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REVIEW ARTICLE

Prevalence of Surgical Site Infection After Hip Arthroplasty; a Systematic Review and Meta-Analysis

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Abstract: **Introduction:** One of the worrisome complications of hip arthroplasty is surgical site infection (SSI). This study aimed to investigate the prevalence of SSI after hip arthroplasty. **Methods:** A comprehensive and systematic exploration was conducted across various international electronic databases, including Scopus, PubMed, and Web of Science, alongside Persian electronic databases such as Iranmedex and the Scientific Information Database (SID). This search strategy entailed the utilization of Medical Subject Headings-derived keywords such as "Prevalence," "Surgical wound infection," "Surgical site infection," and "Arthroplasty," spanning from the earliest records up to January 1, 2024. Each study's weight was assigned based on its inverse variance. A forest plot visualization was used to assess the studies' heterogeneity. Data on sample size and SSI frequency were compiled for each study to calculate the overall effect size. **Results:** The study encompassed a cumulative participant cohort of 1,070,638 hip arthroplasty procedures drawn from seventeen selected studies. Notably, the female gender constituted 59.10% of the overall participant demographic. The aggregate SSI among patients undergoing hip arthroplasty was estimated to be 1.9% (95% CI: 1.3% to 2.8%; I2=99.688%; P<0.001). The results of the meta-regression analysis unveiled a statistically significant correlation between the prevalence of SSIs after hip arthroplasty and the year of publication (Coefficient=-0.0020; 95% CI: -0.0021 to -0.0018; Z=-19.39, P<0.001). **Conclusions:** The study findings indicated a prevalence rate of 1.9% for SSI following hip arthroplasty. This prevalence underscores the importance of vigilance in infection prevention and management strategies within orthopedic surgery. However, it is essential to acknowledge the variability in SSI prevalence observed across diverse studies, which can be attributed to multifaceted factors, notably variances in patient populations and associated risk factors.

Keywords: Prevalence; Surgical wound infection; Surgical site infection; Arthroplasty; Meta-analysis

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1. Introduction

Hip arthroplasty, commonly referred to as total hip replacement, constitutes a surgical intervention intended to substitute a compromised or diseased hip articulation with an artificial joint, recognized as a prosthesis (1, 2). The rate of hip arthroplasty in the United States, Switzerland, and Germany has been 200 per 100,000 population, annually. In addition, the rates of hip arthroplasty in Spain and Mexico were 102

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and 8 per 100,000 population, respectively (3). It is predicted that the rate of hip arthroplasty in the world will increase by 176% and 659% by 2040 and 2060, respectively (4). Treatment options for individuals with femoral neck fractures typically involve hip arthroplasty or internal fixation procedures. Hemiarthroplasty and total hip arthroplasty are commonly used surgical interventions for fractures that are displaced.

Hemiarthroplasty is favored over total hip arthroplasty due to its shorter surgical duration, reduced blood loss, lower dislocation rates, and initial cost savings. However, a potential complication following Hemiarthroplasty is acetabular erosion, which can impact long-term patient satisfaction. Total hip arthroplasty may be considered for elderly patients with displaced femoral neck fractures who have high activity levels and minimal comorbidities. Nevertheless, there is a lack of clear criteria to determine what constitutes high activity and low comorbidity in this context (5). Hence, one of the worrisome complications of hip arthroplasty is surgical site infection (SSI). SSI denotes an infectious complication that manifests after surgical intervention, localized within the anatomical region subjected to the operative procedure (6, 7). SSIs exhibit a spectrum of severity, spanning from superficial infections affecting the dermal and subcutaneous layers to more profound infections implicating internal organs or incorporating implanted materials (8). The commencement of SSI is contingent upon various determinants including the surgical modality, microbial pathogenicity, and the systemic health condition of the patient (9, 10). Conventionally, SSIs may manifest within a timeframe spanning from days to weeks after the surgical procedure (11). SSI after hip arthroplasty constitutes a notable apprehension within orthopedic surgery owing to its propensity to engender considerable morbidity, augmented healthcare expenditures, and protracted durations of hospitalization (12, 13). As indicated by certain reports, it is anticipated that the incidence of SSI following hip arthroplasty will escalate by approximately 2% to 6.5% in the forthcoming decades, thereby resulting in a commensurate rise in overall expenses associated with therapeutic interventions (14, 15). A study examining the incidence of SSI following hip arthroplasty in Germany revealed a prevalence of 0.77% (16). Conversely, a similar investigation conducted in Italy reported a prevalence rate of 3.17% for SSI after hip arthroplasty (14). Additionally, research conducted in Serbia demonstrated a prevalence of 7.84% for SSI following the same procedure (17). Also, the results of another study showed that 9.49% of people suffer from SSI after hip arthroplasty (18). Based on the findings acquired, a synopsis is warranted concerning the prevalence of SSI after hip arthroplasty.

Investigating the prevalence of SSI after hip arthroplasty constitutes a significant endeavor aimed at consolidating extant evidence, elucidating clinical practices, enhancing patient outcomes, and advancing the collective understanding within the realms of orthopedic surgery and infection control. Therefore, this systematic review and meta-analysis aimed to investigate the prevalence of SSI after hip arthroplasty.

2. Research questions

• What is the prevalence of SSI in patients after hip arthroplasty?
• What is the prevalence of SSI in patients after hip arthroplasty based on gender?
• What is the prevalence of SSI in patients after hip arthroplasty during different years?

3. Methods

This systematic review and meta-analysis adhered to the PRISMA checklist, ensuring compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (19). The current review was not listed in the database of the International Prospective Register of Systematic Reviews (PROSPERO).

3.1. Patient/population, Exposure, and Outcomes (PEO) framework

The PEO framework was used to clarify the purpose of the study. Accordingly, population (patients after hip arthroplasty), exposure (SSI), and outcome (Prevalence of SSI), were included in the systematic review and meta-analysis (Table 1).

3.2. Search strategy

A comprehensive and systematic exploration was conducted across various international electronic databases, including Scopus, PubMed, and Web of Science, alongside Persian electronic databases such as Iranmedex and the Scientific Information Database (SID). This search strategy entailed the utilization of Medical Subject Headings-derived keywords such as "Prevalence," "Surgical wound infection," "Surgical site infection," and "Arthroplasty," spanning from the earliest records up to January 1, 2024. For example, the search strategy in PubMed/MEDLINE database was ((“Arthroplasties, Replacement, Hip”) OR (“Arthroplasty, Hip Replacement”) OR (“Hip Replacement Arthroplasties”) OR (“Hip Prosthesis Implantation”) OR (“Hip Prosthesis Implantations”) OR (“Implantation, Hip Prosthesis”) OR (“Prosthesis Implantation, Hip”) OR (“Replacement Arthroplasties, Hip”) OR (“Replacement Arthroplasty, Hip”) OR (“Arthroplasties, Hip Replacement”) OR (“Hip Replacement Arthroplasty”) OR (“Hip Replacement, Total”) OR (“Replacement, Total Hip”) OR (“Total Hip Replacements”) OR (“Total Hip Replacement”) OR (“Total Hip Arthroplasty”) OR (“Arthroplasty, Total Hip”) OR (“Hip Arthroplasty, Total”) OR (“Total Hip Arthroplasties”)) AND ((“Infections, Surgical Wound”) OR (“Surgical wound infection”) OR (“Surgical Wound Infections”) OR (“Wound Infections, Surgical”) OR (“Infection, Surgical Wound”) OR (“Surgical Site Infection”) OR (“Infection, Surgical Site”) OR (“Infections, Surgical Site”) OR (“Sur-

gical Site Infections") OR ("Wound Infection, Postoperative") OR ("Wound Infection, Surgical")) and (("Infection, Postoperative Wound") OR ("Infections, Postoperative Wound")) and (("Postoperative Wound Infections") OR ("Wound Infections, Postoperative")) and (("Postoperative Wound Infection")) AND (("Prevalence") OR ("Incidence") OR ("Epidemiology") OR ("Frequency") OR ("Burden")). The search strategy in different databases is presented in Table 2.
Furthermore, Persian keyword equivalents were utilized for Iranian electronic databases. Two independent researchers executed these extensive searches. Notably, this systematic review and meta-analysis excluded gray literature, which encompasses expert commentary, conference presentations, theses, research and committee reports, and ongoing studies. Gray literature denotes written material lacking official approval for commercial publication, whether in print or online (20).

3.3. Inclusion and exclusion criteria

This systematic review investigated published original research, encompassing both Persian and English studies, focusing on the incidence of SSI among patients undergoing hip arthroplasty. Excluded from our analysis were reviews, case studies, conference materials, letters to the editor, legal proceedings, and qualitative research.

3.4. Study selection

For data management in this systematic review, EndNote 20 software was utilized. The selection of research based on predefined inclusion and exclusion criteria followed the following procedures: 1) Initial screening involved assessing the titles and abstracts of identified studies. 2) Duplicate papers were identified through both electronic and manual methods. 3) The full contents of publications were reviewed to make final inclusion or exclusion determinations. In cases where disparities emerged between the initial two researchers during the study selection process, a third researcher intervened to arbitrate any disagreements. Furthermore, a comprehensive examination of references was undertaken as a final precautionary measure to mitigate potential data loss.

3.5. Data extraction and quality assessment

The researchers collected a range of information for this review, encompassing details such as the primary author's name, publication year, study location, sample size, age distribution, gender distribution, incidence of SSI, and type of arthroplasty. To evaluate the quality of the included studies, the Appraisal tool for Cross-Sectional Studies (AXIS tool) was employed. This tool consists of 20 items, each rated on a two-point Likert scale, where a response of "yes" is assigned a score of 1, and a response of "no" is assigned a score of 0 (21).

3.6. Statistical analysis

In our analysis, we utilized version 3 of the Comprehensive Meta-Analysis (CMA) program. The weight assigned to each study was determined based on its inverse variance. To evaluate the heterogeneity among the studies, we employed a forest plot visualization. We compiled data on sample size and the frequency of SSI for each study, utilizing this information to compute the overall effect size. The degree of heterogeneity was assessed using I2 statistics, where values of 25%, 50%, and 75% represented mild, moderate, and high heterogeneity, respectively.
Given the substantial variability observed in the results, we employed a random effects model. Additionally, for study-specific variables such as year of publication, meta-regression analysis was conducted to explore the prevalence of SSI.

3.7. Sensitivity analysis

A sensitivity analysis was undertaken to evaluate the impact of excluding individual studies on the overall prevalence estimation of SSI. This analytical approach allowed for a comprehensive assessment of the robustness of the findings by systematically excluding each study from the analysis and observing the resulting changes in the calculated prevalence of SSI.

3.8. Publication bias

To evaluate the potential for publication bias, we employed Egger's test in conjunction with a Funnel plot analysis. This combined approach allowed for a comprehensive assessment of the presence and magnitude of publication bias within the reviewed studies. Egger's test provides statistical evidence of asymmetry in the distribution of effect sizes, while the Funnel plot visually depicts the spread of study results relative to their precision, facilitating the identification of potential publication bias.

4. Results

4.1. Study selection

As illustrated in Figure 1, the initial database searches retrieved a total of 1,125 studies pertinent to the systematic review and meta-analysis. Subsequent removal of duplicate studies reduced the corpus to 704 papers. Following a comprehensive review of titles and abstracts, 632 studies were excluded due to misalignment with the study's objectives. Additionally, 35 studies were disregarded due to the presence of case reports, editorial letters, conference papers, dissertations, reviews, or other non-research-related content. Upon thorough examination of the full text of thirty-two studies, nine were further excluded on the grounds of suboptimal research design or unsuitable results, while six were removed due to insufficient data availability. Ultimately, seventeen studies (13, 14, 16-18, 22-33) met the inclusion criteria and were incorporated into this systematic review and meta-analysis.

4.2. Study characteristics

As delineated in Table 3, the study encompassed a cumulative participant cohort of 1,070,638 hip arthroplasty procedures drawn from seventeen selected studies (13, 14, 16-18, 22-33). Notably, the female gender constituted 59.10% of the overall participant demographic.

4.3. Methodological quality assessment of eligible studies

As depicted in Figure 2, it was determined that all studies (13, 14, 16-18, 22-33) included in the analysis exhibited a high level of quality. However, six studies (13, 22, 23, 28, 30, 32) omitted disclosure of funding sources or conflicts of interest, while two studies (13, 24) failed to provide information regarding the limitations of the study.

4.4. Prevalence of SSI

As illustrated in Figure 3 and Table 4, the aggregate SSI among patients undergoing hip arthroplasty, as documented in the seventeen studies incorporated in the analysis, was estimated to be 1.9% (95% CI: 1.3% to 2.8%; I2=99.688%; P<0.001).

4.5. Prevalence of SSI based on gender

As shown in Figure 4, the odds ratio (OR) for the prevalence of SSI in women appeared higher compared to that in men; nevertheless, this disparity did not attain statistical significance (OR: 1.030; 95% CI: 0.895 to 1.185; Z=0.410; P=0.681).

4.6. Prevalence of SSI during different years

As depicted in Figure 5, the results of the meta-regression analysis unveiled a statistically significant correlation between the prevalence of SSIs after hip arthroplasty and the year of publication (Coefficient=-0.0020; 95% CI: -0.0021 to -0.0018; Z=-19.39, P<0.001). This finding suggests a discernible relationship between the temporal aspect of publication and the observed incidence of SSI following hip arthroplasty.

4.7. Sensitivity analysis

As demonstrated in Figure 6, sensitivity analyses were conducted by systematically excluding one study at a time to assess the impact of each study on the overall outcomes and the level of heterogeneity among the studies. The results indicated that the exclusion of any individual study encompassed within the scope of this meta-analysis did not result in a statistically significant alteration in the pooled prevalence of SSI following hip arthroplasty.

4.8. Publication bias

As depicted in Figure 7, a funnel plot was utilized to evaluate the possibility of publication bias in the assessment of SSI prevalence following hip arthroplasty. Notably, no discernible indications of asymmetry were observed in the funnel plot. Furthermore, the results of Egger's regression test indicated no significant evidence of publication bias in the assessment of SSI prevalence (t=1.359, P=0.194).

5. Discussion

This systematic review and meta-analysis aimed to investigate the incidence of SSI among individuals undergoing hip arthroplasty. The results of the study indicated that the prevalence of SSI within this cohort was 1.9%.

The ramifications of SSI on patients underscore the critical necessity for the implementation of preventive strategies, timely detection, and expeditious management to mitigate complications and enhance outcomes after hip arthroplasty and analogous surgical interventions (34, 35). Orthopedic surgical procedures are commonly associated with a potential risk of SSI, albeit the specific magnitude of this risk may vary across individual cases (36-39).

The findings of a comprehensive systematic review conducted on individuals undergoing hip arthroplasty in 2010 revealed notable prevalence rates of SSI. Specifically, the prevalence was reported to be 0.2% prior to discharge and 1.1% post-discharge (40). In contrast to the findings of the present investigation, it was demonstrated that the incidence of SSI after hip arthroplasty among patients surpasses that reported in the 2010 study (40). The outcomes of a systematic review and meta-analysis investigation concerning individuals undergoing foot and ankle surgery unveiled a postoperative SSI prevalence of 4.2% (41). Additionally, findings from another systematic review and meta-analysis study focusing on patients undergoing long-bone surgery revealed a post-surgical SSI prevalence of 3.3% among this cohort (42). These findings and our study findings underscore distinct prevalence rates of SSI in different surgical contexts, shedding light on the nuanced nature of infection risk across various orthopedic procedures.

The findings of the systematic review and meta-analysis indicate a higher prevalence of SSI following arthroplasty in women compared to men; however, this discrepancy does not achieve statistical significance. Conversely, a separate systematic review and meta-analysis conducted in 2016 focusing on patients undergoing total joint arthroplasty surgery revealed a higher prevalence of periprosthetic infection in men relative to women (43). These observations underscore gender-specific variations in infection rates post-arthroplasty, elucidating potential areas for further investigation into underlying contributing factors.

The outcomes of meta-regression analysis conducted on the publication year of articles within this systematic review revealed a statistically significant decline in the prevalence of SSI among patients following hip arthroplasty over successive years. This downward trend underscores potential advancements in surgical techniques, perioperative care, and infection prevention strategies contributing to the reduction in post-arthroplasty SSI rates over time. Further exploration into the specific factors driving this observed decrease may yield valuable insights for enhancing patient outcomes in orthopedic surgery.

Moreover, the findings derived from the studies incorporated into this systematic review and meta-analysis indicate the noteworthy influence of comorbidities on the prevalence of SSI after hip arthroplasty (13, 17, 28, 31, 33). These results underscore the substantial impact of underlying medical conditions on postoperative outcomes, highlighting the importance of comprehensive preoperative assessment and management of comorbidities to mitigate the risk of SSI in patients undergoing hip arthroplasty. Further investigation into the specific comorbidities and their associated effects on SSI prevalence could inform targeted interventions aimed at optimizing patient care and reducing postoperative complications in this population.

5.1. Limitations

This study is subject to various limitations that warrant consideration. A notable constraint is the substantial heterogeneity observed among the included studies, which is a common concern in prevalence meta-analyses. Moreover, results from the assessment of publication bias indicate the necessity for further investigation to establish the genuine prevalence of SSI in patients following hip arthroplasty. Despite exhaustive searches across multiple databases, it is plausible that not all pertinent studies on this subject were identified. Additionally, it is pertinent to acknowledge that this review exclusively incorporated studies published in English or Persian, potentially introducing language barriers, and possibly resulting in the exclusion of valuable data from studies conducted in other languages, which were not encompassed in the analysis. Also, owing to the limited number of studies that reported the prevalence of SSI in relation to variables such as age group, countries, type of operation, the risk factors related to the infection of the operated area, and comorbidities, it was not feasible to conduct a meta-analysis for these variables.

5.2. Implications for healthcare providers, managers, and policymakers

It is imperative for healthcare professionals to have a thorough understanding of the elevated occurrence of surgical site infections in patients following hip arthroplasty, as well as the various risk factors linked to these infections. This knowledge equips providers with the ability to pinpoint individuals who are more susceptible to infection and implement suitable preventive strategies to diminish the chances of infection.

Healthcare providers must remain vigilant in their surveillance of patients' post-hip arthroplasty, actively looking out for any indications or symptoms of infection, such as heightened pain, redness, swelling, or discharge at the surgical site. Timely identification and immediate treatment of infections play a crucial role in averting severe complications and enhancing patient outcomes. Furthermore, it is essential for healthcare providers to ensure strict adherence to infection control measures during hip arthroplasty procedures, including meticulous hand hygiene, sterile surgical practices, and judicious use of antibiotics. By adhering to evidence-based guidelines and protocols for preventing surgical site infections, providers can significantly lower the overall incidence of infections in patients undergoing hip arthroplasty. In addition, policymakers should contemplate the enforcement of regulations and policies that advocate for adherence to evidence-based guidelines for infection prevention during hip arthroplasty procedures. This could involve the establishment of quality indicators for monitoring and reporting surgical site infections, the introduction of incentives for healthcare facilities that achieve low infection rates, and the enforcement of accountability measures for facilities that fail to implement optimal infection control practices. Managers need to engage in collaborative efforts with healthcare providers to devise and execute comprehensive infection prevention strategies, which include routine monitoring and reporting of infection rates, analysis of infection data trends, and the implementation of targeted interventions to address identified risk factors. By concentrating on proactive measures to prevent surgical site infections in patients after hip arthroplasty, managers and policymakers can enhance patient outcomes, elevate the standard of care, and diminish healthcare expenses linked to the treatment of postoperative infections.

5.3. Recommendations for future research

To advance understanding and optimize outcomes in patients undergoing hip arthroplasty while addressing the burden of SSIs, future research should prioritize several key recommendations. Firstly, the execution of prospective cohort studies is imperative to longitudinally examine SSI occurrence post-hip arthroplasty. These studies should encompass comprehensive data collection on patient demographics, surgical techniques, perioperative care, and postoperative outcomes. Secondly, health economic evaluations are essential to assess the financial ramifications of SSI prevention and management strategies. This evaluation should encompass short-term healthcare costs and long-term societal impacts to inform resource allocation and healthcare policy decisions effectively. Lastly, fostering international collaboration and data-sharing initiatives is pivotal. This facilitates data pooling from diverse healthcare systems and geographical regions, enabling comprehensive analyses and generalizable conclusions. Adhering to these recommendations will propel advancements in knowledge, refine clinical practices, and ultimately optimize outcomes for hip arthroplasty patients while mitigating the burden of SSIs. It is further proposed that ensuing research endeavors explore the incidence of SSI subsequent to hip arthroplasty, taking into account influential variables and comorbidities.

6. Conclusions

The study findings indicated a prevalence rate of 1.9% for SSI following hip arthroplasty. This prevalence underscores the importance of vigilance in infection prevention and management strategies within orthopedic surgery. However, it is essential to acknowledge the variability in SSI prevalence observed across diverse studies, which can be attributed to multifaceted factors, notably variances in patient populations, and associated risk factors. Specifically, comorbidities and gender disparities emerge as potential contributors to the observed differences in SSI rates. In conclusion, the prevalence of SSI following hip arthroplasty, as evidenced by this study, highlights the ongoing need for robust infection control measures and tailored interventions to mitigate the risk of postoperative complications. Future research endeavors should continue to explore the intricacies of SSI epidemiology, incorporating comprehensive assessments of patient characteristics, surgical techniques, and healthcare practices to optimize outcomes and enhance patient care standards in orthopedic surgery.

7. Declarations

7.1. Acknowledgments

None.

7.2. Conflict of interest

The authors declare no conflict of interest.

7.3. Funding

None.

7.4. Authors' contribution

Study concept and design by all authors; Data acquisition by all authors; Data interpretation by all authors; drafting of the manuscript by all authors; Revision of the manuscript by all authors; the final version of the manuscript is approved by all authors.

7.5. Data availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

7.6. Using artificial inteligence chatbots

The authors declare that they have not used artificial intelligence chatbots.

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Table 1: Patient/population, Exposure, and Outcomes (PEO) framework and search strategy terms

PEO	Keywords	#*	Search Terms
Population	Patients after hip arthroplasty	1	((“Arthroplasties, Replacement, Hip”) OR (“Arthroplasty, Hip Replacement”) OR (“Hip Replacement Arthroplasties”) OR (“Hip Prosthesis Implantation”) OR (“Hip Prosthesis Implantations”) OR (“Implantation, Hip Prosthesis”) OR (“Prosthesis Implantation, Hip”) OR (“Replacement Arthroplasties, Hip”) OR (“Replacement Arthroplasty, Hip”) OR (“Arthroplasties, Hip Replacement”) OR (“Hip Replacement Arthroplasty”) OR (“Hip Replacement, Total”) OR (“Replacement, Total Hip”) OR (“Total Hip Replacements”) OR (“Total Hip Replacement”) OR (“Total Hip Arthroplasty”) OR (“Arthroplasty, Total Hip”) OR (“Hip Arthroplasty, Total”) OR (“Total Hip Arthroplasties”))
Exposure	surgical site infection (SSI)	2	((“Infections, Surgical Wound”) OR (“Surgical wound infection”) OR (“Surgical Wound Infections”) OR (“Wound Infections, Surgical”) OR (“Infection, Surgical Wound”) OR (“Surgical Site Infection”) OR (“Infection, Surgical Site”) OR (“Infections, Surgical Site”) OR (“Surgical Site Infections”) OR (“Wound Infection, Postoperative”) OR (“Wound Infection, Surgical”)) and ((“Infection, Postoperative Wound”) OR (“Infections, Postoperative Wound”)) and ((“Postoperative Wound Infections”) OR (“Wound Infections, Postoperative”)) and ((“Postoperative Wound Infection”))
Outcome	Prevalence of SSI	3	((“Prevalence”) OR (“Incidence”) OR (“Epidemiology”) OR (“Frequency”) OR (“Burden”))

* #1, #2, and #3 combined with “AND” operator. √ To widen search results and avoid missing data, terms for comparison and outcomes were not included in the search strategy.

Table 2: Search strategy

Databases	Search strategy
Scopus	((“Arthroplasties, Replacement, Hip”) OR (“Arthroplasty, Hip Replacement”) OR (“Hip Replacement Arthroplasties”) OR (“Hip Prosthesis Implantation”) OR (“Hip Prosthesis Implantations”) OR (“Implantation, Hip Prosthesis”) OR (“Prosthesis Implantation, Hip”) OR (“Replacement Arthroplasties, Hip”) OR (“Replacement Arthroplasty, Hip”) OR (“Arthroplasties, Hip Replacement”) OR (“Hip Replacement Arthroplasty”) OR (“Hip Replacement, Total”) OR (“Replacement, Total Hip”) OR (“Total Hip Replacements”) OR (“Total Hip Replacement”) OR (“Total Hip Arthroplasty”) OR (“Arthroplasty, Total Hip”) OR (“Hip Arthroplasty, Total”) OR (“Total Hip Arthroplasties”)) AND ((“Infections, Surgical Wound”) OR (“Surgical wound infection”) OR (“Surgical Wound Infections”) OR (“Wound Infections, Surgical”) OR (“Infection, Surgical Wound”) OR (“Surgical Site Infection”) OR (“Infection, Surgical Site”) OR (“Infections, Surgical Site”) OR (“Surgical Site Infections”) OR (“Wound Infection, Postoperative”) OR (“Wound Infection, Surgical”)) and ((“Infection, Postoperative Wound”) OR (“Infections, Postoperative Wound”)) and ((“Postoperative Wound Infections”) OR (“Wound Infections, Postoperative”)) and ((“Postoperative Wound Infection”)) AND ((“Prevalence”) OR (“Incidence”) OR (“Epidemiology”) OR (“Frequency”) OR (“Burden”))
PubMed	((“Arthroplasties, Replacement, Hip”) OR (“Arthroplasty, Hip Replacement”) OR (“Hip Replacement Arthroplasties”) OR (“Hip Prosthesis Implantation”) OR (“Hip Prosthesis Implantations”) OR (“Implantation, Hip Prosthesis”) OR (“Prosthesis Implantation, Hip”) OR (“Replacement Arthroplasties, Hip”) OR (“Replacement Arthroplasty, Hip”) OR (“Arthroplasties, Hip Replacement”) OR (“Hip Replacement Arthroplasty”) OR (“Hip Replacement, Total”) OR (“Replacement, Total Hip”) OR (“Total Hip Replacements”) OR (“Total Hip Replacement”) OR (“Total Hip Arthroplasty”) OR (“Arthroplasty, Total Hip”) OR (“Hip Arthroplasty, Total”) OR (“Total Hip Arthroplasties”)) AND ((“Infections, Surgical Wound”) OR (“Surgical wound infection”) OR (“Surgical Wound Infections”) OR (“Wound Infections, Surgical”) OR (“Infection, Surgical Wound”) OR (“Surgical Site Infection”) OR (“Infection, Surgical Site”) OR (“Infections, Surgical Site”) OR (“Surgical Site Infections”) OR (“Wound Infection, Postoperative”) OR (“Wound Infection, Surgical”)) and ((“Infection, Postoperative Wound”) OR (“Infections, Postoperative Wound”)) and ((“Postoperative Wound Infections”) OR (“Wound Infections, Postoperative”)) and ((“Postoperative Wound Infection”)) AND ((“Prevalence”) OR (“Incidence”) OR (“Epidemiology”) OR (“Frequency”) OR (“Burden”))
WOS	((“Arthroplasties, Replacement, Hip”) OR (“Arthroplasty, Hip Replacement”) OR (“Hip Replacement Arthroplasties”) OR (“Hip Prosthesis Implantation”) OR (“Hip Prosthesis Implantations”) OR (“Implantation, Hip Prosthesis”) OR (“Prosthesis Implantation, Hip”) OR (“Replacement Arthroplasties, Hip”) OR (“Replacement Arthroplasty, Hip”) OR (“Arthroplasties, Hip Replacement”) OR (“Hip Replacement Arthroplasty”) OR (“Hip Replacement, Total”) OR (“Replacement, Total Hip”) OR (“Total Hip Replacements”) OR (“Total Hip Replacement”) OR (“Total Hip Arthroplasty”) OR (“Arthroplasty, Total Hip”) OR (“Hip Arthroplasty, Total”) OR (“Total Hip Arthroplasties”)) AND ((“Infections, Surgical Wound”) OR (“Surgical wound infection”) OR (“Surgical Wound Infections”) OR (“Wound Infections, Surgical”) OR (“Infection, Surgical Wound”) OR (“Surgical Site Infection”) OR (“Infection, Surgical Site”) OR (“Infections, Surgical Site”) OR (“Surgical Site Infections”) OR (“Wound Infection, Postoperative”) OR (“Wound Infection, Surgical”)) and ((“Infection, Postoperative Wound”) OR (“Infections, Postoperative Wound”)) and ((“Postoperative Wound Infections”) OR (“Wound Infections, Postoperative”)) and ((“Postoperative Wound Infection”)) AND ((“Prevalence”) OR (“Incidence”) OR (“Epidemiology”) OR (“Frequency”) OR (“Burden”))

WOS: Web of Science.

Table 3: Comparing the management and outcomes of sepsis patients who were and were not admitted to an ICU/HDU

First Author/year	Location	Sample size	Mean age (year)	M/F ratio (%)	Key results
Ridgeway et al., 2005 (30)	UK	24808	N/A	36.67/63.33	N/A
Wilson et al., 2008 (32)	UK	22160	N/A	N/A	N/A
González-Vélez et al., 2011 (25)	Spain	3067	73.00	34.01/65.99	There was a significant positive relationship between age and SSI prevalence (P=0.024) There was a significant positive relationship between preoperative stay and SSI prevalence (P=0.024)
Namba et al., 2012 (28)	USA	30491	N/A	42.69/57.31	There was a significant relationship between diabetes and SSI prevalence (P=0.006) There was a significant relationship between BMI and SSI prevalence (P<0.001) There was a significant relationship between surgery duration and SSI prevalence (P=0.027)
Song et al., 2012 (31)	Korea	3422	N/A	41.09/58.91	There was a significant relationship between diabetes and SSI prevalence (P<0.05) There was a significant relationship between revision surgery and SSI prevalence (P<0.05) There was a significant relationship between surgery duration and SSI prevalence (P<0.05) There was a significant relationship between trauma and SSI prevalence (P<0.05)
Poultsides et al., 2013 (13)	USA	412356	N/A	42.32/57.68	There was a significant relationship between alcohol abuse and SSI prevalence (P<0.001) There was a significant relationship between congestive heart failure and SSI prevalence (P<0.001) There was a significant relationship between coagulopathy and SSI prevalence (P<0.001) There was a significant relationship between chronic lung disease and SSI prevalence (P<0.001) There was a significant relationship between diabetes and SSI prevalence (P=0.0035) There was a significant relationship between liver disease and SSI prevalence (P<0.001) There was a significant relationship between fluid and electrolyte disturbance and SSI prevalence (P<0.001) There was a significant relationship between metastatic cancer and SSI prevalence (P<0.001) There was a significant relationship between neurologic disorder and SSI prevalence (P<0.001) There was a significant relationship between pulmonary circulatory disease and SSI prevalence (P<0.001) There was a significant relationship between renal disease and SSI prevalence (P<0.001) There was a significant relationship between valvular disease and SSI prevalence (P=0.0206)
Yokoe et al., 2013 (33)	USA	91121	70.50 (SD=13.80)	39.01/60.99	There was a significant relationship between race and electrolyte disturbance and SSI prevalence (P=0.001) There was a significant relationship between length of stay and SSI prevalence (P<0.001) There was a significant relationship between diabetes and SSI prevalence (P<0.001) There was a significant relationship between congestive heart failure and SSI prevalence (P<0.001) There was a significant relationship between renal failure and SSI prevalence (P<0.001) There was a significant relationship between metastatic cancer and SSI prevalence (P=0.001) There was a significant relationship between liver disease and SSI prevalence (P<0.001) There was a significant relationship between rheumatoid arthritis and SSI prevalence (P<0.001) There was a significant relationship between obesity and SSI prevalence (P<0.001)
Carroll et al., 2014 (18)	Australia	453	N/A	60.04/39.96	There was a significant relationship between BMI and SSI prevalence (P<0.001)

Table 3: Comparing the management and outcomes of sepsis patients who were and were not admitted to an ICU/HDU (continue)

First Author/year	Location	Sample size	Mean age (year)	M/F ratio (%)	Key results
Dicks et al., 2015 (23)	USA	25531	N/A	N/A	There was a significant positive relationship between surgery duration and SSI prevalence (P<0.01)
Grammatico-Guillon et al., 2015 (26)	France	21633	N/A	N/A	N/A
Pugely et al., 2015 (29)	USA	7971	N/A	N/A	N/A
Almustafa et al., 2018 (22)	Scotland	1832	67.90 (SD=10.20)	39.80/60.20	N/A
Dyck et al., 2019 (24)	Canada	4899	N/A	N/A	N/A
Hijas-Gómez et al., 2020 (27)	Spain	1808	72.10 (SD=13.50)	42.81/57.19	There was a significant relationship between type of surgery and SSI prevalence (P=0.001)
Marusic et al., 2021 (17)	Serbia	459	64.88 (SD=10.59)	42.48/57.52	There was a significant positive relationship between smoking and SSI prevalence (P=0.004) There was a significant positive relationship between peripheral vascular disease and SSI prevalence (P<0.001) There was a significant positive relationship between BMI and SSI prevalence (P=0.033) There was a significant positive relationship between the number of blood units given and SSI prevalence (P=0.039)
Maritati et al., 2022 (14)	Italy	315	N/A	N/A	N/A
Bischoff et al., 2023 (16)	Germany	418312	N/A	41.17/58.83	N/A

SD: Standard Deviation; SSI: Surgical Site Infection; M/F: male/female; BMI: body mass index; N/A: not available.

Table 4: SSI prevalence and related factors

First Author/year	SSI n (%)	Gender		Arthroplasty type		
		SSI n/Total n		SSI n/Total n		
		Male	Female	Partial	Total	Revision
Ridgeway et al., 2005 (30)	761 (3.07)	250/8601	511/16207	288/5769	363/16291	110/2748
Wilson et al., 2008 (32)	430 (1.94)	N/A	N/A	219/5395	211/16765	0/0
González-Vélez et al., 2011 (25)	83 (2.71)	N/A	N/A	N/A	N/A	N/A
Namba et al., 2012 (28)	155 (0.51)	55/13017	100/17474	N/A	N/A	N/A
Song et al., 2012 (31)	78 (2.28)	26/1406	52/2016	N/A	N/A	N/A
Poultsides et al., 2013 (13)	1494 (0.36)	673/173,836	821/238520	N/A	N/A	N/A
Yokoe et al., 2013 (33)	2114 (2.32)	863/35547	1251/55574	N/A	N/A	N/A
Carroll et al., 2014 (18)	43 (9.49)	N/A	N/A	N/A	N/A	N/A
Dicks et al., 2015 (23)	340 (1.33)	N/A	N/A	N/A	N/A	N/A
Grammatico-Guillon et al., 2015 (26)	383 (1.77)	N/A	N/A	N/A	N/A	N/A
Pugely et al., 2015 (29)	94 (1.18)	N/A	N/A	N/A	N/A	N/A
Almustafa et al., 2018 (22)	27 (1.47)	N/A	N/A	N/A	N/A	N/A
Dyck et al., 2019 (24)	94 (1.92)	N/A	N/A	N/A	N/A	N/A
Hijas-Gómez et al., 2020 (27)	55 (3.04)	23/774	32/1034	23/1047	18/523	14/238
Marusic et al., 2021 (17)	36 (7.84)	N/A	N/A	N/A	N/A	N/A
Maritati et al., 2022 (14)	10 (3.17)	N/A	N/A	N/A	N/A	N/A
Bischoff et al., 2023 (16)	3231 (0.77)	1550/172199	1681/246113	N/A	N/A	N/A

SSI: Surgical Site Infection; N/A: not available.

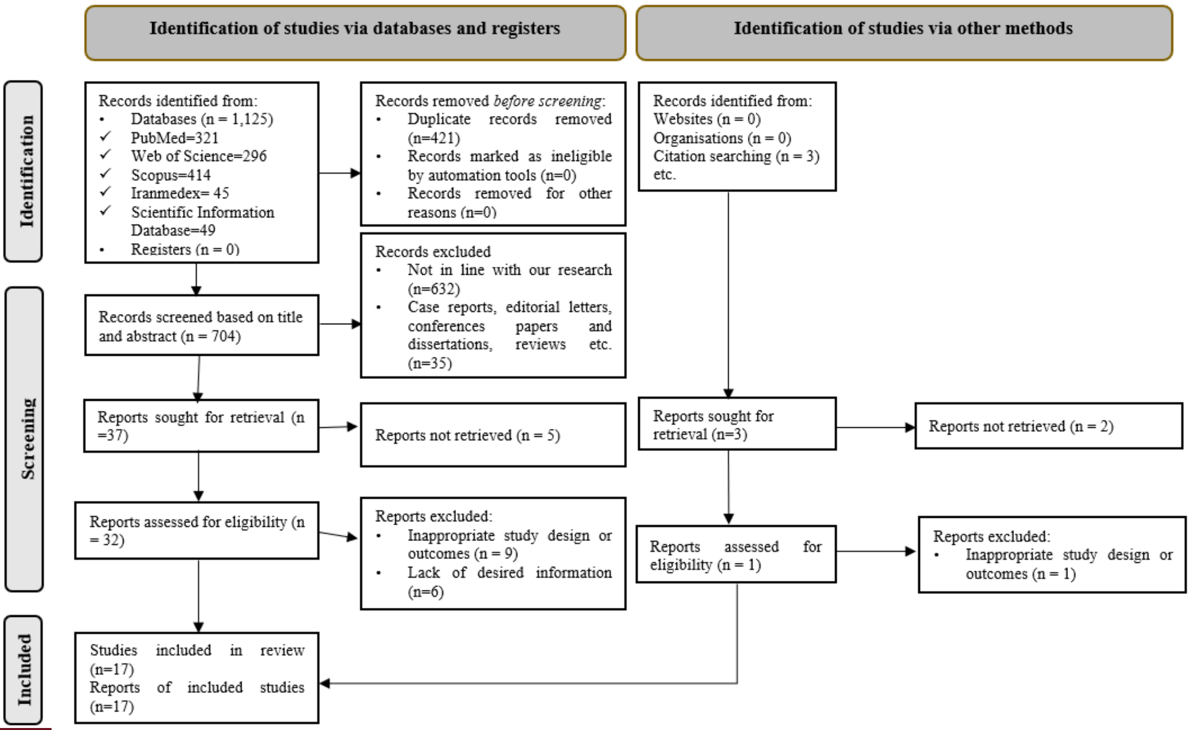


Figure 1: Flow diagram of the study selection process.

Section	Item	Ridgeway et al., 2005	Wilson et al., 2008	González-Vélez et al., 2011	Namba et al., 2012	Song et al., 2012	Poultsides et al., 2013	Yokoe et al., 2013	Carroll et al., 2014	Dicks et al., 2015	Grammatico-Guillon et al., 2015	Pugely et al., 2015	Almustafa et al., 2018	Dyck et al., 2019	Hijas-Gómez et al., 2020	Marusic et al., 2021	Maritati et al., 2022	Bischoff et al., 2023
Introduction	Clear aims	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Appropriate design	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Methods	Sample size justified	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Population defined	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Sample representative of population	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Selection process representative	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Measures to address non-responders	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Appropriate outcome variables	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Valid measures	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Defined statistical significance	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Methods described	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Results	Results data described	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Concerns about non-response bias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Non-responder information described	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Results internally consistent	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Results presented for analyses	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Discussion	Conclusions justified	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Figure 2: Methodological quality assessment of included studies.

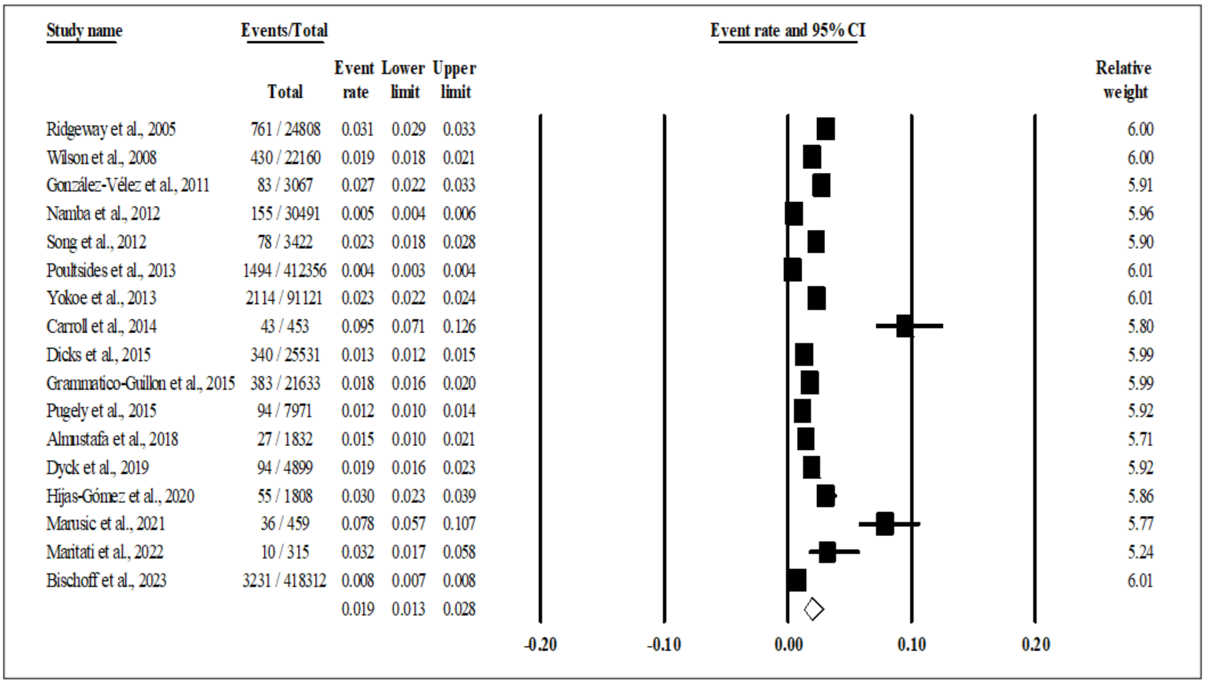


Figure 3: Forest plot prevalence of SSI.

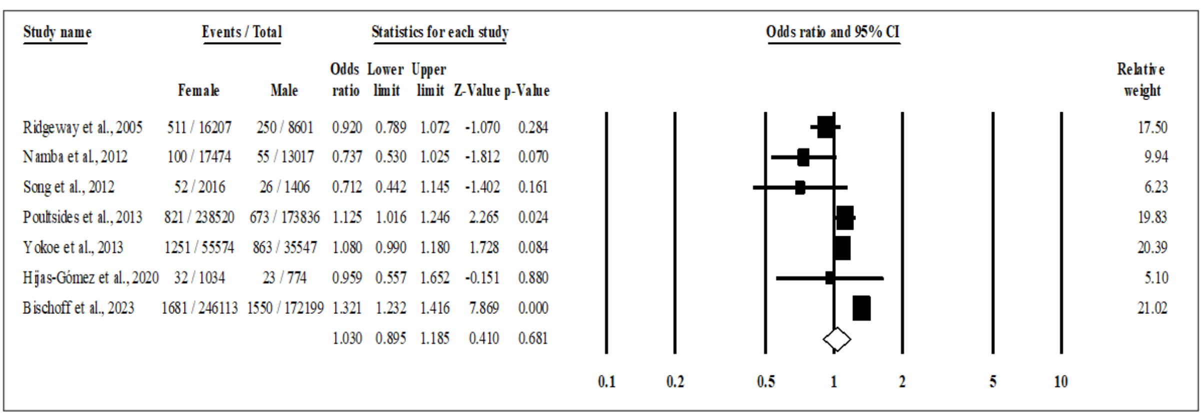


Figure 4: The odds ratio of surgical site infection (SSI) based on gender. CI: confidence interval.

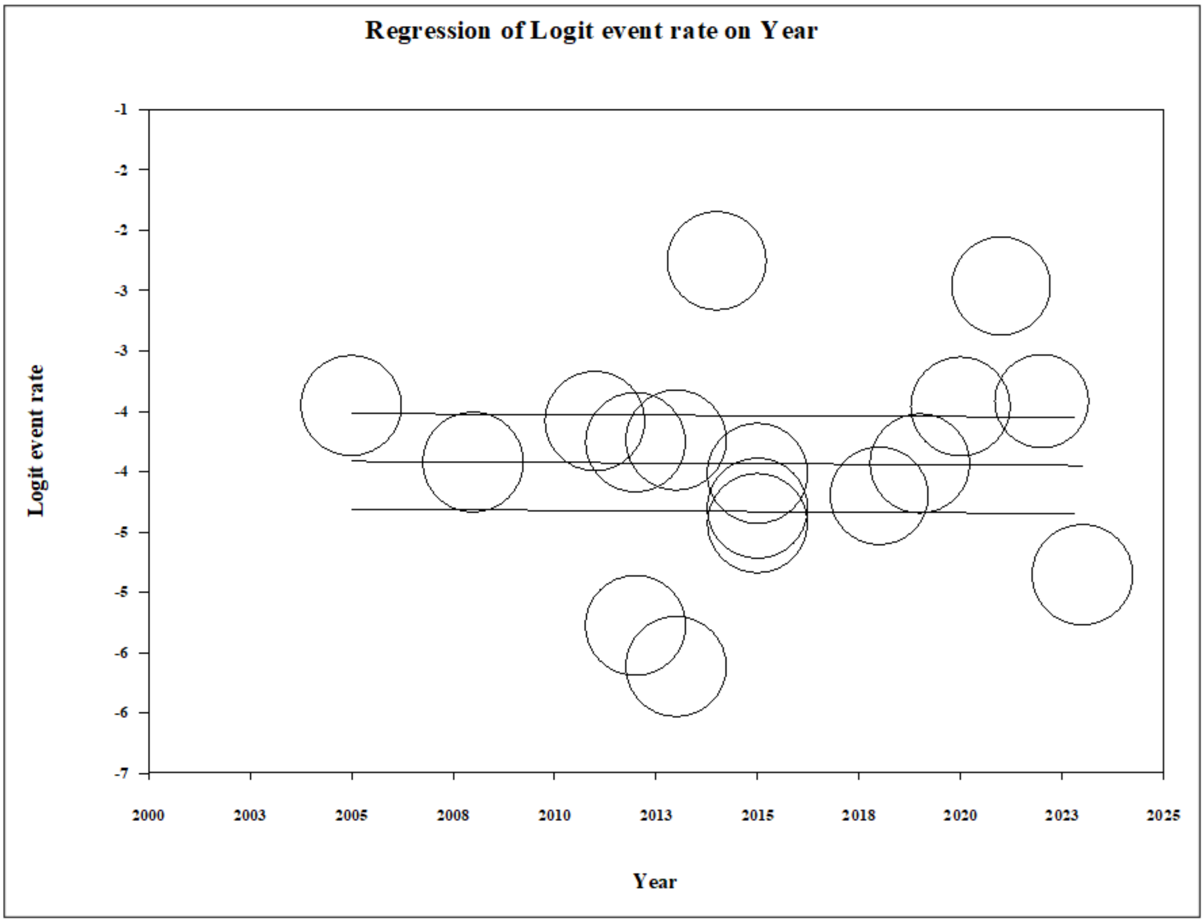
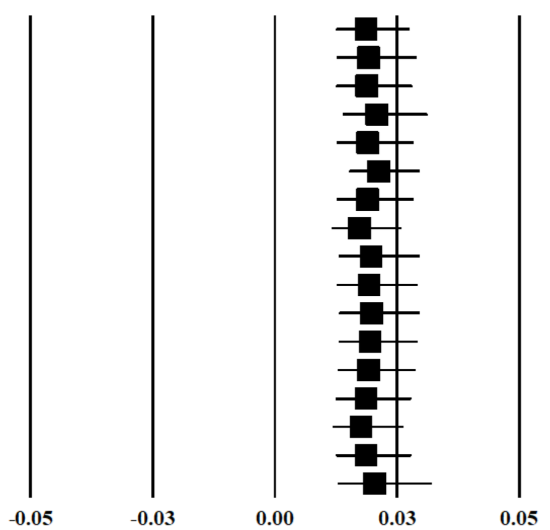


Figure 5: Meta-regression based on the relationship between surgical site infection (SSI) prevalence and years of publications.



Study name	Statistics with study removed			
	Point	Lower limit	Upper limit	p-Value
Ridgeway et al., 2005	0.019	0.013	0.028	0.000
Wilson et al., 2008	0.019	0.013	0.029	0.000
González-Vélez et al., 2011	0.019	0.013	0.028	0.000
Namba et al., 2012	0.021	0.014	0.031	0.000
Song et al., 2012	0.019	0.013	0.028	0.000
Poultsides et al., 2013	0.021	0.015	0.030	0.000
Yokoe et al., 2013	0.019	0.013	0.028	0.000
Carroll et al., 2014	0.017	0.012	0.026	0.000
Dicks et al., 2015	0.020	0.013	0.030	0.000
Grammatico-Guillon et al., 2015	0.019	0.013	0.029	0.000
Pugely et al., 2015	0.020	0.013	0.030	0.000
Almustafa et al., 2018	0.020	0.013	0.029	0.000
Dyck et al., 2019	0.019	0.013	0.029	0.000
Hijas-Gómez et al., 2020	0.019	0.012	0.028	0.000
Marusic et al., 2021	0.018	0.012	0.026	0.000
Maritati et al., 2022	0.019	0.012	0.028	0.000
Bischoff et al., 2023	0.020	0.013	0.032	0.000

Figure 6: Sensitivity analysis. CI: confidence interval.

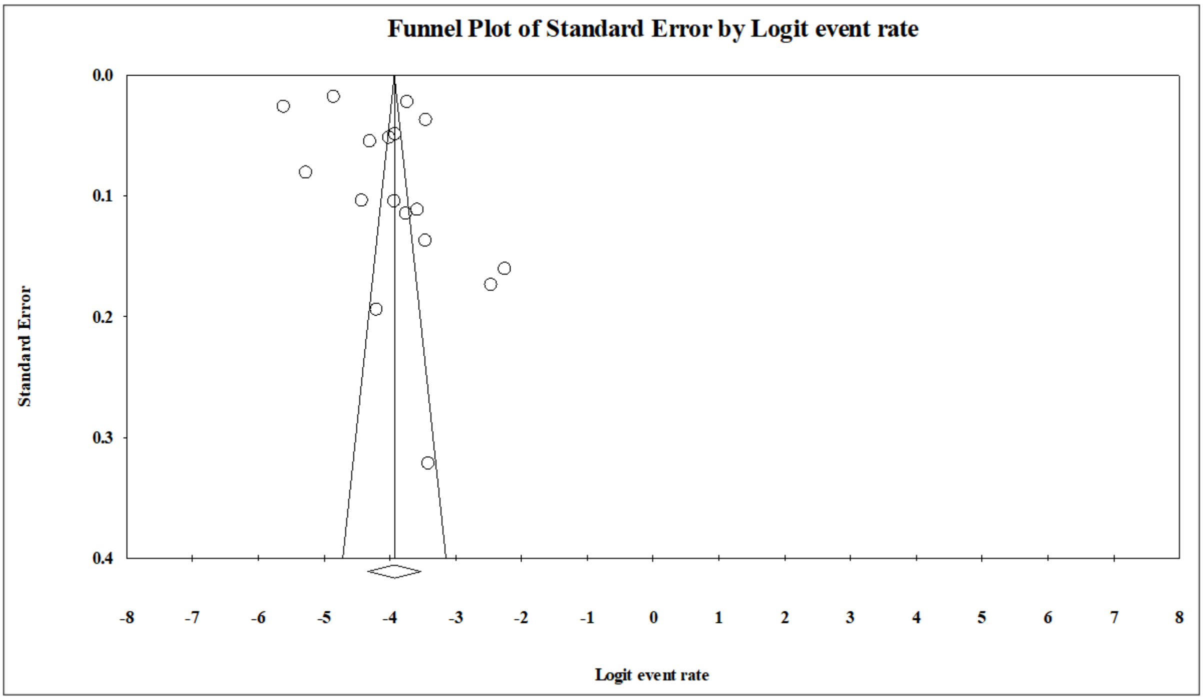


Figure 7: Funnel plot of surgical site infection (SSI).