Journal of Gynecology and Maternal Health
ISSN: 3068-3696
ScitechSeries
Open Access

Post Caesarean Section Surgical Site Infections: A Prospective Comparative Study of Risk Factors Between Infected and Non-Infected Patients in A Teaching Hospital in Northern Nigeria

Abstract

Background: Post-caesarean section surgical site infection is associated with significant morbidity and mortality. Risk factors vary from one centre to another. Therefore, identifying the relevant risk factors in a centre is necessary to formulate an evidence-based protocol

Aim: To identify the relevant risk factors for post-caesarean section surgical site infections.

Objectives: Determining the prevalence, risk factors and bacterial isolates for post-caesarean section wound infections.

Methodology: This was a prospective comparative study of 140 women delivered by caesarean section. The incision sites were inspected for evidence of infection on post-operative days two and four. Non-infected patients were discharged and followed up by telephone calls. Those who reported symptoms of wound infection were examined at the gynaecological emergency, and swabs were taken from all infected wounds for microbiological analysis.

Data was analyzed using the SPSS version 20. Associations between wound infection and known risk factors were tested using chi-square and odd ratio at 95% confidence interval and significant p-value of <0.05.

Results: A total of 7 patients had wound infection, giving a prevalence of 5%. The relevant risk factors were surgeries performed by junior doctors, Prolonged operation time and premature rupture of membranes. Staphylococcus aureus was the most common microorganism responsible for the wound infections.

Conclusion: Post-caesarean section SSI is a significant concern, mainly associated with emergency surgeries performed by junior doctors, prolonged operation time, and PROM.

Research article

Nuhu Teri James[1]*, Yahaya Usman Rahman[2], Mohammed Manga[3], Hassan Umar Muhammed[3], Nickson Namuya[4]

[1]Department of obstetrics and gynaecology, Kettering General Hospital, NHS Trust.

[2]Department of Obstetrics and Gynaecology, Federal Teaching Hospital Gombe

[3]Department of medical microbiology and immunology, Federal Teaching Hospital, Gombe

[4]High Street GP Surgery, Lowestoft, Suffolk, United Kingdom

***Correspondence:** Dr. Nuhu Teri James, Obstetrics and Gynaecology department, Kettering General Hospital, NHS Trust, *Email: nuhuterijames@gmail.com*

Received: 29 Oct, 2025; **Accepted:** 14 Nov, 2025; **Published:** 20 Nov, 2025.

Keywords: Caesarean Section, Comparative Study, Gombe, Infected and Non-Infected Patients, Northern Nigeria, Post-Caesarean Section Surgical Site Infections, Wound Infection

Introduction

Caesarean Section (CS) is a surgical operation which involves delivery of the fetus and placenta after the age of viability, through an incision made on anterior abdominal wall and the uterus [1]. It is a common life-saving surgery with a global rate of 18.6% [2]. Complication such as surgical site infections (SSI) is associated with maternal morbidity and mortality [3,4]. The Centre for Disease Control (CDC) defined Surgical Site Infection (SSI) as infection which occurs at the incision or operation site (including drains) within 30 days after surgical procedure if no implant is

left in place [5-7]. The CDC diagnostic criteria for SSI requires at least one of the following: purulent drainage with or without laboratory confirmation, positive culture from wound swab, at least one of the following signs or symptoms (pain or tenderness, localized swelling, redness or hotness), incision deliberately opened by surgeon unless incision is culture-negative, diagnosis of SSI made by surgeon or attending physician [5].

Surgical site infections complicate 7% to 12.5% of caesarean sections in Nigeria and sub-Saharan Africa [3,4,8-13]. In Asia and United States of America, incidence range between 2-9% has been reported [14-16]. Several risk factors for post caesarean SSI have been reported in the literature, but their relative contributions vary from one centre to another.

Maternal obesity and overweight are recognised risks for SSI following caesarean section: Body Mass Index (BMI) more than 25kg/m2 doubled the odds for post-caesarean section SSI, and the risk increases with rising BMI [9,17]. This association may be due to relative avascularity of subcutaneous fat, which leads to poor tissue oxygenation and poor penetration of prophylactic antibiotics [18-20]. Secondly, the incision in overweight and obese patients is likely to be longer, thus exposing more tissue to manipulation and contamination. Furthermore, obesity may lead to technical difficulty in securing haemostasis and haematoma formation thus, increasing SSI risk [15].

Diabetes predispose to post caesarean SSI. Wloch et al in a prospective multi centre study in England, reported 15.6% risk of post-caesarean SSI among patients with pre-gestational and gestational diabetes compared to 9.6% among non-diabetics (OR 1.8 CI 1.2-2.6) [17]. Diabetes is associated with impaired leukocyte functions and increased risk of vascular atherosclerotic disease, which may delay wound healing and predispose to surgical site infection [17,21]. On the contrary, a retrospective study in Saudi Arabia did not find significant association between post caesarean SSI and diabetes [15].

Pregnancy induced hypertension increased the likelihood of post-caesarean SSI. About four-fold increase in SSI risk was reported among women with hypertensive disorders in pregnancy in India (OR 3.971 CI 2.179-7.237) [14]. Similarly, Mpogoro et al in Tanzania reported more than two-fold increased risk for SSI among hypertensive women compared to normotensive patients (HR 2.2 CI 1.1-4.7) [13]. Dahya et al, in India, reported 29.3% of women who had post-caesarean SSI had pregnancy induced hypertension (PIH) while only 4.03% of the non-infected cases had PIH [22]. Hypertensive disorders may cause hypoalbuminemia and edema in the subcutaneous space, in addition to chronic alteration in peripheral blood supply leading to poor tissue perfusion and delayed wound healing [14,19,22,23].

Significant association has been reported between pre-operation anaemia and post-caesarean section SSI. Retrospective case-controlled study, in Awka, Nigeria, reported a significant significant association between pre-operation PCV less than 30% and Post-caesarean SSI (p=0.0009) [10]. Pre-operative packed cell volume (PCV) less than 30% increased the risk of post caesarean wound infection by 2.6 times compared to value of 30% and above (OR 2.59 CI 1.12-6.003) [1]. Similar finding was reported in India (OR 2.287 CI 0.905-5.780) [14]. Anaemia, causes impaired tissue oxygenation leading to impaired wound healing predisposing to SSI. In addition, it causes dysfunction of oxidative activities within the tissue leading to tissue death, which ultimately create conducive environment for SSI. On the contrary, Ezechi and colleagues in Southern Nigeria reported no association between anaemia and post caesarean section SSI [9].

Rupture of fetal membranes less than 24 hours had 89% lower odds of developing post-caesarean section SSI compared to those with membranes rupture more than 24 hours [3]. Prolonged rupture of membranes quadrupled the risk for post-caesarean SSI according to report, by Ezechi in Southern Nigeria [9]. Premature Rupture of Membranes (PROM) allows easy migration of vaginal organisms to the cervix and amniotic cavity causing chorioamnionitis and predisposing to post caesarean section SSI [18]. Evidence suggest that labour duration more than 12 hours triples the odds of post-caesarean section SSI [13,15]. This may be related to repeated vaginal examinations, labouring in a dirty environment, and subsequently referred to the hospital as potential septic cases for emergency surgeries [3,8].

Prolonged duration of surgery increases the likelihood for post-caesarean SSI. Operation time of more than one hour has been found to be significantly associated with SSI (p-value 0.0009) [10]. The odds for post-caesarean SSI are almost tripled by operation time more than one hour (OR 2.87 CI 1.12-4.23) according to report by Ezechi et al in Nigeria [9]. Found that 92.59% of patients who had surgery duration more than one hour developed post-caesarean section SSI [22]. Prolonged operation time may lead to significant tissue contamination by microorganisms which predispose to SSI [20,22,24,25].

Evidence suggests association between intra-operative blood loss and post-caesarean section SSI. Jasim et al, in a retrospective cross-sectional study in Malaysia found significant relationship between intra-operative blood loss more than 500mls and post-caesarean SSI (p-value = 0.043) [26]. Retrospective case-controlled study in Saudi Arabia, by Aljama reported blood loss of 1000mls, almost doubled the odds for post-caesarean SSI (OR 1.76 CI 0.95-3.26) [15]. High blood loss, may be due to poor haemostasis and use of more sutures, which promote tissue contamination there by increasing the risk SSI [8,11,27].

The level of expertise of the surgeon may be related to risk for post-caesarean SSI. Caesarean Section by junior doctors increased the risk of post-caesarean section SSI by 4-fold compared with those done by senior doctors in Tanzania [13]. Senior doctors are likely to have excellent surgical techniques such as effective haemostasis, gentle tissue handling, and avoiding injuries to hollow viscera. Therefore, the SSI rate is reduced [19]. On the contrary, Vijiyan and colleagues in India reported cases of SSI among caesarean section performed by faculty compared to those done by junior doctors (p=0.019). This could be explained by the fact that all high risk cases were done by senior doctors. A study in Southern Nigeria found no association between cadre of the surgeon and risk of SSI (p=0.1483) [10].

Emergency caesarean section (EMCS) is associated with a higher rate of SSI than elective caesarean section (ELCS). Systematic review by Newlin reported tripled odds for developing SSI following EMCS compared to ELCS (OR 3.0 CI 1.4-6.5) [19]. In Tanzania, study by Mpogoro found SSI only among patients who had EMCS [13], while Onyegbule and colleagues in Nigeria, reported infection rate of 20% in EMCS group compared to 5% in the ELCS group [3]. Emergency caesarean section is likely to be associated with inadequate preparation time owing to fetal or maternal threats. Also, the patients undergoing emergency CS are likely to have had multiple vaginal examinations, ruptured fetal membranes, and attempted home delivery by local midwife. These may increase the risk of bacterial contamination thereby increasing the risk of SSI [11,22,25].

Post-caesarean section SSI has distinctive sources of pathogens comprising skin and vaginal origin [18,27]. Staphylococcus aureus is the commonest pathogen [6,8,28]. Escherichia coli, Proteus mirabilis, Staphylococcus epidermidis, Bacteroides species, Clostridia Species, and Streptococcus species have also been isolated [8,9,22].

While it is evident that risk factors for post caesarean SSI are generally similar, their relative contributions vary from one centre to another. Therefore, this study was conducted mainly to determine the relevant risk factors, prevalence and bacterial pathogens for post-caesarean section surgical site infections in a busy obstetrics unit in Northern Nigeria in order to guide the design of evidence based protocol for it's prevention. The study further adds to existing body of knowledge on post caesarean SSI with reference to Northern Nigeria.

Methodology

This was a prospective comparative study of 140 pregnant women who had caesarean section at the Federal Teaching Hospital, Gombe, Northern Nigeria from October 2020 to February 2021. Convenience sampling method was used to recruit the participants until the required sample size was reached. A standardized caesarean section technique was used for all patients. They all had prophylactic Intravenous antibiotics (Co-Amoxiclav), with an additional 5-day course of oral antibiotics based on the existing hospital protocol.

Ethical approval was obtained from Research and Ethics Committee of the Federal Teaching Hospital Gombe (NHREC/25/10/2013), and consent to participate in the study was obtained from all patients.

Data were collected using a pretested questionnaire. Relevant information were recorded, and the questionnaires were updated on the days of wound inspections.

The Data were analysed using the SPSS version 20. Those who developed wound infection were compared to those who were not infected. The presence of association between post-caesarean SSI and known risk factors was tested using Odds Ratio at 95% Confidence Interval. A p- value of <0.05 was accepted as significant.

Sample Size Calculation

Using the prevalence of 9.1% from a study in Kano, Northern Nigeria [8]. The sample size was calculated using Fischer's exact formula for proportion:

$n = Z^2P(1-P)/D^2$

where n = sample size

z = constant (z)= 1.96 using 95% confidence interval

P= Prevalence

D= absolute precision of the study, which is 0.05.

Therefore, $n = 1.96^2 \times 0.091 \times 0.909/0.05^2$

n = 128

An additional 10% of the calculated sample size (12.8) was added to account for attrition which gave a total of 141 patients

Results

A total of 140 patients participated in this study. Seven of them developed SSI, giving a prevalence of 5.0%.

The socio-demographic characteristics of the patients are shown in (table 1). All the infected patients were within the age groups 15 to 34 years with a mean age of 25.1±5.7 years while that of the non-infected patients was 29±7.3 years. This difference was not statistically significant. Overall, 87.1% of the patients had formal education.

Characteristics		SSI		Total	x2	p-value
		Yes n (%)	No n (%)			
Age (years)	15-24	3 (2.1)	36 (25.8)	39 (27.9)	0.8259	0.1504
	25-34	4 (2.9)	66 (47.1)	70 (50.0)	0.3637	0.6981
	35-44	0 (0.0)	29 (20.7)	29 (20.7)		
	≥45	0 (0.0)	2 (1.4)	2 (1.4)		
Educational level	None	2 (1.4)	16 (11.5)	18 (12.9)	2.9424	0.4005
	Primary	1 (0.7)	12 (8.6)	13 (9.3)		
	Secondary	3 (2.1)	49 (35.0)	52 (37.1)		
	Tertiary	1 (0.7)	56 (40.0)	57 (40.7)		
Occupation	Unemployed	5 (3.6)	63 (45.0)	68 (48.6)	2.9717	0.0847
	Civil servant	1 (0.7)	41 (29.3)	42 (30.0)	0.8665	0.3519
	Trading	1 (0.7)	6 (4.3)	7 (5.0)	1.3376	0.2474
	Student	0 (0.0)	15 (10.7)	15 (10.7)		
	Others	0 (0.0)	8 (5.7)	8 (5.7)		
Ethnicity	Fulani	2 (1.4)	50 (35.7)	52 (37.1)	0.2319	0.6301
	Tangale	0 (0.0)	16 (11.4)	16 (11.4)		
	Hausa	0 (0.0)	13 (9.3)	13 (9.3)		
	Yoruba	0 (0.0)	3 (2.1)	3 (2.1)		
	Igbo	1 (0.7)	4 (2.9)	5 (3.6)	2.4561	0.1170
	Others	4 (2.9)	47 (33.6)	51 (36.5)	1.3652	0.2426
Religion	Christianity	1 (0.7)	47 (33.6)	48 (34.3)	1.3082	0.2527
	Islam	6 (4.3)	86 (61.4)	92 (65.7)		
Marital status parity	Married	7 (5.0)	133 (95.0)	140 (100)		
	Primigravida	5 (3.6)	32 (22.9)	37 (26.5)	7.6739	0.005
	Multigravida	2 (1.4)	101 (72.1)	103 (73.5)		

Booking status	Booked	3 (2.1)	78 (55.7)	81 (57.8)	0.7662	0.3813
	Unbooked	4 (2.9)	55 (39.3)	59 (42.2)		

Table 1: Socio-demographic characteristics of the patients

A progressive decrease in proportion of infected patients with an increasing level of education was observed, from 11.1% among those with no formal education to 1.8% among patients with tertiary levels of education.

The majority (73.6%) of the patients were multigravida. However, most (71.4%) of the infected patients were primigravida. This was statistically significant (p = 0.005).

The most common indications for the caesarean section were previous caesarean section(s), cephalopelvic disproportion, and hypertensive disorders. They were responsible for 58.6% of all the caesarean sections (table 2).

Indication	SSI		Total N (%)
	Yes n (%)	No n (%)	
Previous Caesarean section	0	31 (22.1)	31 (22.1)
CPD	1 (0.7)	25 (18.6)	26 (18.6)
Pre-eclampsia/ Eclampsia	1 (0.7)	24 (17.1)	25 (17.9)
Obstructed labour	3 (2.1)	10 (7.1)	13 (9.3)
Bad obstetrics history	0	10 (7.1)	10 (7.1)
Fetal distress	0	6 (4.2)	6 (4.2)
Placenta previa	0	5 (3.6)	5 (3.6)
Fetal macrosomia	1 (0.7)	4 (2.9)	5 (3.6)
Breech presentation	0	5 (3.6)	5 (3.6)
Prolonged infertility	0	4 (2.9)	4 (2.9)
Abruptio placentae	1 (0.7)	2 (1.4)	3 (2.1)
Others	0	7 (5.0)	7 (5.0)
Total	7	133	140 (100)

Table 2: Indications for Caesarean Section and occurrence of SSI

In (table 3), the risk factors for post-caesarean section SSI were compared between infected and non-infected patients. The risk of post caesarean section SSI in prolonged operation time was statistically significant (4.3% vs 0.7%, p-value = 0.005). It was 14 times more likely to develop post caesarean SSI when the operation time is prolonged (OR = 14.5). Patients with premature rupture of membranes were 10 times more likely to develop SSI compared to those with intact membranes (OR = 10.2, 95% CI =1.6-66.3), p = 0.04. The differences in the risks of post caesarean section SSI between infected and non-infected obese patients (2.9% vs 2.1%, p = 0.5) and hypertensive patients (2.1% vs 2.9%, p = 0.7) were not statistically significant. Other identified risk factors (prolonged labour, p = 0.09 and anaemia p = 0.674), were not statistically significant when similarly compared. All the cases of post caesarean section SSI occurred in the patients who had emergency caesarean sections. Majority (85.7%) of all cases of SSI in this study, had caesarean section performed by junior doctors while only 14.3% of cases were reported among surgeries by senior doctors. This translated to wound Infection rate of 8.5% (6 in 71 surgeries) among junior doctors versus 1.5 (1 in 69 surgeries) for senior doctors.

Risk factor	SSI n = 140(%)		Total	z	p-value	OR	95% CI
	Yes	No					
Obesity				0.773	0.4393	1.8	0.4-8.5
Yes	4 (2.9)	56 (40.0)	60 (42.9)				
No	3 (2.1)	77 (55.0)	80 (57.1)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				
Prom				2.442	0.0146	10.2	1.6-66.3
Yes	2 (1.4)	5 (3.6)	7 (5.0)				
No	5 (3.6)	128 (91.4)	33 (95.0)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				

Prolonged labour				1.602	0.1092	3.6	0.8-17.1
Yes	3 (2.1)	23 (16.4)	26 (18.5)				
No	4 (2.9)	110 (78.6)	114 (81.5)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				
Prolonged operation time				2.436	0.0149	14.5	1.7-124.1
Yes	6 (4.3)	39 (27.9)	45 (32.2)				
No	1 (0.7)	94 (67.1)	95 (67.8)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				
Anaemia				0.764	0.4449	0.4	0.1-3.7
Yes	1 (0.7)	37 (26.4)	38 (27.1)				
No	6 (4.3)	96 (68.6)	102 (72.9)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				
Hypertensive disorders				0.403	0.6868	1.4	0.3-6.4
Yes	3 (2.1)	47 (33.6)	50 (35.7)				
No	4 (2.9)	86 (61.4)	90 (64.3)				
Total	**7 (5.0)**	**133 (95.0)**	**140 (100)**				

Table 3: Comparing risk factors between infected and non-infected patients

Staphylococcus aureus (40.0%) was the most common bacterium isolated from the infected wounds. All the bacterial isolates were sensitive to Amoxicillin-clavulanic acid.

Discussion

The prevalence of post-caesarean section SSI in this study was 5%. This is similar to the incidence of 4.9% reported in Rwanda [12]. This may be due to similarity in designs of both studies. A higher incidence of 7.3% was reported in a multi centre study by MSF. Study in Kano, Nigeria also reported a much higher incidence of 9.1% [8]. This could be related to the smaller sample size in this study compared to studies cited above. In addition, our study was conducted in a tertiary centre where a high level of asepsis was maintained combined with timely administration of prophylactic antibiotics.

The risk factors associated with post-caesarean section SSI in this study were prolonged operation time, emergency caesarean section, surgery by junior doctors, prolonged labour, obesity, and PROM. Comparison of the associated risk factors between infected and non-infected patients found that the risk of post-caesarean SSI in prolonged operation time was statistically significant (4.3 vs 0.7); p-value = 0.005. Patients with prolonged operation time were about 14 times more likely to develop SSI compared to those with operation time less than or equal to 60 minutes (OR = 14.5, CI = 1.7-124.1). Studies in Nigeria and India, corroborate this finding [10,22].

The difference in the risk factors between infected and non-infected obese patients (2.9% vs 2.1%) was not statistically significant (p = 0.4393). This is similar to report by Mpogoro in Tanzania [13]. This may be related to the fact that in our study, difficult caesarean sections which include caesarean section for obese women were done by senior registrars and consultants, who are more experienced in adopting measures to prevent SSI. The finding is however contrary to results of studies by Ezechi and Wloch in Nigeria and England respectively [9,17].

Patients with pre-labour rupture of membranes (PROM), were 10 times more likely to develop SSI compared to those with intact membranes before the onset of labour (OR = 10.2, 95% CI = 1.6-66.3). The difference between infected and non-infected patients with PROM (1.4% vs 3.6%) was statistically significant (p = 0.0146). This is similar to the results of the study by Ezechi in Southern Nigeria [9].

Observations from this study revealed that prolonged labour almost quadrupled the odds for post-caesarean SSI (OR 3.6 CI 0.8-17.1). The difference between infected and non-infected patients with prolonged labour was, however, not statistically significant (p = 0.09). This is similar to the report by Ezechi in Nigeria [9]. On the contrary, a study in Tanzania found

significant association between prolonged labour and SSI (OR 3.0 CI 1.6-6.0), (p = 0.002) [13].

All the cases of SSI in this study occurred in patients who had emergency caesarean sections. Studies in Tanzania and Estonia corroborate this finding [13,29]. This may be related to the fact that these patients were likely to have had multiple vaginal examinations, ruptured fetal membranes and had attempts of home delivery by local midwife which may predispose to development of SSI.

The majority (85.7%) of cases of SSI in this study occurred in patients whose surgeries were performed by junior doctors. Only 14.3% of cases of SSI occurred among patients who had their caesarean section performed by senior doctors. Similar finding was reported in Tanzania [13]. This may be because senior doctors are likely to have excellent surgical techniques to minimize the risk for SSI. On the contrary, Vijiyan et al, in India reported more cases of SSI among patients operated by consultants compared to those done by residents (p=0.019) [14]. In their study, however, all complicated cases and most emergency surgeries were performed by assistant professors while residents performed uncomplicated surgeries assisted by consultants.

The most common bacterial pathogen responsible for post-caesarean SSI in this study was Staphylococcus aureus. It was isolated in 40.0% of the culture positive cases. This finding is similar to reports by Kondakasseril and Jido in India and Nigeria respectively [6,8]. On the contrary, Nwanko et al in Nigeria and Dahya et al in India, found Escherichia coli as the commonest pathogen [22,30]. Other organism we isolated were Escherichia coli, Enterococcus Spp. and Streptococcus Spp. We found sterile infection in 28.5% of cases of SSI, which is much higher than 6.8% reported in Kano, Nigeria [8].

Limitations of the Study

Convenience sampling method used in this study is associated with bias and may not be true reflection of the entire population. Secondly, the sample size was small; a cohort study with larger sample size may reveal more information on the risk factors for post-caesarean SSI in our centre. The patients' personal hygiene and other follow-up instructions could not be controlled at home.

Conclusion

Post-caesarean section SSI is a significant concern. It is significantly associated with premature rupture of fetal membranes, emergency caesarean section, surgeries performed by junior doctors and prolonged operation time. Staphylococcus aureus is the most common organism responsible for post-caesarean SSI.

Acknowledgement

All staff of the department of obstetrics and gynecology, and microbiology Federal Teaching Hospital, Gombe, Nigeria.

Conflict of Interest

No conflicts of interest.

References

1. Dacho, A. M., and A. T. Angelo. "Magnitude of post caesarean section surgical site infection and its associated factors among mothers who underwent caesarean section in Mizan Tepi University Teaching Hospital, South West Ethiopia, 2017." J Nurs Care 7, no. 454 (2018): 1168-2167.
2. Betrán, Ana Pilar, Jianfeng Ye, Anne-Beth Moller, Jun Zhang, A. Metin Gülmezoglu, and Maria Regina Torloni. "The increasing trend in caesarean section rates: global, regional and national estimates: 1990-2014." PloS one 11, no. 2 (2016): e0148343.
3. Onyegbule, Onyema A., Comfort N. Akujobi, Ifeanyichukwu U. Ezebialu, Arinze C. Nduka, Ikenna C. Anahalu, V. E. Okolie, Innocent I. Mbachu, and Livinus O. Okor. "Determinants of post-caesarean wound infection in Nnewi, Nigeria." British Journal of Medicine and Medical Research 5, no. 6 (2014): 767-774.

4. Agboeze, Joseph, Robinson Onoh, Odidika Umeora, Paul Ezeonu, Chukwuemeka Ukaegbe, Azubike Onyebuchi, Conrad Egbuji, and Emmanuel Ndukwe. “Microbiological pattern of postcesarean wound infection at Federal Teaching Hospital, Abakaliki.” African Journal of Medical and Health Sciences 12, no. 2 (2013): 97-97.
5. Mangram, Alicia J., Teresa C. Horan, Michele L. Pearson, Leah Christine Silver, William R. Jarvis, and Hospital Infection Control Practices Advisory Committee. “Guideline for prevention of surgical site infection, 1999.” Infection Control & Hospital Epidemiology 20, no. 4 (1999): 247-280.
6. Kondakasseril RN, Hiran N, Andrews AM. Surgical Site Infections Following Lower Segment Caesarean section in a Tertiary Care Hospital. J Evolution Med Dent Sci. 2016; 5:1306-1309.
7. Horam TC, Gaynes RP, Martone WJ, Jaris WR, Emori TG. CDC definitions of nosocomial Surgical site infection. Infect Contr Hosp Epid. 1992; 13:606-608.
8. Jido, T. A., and I. D. Garba. “Surgical-site infection following cesarean section in Kano, Nigeria.” Annals of medical and health sciences research 2, no. 1 (2012): 33-36.
9. Ezechi, Oliver C., Asuquo Edet, Hakim Akinlade, Chidinma V. Gab-Okafor, and Ebiere Herbertson. “Incidence and risk factors for caesarean wound infection in Lagos Nigeria.” BMC research notes 2, no. 1 (2009): 186.
10. Ojiyi, E. C., E. I. Dike, C. Okeudo, E. C. Ejikem, and A. E. C. Nzewuihe. “Wound infection following caesarean section in a university teaching hospital in South-East Nigeria.” Orient Journal of Medicine 25, no. 1-2 (2013): 8-13.
11. Chu, Kathryn, Rebecca Maine, and Miguel Trelles. “Cesarean section surgical site infections in sub-Saharan Africa: a multi-country study from Medecins Sans Frontieres.” World journal of surgery 39, no. 2 (2015): 350-355.
12. Bizimana, J. Kalibushi, J. Ndoli, C. Bayingana, I. Baluhe, G. J. Gilson, and E. Habimana. “Prevalence and risk factors for post cesarean delivery surgical site infection in a teaching hospital setting in rural Rwanda: a prospective cross sectional study.” Int J Curr Microbiol App Sci 5, no. 6 (2016): 631-641.
13. Mpogoro, Filbert J., Stephen E. Mshana, Mariam M. Mirambo, Benson R. Kidenya, Balthazar Gumodoka, and Can Imirzalioglu. “Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania.” Antimicrobial resistance and infection control 3, no. 1 (2014): 25.
14. Vijayan CP, Mohandas S, Nath AG. Surgical Site Infections Following Caesarean Section in a Teaching Hospital. Int J Sci Stud. 2016; 3:97-101.
15. Al Jama, Fathia E. “Risk factors for wound infection after lower segment cesarean section.” Qatar medical journal 2012, no. 2 (2013): 9.
16. Kawakita, Tetsuya, and Helain J. Landy. “Surgical site infections after cesarean delivery: epidemiology, prevention and treatment.” Maternal health, neonatology and perinatology 3, no. 1 (2017): 12.
17. Wloch, Catherine, J. Wilson, Theresa Lamagni, Pauline Harrington, Andre Charlett, and Elizabeth Sheridan. “Risk factors for surgical site infection following caesarean section in England: results from a multicentre cohort study.” BJOG: An International Journal of Obstetrics & Gynaecology 119, no. 11 (2012): 1324-1333.
18. Dhar, Hansa, Ibrahim Al-Busaidi, Bhawna Rathi, Eman A. Nimre, Vibha Sachdeva, and Ilham Hamdi. “A study of post-caesarean section wound infections in a regional referral hospital, Oman.” Sultan Qaboos University Medical Journal 14, no. 2 (2014): e211.

19. Newlin, Charles, Thomas J. Kuehl, Anthony Pickrel, Chase R. Cawyer, and Richard O. Jones. “Cesarean section incision complications and associated risk factors: a quality assurance project.” Open Journal of Obstetrics and Gynecology 5, no. 14 (2015): 789.
20. Adeyinka, A., O. Egagifo, and G. O. Igberase. “Review of cesarean delivery infection in Nigeria.” Annals of Clinical Case Reports-Gynecology 3 (2018).
21. Tariq, A., H. Ali, F. Zafar, A. Sial, K. Hameed, and S. Naveed. “A systemic review on surgical site infections: classification, risk factors, treatment complexities, economical and clinical scenarios.” J Bioequiv Availab 9, no. 1 (2017): 336-40.
22. Dahiya, Priyanka, Vinita Gupta, Seema Pundir, and Dolly Chawla. “Study of incidence and risk factors for surgical site infection after cesarean section at first referral unit.” Int J Contemp Med Res 3, no. 4 (2016): 1102-1104.
23. Chhetry, Manisha, Shanti Subedi, and Basudeb Banerjee. “Risk factors for post caesarean surgical site infection at a tertiary care center in Eastern Nepal.” Journal of College of Medical Sciences-Nepal 13, no. 3 (2017): 314-317.
24. Zuarez-Easton, Sivan, Noah Zafran, Gali Garmi, and Raed Salim. “Postcesarean wound infection: prevalence, impact, prevention, and management challenges.” International journal of women’s health (2017): 81-88.
25. Shree, Raj, Seo Young Park, Richard H. Beigi, Shannon L. Dunn, and Elizabeth E. Krans. “Surgical site infection following cesarean delivery: patient, provider, and procedure-specific risk factors.” American journal of perinatology 33, no. 02 (2016): 157-164.
26. Jasim, Hanan Hussein, Syed Azhar Syed Sulaiman, Amer Hayat Khan, Omar Thanoon Dawood, Aseel Hadi Abdulameer, and R. Usha. “Incidence and risk factors of surgical site infection among patients undergoing cesarean section.” Clinical Medicine Insights: Therapeutics 9 (2017): 1179559X17725273.
27. Gur, Renu, Shalini Dewan Duggal, Sharon Rainy Rongpharpi, Ruhi Srivastava, Avinash Kumar, Vinita Gupta, Dolly Chawla, and Seema Pundhir. “Post caesarean surgical site infections.” Archives of clinical microbiology 6, no. 1 (2015).
28. Hassan, Khadijah Olatayo, and Justina Omoikhefe Alegbeleye. “Post caesarean section wound infection and microbiological pattern at the University of Port Harcourt Teaching Hospital, Southern Nigeria.” Res Obstet Gynecol 6 (2018): 1-8.
29. Mitt, Piret, Katrin Lang, Aira Peri, and Matti Maimets. “Surgical-site infections following cesarean section in an Estonian university hospital: postdischarge surveillance and analysis of risk factors.” Infection Control & Hospital Epidemiology 26, no. 5 (2005): 449-454.
30. Nwankwo, E., and S. Shuaibu. “Bacteriology of post caesarean wound infection in a specialist hospital in Kano, North Western Nigeria.” Sierra Leone Journal of Biomedical Research 5, no. 1 (2013): 15-22.

Citation: James NT, Rahman YU, and Manga M et al. “Post Caesarean Section Surgical Site Infections: A Prospective Comparative Study of Risk Factors Between Infected and Non-Infected Patients in A Teaching Hospital in Northern Nigeria.” J Gynecol Matern Health (2025): 119. DOI: 10.59462/3068-3696.3.1.119