social sciences. In this study, we

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employed a meta-analysis to evaluate the efficacy of surgical interventions for UP, offering healthcare providers and patients more informed treatment options. Thus, we aimed to conduct a meta-analysis of the effectiveness of different surgical approaches for treating UP to provide more accurate treatment recommendations.

Materials and Methods

Literature Retrieval

This study was initiated with computer searches, and PubMed and Web of Science databases were selected. Our search period was extended to October 2023, with the aim of identifying relevant literature published to that date and comparing the effectiveness of different surgical methods in treating UP. In the PubMed search, our search terms were set as: ("pelvic organ prolapse" OR "descensus" OR "vaginal prolapse") AND "hysteropexy"; whereas in the Web of Science search, our search terms were set as: Topic Search (TS) = (("pelvic organ prolapse" OR "descensus" OR "vaginal prolapse") AND "hysteropexy"). This systematic review is reported according to PRISMA 2020 guidelines (**Supplementary Material**).

Reference Inclusion and Exclusion Criteria

Inclusion Criteria

The following studies were included: (1) Reasonably designed retrospective studies, prospective studies, or randomized controlled trials, regardless of whether blinding was employed; data from the two groups must be compared; (2) Patients diagnosed as requiring either hysterectomy or uterine fixation; (3) Studies encompassing both hysterectomy and uterine fixation procedures as the intervention measures; and (4) Outcome indicators that included surgical approach, duration, intraoperative blood loss, adverse reactions during surgery, and adverse reactions post-surgery.

Exclusion Criteria

The following studies were excluded: (1) Studies of "Books and Documents", "meta-analysis", "Review", and "Systematic Review"; (2) Studies categorized as summaries and conference papers; (3) Studies lacking pertinent clinical data; and (4) Studies with incongruent outcome indicators.

Literature Screening and Information Extraction

Literature screening was handled by two independent researchers tasked with searching and sifting through the literature, followed by cross-verification. In cases of disagreement, resolution is sought by a third party. For the included studies, we meticulously read and extracted data on account of the research in the literature, encompassing: (1) general information (author, publication date, source of literature); (2) study characteristics (study design, research subjects, basic patient information, intervention measures, statistical methods); and (3) outcome indicators (surgical methods, duration, blood loss, intraoperative complications [massive hemorrhage, rectum or colon injury, bladder injury, blood transfusion, bladder lesions, vaginal injury], and postoperative complications [conversion to open, bladder perforation, cystotomy, ureteral kink, ureteral injury, transfusion or Estimated Blood Loss (EBL) $>$500 mL]).

Risk of Bias and Quality Assessment

The quality of the included literature was evaluated using the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool.

Subgroup Analysis

In this meta-analysis, retrospective studies, prospective studies, and randomized controlled trials were included. Subgroup analysis was conducted using the meta package in R to reduce potential sources of bias in retrospective studies, prospective studies, and randomized controlled trials included in this meta-analysis.

Statistical Analysis

Meta-analysis

This meta-analysis was carried out using R software (version 3.6.1, R Foundation for Statistical Computing, Vienna, Austria). We employed the mean difference (MD) to analyze continuous data and the risk ratio (RR) for binary data analysis. All analyses were performed with 95% confidence intervals (CI). Statistical significance was set at $p \leq 0.05$; otherwise, the difference was deemed insignificant. Before consolidating the data, we conducted a heterogeneity test on various study data, with RR as the metric. Initially, we utilized a fixed effects model to obtain the meta-analysis I^2, H2, and Q values. A larger Q value corresponds to a smaller p value. If $Q > 0.05$ and $I^2 < 50\%$, we used the fixed effects model; if $Q < 0.05$ and $I^2 > 50\%$, we opted for the random-effects model.

Model Evaluation and Sensitivity Analysis

The Meta package in R were used to plot funnel and radar plots for model evaluation.
The Meta package in R was used for sensitivity analysis of studies with low and unclear bias risks and observational studies.

Results

Literature Retrieval Results

We conducted searches of PubMed and Web of Science databases, resulting in 500 relevant articles. After applying the exclusion criteria, we narrowed the selection to 40 articles (related to uterine fixation and hysterectomy) [9–48], which were included in the meta-analysis. The detailed steps of literature screening and the fundamental character-

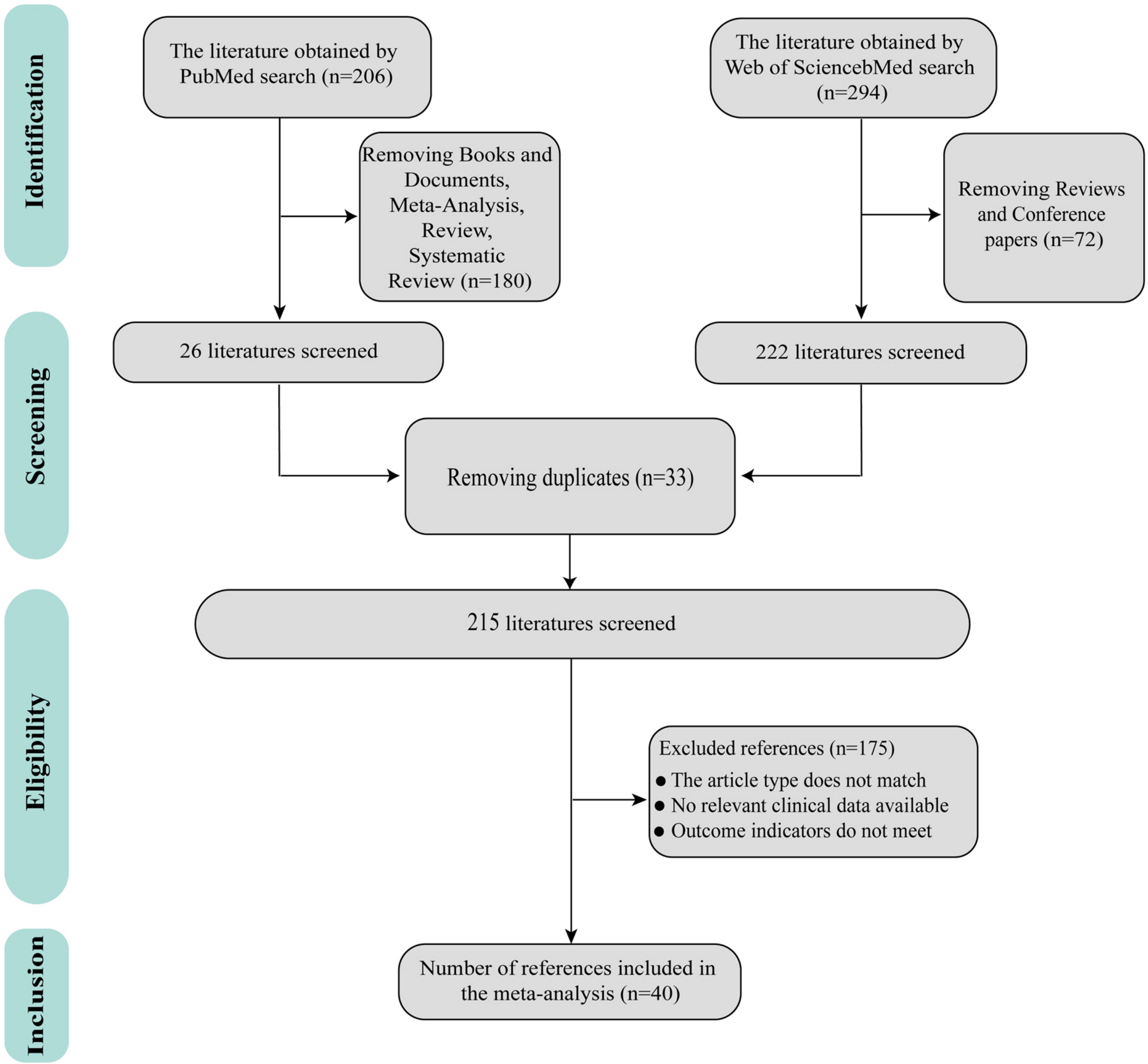

Fig. 1. Document inclusion and exclusion flow chart.

istics of the selected articles are presented in Fig. 1 and Table 1 (Ref. [9–48]), respectively.

Risk of Bias

Using the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool, bias risk assessment was conducted on these 40 studies, revealing 10 studies with low bias risk [14, 17, 19, 23, 26, 30, 40, 41, 45, 47], 26 studies with moderate bias risk [9, 10, 11, 12, 13, 16, 18, 20, 21, 22, 24, 27, 29, 31, 32, 33, 34, 35, 36, 38, 39, 42, 43, 44, 46, 48], and 4 studies with high bias risk [15, 25, 28, 37] (Fig. 2).

Subgroup Analysis

Subgroup analysis was conducted on the 40 studies, revealing 27 retrospective studies [9, 10, 11, 14, 15, 18, 20, 21, 22, 24, 25, 27, 28, 29, 31, 32, 33, 34, 35, 38, 39, 42, 43, 44, 45, 46, 47], 6 prospective studies [12, 13, 16, 36, 37, 48], and 7 randomized controlled trials [17, 19, 23, 26, 30, 40, 41] (Fig. 3). The heterogeneity among retrospective studies was $I^2 = 73\%$, prospective studies was $I^2 = 19\%$, and randomized controlled trials was $I^2 = 53\%$. The primary source of heterogeneity was found to be retrospective studies.

Meta-analysis Results

Comparison of Different Surgical Methods' Success Rates

Our article referenced 40 studies [9–48], involving surgical data from 25,896 patients. Using a random effects model for analysis ($I^2 = 69\%$, $p < 0.01$), the meta-analysis results indicated an RR value of 1.00 [0.98; 1.03] for the success rates between the procedures of retaining and not retaining the uterus. This suggests that the different surgical approaches did not significantly impact the success rates of the surgeries (Fig. 4).

Table 1. Basic information table for included literature.

Study	Method hysterectomy	Method hysteropexy	Study design	Years	RR	Outcome
Thys *et al*. [9], 2011	vaginal hysterectomy	Manchester Fothergill	nRCs	0–1	1.0540541	Shorter operation time and less blood loss in the MF group
Zhu *et al*. [10], 2021	sacrospinous ligament fixation	laparoscopic uterine suspension	nRCs	0–1	1.0000000	Hysteropexy preserves vaginal length, reduces complications, and improves outcomes.
Wang *et al*. [11], 2022	bilateral sacrospinous ligament fixation with vaginal hysterectomy	bilateral sacrospinous hysteropexy	nRCs	2–3	1.0858961	BSHP procedure yields noninferior anatomical and functional outcomes
Chang *et al*. [12], 2023	hysterectomy	hysteropexy	nRCs	0–1	1.0000000	Native-tissue pelvic organ prolapse surgery significantly improves sexual function
Gracia *et al*. [13], 2015	laparoscopically conducted subtotal hysterectomy plus cervicopexy	sacral laparoscopic hysteropexy	nRCs	0–1	1.0000000	The overall success rate was significantly higher in the laparoscopic subtotal hysterectomy plus cervicopexy group
Illiano *et al*. [37], 2020	laparoscopic hysterectomy with sacrocolpopexy	laparoscopic hysteropexy	nRCs	0–1	1.0000000	No differences in the anatomical and functional outcomes between LSC with or without hysterectomy for POP
Yan *et al*. [14], 2023	laparoscopic supracervical hysterectomy with concomitant laparoscopic sacrocervicopexy	laparoscopic sacrohysteropexy	nRCs	2–3	1.0357244	LSCH + LSC offers favorable outcomes in terms of anatomic correction, quality of life improvement, and reduced risk of severe complications
	laparoscopic supracervical hysterectomy with concomitant laparoscopic sacrocervicopexy	laparoscopic sacrohysteropexy	nRCs	2–3	1.0405927	
Şükür *et al*. [15], 2020	vaginal hysterectomy with McCall suspension	laparoscopic sacrohysteropexy	nRCs	0–1	0.9685732	In younger patients, VH & McCall increases the risk of symptomatic prolapse recurrence relative to LSHP
Ker *et al*. [16], 2018	transvaginal mesh hysterectomy	transvaginal mesh hysteropexy	nRCs	0–1	1.0312500	Patients experience longer vaginal length, shorter operation duration, less blood loss and less post-operation pain with hysteropexy.
Nager *et al*. [17], 2021	vaginal hysterectomy with uterosacral ligament suspension	sacrospinous hysteropexy with graft	nRCs	0–1	0.8901149	Sacrospinous hysteropexy with graft resulted in a lower composite failure rate than vaginal hysterectomy through 5 years.
	vaginal hysterectomy with uterosacral ligament suspension	sacrospinous hysteropexy with graft	nRCs	1–2	0.8724900	
	vaginal hysterectomy with uterosacral ligament suspension	sacrospinous hysteropexy with graft	nRCs	2–3	0.8486111	

Table 1. Continued.

Study	Method hysterectomy	Method hysteropexy	Study design	Years	RR	Outcome
	vaginal hysterectomy with uterosacral ligament suspension	sacrospinous hysteropexy with graft	nRCs	>3	0.7696203	
	vaginal hysterectomy with uterosacral ligament suspension	sacrospinous hysteropexy with graft	nRCs	>3	0.7292308	
Bedford *et al*. [18], 2013	laparovaginal hysterectomy with uterosacral colpopexy	laparoscopic uterosacral hysteropexy	nRCs	0–1	1.0656977	Hysterectomy with laparoscopic uterosacral colpopexy produced better objective success rates than did laparoscopic uterosacral hysteropexy
	laparovaginal hysterectomy with uterosacral colpopexy	laparoscopic uterosacral hysteropexy	nRCs	2–3	1.1452381	
Nager *et al*. [19], 2019	hysterectomy	hysteropexy	nRCs	1–2	0.8991060	Fewer failures for hysteropexy compared to hysterectomy through 5 years
Stanford *et al*. [20], 2015	baseline previous hysterectomy	no hysterectomy	nRCs	1–2	0.9672131	No difference in overall intraoperative complications. A trend toward increased mesh extrusion when a hysterectomy
	concomitant hysterectomy	no hysterectomy	nRCs	1–2	0.9655172	
Al-Badr *et al*. [21], 2017	vaginal hysterectomy with utero-sacral suspension	sacro-spinous hysteropexy	nRCs	1–2	2.0307692	SSHP appeared less success rate and increased risk of recurrent anterior prolapse
Romanzi *et al*. [22], 2012	vaginal hysterectomy	uterosacral hysteropexy	nRCs	1–2	1.0581395	USH women weighed less, were younger, and more constipated with larger rectoceles
Rogers *et al*. [23], 2022	hysterectomy	hysteropexy	nRCs	2–3	1.1899932	More women in the mesh hysteropexy group achieved the MID than in the hysterectomy group
Campagna *et al*. [24], 2022	laparoscopic sacral colpopexy with concomitant supracervical hysterectomy	laparoscopic sacral hysteropexy	nRCs	0–1	1.0679513	No significant differences between the groups in terms of subjective success rate, estimated blood loss, conversion to laparotomy and intra- and postoperative complications. The median operative time (OT) was significantly shorter in LSHP
	laparoscopic sacral colpopexy with concomitant supracervical hysterectomy	laparoscopic sacral hysteropexy	nRCs	1–2	1.0391850	
Pan *et al*. [25], 2016	laparoscopic sacrocolpopexy/total laparoscopic hysterectomy	laparoscopic sacral hysteropexy	nRCs	1–2	1.2202753	TLH with LSC approach provides similar anatomical results, excellent patient satisfaction, and improved quality of life scores

Table 1. Continued.

Study	Method hysterectomy	Method hysteropexy	Study design	Years	RR	Outcome
Izett-Kay *et al*. [26], 2022	vaginal hysterectomy	laparoscopic mesh sacrohysteropexy	nRCs	>3	0.8940887	Laparoscopic sacrohysteropexy had a lower risk of apical reoperation, greater apical support and increased total vaginal length.
Lone *et al*. [27], 2018	vaginal hysterectomy	laparoscopic sacrohysteropexy	nRCs	1–2	1.2901235	At 2 years, both procedures had similar improvement in symptom domains, overall scores, adverse events, recurrent prolapse, and new-onset SUI
Haj-Yahya *et al*. [28], 2020	transvaginal hysterectomy with uterosacral ligament suspension	laparoscopic uterosacral ligament suspension	nRCs	1–2	0.9803922	In both groups, the improved POP-Q points Ba, C, and Bp, as well as the clinical cure rate and anatomical cure rate, were not significantly different.
Lo *et al*. [29], 2015	sacrospinous ligament fixation with hysterectomy	sacrospinous ligament fixation with hysteropexy	nRCs	>3	1.4333333	Mean age, parity, postmenopausal status and mean operating time in the hysterectomy group were significantly higher than in the hysteropexy group
Dietz *et al*. [30], 2010	vaginal hysterectomy	sacrospinous hysteropexy	nRCs	0–1	1.3027295	The sacrospinous hysteropexy for uterine descent is associated with an earlier recovery time, more recurrent apical prolapses
Li *et al*. [31], 2020	laparoscopic supracervical hysterectomy plus cervicopexy	laparoscopic hysteropexy	nRCs	0–1	1.0000000	LHP had a significantly shorter hospital stay and a higher VAS score than LSHCP
Gagyor *et al*. [32], 2021	laparoscopic supra-cervical hysterectomy and laparoscopic sacro-cervicopexy or a total laparoscopic hysterectomy and laparoscopic sacro-colpopexy	laparoscopic sacro-hysteropexy	nRCs	0–1	1.0674226	LSH seems to be associated with higher incidence of anterior compartment failures and suboptimal mesh placement based on postoperative imaging techniques
Yuan *et al*. [33], 2021	hysterectomy	hysteropexy	nRCs	>3	0.7863248	Hysteropexy is associated with lower odds of experiencing AEs, shorter operating times, a shorter length of stay, and less blood loss

Table 1. Continued.

Study	Method hysterectomy	Method hysteropexy	Study design	Years	RR	Outcome
Forde *et al*. [34], 2017	hysterectomy hysterectomy hysterectomy	hysteropexy hysteropexy hysteropexy	nRCs nRCs nRCs	0–1 2–3 >3	1.0017742 0.9979597 0.9547557	Hysterectomy during mesh-based POP surgery in patients under 55 years led to more expensive charges and a longer stay
Chughtai *et al*. [35], 2018	hysterectomy hysterectomy hysterectomy	hysteropexy hysteropexy hysteropexy	nRCs nRCs nRCs	0–1 2–3 >3	1.0161290 1.0000000 1.0300000	Hysterectomy was more expensive and had more surgical complications within 90 days of the initial procedure
Arcieri *et al*. [36], 2023	laparoscopic sacral colpopexy with supracervical hysterectomy	robotic sacral hysteropexy	nRCs	0–1	1.0769231	No difference was found in terms of estimated blood loss, hospital stay, operative time, and intraoperative or postoperative complications
van Brummen *et al*. [38], 2003	vaginal hysterectomy	sacrospinous hysteropexy	nRCs	0–1	1.0529915	Sacrospinous hysteropexy is associated with a faster complete recovery. Vaginal hysterectomy is associated with a threefold higher risk for overactive bladder and urge incontinence symptoms
Carlin *et al*. [39], 2023	vaginal hysterectomy	vaginal sacrospinous hysteropexy	nRCs	>3	0.9647059	The SSH group showed a significantly shorter mean surgery time, fewer hospitalization days, and less intraoperative blood loss
Detollenaere *et al*. [40], 2015	vaginal hysterectomy	sacrospinous hysteropexy	nRCs	0–1	0.9619048	At 12 months, overall anatomical recurrences, functional outcome, quality of life, complications, hospital stay, measures on postoperative recovery, and sexual functioning did not differ between the two groups.
Schulten *et al*. [41], 2019	vaginal hysterectomy	sacrospinous hysteropexy	nRCs	>3	0.8651685	Less anatomical recurrences and a higher of success in sacrospinous hysteropexy
Chou *et al*. [42], 2021	vaginal hysterectomy with sacrospinous colpopexy vaginal hysterectomy with sacrospinous colpopexy	sacrospinous hysteropexy sacrospinous hysteropexy	nRCs nRCs	1–2 1–2	0.5689655 0.6166008	Shorter operation time and lower anatomical recurrence rates in the uterine preservation group
Plair *et al*. [43], 2021	hysterectomy with apical repair	anterior sacrospinous hysteropexy	nRCs	1–2	1.0085164	Anterior sacrospinous hysteropexy has similar short-term efficacy compared to hysterectomy with apical repair with shorter operative time and a trend towards fewer serious complications.

Table 1. Continued.

Study	Method hysterectomy	Method hysteropexy	Study design	Years	RR	Outcome
McDermott *et al.* [44], 2011	total Prolift hysteropexy	total Prolift colpopexy	nRCs	0–1	0.9502924	TPC and TPH have similar surgical outcomes, except for vaginal vault measurements reflected by POP-Q point C
Husby *et al.* [45], 2019	vaginal hysterectomy	Manchester-Fothergill	nRCs	0–1	0.9600380	Sacrospinous hysteropexy has exceedingly high numbers of reoperations due to prolapse recurrence
	vaginal hysterectomy	sacrospinous hysteropexy	nRCs	0–1	1.1498859	
Mao *et al.* [46], 2023	laparoscopic uterosacral suspension with concomitant hysterectomy	laparoscopic uterosacral hysteropexy	nRCs	2–3	0.9428571	No difference was found in the risk of overall recurrence and overall rates of recurrent prolapse between the two groups
	laparoscopic uterosacral suspension with concomitant hysterectomy	laparoscopic uterosacral hysteropexy	nRCs	0–1	0.9285714	
	laparoscopic uterosacral suspension with concomitant hysterectomy	laparoscopic uterosacral hysteropexy	nRCs	1–2	0.9375000	
Milani *et al.* [47], 2020	hysterectomy plus uterosacral ligament suspension	uterosacral hysteropexy	nRCs	2–3	0.9743590	Hysteropexy was associated with shorter operative time and less bleeding and found to be associated with a significantly higher central recurrence rate
Bowen *et al.* [48], 2023	vaginal hysterectomy with uterosacral ligament suspension	vaginal mesh hysteropexy	nRCs	2–3	0.6551724	The hysterectomy group had higher prolapse recurrence

Note: nRCs, non-randomized controlled studies; RR, risk ratio; MF, Manchester Fothergill; BSHP, bilateral sacrospinous hysteropexy; LSC, laparoscopic sacrocolpopexy; POP, pelvic organ prolapse; LSCH, laparoscopic supracervical hysterectomy; VH, vaginal hysterectomy; LSHP, laparoscopic sacrohysteropexy; SSHP, sacro-spinous hysteropexy; USH, uterosacral hysteropexy; MID, minimally important difference; TLH, total laparoscopic hysterectomy; VAS, Visual analog scale; LHP, laparoscopic hysteropexy; LSHCP, laparoscopic supracervical hysterectomy plus cervicopexy; LSH, Laparoscopic supracervical hysterectomy; AEs, adverse events; SSH, sacrospinous hysteropexy; TPC, total prolift colpopexy; TPH, total prolift hysteropexy.

Comparison of Different Surgical Procedures' Duration

Of these 40 studies, 19 provided information about the surgical duration [9, 11, 14, 16, 18, 19, 24, 25, 29, 31, 32, 33, 36, 39, 40, 42, 44, 46, 47]. We conducted an analysis using a random effects model ($I^2 = 91\%, p < 0.01$) and found that the standardized mean difference (SMD) (95% CI) value was 0.78 [0.49; 1.07]. The meta-analysis suggested that the surgical duration for the method of not retaining the uterus was significantly longer than that for the process of retaining the uterus (Fig. 5).

Comparison of Different Surgical Methods' Blood Loss

Of these 40 studies, 19 provided detailed information on patient blood loss during surgery [9, 11, 14, 16, 18, 20, 21, 24, 25, 29, 31, 32, 33, 36, 40, 42, 44, 46, 47]. We conducted a random effects model for analysis ($I^2 = 97\%, p < 0.01$), and the results indicated an SMD (95% CI) of 1.14 [0.21; 2.07]. This meta-analysis revealed that the surgical approach of not retaining the uterus significantly increased the risk of intraoperative blood loss compared to the method of retaining the uterus (Fig. 6).

Comparison of Different Surgical Methods' Intraoperative Complication Reactions

Of these 40 studies, 20 reported patients with adverse reactions during surgery [9, 11, 14, 18, 19, 20, 22, 24, 25, 29, 32, 33, 34, 35, 36, 38, 40, 43, 44, 47]. We used a fixed effects model to analyze these cases ($I^2 = 0\%, p = 0.61$). These results showed (Fig. 7) that the RR (95% CI) value was 1.37 [1.10; 1.71]. This suggests that the surgical method, as indicated by the meta-analysis, demonstrates a drastically higher occurrence of intraoperative complications during the surgery for uterus removal compared to the method for preserving the uterus.

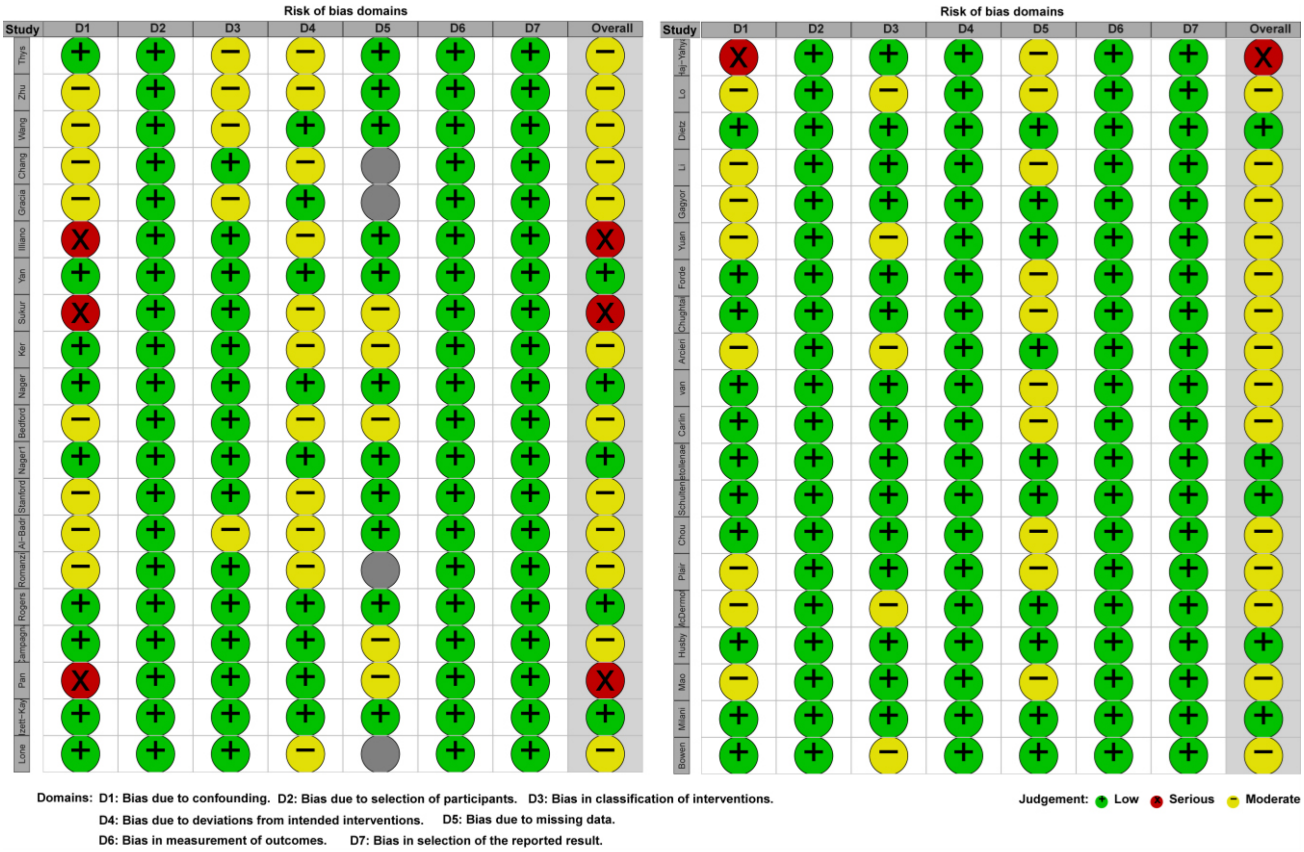

Fig. 2. Risk of bias and applicability.

Comparison on the Postoperative Complication Reactions of Different Surgical Methods

Of these 40 studies, 17 discussed patients with postoperative complications after surgery [9, 11, 14, 16, 18, 19, 24, 25, 33, 36, 39, 40, 42, 43, 44, 46, 47]. Using a random effects model for analysis (I^2 = 54%, $p < 0.01$), the study revealed (Fig. 8) that the RR (95% CI) value was 1.10 [0.83; 1.45]. This meta-analysis suggested that different surgical methods did not notably affect adverse reactions after surgery.

Evaluation of the Meta-analysis Model

Publication Bias

We created a funnel plot (Fig. 9A) and a Galbraith plot (Fig. 9B) based on various outcome indicators. In the funnel plot, the *p* value of Egger's test was 0.43981, with most research data points evenly distributed at the bottom of the funnel and uniformly distributed on both sides of the vertical line. In the Galbraith plot, most research data points were uniformly scattered above and below the black horizontal line. These findings indicate the absence of publication bias in this meta-analysis.

Sensitivity Analysis

By comparing the outcomes of the fixed effects and random effects models for sensitivity analysis, as illustrated in Fig. 10, we observed that the analyses of various research indicators showed a general agreement between the two models. This finding suggests the robustness of the results. An RR (95% CI) of 1.00 [0.98; 1.03] indicated the absence of markedly sensitive articles.

Discussion

Uterine prolapse (UP), which typically occurs postpartum or during menopause, is a common gynecological issue in females. It involves the downward displacement of the uterus, possibly protruding into the vagina. This condition may result in discomfort, pain, and other physical inconveniences that significantly affect a patient's quality of life. Treatment methods for UP include conservative and surgical intervention. Surgical approaches usually involve uterine preservation or removal, each of which has its advantages and limitations. Some published studies have suggested that uterine preservation and uterine removal methods effectively address UP [41, 49, 50, 51]. However, a definitive conclusion is lacking, and further research is needed to assess their relative merits.

This meta-analysis involved 40 articles covering the surgical methods for 25,896 patients with UP, including uterine preservation and removal. We thoroughly screened and analyzed these publications to assess the comparative outcomes of different surgical approaches for treating UP. Our

Study or Subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio MH, Random, 95% CI
Study_category = retrospective						
Thys et al, 2011	78	98	74	98	1.2%	1.05 [0.91; 1.23]
Zhu et al, 2021	47	50	47	50	2.0%	1.00 [0.91; 1.10]
Wang et al, 2022	64	69	41	48	1.4%	1.09 [0.95; 1.24]
Yan et al, 2023	92	95	259	277	3.2%	1.04 [0.99; 1.09]
Yan et al, 2023	108	111	259	277	3.3%	1.04 [1.00; 1.09]
Sukur et al, 2020	67	86	37	46	0.9%	0.97 [0.81; 1.16]
Bedford et al, 2013	141	160	86	104	1.9%	1.07 [0.96; 1.18]
Bedford et al, 2013	111	160	63	104	0.9%	1.15 [0.95; 1.38]
Stanford et al, 2015	59	61	51	51	3.3%	0.97 [0.92; 1.01]
Stanford et al, 2015	28	29	51	51	2.7%	0.97 [0.90; 1.03]
Al−Badr et al, 2017	22	26	10	24	0.1%	2.03 [1.23; 3.35]
Romanzi et al, 2012	91	100	86	100	2.0%	1.06 [0.96; 1.17]
Campagna et al, 2022	54	58	68	78	1.8%	1.07 [0.96; 1.19]
Campagna et al, 2022	51	58	66	78	1.4%	1.04 [0.91; 1.19]
Pan et al, 2016	30	34	47	65	0.8%	1.22 [1.00; 1.48]
Lone et al, 2018	76	81	32	44	0.9%	1.29 [1.07; 1.56]
Haj−Yahya et al, 2020	100	106	51	53	2.6%	0.98 [0.91; 1.05]
Lo et al, 2015	86	120	13	26	0.2%	1.43 [0.96; 2.14]
Li et al, 2020	12	12	11	11	1.0%	1.00 [0.85; 1.18]
Gagyor et al, 2021	243	251	39	43	2.0%	1.07 [0.97; 1.18]
Yuan et al, 2021	184	260	117	130	2.0%	0.79 [0.71; 0.87]
Forde et al, 2017	886	921	653	680	3.8%	1.00 [0.98; 1.02]
Forde et al, 2017	861	921	637	680	3.7%	1.00 [0.97; 1.02]
Forde et al, 2017	772	921	597	680	3.4%	0.95 [0.92; 0.99]
Chughtai et al, 2018	441	455	434	455	3.7%	1.02 [0.99; 1.04]
Chughtai et al, 2018	425	455	425	455	3.6%	1.00 [0.97; 1.04]
Chughtai et al, 2018	412	455	400	455	3.3%	1.03 [0.98; 1.08]
van et al, 2003	28	30	39	44	1.3%	1.05 [0.91; 1.21]
Carlin et al, 2023	82	96	85	96	1.8%	0.96 [0.86; 1.08]
Chou et al, 2021	8	16	58	66	0.2%	0.57 [0.35; 0.94]
Chou et al, 2021	6	11	23	26	0.1%	0.62 [0.35; 1.08]
Plair et al, 2021	90	97	46	50	2.0%	1.01 [0.91; 1.11]
McDermott et al, 2011	20	24	57	65	0.8%	0.95 [0.78; 1.16]
Husby et al, 2019	3645	4045	2615	2786	3.9%	0.96 [0.95; 0.97]
Husby et al, 2019	3645	4045	326	416	3.1%	1.15 [1.09; 1.21]
Mao et al, 2023	44	60	35	45	0.7%	0.94 [0.76; 1.17]
Mao et al, 2023	52	60	42	45	1.5%	0.93 [0.82; 1.05]
Mao et al, 2023	50	60	40	45	1.2%	0.94 [0.80; 1.09]
Milani et al, 2020	38	52	39	52	0.6%	0.97 [0.78; 1.22]
Total (95% CI)		14749		8899	74.4%	1.01 [0.98; 1.04]
Heterogeneity: $Tau^2 = 0.0029$; $Chi^2 = 141.14$, df = 38 ($P < 0.01$); $I^2 = 73\%$						
Study_category = prospective						
Chang et al, 2023	28	28	31	31	2.8%	1.00 [0.94; 1.07]
Gracia et al, 2015	30	30	15	15	1.9%	1.00 [0.90; 1.11]
Gracia et al, 2015	30	30	15	15	1.9%	1.00 [0.90; 1.11]
Illiano et al, 2020	82	82	54	54	3.6%	1.00 [0.97; 1.03]
Ker et al, 2018	30	30	64	66	3.4%	1.03 [0.99; 1.08]
Arcieri et al, 2023	42	44	39	44	1.6%	1.08 [0.95; 1.22]
Bowen et al, 2023	19	41	29	41	0.2%	0.66 [0.45; 0.96]
Total (95% CI)		285		266	15.4%	1.01 [0.98; 1.04]
Heterogeneity: $Tau^2 = < 0.0001$; $Chi^2 = 7.38$, df = 6 ($P = 0.29$); $I^2 = 19\%$						
Study_category = randomized						
Nager et al, 2021	66	87	75	88	1.2%	0.89 [0.77; 1.03]
Nager et al, 2021	55	83	60	79	0.8%	0.87 [0.72; 1.06]
Nager et al, 2021	47	80	54	78	0.6%	0.85 [0.67; 1.07]
Nager et al, 2021	40	79	50	76	0.5%	0.77 [0.59; 1.01]
Nager et al, 2021	36	78	50	79	0.4%	0.73 [0.54; 0.98]
Nager et al, 2019	24	87	27	88	0.2%	0.90 [0.57; 1.43]
Rogers et al, 2022	40	87	34	88	0.3%	1.19 [0.84; 1.69]
Izett−Kay et al, 2022	22	29	28	33	0.5%	0.89 [0.70; 1.15]
Dietz et al, 2010	30	31	26	35	0.8%	1.30 [1.06; 1.60]
Detollenaere et al, 2015	101	105	103	103	3.5%	0.96 [0.93; 1.00]
Schulten et al. , 2019	77	102	89	102	1.4%	0.87 [0.76; 0.99]
Total (95% CI)		848		849	10.2%	0.92 [0.83; 1.02]
Heterogeneity: $Tau^2 = 0.0106$; $Chi^2 = 21.09$, df = 10 ($P = 0.02$); $I^2 = 53\%$						
Total (95% CI)		**15882**		**10014**	**100.0%**	**1.00 [0.98; 1.03]**
Heterogeneity: $Tau^2 = 0.0025$; $Chi^2 = 179.10$, df = 56 ($P < 0.01$); $I^2 = 69\%$						
Test for subgroup differences: $Chi^2 = 3.78$, df = 2 ($P = 0.15$)						

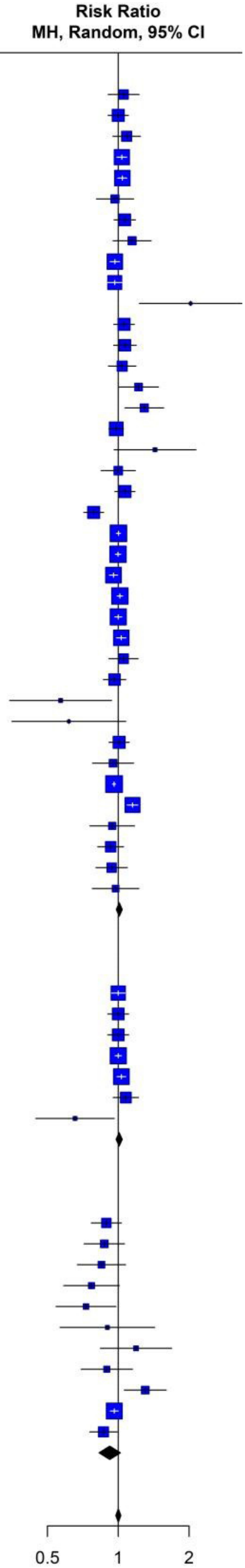

Fig. 3. Subgroup analysis. MH, Mantel-Haenszel; CI, confidence intervals.

Study	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio MH, Random, 95% CI
Thys et al, 2011	78	98	74	98	1.2%	1.05 [0.91; 1.23]
Zhu et al, 2021	47	50	47	50	2.0%	1.00 [0.91; 1.10]
Wang et al, 2022	64	69	41	48	1.4%	1.09 [0.95; 1.24]
Chang et al, 2023	28	28	31	31	2.8%	1.00 [0.94; 1.07]
Gracia et al, 2015	30	30	15	15	1.9%	1.00 [0.90; 1.11]
Gracia et al, 2015	30	30	15	15	1.9%	1.00 [0.90; 1.11]
Illiano et al, 2020	82	82	54	54	3.6%	1.00 [0.97; 1.03]
Yan et al, 2023	92	95	259	277	3.2%	1.04 [0.99; 1.09]
Yan et al, 2023	108	111	259	277	3.3%	1.04 [1.00; 1.09]
Sukur et al, 2020	67	86	37	46	0.9%	0.97 [0.81; 1.16]
Ker et al, 2018	30	30	64	66	3.4%	1.03 [0.99; 1.08]
Nager et al, 2021	66	87	75	88	1.2%	0.89 [0.77; 1.03]
Nager et al, 2021	55	83	60	79	0.8%	0.87 [0.72; 1.06]
Nager et al, 2021	47	80	54	78	0.6%	0.85 [0.67; 1.07]
Nager et al, 2021	40	79	50	76	0.5%	0.77 [0.59; 1.01]
Nager et al, 2021	36	78	50	79	0.4%	0.73 [0.54; 0.98]
Bedford et al, 2013	141	160	86	104	1.9%	1.07 [0.96; 1.18]
Bedford et al, 2013	111	160	63	104	0.9%	1.15 [0.95; 1.38]
Nager et al, 2019	24	87	27	88	0.2%	0.90 [0.57; 1.43]
Stanford et al, 2015	59	61	51	51	3.3%	0.97 [0.92; 1.01]
Stanford et al, 2015	28	29	51	51	2.7%	0.97 [0.90; 1.03]
Al−Badr et al, 2017	22	26	10	24	0.1%	2.03 [1.23; 3.35]
Romanzi et al, 2012	91	100	86	100	2.0%	1.06 [0.96; 1.17]
Rogers et al, 2022	40	87	34	88	0.3%	1.19 [0.84; 1.69]
Campagna et al, 2022	54	58	68	78	1.8%	1.07 [0.96; 1.19]
Campagna et al, 2022	51	58	66	78	1.4%	1.04 [0.91; 1.19]
Pan et al, 2016	30	34	47	65	0.8%	1.22 [1.00; 1.48]
Izett−Kay et al, 2022	22	29	28	33	0.5%	0.89 [0.70; 1.15]
Lone et al, 2018	76	81	32	44	0.9%	1.29 [1.07; 1.56]
Haj−Yahya et al, 2020	100	106	51	53	2.6%	0.98 [0.91; 1.05]
Lo et al, 2015	86	120	13	26	0.2%	1.43 [0.96; 2.14]
Dietz et al, 2010	30	31	26	35	0.8%	1.30 [1.06; 1.60]
Li et al, 2020	12	12	11	11	1.0%	1.00 [0.85; 1.18]
Gagyor et al, 2021	243	251	39	43	2.0%	1.07 [0.97; 1.18]
Yuan et al, 2021	184	260	117	130	2.0%	0.79 [0.71; 0.87]
Forde et al, 2017	886	921	653	680	3.8%	1.00 [0.98; 1.02]
Forde et al, 2017	861	921	637	680	3.7%	1.00 [0.97; 1.02]
Forde et al, 2017	772	921	597	680	3.4%	0.95 [0.92; 0.99]
Chughtai et al, 2018	441	455	434	455	3.7%	1.02 [0.99; 1.04]
Chughtai et al, 2018	425	455	425	455	3.6%	1.00 [0.97; 1.04]
Chughtai et al, 2018	412	455	400	455	3.3%	1.03 [0.98; 1.08]
Arcieri et al, 2023	42	44	39	44	1.6%	1.08 [0.95; 1.22]
van et al, 2003	28	30	39	44	1.3%	1.05 [0.91; 1.21]
Carlin et al, 2023	82	96	85	96	1.8%	0.96 [0.86; 1.08]
Detollenaere et al, 2015	101	105	103	103	3.5%	0.96 [0.93; 1.00]
Schulten et al. , 2019	77	102	89	102	1.4%	0.87 [0.76; 0.99]
Chou et al, 2021	8	16	58	66	0.2%	0.57 [0.35; 0.94]
Chou et al, 2021	6	11	23	26	0.1%	0.62 [0.35; 1.08]
Plair et al, 2021	90	97	46	50	2.0%	1.01 [0.91; 1.11]
McDermott et al, 2011	20	24	57	65	0.8%	0.95 [0.78; 1.16]
Husby et al, 2019	3645	4045	2615	2786	3.9%	0.96 [0.95; 0.97]
Husby et al, 2019	3645	4045	326	416	3.1%	1.15 [1.09; 1.21]
Mao et al, 2023	44	60	35	45	0.7%	0.94 [0.76; 1.17]
Mao et al, 2023	52	60	42	45	1.5%	0.93 [0.82; 1.05]
Mao et al, 2023	50	60	40	45	1.2%	0.94 [0.80; 1.09]
Milani et al, 2020	38	52	39	52	0.6%	0.97 [0.78; 1.22]
Bowen et al, 2023	19	41	29	41	0.2%	0.66 [0.45; 0.96]
Total (95% CI)		**15882**		**10014**	**100.0%**	**1.00 [0.98; 1.03]**

Heterogeneity: $Tau^2 = 0.0025$; $Chi^2 = 179.10$, df = 56 ($P < 0.01$); $I^2 = 69\%$

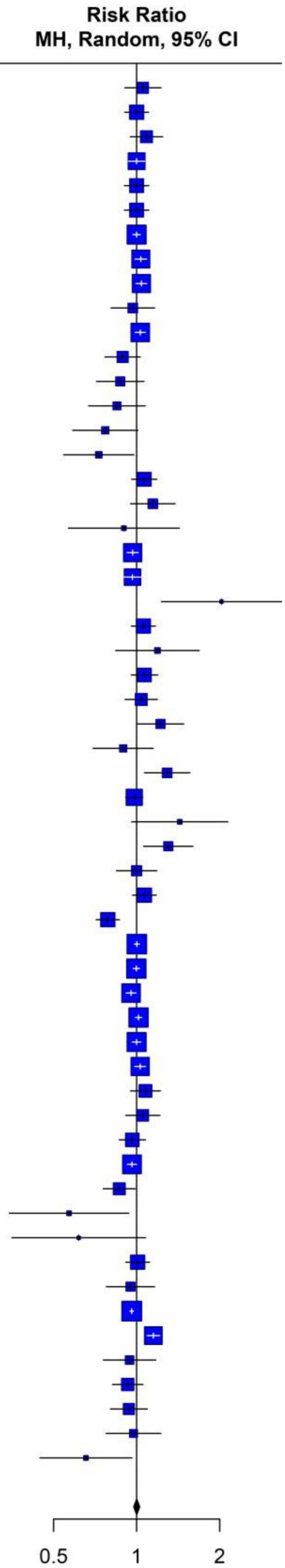

Fig. 4. Meta-analysis forest map comparing the success rate of the different surgical methods. Note: The success rate is the objective success rate.

Study	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Thys et al, 2011	101.00	22.0000	98	67.00	20.0000	98	4.2%	1.61 [1.29; 1.93]
Wang et al, 2022	110.45	31.7200	69	62.91	25.6300	48	4.0%	1.61 [1.18; 2.03]
Yan et al, 2023	138.00	24.3000	95	104.00	30.5000	277	4.3%	1.17 [0.92; 1.42]
Yan et al, 2023	129.00	31.6000	111	104.00	30.5000	277	4.3%	0.81 [0.58; 1.04]
Ker et al, 2018	78.00	16.0000	30	46.00	20.6000	66	3.9%	1.64 [1.15; 2.14]
Bedford et al, 2013	140.00	36.7000	160	120.00	37.5000	104	4.3%	0.54 [0.29; 0.79]
Bedford et al, 2013	140.00	36.7000	160	120.00	37.5000	104	4.3%	0.54 [0.29; 0.79]
Nager et al, 2019	156.70	43.9000	87	111.50	39.7000	88	4.2%	1.08 [0.76; 1.39]
Campagna et al, 2022	150.00	37.5000	58	120.00	30.0000	78	4.1%	0.89 [0.54; 1.25]
Campagna et al, 2022	150.00	37.5000	58	120.00	30.0000	78	4.1%	0.89 [0.54; 1.25]
Pan et al, 2016	128.41	39.7400	34	95.91	36.6300	65	4.0%	0.86 [0.42; 1.29]
Lo et al, 2015	65.40	15.8000	120	48.80	12.9000	26	4.0%	1.08 [0.63; 1.52]
Li et al, 2020	176.00	13.5000	12	154.00	12.8000	11	2.9%	1.61 [0.65; 2.57]
Gagyor et al, 2021	125.00	30.0000	251	120.00	25.8000	43	4.2%	0.17 [−0.15; 0.49]
Yuan et al, 2021	144.00	35.5000	260	96.00	27.5000	130	4.3%	1.45 [1.22; 1.68]
Arcieri et al, 2023	180.00	14.0000	44	175.00	33.3000	44	4.0%	0.19 [−0.22; 0.61]
Carlin et al, 2023	95.00	62.0000	96	65.00	48.0000	96	4.2%	0.54 [0.25; 0.83]
Detollenaere et al, 2015	72.00	21.0000	105	59.00	13.0000	103	4.2%	0.74 [0.46; 1.02]
Chou et al, 2021	176.60	99.2000	16	97.30	20.4000	66	3.6%	1.68 [1.07; 2.29]
Chou et al, 2021	153.70	53.9000	11	99.40	22.5000	26	3.2%	1.54 [0.74; 2.34]
McDermott et al, 2011	127.00	45.0000	24	127.00	33.0000	65	3.9%	0.00 [−0.47; 0.47]
Mao et al, 2023	129.60	40.4000	60	120.20	37.1000	45	4.1%	0.24 [−0.15; 0.63]
Mao et al, 2023	129.60	40.4000	60	120.20	37.1000	45	4.1%	0.24 [−0.15; 0.63]
Mao et al, 2023	129.60	40.4000	60	120.20	37.1000	45	4.1%	0.24 [−0.15; 0.63]
Milani et al, 2020	77.00	20.0000	52	113.00	29.0000	52	4.0%	−1.43 [−1.87; −1.00]
Total (95% CI)			**2131**			**2080**	**100.0%**	**0.78 [0.49; 1.07]**

Heterogeneity: $Tau^2 = 0.4413$; $Chi^2 = 278.35$, df = 24 (P < 0.01); $I^2 = 91\%$

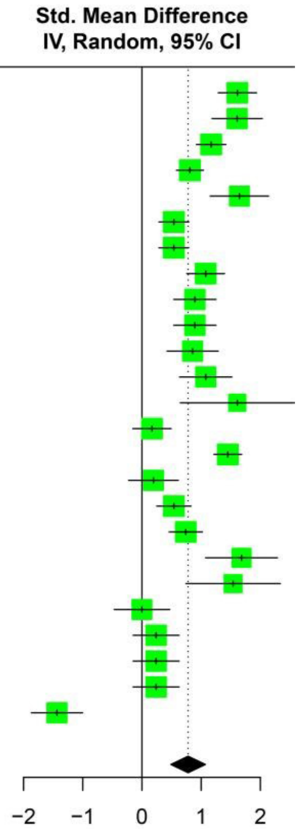

Fig. 5. Meta-analysis forest map on comparing the duration of different surgical methods. SD, Standard Deviation.

Study	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Thys et al, 2011	358.00	235.0000	98	250.00	210.0000	98	3.9%	0.48 [0.20; 0.77]
Wang et al, 2022	138.77	50.2600	69	73.61	35.0500	48	3.9%	1.45 [1.04; 1.86]
Yan et al, 2023	100.00	25.0000	95	50.00	28.3000	277	3.9%	1.81 [1.55; 2.08]
Yan et al, 2023	100.00	21.7000	111	50.00	28.3000	277	3.9%	1.88 [1.62; 2.13]
Ker et al, 2018	36.70	18.1000	30	18.50	6.9000	66	3.9%	1.56 [1.07; 2.05]
Bedford et al, 2013	50.00	160.0000	160	50.00	116.0000	104	3.9%	0.00 [−0.25; 0.25]
Bedford et al, 2013	50.00	160.0000	160	50.00	116.0000	104	3.9%	0.00 [−0.25; 0.25]
Stanford et al, 2015	50.00	50.0000	61	50.00	48.0000	51	3.9%	0.00 [−0.37; 0.37]
Stanford et al, 2015	50.00	50.0000	29	50.00	48.0000	51	3.9%	0.00 [−0.46; 0.46]
Al−Badr et al, 2017	382.70	203.4000	26	360.40	143.7000	24	3.8%	0.12 [−0.43; 0.68]
Campagna et al, 2022	30.00	24.0000	58	30.00	18.0000	78	3.9%	0.00 [−0.34; 0.34]
Campagna et al, 2022	30.00	24.0000	58	30.00	18.0000	78	3.9%	0.00 [−0.34; 0.34]
Pan et al, 2016	86.77	38.7500	34	52.77	31.0500	65	3.9%	1.00 [0.56; 1.43]
Lo et al, 2015	105.20	90.3000	120	79.60	64.8000	26	3.9%	0.29 [−0.13; 0.72]
Li et al, 2020	54.40	4.5000	12	64.10	8.9000	11	3.7%	−1.34 [−2.27; −0.42]
Gagyor et al, 2021	200.00	125.0000	251	150.00	225.0000	43	3.9%	0.35 [0.02; 0.67]
Yuan et al, 2021	150.00	99.0000	260	50.00	30.8000	130	3.9%	1.21 [0.98; 1.43]
Arcieri et al, 2023	30.00	33.3000	44	30.00	33.3000	44	3.9%	0.00 [−0.42; 0.42]
Detollenaere et al, 2015	209.00	112.0000	105	202.00	74.0000	103	3.9%	0.07 [−0.20; 0.35]
Chou et al, 2021	114.70	82.5000	16	85.80	89.1000	66	3.8%	0.33 [−0.22; 0.87]
Chou et al, 2021	112.30	84.9000	11	68.70	85.2000	26	3.8%	0.50 [−0.21; 1.22]
McDermott et al, 2011	164.00	141.0000	24	177.00	124.0000	65	3.9%	−0.10 [−0.57; 0.37]
Mao et al, 2023	70.00	5.0000	60	40.00	2.5000	45	3.7%	7.23 [6.16; 8.29]
Mao et al, 2023	70.00	5.0000	60	40.00	2.5000	45	3.7%	7.23 [6.16; 8.29]
Mao et al, 2023	70.00	5.0000	60	40.00	2.5000	45	3.7%	7.23 [6.16; 8.29]
Milani et al, 2020	203.00	130.0000	52	342.00	187.0000	52	3.9%	−0.86 [−1.26; −0.45]
Total (95% CI)			**2064**			**2022**	**100.0%**	**1.14 [0.21; 2.07]**

Heterogeneity: $Tau^2 = 5.0950$; $Chi^2 = 871.94$, df = 25 (P < 0.01); $I^2 = 97\%$

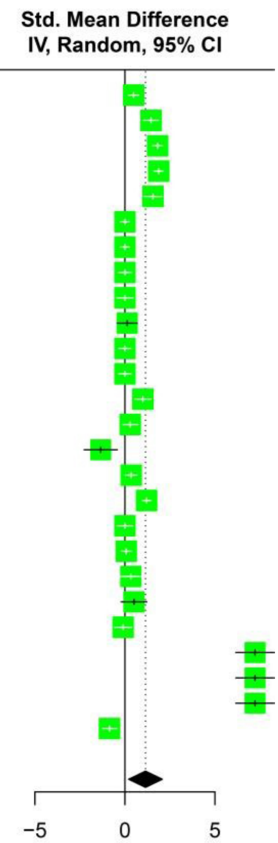

Fig. 6. Meta-analysis forest map on comparing blood loss of different surgical methods.

Study	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk Ratio MH, Random, 95% CI
Thys et al, 2011	4	98	4	98	2.7%	1.00 [0.26; 3.89]
Wang et al, 2022	3	69	4	48	2.3%	0.52 [0.12; 2.23]
Yan et al, 2023	0	95	0	277	0.0%	
Yan et al, 2023	0	111	0	277	0.0%	
Bedford et al, 2013	0	160	1	104	0.5%	0.22 [0.01; 5.28]
Bedford et al, 2013	0	160	1	104	0.5%	0.22 [0.01; 5.28]
Nager et al, 2019	0	87	0	88	0.0%	
Stanford et al, 2015	3	61	7	51	2.9%	0.36 [0.10; 1.32]
Stanford et al, 2015	3	29	7	51	3.0%	0.75 [0.21; 2.69]
Romanzi et al, 2012	9	100	6	100	4.9%	1.50 [0.55; 4.06]
Campagna et al, 2022	1	58	2	78	0.9%	0.67 [0.06; 7.24]
Campagna et al, 2022	1	58	2	78	0.9%	0.67 [0.06; 7.24]
Pan et al, 2016	4	34	6	65	3.4%	1.27 [0.39; 4.21]
Lo et al, 2015	7	120	1	26	1.2%	1.52 [0.19; 11.80]
Gagyor et al, 2021	15	251	4	43	4.4%	0.64 [0.22; 1.84]
Yuan et al, 2021	28	260	3	130	3.6%	4.67 [1.45; 15.06]
Forde et al, 2017	22	921	11	680	9.5%	1.48 [0.72; 3.02]
Forde et al, 2017	22	921	11	680	9.5%	1.48 [0.72; 3.02]
Forde et al, 2017	22	921	11	680	9.5%	1.48 [0.72; 3.02]
Chughtai et al, 2018	22	455	11	455	9.6%	2.00 [0.98; 4.08]
Chughtai et al, 2018	22	455	11	455	9.6%	2.00 [0.98; 4.08]
Chughtai et al, 2018	22	455	11	455	9.6%	2.00 [0.98; 4.08]
Arcieri et al, 2023	0	44	1	44	0.5%	0.33 [0.01; 7.96]
van et al, 2003	3	30	3	44	2.1%	1.47 [0.32; 6.78]
Detollenaere et al, 2015	1	105	1	103	0.6%	0.98 [0.06; 15.47]
Plair et al, 2021	7	97	2	50	2.1%	1.80 [0.39; 8.36]
McDermott et al, 2011	1	24	4	65	1.1%	0.68 [0.08; 5.76]
Milani et al, 2020	7	52	7	52	5.1%	1.00 [0.38; 2.65]
Total (95% CI)		**6231**		**5381**	**100.0%**	**1.37 [1.10; 1.71]**

Heterogeneity: $Tau^2 = 0$; $Chi^2 = 21.48$, df = 24 (P = 0.61); $I^2 = 0\%$

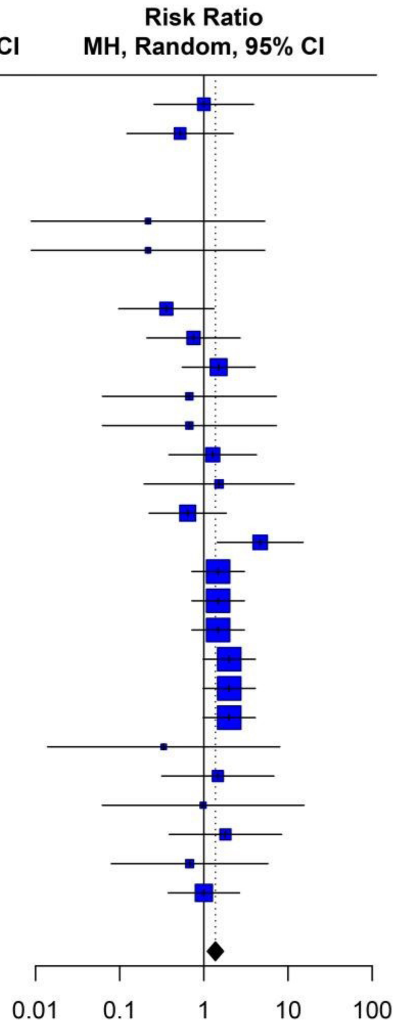

Fig. 7. Meta-analysis forest map on comparing intraoperative adverse reactions of different surgical modalities.

meta-analysis results regarding success rates indicated that the surgical methods of uterine preservation and removal did not significantly affect the success rate, with a risk ratio (RR) of 1.00 [0.98; 1.03]. This suggests that the choice between preserving or not preserving the uterus during UP treatment does not result in a significant difference in success rates. However, there were some differences between the different surgical methods regarding surgical duration, intraoperative blood loss, and intraoperative and postoperative adverse reactions. Specifically, compared to the surgical approach of uterine preservation, uterine removal showed significantly higher values in terms of surgical duration and intraoperative blood loss. Previous studies have argued that keeping the uterus during surgery may help reduce the operation time [29, 52]. A review article noted that in the comparison of vaginal hysterectomy, the procedure of preserving the uterus is linked to shorter operation duration, reduced hospital stay, and less bleeding [53]. Additionally, the incidence of adverse reactions during surgery was notably higher with hysterectomy than with uterine preservation. However, regarding postoperative adverse reactions, the meta-analysis results indicated that different surgical methods did not significantly affect postoperative adverse reactions.

Assessing the meta-analysis model, we thoroughly evaluated the publication bias and sensitivity. Our findings indicated that the meta-analysis was not influenced by publication bias, and the sensitivity analysis results were robust, confirming the reliability of the study outcomes. Overall, this meta-analysis offers valuable insights on comparing UP surgical approaches. Despite significant differences in some indicators among the various surgical methods, no noticeable differences were observed regarding the success rates. However, this study still has some limitations that must be considered and addressed in result interpretation and future study designs. The results of this study are based on published literature, which may introduce publication bias and may only cover some relevant studies, potentially leading to an incomplete assessment of the efficacy of different surgical methods. Different studies may use different definitions, criteria, and surgical techniques when comparing surgical methods, potentially resulting in methodologi-

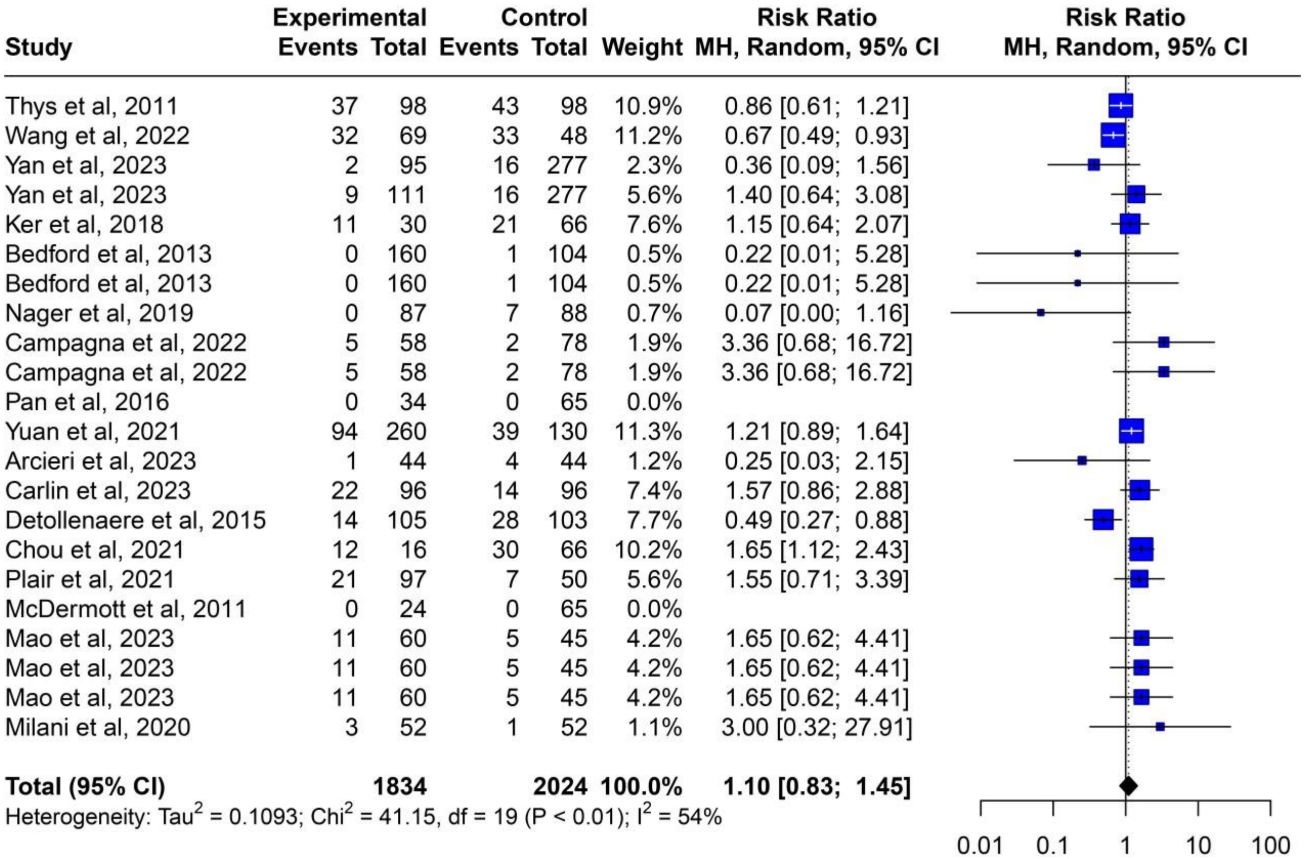

Fig. 8. Meta-analysis forest map of postoperative adverse reactions of different surgical methods.

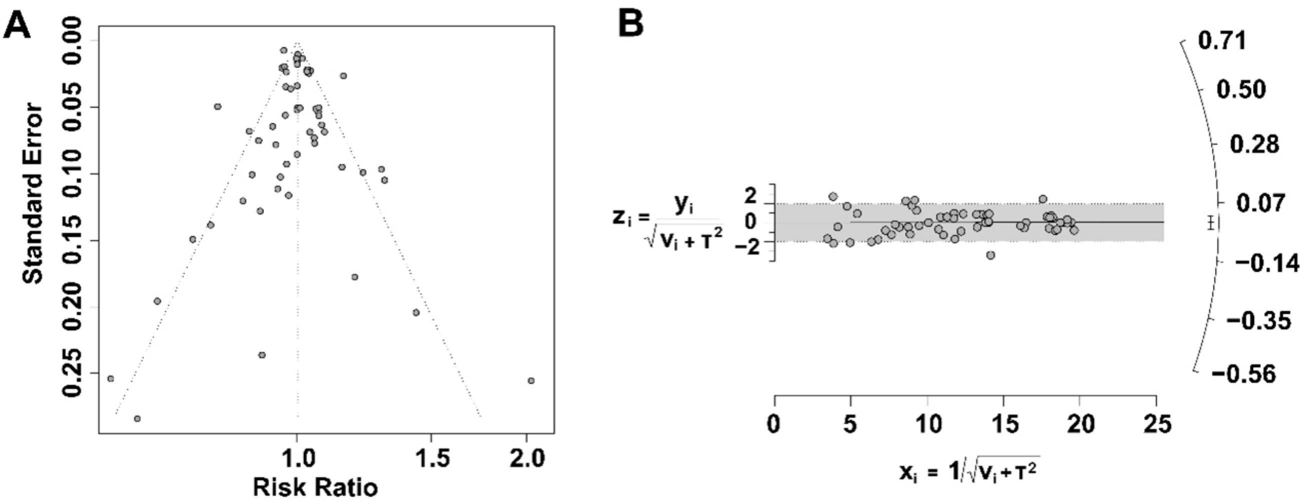

Fig. 9. Potential publication bias. (A) Funnel Plot: X-axis represents the effect size (natural logarithm); Y-axis represents the standard error (SE) of the effect size; each point, uniform in size, represents an individual study; the funnel consists of three lines, with the vertical line indicating the position of the combined effect size on the X-axis and the two diagonal lines representing the 95% confidence intervals (CI). Visual inspection of whether included studies are symmetrically distributed around the combined effect size on the funnel plot helps identify publication bias—an asymmetric funnel plot suggests potential bias, while a symmetric distribution indicates no publication bias. (B) Galbraith Plot: X-axis measures the study size with the reciprocal of the standard error of the effect size; Y-axis represents the standardized effect size; each uniformly sized point signifies an individual study; three horizontal lines are present, with the central black line indicating the fixed-effect combined value, and the two outer lines representing its 95% CI; theoretically, if there is no heterogeneity or publication bias, approximately 5% of studies should fall outside the two 95% CI lines.

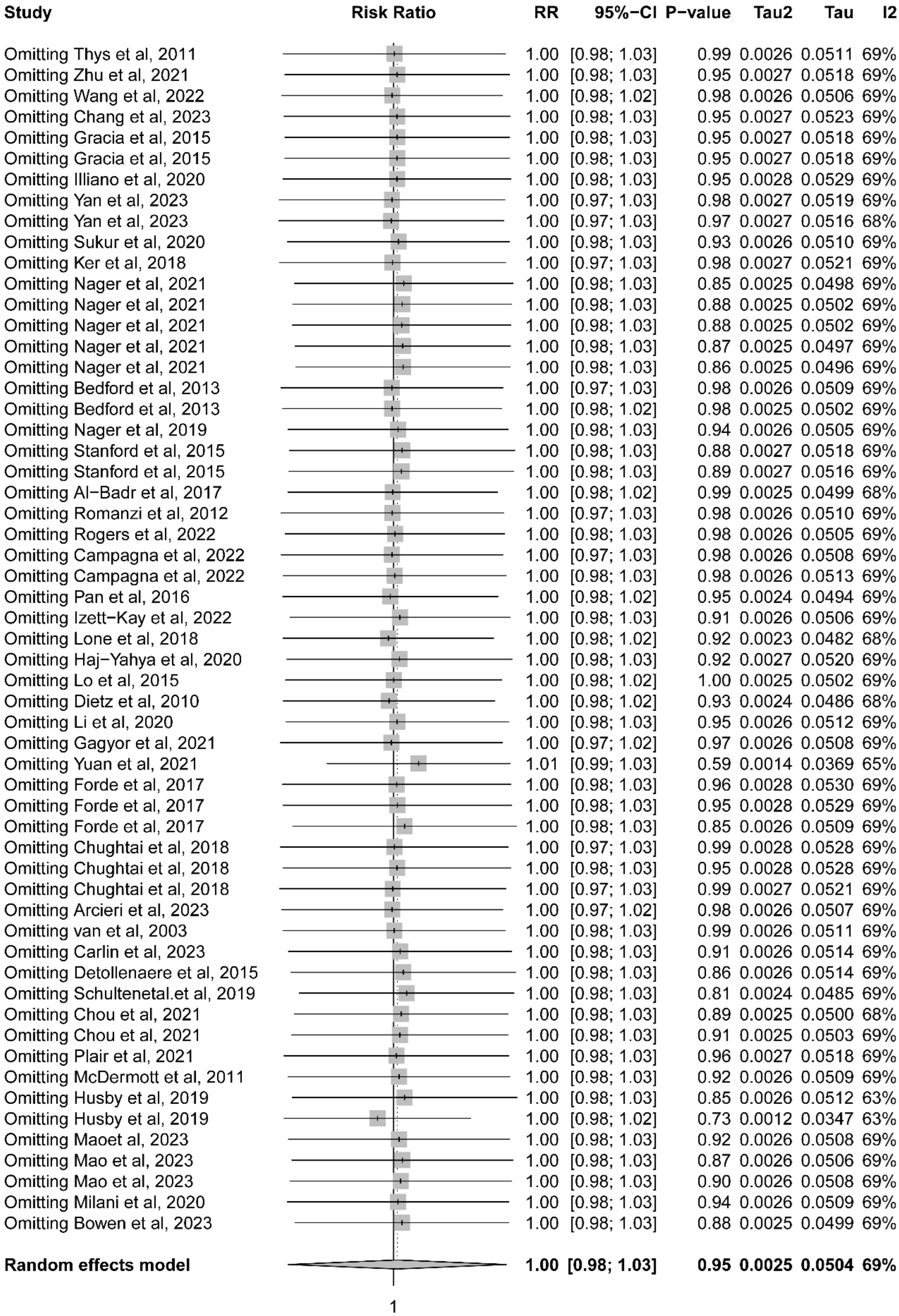

Fig. 10. Sensitivity analysis results.

cal heterogeneity that could affect the consistency and comparability of results. Although this study found that hysterectomy and uterine fixation showed similar performance in terms of surgical success rate and postoperative adverse events in the treatment of uterine prolapse, the interpretation of the results may be limited due to limitations. There was high data heterogeneity in the analysis of some results, which may be influenced by differences between studies and inconsistencies in data reporting, thus requiring cautious interpretation of the results. A literature search was conducted until October 2023 and may not include the latest research findings, potentially leading to an inadequate understanding of the latest developments in this field.

Conclusions

Regarding UP treatment, there is no obvious difference in the surgical success rate or postoperative adverse reactions between uterine removal surgery and uterine fixation surgery. However, uterine removal surgery tends to result in longer operation duration, increased blood loss, and higher occurrence of adverse reactions during surgery than uterine fixation surgery. Thus, when selecting a treatment method for UP, doctors and patients should meticulously assess these factors, carefully evaluate the pros and cons, and formulate a treatment plan tailored to the individual's specific circumstances.

Availability of Data and Materials

Data to support the findings of this study are available on reasonable request from the corresponding author.

Author Contributions

HXC and XMW conceived, designed, and performed the experiments, and wrote the initial draft. NK and SY analyzed and interpreted the data, and provided analytical tools. All authors revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

Acknowledgment

Not applicable.

Funding

This study was supported by the National Key Research and Development Program of China (No. 2021YFC2009100, 2021YFC2009105).

Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.62713/aic.3385.

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