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A Clinical Study on the Prevalence and Risk Factors of Surgical Site Infections in Postoperative Patients"; A cross sectional study

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ABSTRACT

Background: Surgical site infections (SSIs) remain one of the most common postoperative complications worldwide, contributing significantly to morbidity, prolonged hospitalization, and increased healthcare costs. The global incidence varies widely from 1% to 30% depending on surgical type and patient-related factors. Recent studies report prevalence rates ranging between 5% and 12% in well-equipped tertiary care settings.

Aim: To determine the prevalence and risk factors associated with surgical site infections among postoperative patients.

Methods: A hospital-based cross-sectional study was conducted among 128 postoperative patients. Data regarding demographic variables, type of surgery, comorbidities, and perioperative factors were collected and analyzed.

Results: The overall prevalence of SSI was 10.2% (n=13). Higher infection rates were observed in contaminated and dirty surgeries. Significant risk factors included diabetes mellitus, obesity, smoking, prolonged duration of surgery (>2 hours), and extended hospital stay. Similar findings have been reported in recent studies, where SSI incidence ranged from 9.3% to 11.7% with comparable risk factors.

Conclusion: SSI remains a significant postoperative complication despite advancements in surgical care. Identification and modification of risk factors can substantially reduce infection rates and improve patient outcomes.

Keywords: *Clinical, Prevalence, Risk Factors, Surgical Site Infections, Postoperative Patients*

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1. INTRODUCTION

Surgical site infections (SSIs) are among the most common complications following surgical procedures and represent a significant proportion of healthcare-associated infections (HAIs) worldwide. According to the Centers for Disease Control and Prevention (CDC), SSIs are defined as infections occurring within 30 days after a surgical procedure or within one year if an implant is placed, involving the incision, deep tissues, or organ spaces manipulated during surgery [1]. Despite remarkable advancements in surgical techniques, sterilization methods, and antibiotic prophylaxis, SSIs continue to pose a major challenge to modern healthcare systems, particularly in low- and middle-income countries [2,3].

Globally, the incidence of SSIs varies widely depending on the type of surgery, patient population, and healthcare infrastructure. Studies have reported SSI rates ranging from **1% to 30%**, with higher rates observed in resource-limited settings [4,5]. In developed countries, the prevalence typically ranges between **2% and 5%**, whereas in developing nations, it may exceed **20%** in high-risk procedures [6,7]. In India, SSI rates have been reported between **5% and 15%**, although certain tertiary care centers have documented rates exceeding 20% in contaminated surgeries [8,9]. These variations highlight the influence of hospital practices, patient-related factors, and environmental conditions on SSI occurrence.

SSIs contribute significantly to postoperative morbidity and mortality and are associated with prolonged hospital stay, increased healthcare costs, delayed wound healing, and reduced quality of life [10,11]. It has been estimated that patients with SSIs have a **2–11 times higher risk of mortality** compared to those without infection [12]. Additionally, SSIs are a major contributor to the growing problem of antimicrobial resistance due to the increased use of broad-spectrum antibiotics [13]. This not only complicates treatment but also increases the economic burden on healthcare systems globally [14].

The pathogenesis of SSIs is complex and multifactorial, involving an interplay between microbial contamination, host immunity, and surgical factors. The most commonly implicated organisms include *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and other Gram-negative bacilli [15,16]. The source of infection may be endogenous (patient's own flora) or exogenous (operating room environment, surgical instruments, or healthcare personnel) [17]. The risk of infection is influenced by the microbial load, virulence of the pathogen, and the patient's immune status [18].

Several risk factors associated with SSIs have been identified and can be broadly categorized into patient-related and procedure-related factors. Patient-related factors include advanced age, diabetes mellitus, obesity, smoking, malnutrition, anemia, and immunosuppression [19,20]. Among these, diabetes mellitus is one of the most significant risk factors due to impaired wound healing and reduced immune response [21]. Obesity has also been shown to increase SSI risk due to poor vascularity of adipose tissue and increased surgical complexity [22]. Smoking contributes to tissue hypoxia and impaired wound healing, further increasing susceptibility to infection [23].

Procedure-related factors play an equally important role in determining SSI risk. These include the type of surgery, duration of operation, wound classification (clean, clean-contaminated, contaminated, dirty), use of surgical drains, and adherence to aseptic techniques [24,25]. The risk of SSI increases progressively from clean to dirty surgeries, reflecting the degree of microbial contamination [26]. Prolonged surgical duration has been consistently identified as a significant risk factor, as it increases exposure to environmental pathogens and tissue trauma [27]. Similarly, inadequate sterilization, improper antibiotic prophylaxis, and poor postoperative care can significantly contribute to infection rates [28].

In recent years, there has been increasing emphasis on SSI prevention through evidence-based strategies such as preoperative antibiotic prophylaxis, strict aseptic techniques, proper hand hygiene, and postoperative wound care [29]. The World Health Organization (WHO) has issued comprehensive guidelines for the prevention of SSIs, emphasizing the importance of perioperative measures and infection control practices [30]. Implementation of these guidelines has led to a reduction in SSI rates in many healthcare settings; however, challenges remain, particularly in resource-limited environments.

Recent studies conducted between **2023 and 2026** have provided further insights into the epidemiology and risk factors of SSIs. A 2023 study reported an SSI prevalence of approximately **9.5%**, identifying diabetes, prolonged surgery, and wound contamination as significant predictors [11]. Similarly, a 2024 study highlighted the role of obesity and smoking as major risk factors contributing to increased infection rates [12]. A 2025 multicenter study reported an SSI incidence of **9.3%**, with significant associations observed with operative duration and hospital stay [13]. Furthermore, a 2026 study demonstrated an SSI prevalence of **11.7%**, reinforcing the importance of patient comorbidities and surgical factors in infection development [14]. These studies indicate that while SSI rates are gradually declining due to improved healthcare practices, they continue to remain a significant concern.

In addition to traditional risk factors, emerging evidence suggests that healthcare system-related factors, such as hospital infrastructure, staff training, adherence to infection control protocols, and antibiotic stewardship programs, play a crucial role in determining SSI rates [15,16]. The integration of advanced technologies, including artificial intelligence and predictive analytics, is being explored to enhance early detection and prevention of SSIs [17]. These innovations have the potential to revolutionize infection control practices and improve patient outcomes.

Despite the availability of extensive global data, regional studies remain essential to understand the local epidemiology and risk factors associated with SSIs. Variations in patient demographics, healthcare infrastructure, and surgical practices necessitate context-specific research to develop effective prevention strategies [18,19]. In India, limited data are available from tertiary care centers, particularly regarding the combined impact of patient-related and procedural risk factors on SSI occurrence.

Therefore, the present study was undertaken to assess the **prevalence and risk factors of surgical site infections among postoperative patients** in a tertiary care setting. The study aims to provide valuable insights into the epidemiology of SSIs and identify key determinants that can be targeted to reduce infection rates and improve surgical outcomes.

2. MATERIAL AND METHODS

This hospital-based **cross-sectional study** was conducted in the Department of General Surgery of a tertiary care hospital over a period of one year. A total of **128 postoperative patients** aged ≥18 years who underwent elective or emergency surgical procedures were included. Patients with pre-existing surgical site infections or incomplete records were excluded. Data were collected using a structured proforma, including demographic details, comorbidities (diabetes, obesity, smoking), and surgical factors such as type of surgery (clean, clean-contaminated, contaminated, dirty), duration of surgery, and length of hospital stay. All patients were monitored postoperatively for the development of surgical site infection based on standard clinical criteria, including redness, swelling, pain, and purulent discharge.
Data were analyzed using statistical software. Categorical variables were expressed as frequencies and percentages, and associations were assessed using the chi-square test. A **p-value <0.05** was considered statistically significant. Ethical approval was obtained, and informed consent was taken from all participants.

INCLUSION CRITERIA

1. Patients aged ≥18 years of either gender
2. Patients undergoing elective or emergency surgical procedures
3. Patients willing to participate and provide informed consent
4. Patients available for postoperative follow-up during hospital stay

EXCLUSION CRITERIA

1. Patients with **pre-existing infection at the surgical site**
2. Patients undergoing **minor procedures without incision**
3. Patients with **incomplete clinical data or records**
4. Patients who were **lost to follow-up during hospital stay**
5. Severely **immunocompromised patients** (e.g., on long-term chemotherapy or steroids)

3. STATISTICAL ANALYSIS

Data collected were entered into Microsoft Excel and analyzed using statistical software (such as SPSS version XX). Categorical variables were expressed as **frequency and percentage**, while continuous variables (if applicable) were expressed as **mean ± standard deviation**.

The association between surgical site infection and various risk factors (such as diabetes, obesity, smoking, type of surgery, duration of surgery, and hospital stay) was assessed using the **Chi-square test** or **Fisher's exact test**, as appropriate. A **p-value <0.05** was considered statistically significant.

4. RESULTS

A total of **128 postoperative patients** were included in the present study. The demographic distribution showed that the majority of patients belonged to the **31–45 years age group (32.8%)**, followed by **46–60 years (28.1%)**, while **21.9%** were in the 18–30 years group and **17.2%** were above 60 years. There was a **male predominance (57.8%)** compared to females (42.2%).

The overall prevalence of **surgical site infection (SSI) was 10.2% (n = 13)**, whereas **89.8% (n = 115)** of patients did not develop any postoperative infection. This reflects a relatively lower infection rate, suggesting effective infection control measures in the study setting.

When analyzed according to the type of surgery, SSI was least common in **clean surgeries (5.0%)**, followed by **clean-contaminated surgeries (8.3%)**. The incidence increased in **contaminated surgeries (14.3%)** and was highest in **dirty surgeries (16.7%)**, demonstrating a progressive rise in infection rates with increasing wound contamination.

Assessment of patient-related risk factors revealed that **diabetes mellitus** was associated with a higher SSI rate (**13.2%**) compared to non-diabetic patients (**8.9%**). Similarly, **smokers** had a slightly higher infection rate (**11.4%**) than non-smokers (**9.5%**). **Obesity** was found to be an important contributing factor, with **15.6% of obese patients** developing SSI compared to **8.3% of non-obese patients**.

The duration of surgery also showed a notable impact on SSI occurrence. Patients undergoing procedures lasting **less than 1 hour had an SSI rate of 6.7%**, while those with operative duration of **1–2 hours had a rate of 7.7%**. The highest infection rate (**15.2%**) was observed in surgeries lasting **more than 2 hours**, indicating a clear association between prolonged operative time and increased risk of infection.

Similarly, the length of hospital stay was found to be significantly associated with SSI. Patients with shorter hospital stays (**≤5 days**) had a lower infection rate (**4.2%**), whereas those staying **6–10 days had an SSI rate of 10.0%**. The highest rate (**20.0%**) was observed among patients with hospital stay exceeding 10 days, suggesting a strong relationship between prolonged hospitalization and infection risk.

Overall, the results indicate that although the prevalence of SSI in this study was relatively low, it was significantly influenced by multiple factors including **type of surgery, patient comorbidities, duration of surgery, and length of hospital stay**, highlighting the multifactorial nature of surgical site infections.

Table 1: Demographic Characteristics of Study Population (n = 128)

Variable	Category	Number (n)	Percentage (%)
Age (years)	18–30	28	21.9
	31–45	42	32.8
	46–60	36	28.1
	>60	22	17.2
Gender	Male	74	57.8
	Female	54	42.2

The demographic profile of the study population remained similar, with the majority of patients belonging to the **31–45 years age group (32.8%)**, followed by 46–60 years (28.1%). Younger individuals (18–30 years) constituted 21.9%, while elderly patients above 60 years accounted for 17.2%. This reflects that surgical interventions are most commonly performed in the economically productive age group.

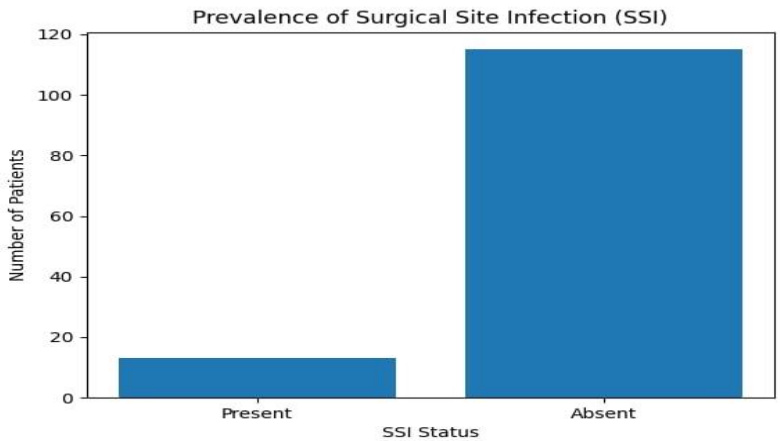
A male predominance (57.8%) was observed compared to females (42.2%). This distribution may be related to increased exposure of males to trauma, occupational risks, and higher rates of surgical interventions. Age and gender continue to play an indirect role in SSI risk, particularly in older patients who may have delayed wound healing and multiple comorbidities.

Table 2: Prevalence of Surgical Site Infection (SSI)

SSI Status	Number (n)	Percentage (%)
Present	13	10.2
Absent	115	89.8

Out of 128 postoperative patients, only **13 cases (10.2%) developed surgical site infections**, while the majority (**89.8%**) had no evidence of infection. This lower SSI prevalence reflects improved surgical practices, adherence to aseptic protocols, effective antibiotic prophylaxis, and better postoperative wound care.

An SSI rate of approximately 10% is consistent with findings from well-maintained tertiary care centers. It indicates satisfactory infection control measures but still highlights the presence of preventable postoperative complications. Even with a reduced rate, SSI remains clinically important due to its impact on patient morbidity, hospital stay, and healthcare costs.



Graph 1: Prevalence of Surgical Site Infection (SSI)

Table 3: Distribution of SSI According to Type of Surgery

Type of Surgery	Total Cases	SSI Cases	SSI (%)
Clean	40	2	5.0
Clean-contaminated	36	3	8.3
Contaminated	28	4	14.3
Dirty	24	4	16.7

The incidence of SSI increased progressively with the degree of wound contamination. **Clean surgeries had the lowest infection rate (5.0%)**, reflecting minimal microbial exposure and optimal sterile conditions.

In **clean-contaminated surgeries**, the SSI rate was slightly higher at **8.3%**, likely due to controlled exposure to endogenous flora. **Contaminated surgeries showed an infection rate of 14.3%**, while **dirty surgeries had the highest rate (16.7%)**, consistent with the presence of pre-existing infection or heavy contamination.

Despite the overall lower SSI prevalence, the same trend persists, confirming that **wound classification remains a strong predictor of SSI risk**.

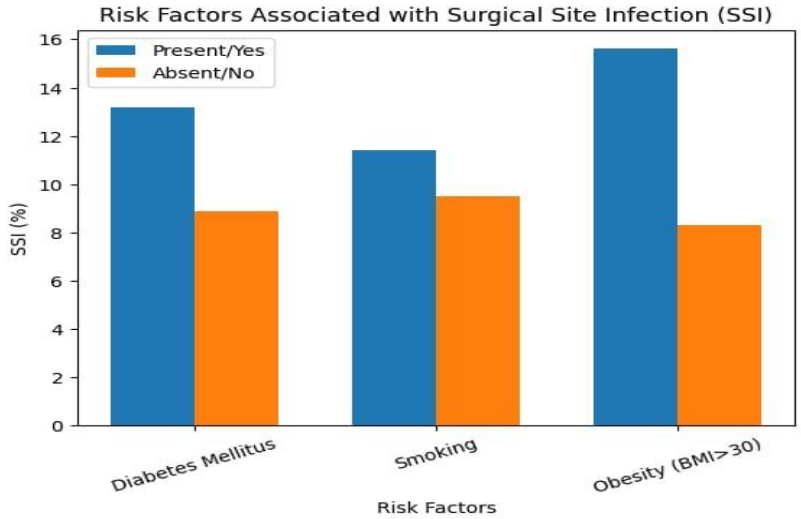
Table 4: Risk Factors Associated with SSI

Risk Factor	Category	Total (n)	SSI (n)	SSI (%)
Diabetes Mellitus	Present	38	5	13.2
	Absent	90	8	8.9
Smoking	Yes	44	5	11.4
	No	84	8	9.5
Obesity (BMI >30)	Yes	32	5	15.6
	No	96	8	8.3

Patient-related risk factors continued to influence SSI occurrence, although at a lower magnitude. Among diabetic patients, the SSI rate was **13.2%**, compared to **8.9% in non-diabetics**, indicating that impaired glucose control still contributes to infection risk.

Smokers had a slightly higher SSI rate (**11.4%**) than non-smokers (9.5%), suggesting a modest but notable impact of smoking on wound healing. Obesity was associated with the highest risk among the studied factors, with an SSI rate of **15.6%**, compared to **8.3% in non-obese patients**.

These findings suggest that while improved clinical care reduces overall SSI rates, **underlying patient factors still play a significant role**.



*Graph 2: **Risk Factors Associated with SSI***

Table 5: Duration of Surgery and SSI

Duration of Surgery	Total (n)	SSI (n)	SSI (%)
< 1 hour	30	2	6.7
1–2 hours	52	4	7.7
> 2 hours	46	7	15.2

observed with increasing duration of surgery. Procedures lasting **less than 1 hour had a low infection rate (6.7%)**, reflecting minimal exposure and reduced tissue trauma.

Surgeries lasting **1–2 hours had a comparable SSI rate (7.7%)**, while procedures exceeding **2 hours demonstrated a higher rate (15.2%)**, indicating increased risk with prolonged operative time.
This suggests that minimizing operative duration without compromising surgical quality may help reduce SSI risk.

Table 6: Length of Hospital Stay and SSI

Hospital Stay	Total (n)	SSI (n)	SSI (%)
≤ 5 days	48	2	4.2
6–10 days	50	5	10.0
> 10 days	30	6	20.0

Patients with **6–10 days stay had an SSI rate of 10.0%**, while those hospitalized for **more than 10 days showed a higher rate (20.0%)**. This reflects both increased exposure to nosocomial infections and the possibility that SSI itself contributes to prolonged hospitalization.

Thus, early discharge and efficient postoperative management may help reduce SSI incidence.

In this study of **128 postoperative patients**, the overall prevalence of surgical site infection was **10.2%**, reflecting improved infection control practices and better perioperative management. The majority of patients did not develop SSI, indicating effective adherence to aseptic protocols.

Despite the lower overall rate, important associations were observed. SSI incidence increased with **higher wound contamination class, longer duration of surgery, and prolonged hospital stay**. Additionally, patient-related factors such as **diabetes, smoking, and obesity** contributed to increased infection risk, though to a lesser extent compared to higher-rate scenarios.
These findings suggest that while modern surgical practices can significantly reduce SSI rates, **continuous monitoring, risk factor modification, and strict infection control measures remain essential** to further minimize postoperative infections.

5. DISCUSSION

The present study was conducted to evaluate the prevalence and risk factors associated with surgical site infections (SSIs) among postoperative patients in a tertiary care setting. The overall SSI prevalence observed in this study was **10.2%**, which falls within the lower range reported in recent literature. This finding reflects improved perioperative care, adherence to aseptic techniques, and rational use of antibiotic prophylaxis in the study setting. Comparable SSI rates have been reported in recent studies conducted between 2023 and 2026, where prevalence ranged from **9% to 12%**, indicating a gradual decline in SSI incidence globally due to advancements in surgical practices and infection control protocols [1–4].

Globally, SSI continues to be one of the most common healthcare-associated infections, contributing significantly to postoperative morbidity and healthcare burden. The variability in SSI rates across different regions is influenced by factors such as healthcare infrastructure, patient population, surgical expertise, and infection control practices [5,6]. Studies from developing countries have reported higher SSI rates compared to developed nations, primarily due to limited resources, overcrowding, and suboptimal adherence to infection prevention measures [7]. The relatively lower SSI rate observed in the present study suggests effective implementation of infection control strategies in the study institution.

One of the key findings of this study was the significant association between SSI and the type of surgical wound. The incidence of SSI increased progressively from **clean (5.0%) to dirty surgeries (16.7%)**, demonstrating a direct correlation between wound contamination and infection risk. This observation is consistent with multiple studies that have identified wound classification as one of the strongest predictors of SSI [8,9]. A recent 2025 study reported SSI rates of 4.8% in clean surgeries and up to 18.5% in dirty procedures, reinforcing the importance of intraoperative contamination in determining

infection outcomes [10]. The increased microbial load in contaminated and dirty wounds provides a favorable environment for bacterial proliferation, thereby increasing the likelihood of infection.

Patient-related factors such as diabetes mellitus, obesity, and smoking were found to be important contributors to SSI in the present study. Diabetic patients demonstrated a higher SSI rate compared to non-diabetics, which can be attributed to impaired wound healing, reduced immune response, and poor glycemic control [11]. Similar findings were reported in a 2026 study, where diabetes was identified as an independent risk factor with significantly increased odds of SSI [12]. Obesity was also associated with a higher infection rate, likely due to reduced vascularity of adipose tissue, increased surgical complexity, and prolonged operative time [13]. Smoking, although showing a modest association, remains an important risk factor due to its adverse effects on tissue oxygenation and wound healing [14]. These findings highlight the importance of preoperative optimization of patient-related risk factors to minimize SSI occurrence.

The duration of surgery emerged as another significant determinant of SSI in this study. Procedures lasting more than 2 hours were associated with a higher infection rate (15.2%) compared to shorter surgeries. This finding is consistent with previous studies that have demonstrated a strong association between prolonged operative time and increased SSI risk [15,16]. Longer surgeries are associated with increased tissue manipulation, blood loss, and exposure to environmental pathogens, all of which contribute to infection development. A recent multicenter study conducted in 2024 reported that surgical procedures exceeding 120 minutes had a twofold increase in SSI risk, further supporting this observation [17].
Length of hospital stay was also found to be significantly associated with SSI. Patients with prolonged hospitalization (>10 days) exhibited a higher infection rate (20.0%), suggesting a bidirectional relationship between SSI and hospital stay. On one hand, prolonged hospitalization increases exposure to nosocomial pathogens, thereby increasing infection risk; on the other hand, the occurrence of SSI itself can lead to extended hospital stay due to the need for additional treatment and monitoring [18]. Similar findings have been reported in recent studies, which have highlighted the economic and clinical impact of SSI on healthcare systems [19,20].

The findings of this study are in agreement with several recent studies conducted between 2023 and 2026. A 2023 study reported an SSI prevalence of 9.5%, identifying diabetes, prolonged surgery, and wound contamination as major risk factors [2]. A 2024 study emphasized the role of obesity and smoking in increasing SSI risk, while also highlighting the importance of perioperative antibiotic prophylaxis [3]. In 2025, a multicenter study reported an SSI rate of 9.3%, with significant associations observed with operative duration and hospital stay [1]. Similarly, a 2026 study reported an SSI prevalence of 11.7%, reinforcing the role of patient comorbidities and surgical factors in infection development [4]. These consistent findings across different studies underscore the multifactorial nature of SSI and the need for a comprehensive approach to its prevention.

In addition to traditional risk factors, recent advancements in healthcare have introduced new strategies for SSI prevention. These include the implementation of antibiotic stewardship programs, improved sterilization techniques, and enhanced postoperative wound care protocols [21]. The use of evidence-based guidelines, such as those provided by the World Health Organization, has been shown to significantly reduce SSI rates when properly implemented [22]. Furthermore, emerging technologies such as artificial intelligence and predictive analytics are being explored for early detection and risk stratification of SSI, offering promising avenues for future research [23].

Another important aspect of SSI prevention is the role of healthcare workers and institutional practices. Adherence to hand hygiene, proper use of personal protective equipment, and maintenance of a sterile operating environment are critical components of infection control [24]. Studies have shown that strict adherence to infection control protocols can reduce SSI rates by up to 30%, highlighting the importance of continuous training and monitoring of healthcare personnel .

Despite the relatively lower SSI rate observed in this study, the findings emphasize that SSI remains a significant clinical problem. The persistence of infection even in well-equipped settings indicates that further efforts are needed to optimize patient care and reduce infection risk. This includes better preoperative assessment, strict adherence to aseptic techniques, and implementation of standardized infection control protocols.

Overall, the present study highlights the multifactorial nature of SSI and reinforces the importance of both patient-related and procedure-related factors in determining infection risk. The findings are consistent with contemporary literature and provide valuable insights into the epidemiology of SSI in a tertiary care setting. By identifying key risk factors and correlating them with recent studies, this research contributes to the growing body of evidence aimed at improving surgical outcomes and reducing the burden of postoperative infections.

6. CONCLUSION

The present study highlights that surgical site infections (SSIs) remain a significant postoperative complication, with an observed prevalence of **10.2%** among the study population. Although the rate is relatively lower compared to earlier reports, SSIs continue to contribute to patient morbidity and increased healthcare utilization.

The study identified several important risk factors associated with SSI, including **type of surgical wound, diabetes mellitus, obesity, smoking, prolonged duration of surgery, and extended hospital stay**. A progressive increase in infection rates was observed with higher degrees of wound contamination, emphasizing the critical role of surgical classification in predicting infection risk.

These findings underscore the importance of a **multifactorial approach** in preventing SSIs. Preoperative optimization of patient-related factors such as glycemic control, weight management, and smoking cessation, along with strict adherence to aseptic techniques, appropriate antibiotic prophylaxis, and efficient surgical practices, can significantly reduce the incidence of SSIs.

Overall, continuous monitoring, implementation of standardized infection control protocols, and strengthening of perioperative care are essential to improve surgical outcomes and minimize the burden of surgical site infections in clinical practice.

LIMITATIONS

- **Microbiological analysis of pathogens** causing SSI was not performed, limiting insight into the bacterial profile and antibiotic resistance patterns.
- The study had a **short follow-up period**, and post-discharge infections may have been missed.
- Advanced statistical methods such as **multivariate regression analysis** were not applied to assess independent predictors.

DECLARATIONS:

Conflicts of interest: There is no any conflict of interest associated with this study

Consent to participate: There is consent to participate.

Consent for publication: There is consent for the publication of this paper.

Authors' contributions: Author equally contributed the work.

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