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Exploring the Incidence and Determinants of Surgical Site Infections in Caesarean Sections: A Five-Year Study

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EXPLORINGTHEINCIDENCEANDDETERMINANTSOFSURGICALSITEINFECTIONSINCAESAREANSECTIONSAFIVEYEARSTUDY

Strictly as per the compliance and regulations of:

Exploring the Incidence and Determinants of Surgical Site Infections in Caesarean Sections: A Five-Year Study

Nirupama Padmaja Bondili [α], Pallavi Chandra Ravula [σ], Sapam Anju Devi [ρ] & Sadguna Gurrampally [ω]

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Methodology: This was a 5- year observational study conducted at Fernandez Hospital from 2018 to 2022. This study included all case records of women who had caesarean sections at Fernandez Hospital.

Results: The incidence of SSI during the study period was 1.03%. It is found that, overweight and obesity were strongly correlated with increased SSIs. Overweight, Class I obese women, class II obese women and class III obese women were respectively 2.332 times (adjusted OR: 2.332; 95% CI: 1.432 to 3.799), 6.548 times (adjusted OR: 6.548; 95% CI: 4.071 to 10.530), 14.061 times (adjusted OR: 14.061; 95% CI: 8.360 to 23.650), and 37.349 times (adjusted OR: 37.349; 95% CI: 21.444 to 65.051) more likely to have SSI as compared to women with normal BMI. Emergency cesarean sections significantly increased SSI risk compared to elective cesareans (adjusted OR: 1.476, $p<0.001$). Rupture of membranes, women undergoing IOL, women who had more than 5 vaginal examinations and PPH are significant among the other risk factors. Most common isolates are Escherichia coli and Staphylococcus aureus.

Conclusion: The SSI rates at the study site were within the benchmark set for the institute, by taking precautions while dealing with the above mentioned, high- risk group of women.

Keywords: surgical site infections (SSI), cesarean section, risk factors, maternal health, infection control.

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I. Introduction

Caesarean section is the most common surgical procedure performed worldwide. Rising rates are attributed to various medical and non-medical factors[1]. With an increase in the number of cesarean sections, there is a significant increase in the number of SSIs[2,3]. The incidence of SSI following cesarean section worldwide has been reported to range between 0.63 to 9.85%[4–6]. SSIs are the most common health care associated infections (HAI) in India. The incidence of post caesarean SSI in India varies from 3.1 to 24.2%[7,8]. This trend emphasizes the need for robust surveillance and preventive strategies to mitigate the risk of SSIs. This will help to develop targeted interventions to reduce SSIs and improve patient outcomes.

There is a dearth in the existing literature with large data sets of Indian studies and there is lack of uniformity in practices. This study aims at bringing in the uniformity in post operative practices to bring down the SSI rates to acceptable rates. The SSI rates in India differ from international numbers based on the patient demographics, hospital settings, resource limitations and infrastructure etc.

Caesarean sections have a low procedure-level risk of infection as they are considered as clean wound type. Most SSIs after caesarean are preventable with adherence to infection control strategies and good surgical practices.

SSI post cesarean section is defined as an infection that occurs at or near the surgical site within 30 days of the procedure[9]. SSI can be because of contamination before the surgery (traumatic injuries), contamination from the patient (skin flora) or contamination during the surgery (staff, equipment). It is considered as SSI, if one of the following is *observed or reported:*

- A purulent (pus) discharge in, or coming from, the wound (including evidence of an abscess) OR
- Evidence of fever with painful, spreading erythema surrounding the surgical site OR
- Any reopening of the surgical wound

The diagnosis of wound infection does not require bacteriology / laboratory confirmation. Sometimes, it is difficult to identify the causative organism, because multiple organisms are often found in a single infected wound. Most of the time, anaerobes play a major role. SSIs are classified as superficial (involving only the skin and subcutaneous tissue), deep (discharging wounds with deep tissue involvement of the fascial and muscle layers) and organ space SSIs (extend beyond the facial and muscle layers)(10). Each type presents distinct clinical challenges and requires specific management approaches. Understanding the classification of the SSI and the microbiological profile of these infections is essential for optimizing the treatment regimens. Most of the superficial SSI are managed symptomatically with dressings or antibiotics while deep SSI need surgical interventions.

This study aims to provide comprehensive insights into the incidence and the risk factors following Caesarean sections from a five-year period data.

Primary Objective:

- To determine the incidence of surgical site infections (SSI) following caesarean section.

Secondary Objectives:

- To analyse the risk factors associated with SSIs in women undergoing both elective and emergency caesarean sections.
- To classify SSIs into superficial, deep, or organ space infections.
- To identify and analyse the bacterial isolates in the cases of SSI and plot an antibiogram for the institute.

II. Materials and Method

This 5- year observational study was conducted at Fernandez Hospital, a tertiary care referral centre in Hyderabad, Telangana, India, specializing in obstetrics, gynaecology, and neonatology. Utilizing data from five years, the study included all women who had caesarean sections at the study site from January 2018 to December 2022, with patients being followed up to 30 days post-operative period. The reason for choosing this study period was the introduction of the HICC (Hospital Infection Control Committee) team with ICO (Infection Control officer) and ICN (Infection Control Nurse). Data collection was done meticulously, and a standard protocol was practiced. Data were sourced from medical records and hospital infection control surveillance data, encompassing all confirmed cases of surgical site infections (SSIs) during this period.

The women who underwent caesarean sections at other hospitals but came to the study site for follow-up of wound infection and women who were lost to follow-up after caesarean section were excluded. The reason for excluding women who had caesareans in other hospitals was the possibility of difference in practices and inability to get the details of pre OP intra OP and post OP findings.

Hospital protocol: A surgical safety check list adapted from WHO has been used at the study site for monitoring and surveillance. The institute follows usage of single dose antibiotic prophylaxis 30 to 60 minutes prior to the surgical incision(11).

Surveillance: The study procedure involved surveillance of caesarean births, starting from post-operative day 1, continuing as inpatients, and extending up to 30 days post-caesarean sections. This surveillance was carried out by designated staff, including a dedicated staff nurse and the Infection Control Nurse (ICN). The role of ICN was to train the staff in following the set practices in reducing the SSI and follow up the women in the immediate postoperative period, sensitize them about the practices to be followed at home and alerts to visit the hospital after discharge. Data collection methods included postnatal visit forms, with relevant information recorded and maintained as excel sheets. The data was collected in real- time and was entered in the excel sheets. The ICN s were trained to maintain standard data collection and entry. The Infection Control Officer (ICO) analysed the collected data and discussed it with clinicians during monthly Hospital Infection Control Committee (HICC) meetings to identify and address gaps in infection prevention measures. The SSI rate was calculated. The organizational benchmark for SSI was set at 2% with the consensus of HICC based on the Institutional records. Ethical considerations were strictly adhered to throughout the study.

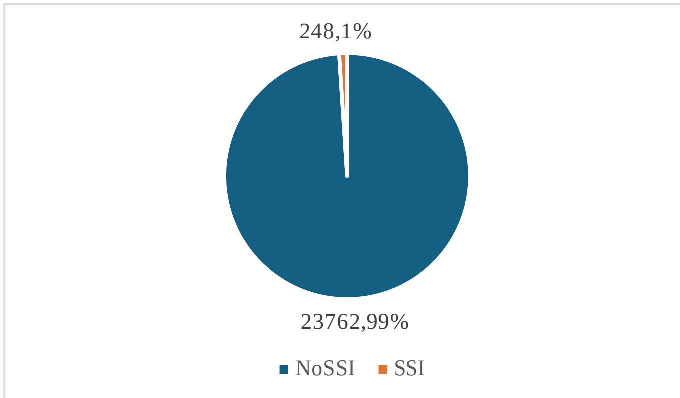
Statistical analysis: Descriptive analysis was carried out by frequency and proportion for categorical variables. Continuous variables were presented as median (IQR) due to non-normal data. The chi-square test was used to test the statistical significance of cross-tabulation between categorical variables. Mann-Whitney U test was used to compare the median (IQR) of continuous variables between two groups. Binary logistic regression was used to assess the predictors of the outcome.

P value < 0.05 was considered statistically significant. RStudio Desktop latest version was used for statistical analysis. (Reference: *R Studio Team (2024). R Studio: Integrated Development for R. R*

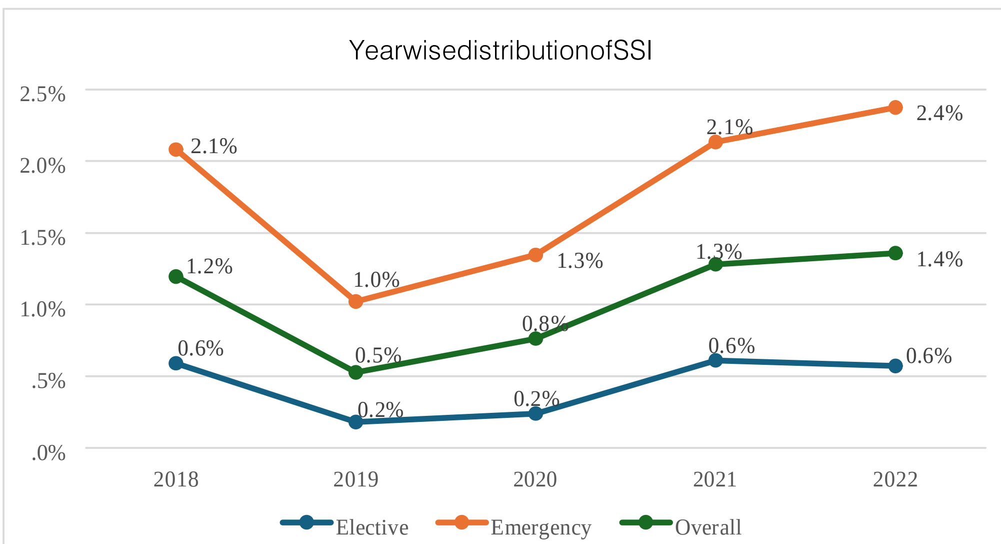
Studio, PBC, Boston, MA URL http://www.rstudio.com/.)

III. Results

A total of 24,010 women had cesarean sections in the study period. Out of these 13628 (56.7%) were elective and 10382 (43.2%) were emergency cesarean sections. A total of 248 women had SSI during the study period with an incidence of 1.03%. The SSI rate following elective caesarean was 0.44% (60/13628) and SSI rate after emergency caesarean was 1.81% (188/10382).



Pie Chart: SSI among CS deliveries (N=24010)



Year wise distribution of SSIs

The baseline characteristics of the patients with SSI are mentioned in Table 1.

Most SSIs occurred in the 20 to 34 years age group (82.7%), with a small proportion in the <= 19 years (0.8%) and >= 35 years (16.5%) age groups. There was a significant variation in SSI cases across different BMI categories. The incidence of SSI was directly proportional to BMI. The distribution of SSI cases between preterm and term cases were 27.8% and 72.2 % respectively. Out of the total SSI 24.2% were following an elective caesarean section and 75.8% were following an emergency caesarean section. 34.7% of the women were Diabetic and 22.2% of the women had hypertensive disorders in pregnancy. 92.7% of the women had singleton pregnancies and 7.3% of the pregnancies were multifetal.

Table 2 compares the basic and obstetric characteristics between the SSI group and the control group.

When compared with the control group, SSI group had higher incidence in women with Class I, Class II and Class III obesity with a significant p value. Emergency LSCS, prelabour rupture of membranes and PPH also showed a significant difference in SSI group when compared with the control group with no SSI.

Table 3 explains the logistic regression to assess the risk factors of SSI.

Higher age, obesity, emergency cesarean section, prelabour rupture of membranes and PPH were found to be significant predictors of SSI following a cesarean section according to univariate analysis ($p<0.05$). Those variables with $p<0.05$ in the univariate analysis were included in the multivariable analysis. Women aged between 20 to 34 were 44.9% (adjusted OR: 0.551; 95% CI: 0.385 to 0.789) less likely to have SSI following CS as compared to women aged >=35 years. Overweight, Class I obese women, class II obese women and class III obese women were respectively 2.332 times (adjusted OR: 2.332; 95% CI: 1.432 to 3.799), 6.548 times (adjusted OR: 6.548; 95% CI: 4.071 to 10.530), 14.061 times (adjusted OR: 14.061; 95% CI: 8.360 to 23.650), and 37.349 times (adjusted OR: 37.349; 95% CI: 21.444 to 65.051) more likely to have SSI as compared to women with normal BMI. Women with emergency cesarean section were 3.822 times (adjusted OR: 3.822; 95% CI: 2.735 to 5.340) more likely to have SSI compared to women with elective cesarean section. Women with PPROM/PROM were 3.75 times (adjusted OR: 3.750; 95% CI: 2.731 to 5.149) more likely to have SSI following cesarean section as compared to women without rupture of membranes. Women with PPH were 1.711 times (adjusted OR: 1.711; 95% CI: 1.167 to 2.508) more likely to have SSI following cesarean section as compared to women without PPH.

Table 4 presents a comparison of various risk factors between elective (n=60) and emergency (n=188) cesarean sections. This detailed comparison highlights the statistically significant difference between the elective and emergency cesarean sections in terms of risk factors such as BMI, Induction of labor, number of vaginal examinations, intrapartum pyrexia and rupture of membranes. Other factors, including age, hypertensive disorders, Diabetes mellitus, autoimmune disorders, PPH, anemia and gestational age did not show significant differences between the two groups.

Majority of the SSI cases (99.19%) were classified as superficial, and 2 cases (0.8%) were classified as deep SSI. The average number of days that the women came back with complaints post-surgery was 10.22 days. Most common complaint was purulent discharge and skin gape at the suture site (31.5%). The commonest organisms isolated in the wound swabs were Escherichia Coli (23%), Staphylococcus aureus (21,4%) followed by Enterococcus fecalis (16.1%) and Klebsiella Pneumoniae (15.7%). In 32 cases (12.9%) no organism was isolated from the wound culture as shown in graph 1.

Organisms isolated from the wound swabs

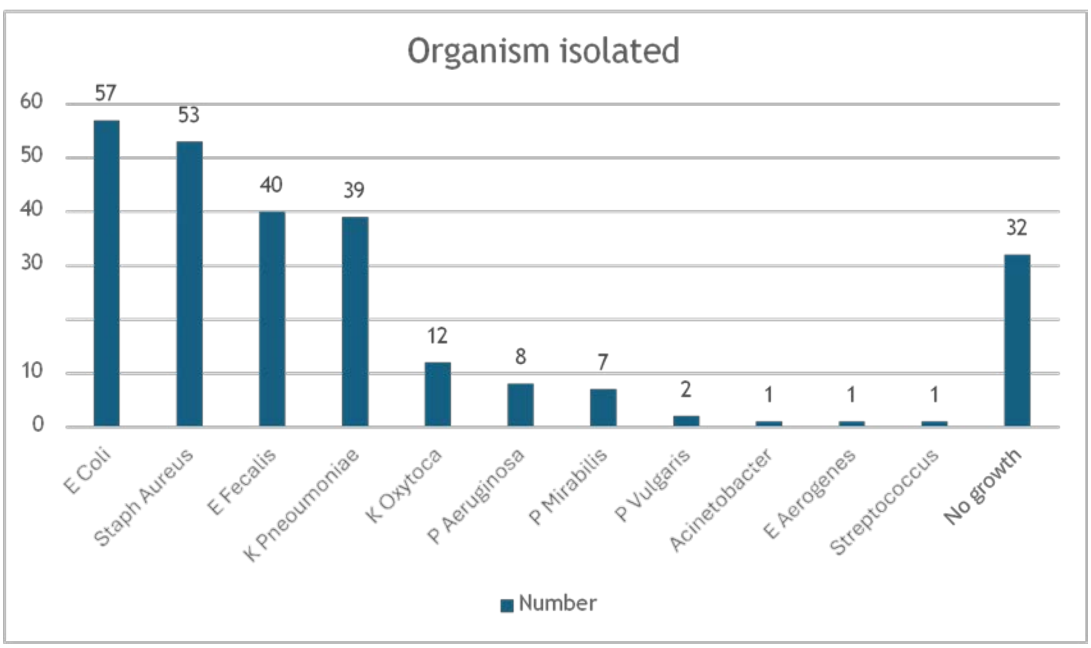


Table 5 highlights the distribution and associations of different organisms isolated from SSI cases with clinical conditions. E. Coli (24.4%), Staphylococcus aureus (18.6%), Klebsiella Pneumoniae (14%) and Enterococcus faecalis (11.6%) are significantly associated with diabetes mellitus.

Of these 248 SSI cases, 241 (97.17%) were managed by conservative management, antibiotics and 7 cases (2.82%) required surgical intervention.

Tables 6 and 7 show the antibiogram plotted for 5 years data taking all the LSCS wound swab samples data. Bacteriological analysis is done in different medical conditions. Antibiogram is plotted following the "*CLSI M39: guidelines for the preparation and use of antibiograms*". Antibiogram for 5 years data taking all the LSCS wound swab samples data was plotted. Antibiotic susceptibility is followed by the CLSI guidelines for the year and Cascade reporting is followed while reporting. As the study population involves mostly naïve mothers without prior exposure to high end antibiotics the sensitivity pattern is very good. The Gram-negative isolates are sensitive to 3rd generation cephalosporins/ BLI preparations, Carbapenems, Aminoglycoside and Fluroquinolones. The Gram-positive isolates are sensitive to Beta lactams, Vancomycin, Fluroquinolones.

IV. Discussion

The findings of this study highlight important factors influencing the incidence of surgical site infections (SSIs) among women undergoing cesarean sections. This study found SSI incidence of 1.03% among caesarean deliveries. In a study done at a teaching hospital by Basany K et al showed SSI incidence as 4.6% and another study done by Hirani S et al showed an SSI incidence of 5.63% which is higher than the current study[7,12] . The prevalence of SSI in Polish hospitals and at a study site in Kenya was reported to be 0.5% and 2.1% respectively indicating varied incidences of SSI in different setups[13,14]. Basany et al showed that 99% of cases were labelled as superficial SSI which is the incidence at the study site[12]. The current study highlights a strong association between higher BMI and increased SSI risk, particularly in the obese and overweight categories.

This aligns with findings from a meta- analysis by Carter et al who reported that obesity is a significant risk factor for SSIs in caesarean sections[15]. A study done by Astha Regmi et al in Nepal also had women with obesity having a higher risk of SSI than those with normal weight and underweight (adjusted OR 15.72 (4.60- 53.67) at p value of <0.001)[16]. Both studies emphasize the need for targeted interventions to restrict weight gain in pregnancy. Emergency caesarean sections had more SSI when compare to elective caesareans which is similar to the study by Panwar D et al and Chhetry et al[8,17] . This is similar to the other studies[18,19]. The increased risk of SSIs in emergency caesarean sections observed in this study is supported by previous research by Gomaa et al. with emergency CS (AOR 2.16; 95% CI =1.61-2.51)(20). The significant association between the number of vaginal examinations and SSIs (p<0.001) is similar to the results of the meta- analysis done in Ethiopia which showed that repeated digital vaginal examination increased the risk of surgical site infection by 3.80 times than the counter parts (AOR = 3.80, 95% CI; (2.45–5.88)[21]. Rupture of membranes was associated with a significant increase in the risk for SSI which is similar to the prospective cohort study done in Ethiopia which showed that the odds of developing an infection after a cesarean section with a history of rupture of membranes was two-fold higher than those without rupture of membranes (AOR: 2.10, 95% CI: 1.04, 4.24)[22]. The timing of antibiotic prophylaxis did not show significant impact on SSI rates (p=0.683). These results corroborate the findings of Baaqeel et. al, who emphasized the importance of timely antibiotic administration to reduce SSIs[23]. The duration of surgery did not show a significant difference when compared to previous studies such as those by Olsen et al[24]. who documented that prolonged operative time increases the risk of infections due to prolonged exposure and the potential for bacterial contamination. Similar studies highlight the need for enhanced infection control measures during emergency caesarean sections. While evaluating the risk factors for SSI in correlation with the maternal medical diseases, the results did not show any significant correlation with diabetes, hypertension or autoimmune disorders as significant risk factor for SSIs. Most of the studies quoted the correlation between diabetes and SSI[25], which is not the same in the current study as most of the women had good glycaemic control during pregnancy. This emphasises the importance of maintaining normoglycemic state. Induction of labour and PPH were also significantly associated with SSI when compared with the control group similar to other studies[26,27].

The predominance of Escherichia coli and Staphylococcus aureus in the study mirrors findings from previous studies, such as those by Haas et al., and other studies[28–31]. The presence of Enterococcus faecalis and other organisms like Klebsiella pneumonia and Pseudomonas aeruginosa in this study suggests a broad spectrum of potential pathogens, emphasizing the need for culture-specific treatment strategies.

Strengths of the study: The strengths of this study lie in its comprehensive real time data collection over five years and rigorous statistical analysis, providing robust insights into the epidemiology and risk factors of SSIs in this setting. The antibiotic policy and the surgical safety checklist have been followed at the study site was as per the WHO criteria. Women were followed up to 30 days postpartum as per the CDC criteria and a team of HICC was constantly monitoring the cases.

Limitations of the study: The results may not reflect the other centres in India as the socio- demographic, medical and obstetric risk factors may not be matched with the other centres in India.

V. Conclusion

The current study's findings highlight the critical need for management of women with high BMI, optimizing maternal medical conditions such as diabetes mellitus, limiting the number of vaginal examinations during labour, and stringent infection control in emergency surgeries and strict adherence to infection control practices. The identification of prevalent organisms and strict compliance with surgical prophylaxis followed by targeted antimicrobial therapy will help reduce the unnecessary use of high-end antibiotics and antimicrobial resistance. The hospital introduced SSI bundle and IPC (Infection Prevention and Control) campaign from 2023, and the month of May has been dedicated to teaching and training the health care workers on infection control practices. Antimicrobial stewardship policy has been implemented strictly adhering to Antibiotic policy of the organization. SSI surveillance is an ongoing process, and a prospective study and publication is planned to look at the impact of introduction of the SSI bundle and IPC campaign on further reducing the SSI rates.

Table 1: Baseline Characteristics of the SSI group (N=248)

Variables	Frequency	Percentage
Age, n (%)		
<= 19 years	2	0.8%
20 to 34 years	205	82.7%
>= 35 years	41	16.5%
BMI, n (%)		
Underweight	0	0.0%
Normal weight	22	8.9%
Overweight	63	25.4%
Class I obese	82	33.1%
Class II obese	45	18.1%
Class III obese	36	14.5%
Parity, n (%)		
Primiparous	179	72.2%
Multiparous	69	27.8%
Gestational age, n (%)		
Preterm	66	26.6%
Term	182	73.4%
Labour, n (%)		
Elective	60	24.2%
Emergency	188	75.8%
Hypertensive disorders, n (%)		
Yes	55	22.2%
No	193	77.8%
DM, n (%)		
Yes	86	34.7%
No	162	65.3%
Autoimmune disease, n (%)		
Yes	5	2.0%
No	243	98.0%

Table 2: Comparison of basic and obstetric characteristics between SSI group and control group

Variables	SSI Group (n=248)	Control group (n=23762)	P value
Age, n (%)			
<= 19 years	2 (0.8%)	138 (0.6%)	0.009
20 to 34 years	205 (82.7%)	21112 (88.8%)	
>= 35 years	41 (16.5%)	2512 (10.6%)	
BMI, n (%)			
Underweight	0 (0.0%)	486 (2.0%)	<0.001
Normal weight	22 (8.9%)	7568 (31.8%)	
Overweight	63 (25.4%)	9337 (39.3%)	
Class I obese	82 (33.1%)	4664 (19.6%)	
Class II obese	45 (18.1%)	1289 (5.4%)	
Class III obese	36 (14.5%)	418 (1.8%)	
Parity, n (%)			
Primiparous	179 (72.2%)	13047 (54.9%)	<0.001
Multiparous	69 (27.8%)	10715 (45.1%)	
Gestational age, n (%)			
Preterm	44 (17.7%)	4594 (19.3%)	0.528
Term	204 (82.3%)	19168 (80.7%)	
Labour, n (%)			
Elective	60 (24.2%)	13525 (56.9%)	< 0.001
Emergency	188 (75.8%)	10237 (43.1%)	
Hypertensive disorders, n (%)			
Yes	55 (22.2%)	4475 (18.8%)	0.180
No	193 (77.8%)	19287 (81.2%)	
DM, n (%)			
Yes	86 (34.7%)	7786 (32.8%)	0.524
No	162 (65.3%)	15976 (67.2%)	
Autoimmune disease, n (%)			
Yes	5 (2.0%)	407 (1.7%)	0.904
No	243 (98.0%)	23355 (98.3%)	
PROM/PPROM, n (%)			
Yes	60 (24.2%)	1371 (5.8%)	< 0.001
No	188 (75.8%)	22391 (94.2%)	
PPH, n (%)			
Yes	33 (13.3%)	1630 (6.9%)	< 0.001
No	215 (86.7%)	22132 (93.1%)	

Table 3: Logistic Regression to Assess the Risk Factors of SSI

Variables	Univariate analysis		Multivariable analysis	
	Crude odds ratio (95%CI)	P-value	Adjusted odds ratio (95%CI)	P-value
Age group				
>=35 years	(Ref)			
20 to 34 years	0.595 (0.424-0.834)	**0.003**	0.551 (0.385-0.789)	**0.001**
<=19 years	0.888 (0.213-3.709)	0.871	0.716 (0.165-3.112)	0.656
BMI				

Normal	(Ref)			
Underweight	-	0.966	-	0.965
Overweight	2.321 (1.427-3.775)	**0.001**	2.332 (1.432-3.799)	**0.001**
Class I obese	6.048 (3.772-9.696)	**<0.001**	6.548 (4.071-10.530)	**<0.001**
Class II obese	12.009 (7.188-20.065)	**<0.001**	14.061 (8.360-23.650)	**<0.001**
Class III obese	29.627 (17.274-50.812)	**<0.001**	37.349 (21.444-65.051)	**<0.001**
Parity				
Primiparous	(Ref)			
Multiparous	0.469 (0.355-0.62)	**<0.001**	0.812 (0.588-1.120)	0.204
Gestational age				
Term	(Ref)			
Preterm	0.9 (0.649-1.248)	0.528		
Labour				
Elective	(Ref)			
Emergency	4.14 (3.092-5.542)	<0.001	3.822 (2.735-5.340)	<0.001
Hypertensive disorders				
No	(Ref)			
Yes	1.228 (0.909-1.660)	0.181		
DM				
No	(Ref)			
Yes	1.089 (0.837-1.417)	0.524		
Autoimmune disease				
No	(Ref)			
Yes	1.181 (0.484-2.878)	0.715		
PPROM/PROM				
No	(Ref)			
Yes	5.212 (3.878-7.006)	<0.001	3.750 (2.731-5.149)	<0.001
PPH				
No	(Ref)			
Yes	2.084 (1.440-3.017)	<0.001	1.711 (1.167-2.508)	0.006

Table 4: Comparison of Basic and Obstetric Characteristics between Elective and Emergency

Variables	Elective(n=60)	Emergency (n=188)	P value
Age, n (%)			
<=19 years	0 (0.0%)	2 (1.1%)	
20 to 34 years	48 (80.0%)	157 (83.5%)	0.527
>=35 years	12 (20.0%)	29 (15.4%)	
BMI, n (%)			
Underweight	0 (0.0%)	0 (0.0%)	
Normal weight	3 (5.0%)	19 (10.1%)	
Overweight	12 (20.0%)	51 (27.1%)	
Class I obese	19 (31.7%)	63 (33.5%)	**0.034**
Class II obese	10 (16.7%)	35 (18.6%)	
Class III obese	16 (26.7%)	20 (10.6%)	

Hypertensive disorders, n (%)			
Yes	14 (23.3%)	41 (21.8%)	0.804
No	46 (76.7%)	147 (78.2%)	
DM, n (%)			
Yes	22 (36.7%)	64 (34.0%)	0.71
No	38 (63.3%)	124 (66.0%)	
Autoimmune disease, n (%)			
Yes	1 (1.7%)	4 (2.1%)	0.825
No	59 (98.3%)	184 (97.9%)	
PROM/PPROM, n (%)			
Yes	7 (11.7%)	53 (28.2%)	**0.009**
No	53 (88.3%)	135 (71.8%)	
PPH, n (%)			
Yes	7 (11.7%)	26 (13.8%)	0.668
No	53 (88.3%)	162 (86.2%)	
Parity, n (%)			
Primiparous	27 (45.0%)	152 (80.9%)	**<0.001**
Multiparous	33 (55.0%)	36 (19.1%)	
Gestational age, n (%)			
Preterm	6 (10.0%)	38 (20.2%)	0.071
Term	54 (90.0%)	150 (79.8%)	
Chorioamnionitis, n (%)			
Yes	0 (0.0%)	5 (2.7%)	0.202
No	60 (100.0%)	183 (97.3%)	
Intrapartum pyrexia, n (%)			
Yes	0 (0.0%)	16 (8.5%)	**0.019**
No	60 (100.0%)	172 (91.5%)	
Anemia, n (%)			
Yes	7 (11.7%)	25 (13.3%)	0.743
No	53 (88.3%)	163 (86.7%)	
Type of SSI, n (%)			
Deep	1 (1.7%)	1 (0.5%)	0.392
Superficial	59 (98.3%)	187 (99.5%)	
Singleton / Multifetal, n (%)			
Multifetal	4 (6.7%)	14 (7.4%)	0.805
Singleton	56 (93.3%)	174 (92.6)	
Induction of labour, n (%)			
Yes	8 (13.3%)	102 (54.3%)	**<0.001**
No	52 (86.7%)	86 (45.7%)	
Number of vaginal examinations after setting into labour, n (%)			
1 to 4	2 (3.3%)	81 (43.1%)	**<0.001**
>=5	0 (0.0%)	29 (15.4%)	
Not done	58 (96.7%)	70 (37.2%)	
Data not available	0 (0.0%)	8 (4.3%)	

Antibiotic prophylaxis, n(%)			
<30 mins	32 (53.3%)	93 (49.5%)	0.683
>=30 mins	27 (45.0%)	88 (46.8%)	
Date not available	1 (1.7%)	7 (3.7%)	
Duration of the surgery, n(%)			
<=45 mins	47 (78.3%)	135 (71.8%)	0.579
>45 mins	10 (16.7%)	43 (22.9%)	
Data not available	3 (5.0%)	10 (5.3%)	

Table 5: Distribution of Organisms Isolated in SSI Cases by Clinical Conditions

Type of organism	HTN (n=55)	DM (n=86)	Autoimmune disease (n=5)	PPROM/PROM (n=60)	PPH (n=33)
E. Coli	15 (27.3%)	21 (24.4%)	3 (60%)	16 (26.7%)	5 (15.2%)
Staphylococcus aureus	11 (20%)	16 (18.6%)	0 (0%)	6 (10%)	9 (27.3%)
Enterococcus faecalis	5 (9.1%)	10 (11.6%)	0 (0%)	15 (25%)	4 (12.1%)
Klebsiella pneumonia	7 (12.7%)	12 (14%)	0 (0%)	13 (21.7%)	8 (24.2%)
Klebsiella oxytoca	4 (7.3%)	5 (5.8%)	0 (0%)	3 (5%)	1 (3%)
Pseudomonas aeruginosa	4 (7.3%)	4 (4.7%)	1 (20%)	1 (1.7%)	2 (6.1%)
Proteus mirabilis	3 (5.5%)	5 (5.8%)	0 (0%)	0 (0%)	0 (0%)
Proteus vulgaris	0 (0%)	2 (2.3%)	0 (0%)	0 (0%)	0 (0%)
Acinetobacter	1 (1.8%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Enterobacter aerogenes	0 (0%)	1 (1.2%)	0 (0%)	0 (0%)	0 (0%)
Streptococcus spp	0 (0%)	1 (1.2%)	0 (0%)	1 (1.7%)	0 (0%)
No growth	8 (14.5%)	12 (14%)	1 (20%)	6 (10%)	5 (15.2%)

Table 6: Gram Negative Antibiogram for 5 years for LSCS Wound swabs

	n=	Amikacin	Gentamycin	Cefaperazone sulbactum	Piperacillin Tazobatum	Levofloxacin	Meropenem	Amoxyclav	Cefepime-IVth	Cefalexin-Ist	Cefazolin-Ist	Cefuroxime-IInd	Cefexime-IIIrd	Ceftazidime-IIIrd	Cefotaxim--IIIrd	Ceftazoxime-IIIrd
E coli	257	99	95	98	94	90	98	63	87	36	36	40	65	74	69	72
Klebsiella	125	98	97	100	99	99	100	45	87	28	28	38	69	70	66	70

Table 7: Gram Positive Antibiogram for 5 years for LSCS Wound swabs

	n	Vancomycin	Linezolid	Piperacillin Tazob atum	Levofloxacin	Ciprofloxacin	Amoxyclav	Amoxycillin	Ampicillin	Penicillin	Clindamycin	Erythromycin
Staphhylococcus aureus	87	-	100	100	98	73	100	100	-	100	98	83
Enterococcus faecalis	55	100	100	100	97	96	91	91	82	85	-	

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References Références Referencias

1. Ferraro F, Piselli P, Pittalis S, Ruscitti LE, Cimaglia C, Ippolito G, et al. Surgical site infection after caesarean section: space for post-discharge surveillance improvements and reliable comparisons. New Microbiol. 2016 Apr;39(2):134–8.
2. Alfouzan W, Al Fadhli M, Abdo N, Alali W, Dhar R. Surgical site infection following cesarean section in a general hospital in Kuwait: trends and risk factors. Epidemiol Infect. 2019 Oct 10;147:e287.
3. Saeed KB, Corcoran P, Greene RA. Incisional surgical site infection following cesarean section: A national retrospective cohort study. Eur J Obstet Gynecol Reprod Biol. 2019 Sep;240:256–60.
4. Zejnullahu VA, Isjanovska R, Sejfija Z, Zejnullahu VA. Surgical site infections after cesarean sections at the University Clinical Center of Kosovo: rates, microbiological profile and risk factors. BMC Infect Dis. 2019 Aug 28;19(1):752.
5. Kvalvik SA, Rasmussen S, Thornhill HF, Baghestan E. Risk factors for surgical site infection following cesarean delivery: A hospital-based case-control study. Acta Obstet Gynecol Scand. 2021 Dec;100(12):2167–75.
6. Zuarez-Easton S, Zafran N, Garmi G, Salim R. Postcesarean wound infection: prevalence, impact, prevention, and management challenges. Int J Womens Health [Internet]. 2017 Feb 17 [cited 2024 Aug 28];9:81–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5322852/
7. Hirani S, Trivedi NA, Chauhan J, Chauhan Y. A study of clinical and economic burden of surgical site infection in patients undergoing caesarian section at a tertiary care teaching hospital in India. PLOS ONE [Internet]. 2022 Jun 3 [cited 2024 Aug 28];17(6):e0269530. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0269530
8. Panwar D, Jodha BS, Prakash P. Study of surgical site infection: An obstetrical surgical morbidity at a tertiary level hospital. Clin Surg Res Commun [Internet]. 2021 Sep 29 [cited 2024 Aug 28];5(3):11–8. Available from: http://www.antpublisher.com/index.php/CSRC/article/view/391
9. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control. 1999 Apr;27(2):97–132; quiz 133–4; discussion 96.
10. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017 Aug 1;152(8):784–91.
11. WHO recommendation on prophylactic antibiotics for women undergoing caesarean section [Internet]. [cited 2024 Aug 28]. Available from: https://www.who.int/publications/i/item/9789240028012
12. Basany K, Chaudhuri S, Shailaja P L, Agiwal V, Angaali N, A Y N, et al. Prospective cohort study of surgical site infections following single dose antibiotic prophylaxis in caesarean section at a tertiary care teaching hospital in Medchal, India. PloS One. 2024;19(1):e0286165.
13. Różańska A, Rosiński J, Jarynowski A, Baranowska-Tateno K, Siewierska M, Wójkowska-Mach J. Incidence of Surgical Site Infections in Multicenter Study—Implications for Surveillance Practice and Organization. Int J Environ Res Public Health [Internet]. 2021 May 18 [cited 2024 Aug 28];18(10):5374. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8158383/
14. D O, J S, A M, R S. Surgical site infections post cesarean section and associated risk factors: a retrospective case-control study at a tertiary hospital in Kenya. Infect Prev Pract [Internet]. 2023 Dec 13 [cited 2024 Aug 28];6(1). Available from: https://pubmed.ncbi.nlm.nih.gov/38222856/
15. Carter EB, Temming LA, Fowler S, Eppes C, Gross G, Srinivas SK, et al. Evidence-Based Bundles and Cesarean Delivery Surgical Site Infections: A Systematic Review and Meta-

analysis. Obstet Gynecol [Internet]. 2017 Oct 1 [cited 2024 Aug 28];130(4):735–46. Available from: https://doi.org/10.1097/AOG.0000000000002249
16. Regmi A, Ojha N, Singh M, Ghimire A, Kharel N. Risk Factors Associated with Surgical Site Infection following Cesarean Section in Tertiary Care Hospital, Nepal. Int J Reprod Med. 2022;2022:4442453.
17. Chhetry M, Subedi S, Banerjee B. Risk factors for post caesarean surgical site infection at a tertiary care center in Eastern Nepal. J Coll Med Sci-Nepal. 2017 Oct 19;13:314.
18. Risk Factors Associated with Surgical Site Infection following Cesarean Section in Tertiary Care Hospital, Nepal - PMC [Internet]. [cited 2024 Aug 28]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9126726/
19. Vallejo MC, Attaallah AF, Shapiro RE, Elzamzamy OM, Mueller MG, Eller WS. Independent risk factors for surgical site infection after cesarean delivery in a rural tertiary care medical center. J Anesth. 2017 Feb;31(1):120–6.
20. Gomaa K, Abdelraheim AR, El Gelany S, Khalifa EM, Yousef AM, Hassan H. Incidence, risk factors and management of post cesarean section surgical site infection (SSI) in a tertiary hospital in Egypt: a five year retrospective study. BMC Pregnancy Childbirth. 2021 Sep 18;21(1):634.
21. Surgical site infection following cesarean section and its predictors in Ethiopia: A systematic review and meta-analysis | PLOS ONE [Internet]. [cited 2024 Aug 28]. Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0296767.
22. Mezemir R, Olayemi O, Dessie Y. Incidence, Bacterial Profile and Predictors of Surgical Site Infection After Cesarean Section in Ethiopia, A Prospective Cohort Study. Int J Womens Health. 2023;15:1547–60.
23. Baaqeel H, Baaqeel R. Timing of administration of prophylactic antibiotics for caesarean section: a systematic review and meta-analysis. BJOG Int J Obstet Gynaecol. 2013 May;120(6):661–9.
24. Olsen MA, Butler AM, Willers DM, Devkota P, Gross GA, Fraser VJ. Risk factors for surgical site infection after low transverse cesarean section. Infect Control Hosp Epidemiol. 2008 Jun;29(6):477–84; discussion 485-486.
25. Shiferaw WS, Aynalem YA, Akalu TY, Petrucka PM. Surgical site infection and its associated factors in Ethiopia: a systematic review and meta-analysis. BMC Surg [Internet]. 2020 May 18 [cited 2024 Aug 28];20(1):107. Available from: https://doi.org/10.1186/s12893-020-00764-1
26. Gadeer R, Baatiah NY, Alageel N, Khaled M. Incidence and Risk Factors of Wound Infection in Women Who Underwent Cesarean Section in 2014 at King Abdulaziz Medical City, Jeddah. Cureus [Internet]. [cited 2024 Aug 28];12(12):e12164. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7814933/
27. Devi SL, Durga DVK. Surgical site infections post cesarean section. Int J Reprod Contracept Obstet Gynecol [Internet]. 2018 May 26 [cited 2024 Aug 28];7(6):2486–9. Available from: https://www.ijrcog.org/index.php/ijrcog/article/view/4875
28. Haas CN. Microbial dose response modeling: past, present, and future. Environ Sci Technol. 2015 Feb 3;49(3):1245–59.
29. Thakur N, Kujur A. Microbiological and antibiotic sensitivity pattern of surgical site infection following caesarean section in a tertiary care center of Chhattisgarh. Int J Reprod Contracept Obstet Gynecol [Internet]. 2021 Jun 28 [cited 2024 Aug 28];10(7):2638–46. Available from: https://www.ijrcog.org/index.php/ijrcog/article/view/10442
30. Gupta S, Manchanda V, Sachdev P, Kumar Saini R, Joy M. Study of incidence and risk factors of surgical site infections in lower segment caesarean section cases of tertiary care hospital of north India. Indian J Med Microbiol. 2021 Jan;39(1):1–5.
31. Njoku CO, Njoku AN. Microbiological Pattern of Surgical Site Infection Following Caesarean Section at the University of Calabar Teaching Hospital. Open Access Maced J Med Sci [Internet]. 2019 May 5 [cited 2024 Aug 28];7(9):1430. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6542387/