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Post Caesarean Surgical Site Infection: Incidence, Prevalence, Risk Factors and Microbiological Profile of Tertiary Care Hospital, Jaipur

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Abstract **Original Research Article**

***Background*:** In the past few decades, the prevalence of cesarean sections (CS) has continuously increased worldwide making it one of the most frequent surgical procedures. CS can often save a patient's life, but there are chances of postoperative consequences such as surgical site infections (SSI). During this study we have determine the occurrence and risk factors associated surgical site infections in women undergoing CS. ***Methodology*:** This is a prospective study conducted in a tertiary care hospital. Total 280 women were selected whose undergoes elective or emergency CS during May 2023 – July 2023. Each woman was properly examined and followed for 7 days to developed SSI. Bacterial profile and antibiotics pattern were examined to relate other factors associated with SSI. ***Results*:** Among 280 candidate 59 candidate suspected for SSI which are 4.74%. after microbiological analysis 5 samples were failed to produce culture, 54 (5.18%) samples were identified as SSI. Among 54 samples 77. 78% (n=42) observed as Single bacterial infection and 22.22 (n=12) observed as Mixed bacterial infection. Among all Coagulase negative *staphylococci* spp (CoNS) showed the highest infection 22.23% followed by *Staphylococcus aureus* 16.95% highest infection was observed in higher age candidate (>30) 37.04%, rural candidate 59.26%, obese candidate 31.48% and Lower-class candidate 53.70%. ***Conclusion*:** This study showed the high incidence of SSI after CS which highlighted the urgent need of prevent and surveillance of SSI. Considering patients demographic and medical history incidences of SSI can be reduced.

Keywords: Cesarean Sections, Surgical Site Infections, Coagulase Negative *Staphylococci* Spp, *Staphylococcus aureus*.

INTRODUCTION

Cesarean section (CS) as a surgical procedure, plays an important part in contemporary obstetrical practice. Which provides a safe option when vaginal delivery poses a life threat to the mother or the fetus (Zejnullahu *et al*., 2019). However, CS is not without complications, the most prominent being surgical site infection (SSI). SSI presents numerous challenges in the postoperative care of patients (Jain *et al*., 2022). SSIs are of paramount interest in every surgical specialty according to CDC. Invasive infections developed with in the 30 days of surgery site considered as SSI (Gomaa *et al*., 2021).

SSI categorised majorly in three categories such as Superficial incisional SSI, Deep incisional SSI and Organ/space SSI. Superficial incisional SSIs are limited to the skin and subcutaneous tissue around the incision site (Njoku and Njoku, 2019). They usually show up within 30 days after surgery and come with symptoms like redness, warmth, swelling, pain, and discharge. Other factors such as surgical techniques without proper sterilization, weak immunity of patient can increase the risk of SSIs (Isanga *et al*., 2020).

Other category of SSI are deep incisional SSIs, in which incision cut the skin and spread into the fascia and muscle layers. They also appear within 30 days except any implant which can go further up to 90 days (Dong *et al*., 2024). Symptoms are continuing pain, severe fever and heavily drainage. This type of incision could be a result of improper surgical technique and blood clotting. The complex category of SSI is Organ/space SSI which affect the other parts of the body like other organ and spaces. These infections also developed the symptoms like pain, fever, systemic infection and sepsis in 30 days after surgery, or in the case of an implant 90 days (Ofuruma *et al*., 2021).

In CS superficial infections such as folliculitis (infection of hair follicles at the incision site) are very

common. It shows symptoms like small red pus-filled bumps. They can be avoided by antibiotics and proper wound care. On the other hand, deep and organ SSI such as uterus (endometritis) infections can cause serious problems which leads to the abscesses, peritonitis, and sepsis (Li and Cui, 2021). SSI are a serious threat which put mother health at risk. For avoiding SSIs in CS proper surgical technique and sterile protocols is required. Giving antibiotics before surgery as a preventive measure and making sure the patient's health is optimized before the operation, by managing chronic conditions and avoiding smoking, are also helpful (Elahi and Alam, 2019). After the surgery, careful monitoring for signs of infection and educating the patient about proper wound care practices are key. Understanding how SSIs are classified and how to manage them is crucial in reducing their occurrence and improving outcomes for patients who undergo surgery, especially Cesarean sections (Choudhury *et al*., 2021).

The current CS rates vary around the world and are approximately 21% as estimated by the WHO, this shows that addressing of SSIs while CS is important. When CS rates have rising in developing country like India, it means better health care delivery and change in the obstetrics practice are required. At the same time, it generates concerns about infection control in diverse health-care facilities with different levels of resource endowment. In CS, the procedure involves giving antibiotics before skin incision, is highly affected as per the research conducted by Boutefnouchet *et al*., (2024). On the other hand, prolonged courses of antibiotics may be required especially in complex surgeries involving the gastrointestinal tract due to the high bacterial burden. Several studies off SSI in CS revealed infection rate between 3.1% to 24.2% in India which is higher in comparison of global rate 0.63% and 9.85% (Basany *et al*., 2024). These statistics underscore the importance of appropriate prevention and infection control measures in obstetrics. However, the practice of SSIs in other major abdominal procedures like colorectal or gastrointestinal surgery involves similarities but also has difference. For instance, procedures like colorectal surgeries come with higher SSI rates, which may be over 10% attributed to the flora in the gastrointestinal system (Zhou *et al*., 2020). These procedures require aggressive preoperative bowel preparation, antibiotic prophylaxis, and careful surgical approach to avoid infection complications. For instance, Gillespie *et al*., (2021) have also established that improving the recovery process and enforcing protocols on infection prevention help lower SSI incidence in colorectal surgery.

In comparison, the physiological and immunological differences that occur during pregnancy make it a challenge to prevent and treat SSIs in CS. Pregnancy alters the immune system, blood volume, and wound healing ability, which may affect the likelihood of getting infected and the healing process (Mezemir *et al*., 2023). Emergency pregnancies are more problematic while elective once because of less time for surgical preparations. Procedural factors also play an important role minimal invasive operation such as laparoscopic surgery showed a decreased SSI risk. However, laparoscopic surgeries are still not feasible in CS. In recent advances of wound closure techniques including subcuticular sutures and negative pressure wound therapy can be a milestone in decreasing SSIs in obstetrics surgeries (Mutahi, 2022).

Understanding the incidence prevalence and risk factors for SSIs after CS is crucial for developing effective prevention and management strategies. SSIs not only extend hospital stays and increase medical costs but also contribute to patient discomfort, delayed recovery and life-threatening conditions in severe cases (Bogdanović *et al*., 2022). This study aims to fill the knowledge gap by providing comprehensive data on SSIs in post-cesarean patients at a tertiary care hospital in Jaipur, Rajasthan.

Study Objectives

This study was conducted at the Zanana Hospital, S.M.S. Medical College in Jaipur, which serves a large and diverse patient population. The main objectives of the study were:

1. To determine the incidence and prevalence of SSIs following cesarean sections.
2. To identify the significant risk factors associated with SSIs in post-cesarean patients.
3. To analyze the microbiological profiles of the pathogens causing SSIs.

Study Design

The study was designed as a prospective analysis conducted in the Department of Obstetrics and Gynecology at Zanana Hospital, S.M.S. Medical College, Jaipur From May 2023 to July 2023. Tertiary care hospital Zanana Hospital provides diverse patient population and high volume of cesarean sections which helpful for examining SSIs.

Study Population

A total of 280 women who underwent elective or emergency cesarean sections in Zanana Hospital during the study period were included. Participants were selected based on specific inclusion and exclusion criteria to ensure the study's reliability and relevance.

The study included patients who met the following criteria: any surgical site infection (SSI) after a cesarean section performed in the Department of Obstetrics and Gynecology at Zanana Hospital, S. M. S. Medical College, Jaipur, from March 2012 to March 2013. The definition of SSIs was based on the CDC criteria. The study included patients with SSIs that were either identified during the hospital stay, or at follow up after the patient was discharged. Some of the criteria included exclusion of irrelevant data in order to have accurate results. Patients who failed to respond to follow

up, patients who had other surgical procedures apart from cesarean sections and patients who had follow up more than 7 days from the time of surgery were excluded. Furthermore, the women who had their cesarean sections at other hospitals and those who refused to participate in the study were also excluded. The strict application of inclusion and exclusion criteria made it possible to compare the results in relation to SSIs after cesarean sections within a relatively similar group of patients.

Data Collection

Data were collected through structured interviews, clinical examinations, and microbiological analyses. Detailed information gathered included socio-demographic details such as age, residency (urban or rural), socioeconomic status, medical history of diabetes, hypertension, obesity, anemia, hypothyroidism and pre and post-operative details such as duration of surgery, blood loss, use of prophylactic antibiotics, type of cesarean section (elective or emergency) were gathered.

Microbiological Analysis

Samples from suspected SSI cases were subjected to microbiological analysis to identify the causative pathogens. Antibiotic susceptibility testing was performed to determine the resistance patterns of the isolated bacteria.

Statistical Analysis

Data were analyzed using descriptive and inferential statistics. Incidence and prevalence rates were calculated, and risk factors were identified through multivariate logistic regression analysis. The significance level was set at $p<0.05$ (Sun *et al*., 2020).

RESULTS

Demographic and Socioeconomic Characteristics

While observing the result age distribution indicates a predominance of individuals over 30 years old, suggesting an older demographic cohort. The place of residence data reveals a significant rural majority. Weight distribution is dispersed, with a notable concentration in the 71-80 kg range. Height data indicates a generally shorter stature, with the largest group being under 149 cm. Socioeconomic status is skewed towards the lower category, underscoring prevalent economic challenges (Figure 1).

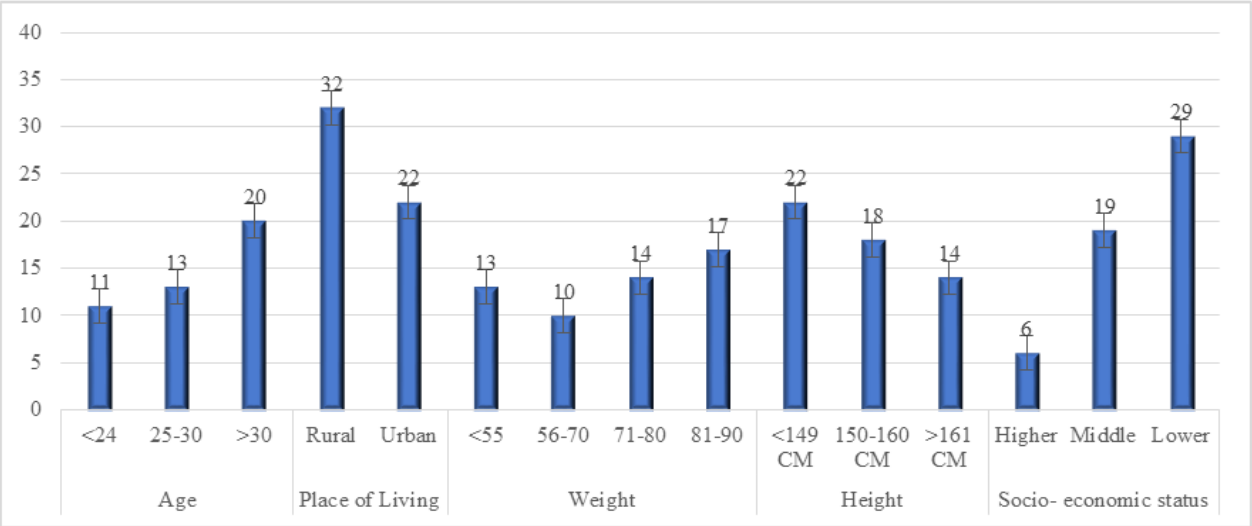


Figure 1: Distribution of Demographic and Socioeconomic Variables

Obstetric and Medical Profile Analysis of Population Sample

While observing previous history A notable proportion of individuals (34) have had previous C-sections, with emergency C-sections (35) being more common than elective ones (21). Multiple pregnancies are more frequent (35) compared to first-time pregnancies (19). Hemoglobin levels show considerable variation, highlighting potential anemia concerns, with 16 individuals below 5, 12 between 5.1-7, 5 between 7.1-8, 21 between 8.1-10, and 19 above 10. Antibiotic use is prevalent (38), and blood transfusion needs are substantial, with 26 individuals receiving transfusions. These findings emphasize the need for targeted healthcare interventions in managing emergency C-sections, anemia, and previous C-section cases.

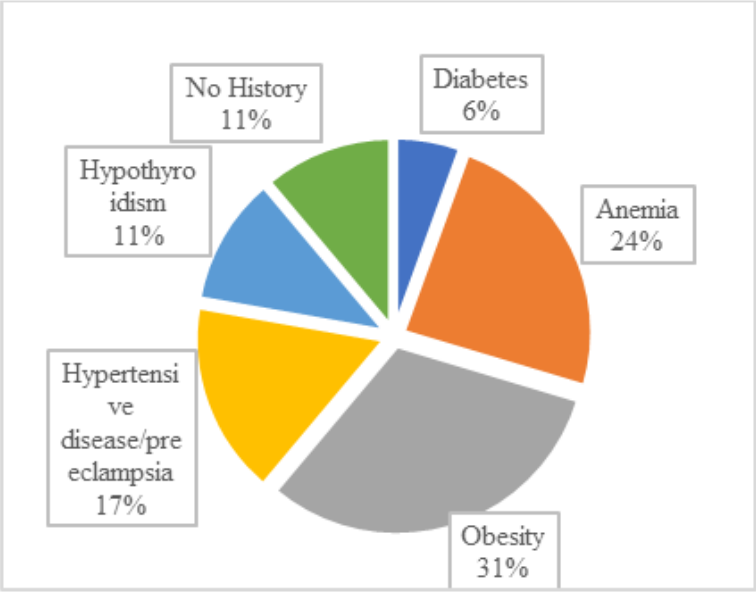
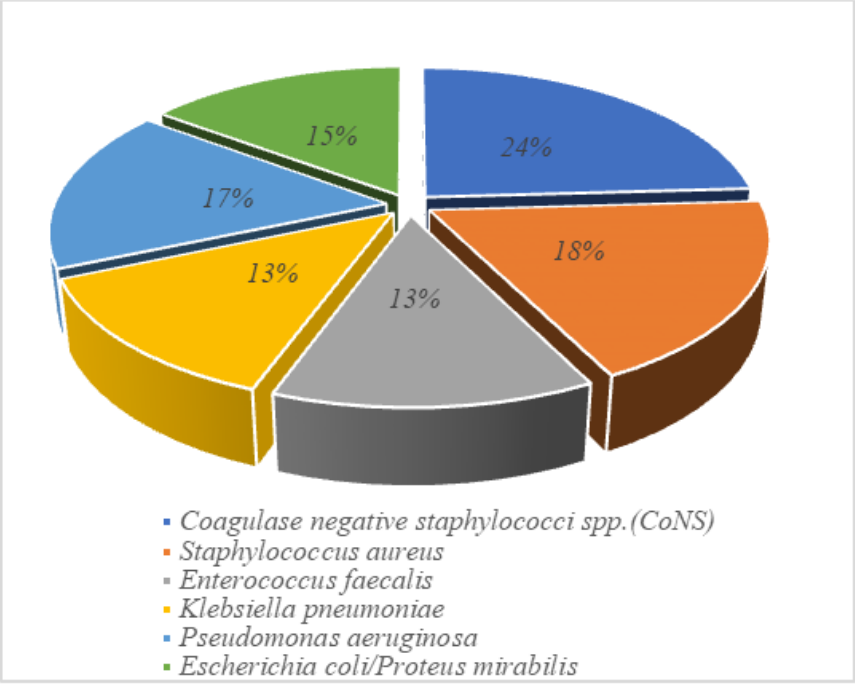


Figure 2: Distribution of Medical Variables in Population Sample

Microbiological Profile

The most common pathogen is coagulase-negative staphylococci (CoNS), accounting for 24% of cases. This is followed by *Staphylococcus aureus* at 18%, *Pseudomonas aeruginosa* at 17%, and both *Enterococcus faecalis* and *Klebsiella pneumoniae* at 13% each. *Escherichia coli/Proteus mirabilis* represent 15% of the sample. These findings highlight the diverse range of bacterial infections present in the population, underscoring the need for targeted antimicrobial strategies to address these prevalent pathogens effectively.



Incidence and Prevalence of SSIs

Among the 280 participants, 59 (4.74%) were initially suspected of having SSI. Microbiological analysis confirmed 54 cases, resulting in a prevalence rate of 5.18%. The breakdown of these cases into single and mixed bacterial infections provides insight into the complexity of SSIs in this population. Notably, the confirmed prevalence was slightly higher than the initial suspicion, highlighting the importance of microbiological confirmation in diagnosing SSIs.

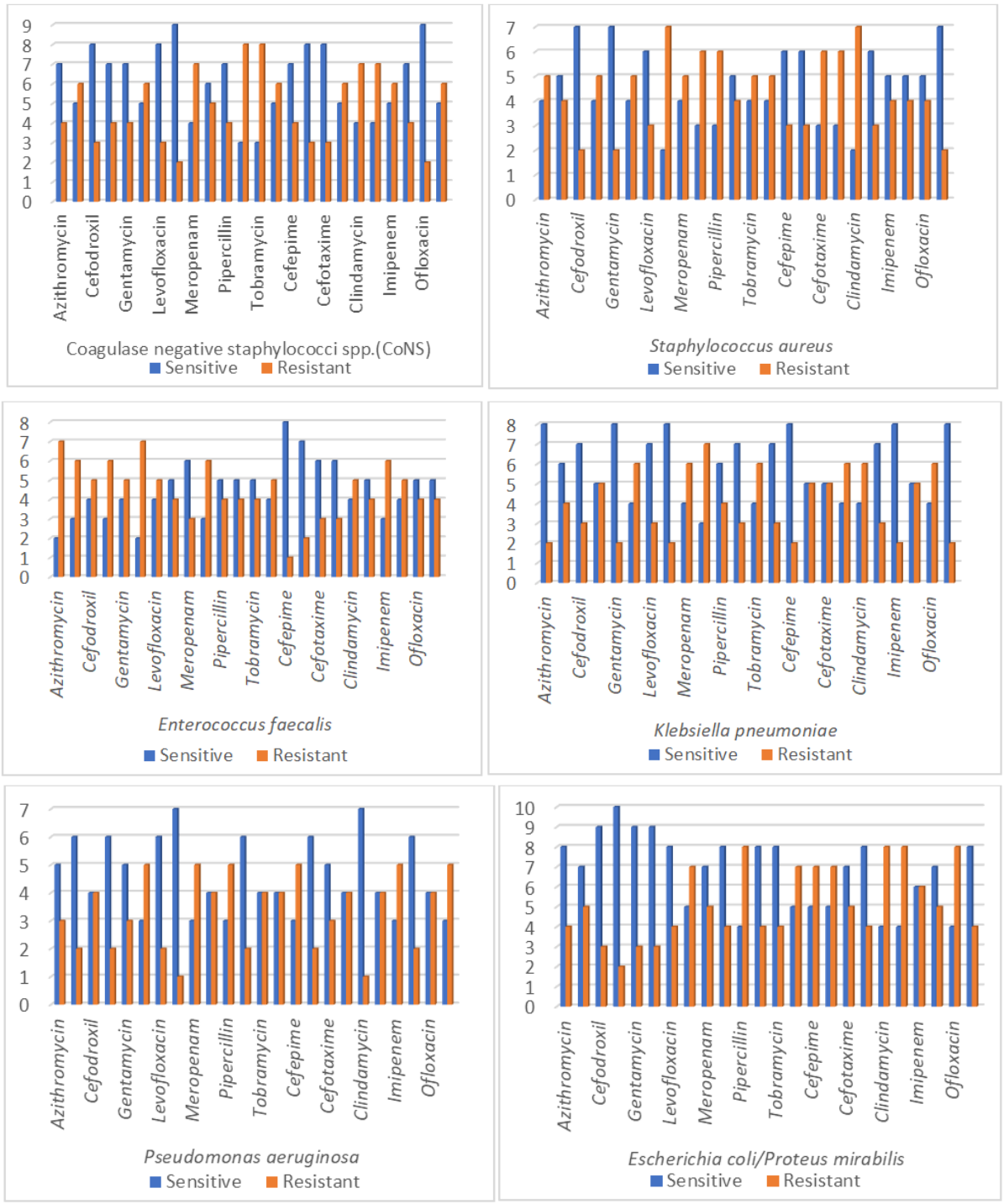


Figure 3: Antibiotic susceptibility pattern against Coagulase negative staphylococci spp.(CoNS), *Staphylococcus aureus, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa* and *Escherichia coli/Proteus mirabilis*

The study identified several significant risk factors for SSIs. Advanced maternal age (≥30 years) was associated with a higher infection rate (37.04%), as were rural residency (59.26%), obesity (31.48%), and lower socioeconomic status (53.70%). These findings emphasize the need for targeted interventions in these high-risk groups.

DISCUSSION

The current study found out that 5.18% of the women who had undergone CS had SSIs in the post-surgical period. This prevalence rate suggests the issue of post-operative infections remains a persistent problem in the obstetric patients. The slightly higher percentage found in this study in comparison study of Gupta *et al.*, (2021), which shows 4.8% rates of SSI in healthcare

institution showed the current scenario of SSI in tertiary care hospitals. Shree *et al.*, (2016) identified an SSI rate of 6.5% which is higher than the results obtained in the current study during the one-year period in a tertiary care hospital. Saeed *et al*., (2019) also noted the SSI prevalence ranging from 3 to 15% across different hospitals, which also indicates that local practice and environment may influence infection rates. These differences indicate that the way through which SSIs can be prevented cannot be generalized and must be adapted to certain contexts and groups of people (Kvalvik *et al*., 2021). These rates contrast with the global trends, and it is evident that SSIs are still a major issue in post-operative care. The given prevalence rates speak about the necessity to follow strict infection control measures and monitor the situation in order not to miss the signs of potential outbreaks. Comparing this study also underlines the need to adopt the consistent diagnostic criteria and reporting methodologies in order to compare the SSI rates across different studies and settings, and thus contribute to the creation of the universally effective prevention measures (Ferraro *et al*., 2016).

The current study revealed that most of the SSI cases (77.78%) presented with single bacterial infection, with Coagulase negative Staphylococci spp (CoNS) being the most commonly isolated pathogen (22.23%) followed by Staphylococcus aureus (16.95%). These results align with the microbial patterns that have been identified in other similar research (Panwar *et al*., 2121). CoNS are resident flora in the skin and are implicated in up to 50% of SSIs because they can attach themselves to the surgical wound and medical devices and form biofilms. Their use highlights the need for strict measures of infection control to be practiced before, during, and after operations (Vijayan *et al.*, 2016). The second most common pathogen identified as *Staphylococcus aureus* also been reported by Al-Kharabsheh and Ahmad (2022) and Mhaske *et al*., (2020) in SSI incidence. *Staphylococcus aureus* is highly pathogenic and resistant to most antibiotics. However microbial landscapes can vary within different geographical areas. According to Shanbhag and Veena (2021) *Escherichia coli* was more prevalent. This highlighted the importance of infection surveillance and antimicrobial stewardship programs at a regional or local level. Knowing the exact microbial flora at various settings will facilitate in designing intervention plans to decrease SSI incidences and enhance patient care.

This research showed that women above 30 years of age were more infected (37.04%), those from rural areas (59.26%), people with obesity (31.48%), and those in low socioeconomic class (53.70%). These demographic factors are important for identifying the population at risk for SSIs and the development of effective prevention measures. Rano and Patel (2020) recommended that there is a direct relationship between increased maternal age and SSI rates. This could be because of the immune system being weaker due to age or other complications that come with age that slow down the healing process (Gan *et al*., 2023). Another interesting finding was that rural dwelling was another major risk factor as majority of the SSI cases were from rural settings at 59.26%. This is in agreement with the study carried out by Wakod and More (2023) that indicated that the rural residents are at a higher risk. The other essential components that have been linked to high SSI rates include obesity and low SES. Agarwal *et al*., (2024) supported the notion that obesity is a risk factor to develop SSI due to factors such as poor wound healing and increased surgery complexity. Kundu *et al*., (2024) noted that low SES is associated with factors such as low health literacy, poor nutritional status, and late presentation to health facilities, which increase vulnerability to infections.

CONCLUSION

This paper offers important information on the incidence and determinant of surgical site infections (SSIs) in relation to Cesarean sections (CSs). Having an SSI prevalence rate of 5. 18%, these results indicate that the problem of infection control in the postoperative period remains a concern. Thus, the importance of strict and uniform protocols for the prevention of infection is quite clear to decrease the rate of SSIs and enhance patients' prognosis. Coagulase-negative Staphylococci spp (CoNS) and *Staphylococcus aureus* are found to be the most common pathogens in this study. The presence of these pathogens emphasizes the need for strict aseptic measures during the operation and adequate post-operative treatment. The results also emphasize the need to implement localized infection surveillance and antimicrobial stewardship programs tailored to the microbial spectra and resistance profiles of various healthcare institutions. It is crucial to perform microbiological audits at least once in a while to check for new pathogens and guarantee infection prevention measures. It was also found that patient related factors including maternal age, residing in rural area, obesity and low socioeconomic status were associated with SSIs. Enhancing the availability of health facilities and human resource development in the rural setting, detailed preoperative evaluation, and postoperative individualized management strategies should be considered as potential ways of addressing these risk factors. Understanding and mitigating these specific risks can help lower SSI rates and improve patient care for those who have undergone CS.

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