



**FACTORS ASSOCIATED WITH POST-CAESAREAN SURGICAL
SITE INFECTION AT RUTONGO DISTRICT HOSPITAL-
RWANDA**

Authors: Dr NTIHABOSE Aimé Patrick¹*, Prof. RULISA Stephen², Dr MONICA Mochama³

***Correspondence:**

Dr NTIHABOSE Aimé Patrick, MD, MPH, Department of Public Health, Mount Kenya University/ Kigali-Rwanda. E-mail: dr.aimeepatrick@gmail.com, Tel: +250788803388

Abstract

Introduction: Post-Caesarean Surgical Site Infection (SSI) is among the most common complications after caesarean delivery (CD), with a prevalence rate of 3% to 15% in developed and developing countries respectively. The risk of developing infections post-CD is 5 to 20 times higher than that of vaginal delivery. SSI is greatly affecting the physical, psychological and economic status of the patient and her family. The study done by Nkurunziza et al (2016), showed that the prevalence of post-caesarean SSI at Kirehe district hospital-Rwanda was 10.9%. Therefore, little is known about the prevalence and the factors associated with post-caesarean SSI at district level including Rutongo district hospital-Rwanda. The overall objective of this study was to determine the factors associated with post-caesarean SSI at Rutongo district hospital. The targeted population was 2016 files of women who underwent CD at Rutongo district hospital from 2017-2021. It was a quantitative retrospective study. The data has been collected using an adapted study checklist and analysed in SPSS 22. The descriptive statistics with frequencies and Logistic Regression were used to determine the prevalence and the associated factors for post-caesarean SSI. All in all, the current study revealed that the prevalence of post-caesarean SSI for mothers who underwent CD from 2017 to 2021 was 5.6%. The factors associated with post-caesarean SSI at Rutongo DH were multiparity, socio-economic category I&II, antenatal care visits less than 4, history of anaemia on pregnancy, history of non-communicable diseases, history of infectious diseases, high body mass index, ASA class >3, use of traditional drugs, PROM, foetal distress, multiple digital vaginal exams>5, no preoperative body bathe, lower experience of surgeon, time of operation >60 minutes, interrupted suture, no preoperative antibiotics, no postoperative, emergency CD, intraoperative blood loss> 1000ml and transfusion, and postoperative hospital stay>3 days. There was no association between post-caesarean SSI with maternal age, occupation, referring health facility, previous uterine scar, arrested labor, skin preparation with iodine-chlorine solution, and type of incision. The researcher recommended that there is a need for prioritizing post-caesarean SSI prevention and control measures within the hospitals. It is important for public health sector to raise women's awareness of factors associated with post-caesarean SSI and how they can be prevented.

Keyword: post-caesarean SSI, Rutongo Hospital, Surgical site infection, incidence of post-caesarean SSI.

I. Background

Surgical site infection (SSI) is one of the most common complications next to caesarean delivery, with a prevalence rate of about 3%–15% (Gomaa et al., 2021). It makes emotional and physical charges on a woman and causes serious financial charges on the health system (Gomaa et al., 2021).

SSI is a healthcare-related infection where a wound becomes infected following an invasive surgery and is associated with maternal mortality by up to 3% (Ahmad & Aggarwal, 2018). Due to the worldwide increase in CD rate, parallelly, it is predicted that the development of SSI also increases, thus its clinical implications (Gomaa et al., 2021).

CD is a crucial obstetrical operation focusing on saving the lives of both foetuses and mothers and may go along with numerous complications and SSI is either of them (Cervac et al., 2021).

In the United States, CD is among the commonest performed procedure. It accounts for 32% of all deliveries (McClelland et al., 2017). A high proportion of SSIs after CD was reported in various developing states: 9.7% in Vietnam, 16.2% in Nigeria, 19% in Kenya, and 10.9 in Tanzania Whereas in developed countries was low: 3.3% in China, 2.7% in USA, 3.7% in Israel, and 3.9% in Spain (Tartari et al., 2017).

In Africa, where most of the countries are classified as developing countries, SSI is a more frequent complication of post-caesarean wounds. 7.3% in south Africa, 8% in Egypt (Alfouzan et al., 2019) [8].

In Rwanda, the research done at University Teaching Hospital of Butare (CHUB), the prevalence rate of post-caesarean SSI was 4.9% (Bizimana et al., 2016). On the other hand, the study done at Kirehe district hospital, the prevalence of post-caesarean SSI was 10.9%. (Nkurunziza et al., 2019).

1.2.Problem statement

Surgical site infection (SSI) affects the physical, psychological and economical status of the patient and her family and it is linked to maternal mortality rate of up to 3% (Ahmad & Aggarwal, 2018). It is great important to know factors leading to it as to preventing it. Worldwide, the associated factors with post-caesarean SSI were found to be but not limited to prolonged premature rupture of membranes, prolonged labor, digital vaginal exams >5, chorioamnionitis, ASA (American Society of Anesthesiologists) class ≥ 3 , lower education level, multiparity, Diabetes Mellitus, and hypertension on pregnancy (Molla et al., 2019). In Rwanda, little is known about the prevalence and factors associated with post-caesarean SSI in many district hospitals including Rutongo district hospital. Hence, the researcher aimed to determine the factors associated with post-caesarean SSI at Rutongo district hospital.

1.3.Objectives

- i) To determine the incidence of post-caesarean surgical site infection at Rutongo district hospital.
- ii) To determine the associated factors with post-caesarean surgical site infection at Rutongo district hospital.

II. LITERATURE REVIEW

2.1 Theoretical Literature Review

Caesarean delivery is among the most familiar hospital-related operations in obstetrics (Momo et al., 2017). The operation is performed to ease delivery where normal vaginal birth is either not practicable or poses unwanted dangers to the foetus, mother or the two (Kan, 2020). Surgical site infection is explained as an invasion of micro-organisms that happens in less than 30 days following any surgical procedure which necessitates skin, fatty tissues and/or deep tissues of the incision site (Gomaa et al., 2021).

2.2. Prevalence of Post-Cesarean SSI

Worldwide, the prevalence of post-caesarean SSI varies from 3% -15% (Gomaa et al., 2021). In Europe, the reported prevalence of post-caesarean SSI was 9.8% in Serbia (Zejnnullahu et al., 2019), 12.65% in Nepal (Molla et al., 2019), and 3.95% in Spain (Ferraro et al., 2016). In Asia the reported prevalence was 1.795 in China (He et al., 2021), 6.5% in Ukraine (Salmanov et al., 2019), and 2.7 in Japan (Kawakita et al., 2017).

For sub-Saharan Africa, research done found that the prevalence of post-caesarean SSI was 15.6% (Sway et al., 2019). Likewise, in East-African states, the reported prevalence was 3.5% in Uganda (Kurigamba et al., 2018), 21.3% in Tanzania (Mpogoro et al., 2014), and 10.4% in Kenya (Chelimo et al., 2019). Again, in Rwanda, according to the research done in the Southern province at a tertiary hospital CHUB (Bizimana et al., 2016), in the Western province at Bushenge provincial hospital (Bizimana et al., 2017), and Eastern province at Kirehe district hospital (Nkurunziza et al., 2019), the prevalence of post-caesarean SSI was 4.9%, 7.2%, and 10.9% respectively.

2.3 Factors Associated with Post-Caesarean SSI

Normally, infection is governed by the agent, host, and surroundings (Burgess et al., 2019). The factors contributing to post-caesarean SSI can be classified into socioeconomic, maternal, antenatal, obstetrical, intrapartum, medical or procedural, and postoperative factors.

Firstly, antenatal factors include neglected antenatal care visits and severe anaemia (Gomaa et al., 2021). Secondary, socioeconomic factors include smoking, low education level, long distance of travel to a health facility and being a housewife compared with a farmer (Nkurunziza et al., 2019, Vallejo et al., 2017; Moulton et al., 2017). Thirdly, maternal factors like ASA class ≥ 3 ; diabetes mellitus, renal and heart diseases, HIV infection, increased BMI, Asthma, age > 35 years, previous CDs, and hyperthyroidism (Gupta et al., 2019, Molla et al., 2019, Moulton et al., 2017,

Mukamuhirwa et al., 2022). Fourthly, obstetrical factors include, prolonged membranes rupture; numerous vaginal exams >5, chorioamnionitis; arrested labor, preterm labor and multiparity (Vallejo et al., 2017), (Molla et al., 2019), (Gomaa et al., 2021), (Akimana et al., 2021). Fifthly, the identified procedural factors include prolonged duration of operation >1hour, vertical skin incision, interrupted suturing, wound contamination class III, operation done by an intern or junior doctor, general anaesthesia, emergent CD, inappropriate antibiotic prophylaxis, and preparation of the skin with one antiseptic (Nkurunziza et al., 2019, Gupta et al., 2021; Vallejo et al., 2017, Moulton et al., 2017, Molla et al., 2019). Last but not least, intrapartum factors include intrapartum blood transfusion (Gupta et al., 2021), blood loss >1000ml (Gomaa et al., 2021) and prolonged duration of hospital stay (Mukagendaneza et al., 2019).

2.4 Conceptual framework

The causes of post-caesarean SSI are compounded. The pair of the patient and healthcare-linked factors may impact the possibility that the patient will get SSI. The conceptual framework beneath demonstrates the study factors and their correspondence in the occurrence of SSI.

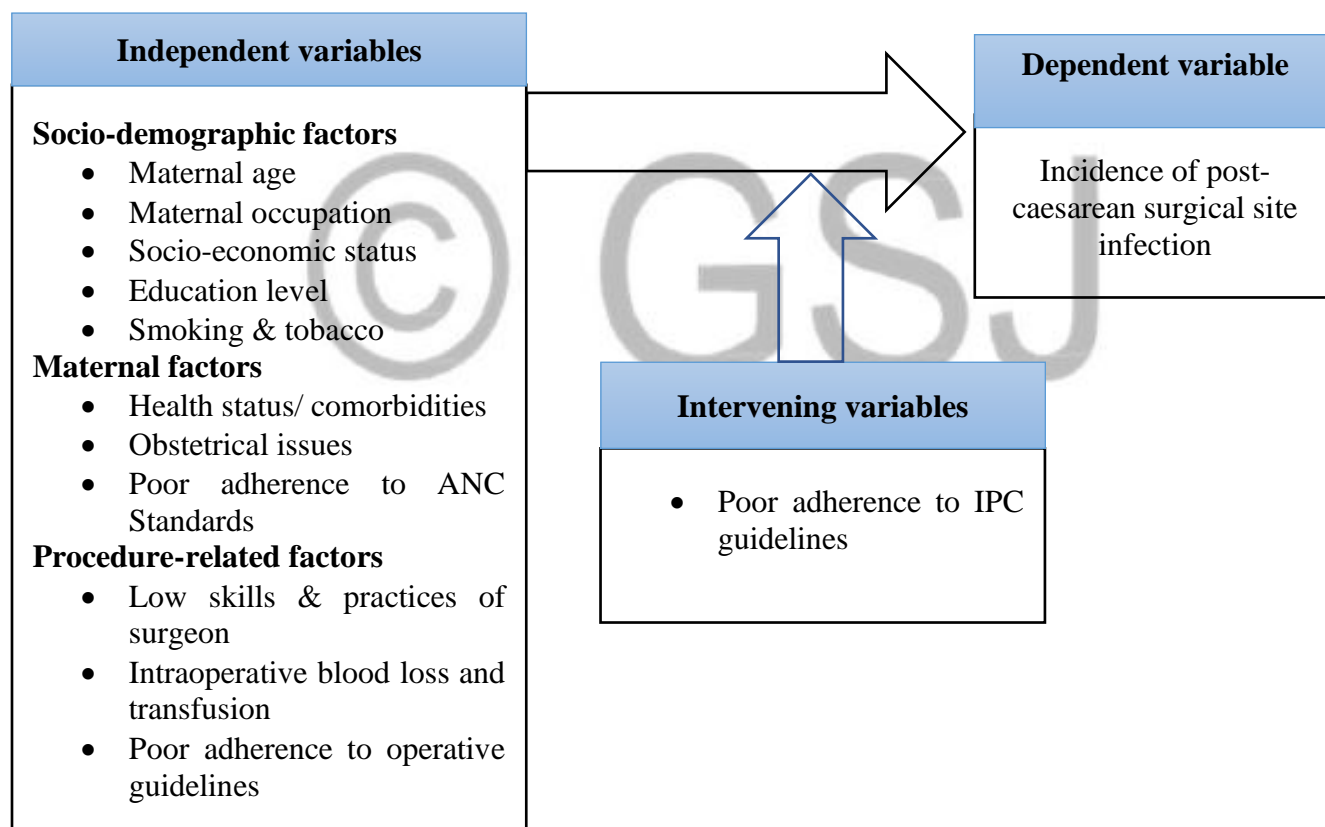


Figure 2. 1 Concept Framework

Source: adopted and modified from (Onwere et al., 2011, Schneiderrmman & Balayla, 2013, Macones et al., 2012).

III. RESEARCH METHODOLOGY

3.1 Research design

A quantitative retrospective study design was used to assess the factors associated with post-caesarean SSI at Rutongo district hospital. The researcher reviewed all files, and registers (CD and SSI registers) in the hospital's archive for the patients admitted and underwent CD in maternity from 2017 to 2021.

3.2 Sample Size

The researcher collected 2016 files of the women who underwent caesarean delivery at Rutongo district hospital from 2017 to 2021.

3.3 Target population

The targeted population of this study was 2016 files of women who underwent CD at Rutongo district hospital from 2017 to 2021.

3.4 Data Collection Source

The researcher utilized a total random selection approach whereby the study checklist has been completed while collecting data. With this technique, the researcher has picked every file complying with the inclusion criteria and filled it correctly concerning found data.

A checklist used to collect data from the selected files was developed by Dégbey (2021) during his study entitled, prevalence and associated factors with SSIs in the University Clinics of Urology & Traumatology of the National University Hospital Centre Hubert Koutoukou Maga in Cotonou. The process of data collection started by obtaining permission from the Rutongo district hospital Ethics and Research Committee to conduct the research in the hospital. The collected data were analysed in SPSS 22 for appropriate generation of the conclusion.

IV. FINDINGS AND CONCLUSION

The analysis was done according to the objectives of the study. The descriptive statistics with frequencies and Logistic Regression [OR (95% CI) and p-value] were used to determine the prevalence and the associated factors for post-caesarean SSI using SPSS 22.

4.1 Maternal Characteristics and Findings from frequency analysis

Table 4. 1 Socio-Demographic Characteristics of Respondents

Variables	Frequency (N=2016)	Percentage (%)
Group age		
Below 18 years	56	2.7
Between 19 -35 years	1471	72.9
Above 35 years.	489	24.4
Maternal occupation		
Farmer	1532	76.0
Businesswoman / public servant	242	12
Housewife	200	9.9
Others (student or jobless)	42	2.1
Socio-economic (Ubudehe) category		
Category I	162	8.0
Category II	641	31.8
Category III	1213	60.2
Referring health facility		
Within Rutongo DH catchment area	1830	90.8
Outside Rutongo DH catchment area	28	1.4
Outside Rulindo District	158	7.8

Table 4. 2 Maternal Factors

Variables	Frequency (N=2016)	Percentage (%)
Maternal parity		
Primiparity	630	31.3
Multiparity	1386	68.7
Antenatal care visit		
Below 4 standard visits	671	33.33
Complete 4 standard visits	1345	66.7
History of anaemia on pregnancy		
Yes	11	0.5
No	2005	99.5
History of NCDs		
Yes	43	2.1
No	1973	97.9
History of infectious diseases		
Yes	126	6.3
No	1890	93.7
Body mass index (BMI)		
Normal BMI (18.5-24.9)	1871	92.8
Abnormal BMI (above 25)	145	7.2
ASA Classification		
Below ASA class III	2011	99.8
Above ASA class III	5	0.2
Use of traditional drugs		
Yes	116	5.8
No	1900	94.2
Obstetrical factors		
Foetal distress	574	28.5
Previous uterine scar	708	35.1
Arrested labor	678	33.6
PROM	56	2.8

Table 4. 3 Procedure Related Factors

Variables	Frequency (n=2016)	Percentage (%)
Multiple digital vaginal exams >5		
Yes	188	9.3
No	1828	90.7
Preoperative body bathe		
Yes	1720	85.3
No	296	14.7
Experience of the surgeon		
Intern doctor	153	7.6
Junior general practitioner	680	33.7
Senior general practitioner	1183	58.6
Time used for the operation		
Below 60 minutes	1793	88.9
Above 60 minutes	223	11.1
Skin preparation with iodine-chlorine solution		
Yes	1978	98.1
No	38	1.9
Type of incision		
Transverse	2009	99.7
Midline	7	0.3
Suturing method		
Continuous	1934	95.9
Interrupted	82	4.1
Preoperative antibiotic prophylaxis		
Yes	1816	90.1
No	200	9.9
Postoperative antibiotic prophylaxis		
Yes	1873	92.9
No	143	7.1
Type of caesarean delivery		
Elective	1577	78.2
Emergency	439	21.8
Blood transfusion during operation		
Yes	26	1.3
No	1990	98.7
Blood loss during operation		
Less than 1000ml	1990	98.7
More than 1000ml	26	1.3
Postoperative hospital Stay		
Below three days	1903	94.4
Above three days	113	5.6

Source: Primary Data (2022)

4.2 The incidence of Post-Caesarean SSI at Rutongo DH

Among 2016 reviewed files, 112 were found to have SSI while 1904 were negative to post-caesarean SSI. therefore, the incidence was 5.6%

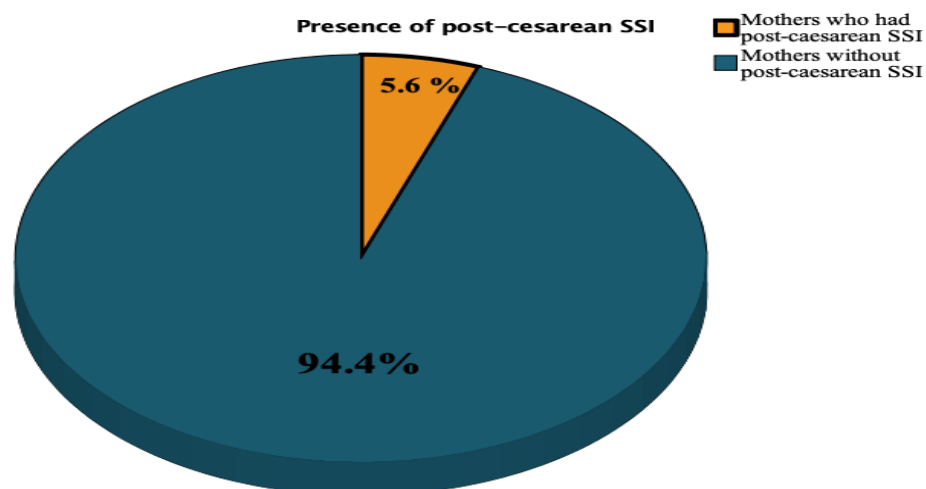


Figure 4. 1 The prevalence of post-caesarean SSI at Rutongo DH

Results presented in Figure 4.1 revealed that the prevalence rate of post-caesarean SSI at Rutongo DH from 2017 to 2021 was 5.6%.

4.3 The factors associated with post-caesarean SSI

The analysis process of the factors associated with post-caesarean SSI was done through SPSS 22. Firstly, the frequency distribution of all variables was done. Secondary, descriptive crosstabulation for each independent variable and dependent variable (presence of SSI) was done. Thirdly, Chi-Square analysis with 2x2 tables was done. Fourthly, the multivariate analysis was used to determine the degree of association with post-caesarean SSI.

Table 4.4 Multivariate Analysis of Socio-Demographic Factors Associated with Post-Caesarean SSI

Variables	Adjusted Odd Ratio	95% CI	P-value
Maternal occupation			
Farmer	2.98	0.407-21.92	0.282
Businesswoman/ public servant	1.05	0.120-9.23	0.964
Housewife	0.414	0.037-4.6	0.476
Others (student or jobless)	Ref.		
Socio-economic (Ubudehe) category			
Category I	62.6	30.06-130.4	<0.001
Category II	11.5	5.6-23.6	<0.001
Category III	Ref.		

Source: Primary Data (2022)

Table 4.4, shows that maternal socio-economic category was strongly associated with post-caesarean SSI. Mothers who are in category I had 62.6 times most likely to develop post-caesarean

SSI in comparison with the mothers in category III. On the other hand, the mothers in Ubudehe category II had 11.5 times higher chances of developing post-caesarean SSI in comparison with mothers in category III.

Table 4. 5 Multivariate Analysis of Maternal Factors Associated with Post-Caesarean SSI

Variables	Adjusted Odd Ratio	95% CI	P-value
Maternal parity			
Primiparity	Ref.		
Multiparity	0.377	0.223- 0.637	<0.001
Antenatal care visit (ANC)			
Below 4 standard visits	10.527	6.428- 17.240	<0.001
Complete 4 standard visits	Ref.		
History of anaemia on pregnancy			
Yes	0.068	0.020- 0.225	<0.001
No	Ref.		
History of non-communicable diseases (NCDs)			
Yes	9.23	4.72- 18.03	<0.001
No	Ref.		
History of infectious diseases			
Yes	0.063	0.041- 0.098	<0.001
No	Ref.		
Body mass index (BMI)			
Normal BMI (18.5-24.9)	Ref.		
Abnormal BMI (above 25)	0.083	0.054- 0.127	<0.001
ASA Classification			
Below ASA class III	Ref.		
Above ASA class III	0.014	0.002- 0.128	<0.001
Use of traditional drugs			
Yes	0.071	0.045- 0.111	<0.001
No	Ref.		
Obstetrical factors			
Foetal distress	4.318	2.395-7.785	<0.001
PROM	41.40	19.96-85.85	<0.001
Arrested labour	1.459	0.746-2.855	0.270
Previous uterine scar	Ref.		

Source: Primary Data (2022)

Table 4.5: In multivariate analysis of maternal factors associated with post-caesarean SSI revealed being primipara, and being in ASA class below 3 were protective factors of post-caesarean SSI. The mothers who had anaemia, infectious diseases, NCDs and high BMI on pregnancy were most likely to develop post-caesarean SSI compared to mothers without them. The mothers who used traditional drugs on pregnancy were most likely to develop post-caesarean SSI than those who never used it. The mothers who did not met 4 standard ANC visits had 10.5 times increased risk of developing post-caesarean SSI than mothers who met 4 or more ANC standard visits. Regarding obstetrical factors in relation with post-caesarean SSI, the mothers with foetal distress increased

the odds of developing post-caesarean SSI 4.3 time's higher chances in comparison with the mothers with no foetal distress. The mothers with PROM had 41.1 times higher chances of developing post-caesarean SSI than the mothers without PROM. There was no strong association between post-caesarean SSI with arrested labour and previous uterine scar.

Table 4.6 Multivariate Analysis of Procedure-Related Factors Associated with Post-Caesarean SSI

Variables	Adjusted Odd Ratio	95% CI	P-value
Multiple digital exams >5			
Yes	0.025	0.016- 0.040	<0.001
No	Ref.		
Preoperative body bathe			
Yes	Ref.		
No	10.89	7.284- 16.282	<0.001
Experience of the surgeon			
Intern doctor	5.352	2.84- 10.07	<0.001
Junior general practitioner	4.757	3.01- 7.509	<0.001
Senior general practitioner	Ref.		
Time used for the operation			
Below 60 minutes	Ref.		
Above 60 minutes	12.86	8.57- 19.28	<0.001
Suturing method			
Continuous	Ref.		
Interrupted	0.318	0.167- 0.606	<0.001
Preoperative antibiotic prophylaxis			
Yes	Ref.		
No	9.714	6.291- 15.001	<0.001
Postoperative antibiotic prophylaxis			
Yes	Ref.		
No	10.737	7.145- 16.135	<0.001
Type of caesarean delivery			
Elective	Ref.		
Emergency	12.445	8.030- 19.289	<0.001
Blood transfusion during operation			
Yes	0.239	0.088- 0.645	<0.001
No	Ref.		
Blood loss during operation			
Less than 1000 ml	Ref.		
Above than 100 ml	0.239	0.088- 0.645	<0.001
Postoperative hospital Stay			
Below three days	Ref.		
Above three days	0.047	0.030- 0.074	<0.001

Source: primary data (2022)

Table 4.6, in multivariate analysis of procedure-related factors associated with post-caesarean SSI found that, multiple vaginal exams >5 times prior to operation, to be operated by an intern or junior doctors, and hospital stay >3 days, were most likely associated with post-caesarean SSI.

Body bathe prior to CD was a protective factor in comparison with no bathing before operation. On the other hand, long operation more than 60 minutes had 12.8 times risk to develop post-caesarean SSI.

The mothers who did not receive preoperative antibiotics had 9.7 times higher chances of developing post-caesarean SSI whereas the mothers who did not receive postoperative antibiotic prophylaxis had 10.7 times higher chances of developing post-caesarean SSI.

The mothers who underwent an emergency caesarean delivery had 12.4 times increased risk of developing post-caesarean SSI than the mothers who underwent an elective CD. In addition, having lost blood more than 1000 ml, and being transfused during operation were more likely to develop post-caesarean SSI compared to not having that. Again more, regarding the suturing method, post-caesarean SSI was most likely in mothers with interrupted suture than in those with continuous suture.

4.2 Conclusions

This study on determining the incidence and factors associated with post-caesarean SSI was conducted at Rutongo DH in Rwanda. All in all, the current study revealed that the incidence of post-caesarean SSI for all mothers who underwent CD from 2017 to 2021 was 5.6%.

The factors associated with post-caesarean SSI at Rutongo DH were maternal multiparity, socio-economic (Ubudehe) category I&II, antenatal care visits less than 4, history of NCDs, history of anaemia, and history of infectious diseases during pregnancy, abnormal body mass index, ASA >3, use of traditional drugs during pregnancy, obstetrical factors like foetal distress and PROM, multiple digital vaginal exams >5, no preoperative whole body bathe, lower experience of the surgeon, operation time above 60 minutes, interrupted suture, no preoperative and postoperative antibiotic prophylaxis, emergency CD, intraoperative blood loss >1000ml and transfusion, and postoperative hospital >3 days. Whereas Age, occupation, referring health facility, skin preparation with iodine-chlorine solution, type of incision, arrested labor and previous uterine scar were not associated with post-caesarean SSI. Thus, awareness among the whole community and healthcare providers to enhance post-caesarean SSI preventive measures should be encouraged.

V. Recommendations

It needs to continue the implementation of maternal health programs to improve pregnancy outcomes and to continue to elaborate the updated protocols regarding post-caesarean SSI prevention for the healthcare providers.

This study revealed that low socio-economic category is strongly associated with post-caesarean SSI. It is important for public health sector to raise women's knowledge on the factors associated with post-caesarean SSI and how they can be prevented early.

It has been found that anaemia, non-communicable and communicable diseases, poor adherence to antenatal care standard visits, and obesity are the major contributors of post-caesarean SSI for pregnant women. Therefore, the programs for prevention and control them should be focused.

Healthcare professionals should educate pregnant women on factors associated with post-caesarean SSI prevention measures like not to use traditional drugs during pregnancy, to attend the 4 standard antenatal care visits, to consult healthcare facilities as early as possible when PROM

happens, to encourage family planning to reduce multiparity as they are the major causes of post-caesarean SSI.

Hospitals should focus on the infection and prevention control (IPC) and surveillance guidelines of post-caesarean SSI with respect to the current protocols of the WHO and the Ministry of health of Rwanda especially preoperative body bathe, preoperative and postoperative antibiotic prophylaxis, and to not expose mothers on nosocomial infections by discharging them less than 3 days for they are strongly associated with post-caesarean SSI.

The surgeons should minimize time of operation less than 60 minutes, minimize intraoperative blood loss more than 1000ml, use continuous rather than interrupted sutures, to minimize preoperative vaginal exams prior to operation, and to use preoperative surgical checklist regularly.

Community health workers should be encouraged to do regular close follow up of pregnant women especially those with low socio-economic status and NCDs and support them to access healthcare services. They should also continue to enhance awareness of the pregnant women regarding not to use tradition medicines and to attend ANC visits regularly.

The researcher recommended that further more studies to assess the incidence, the risk factors, and causative agents of post-caesarean SSI needs to be done in the future mainly at district hospitals level and should be done with mixed research method.

REFERENCES

- [1] Sway, A., Nthumba, P., Solomkin, J., Tarchini, G., Gibbs, R., Ren, Y., & Wanyoro A. (2019). Burden of surgical site infection following cesarean section in sub-Sahara
- [2] Chelimo, A., Arodi, W., Makworo, D., & Mugo, J. (2018). assessment of the incidence and contributing factors of post caesarean section wound sepsis among postnatal mothers at kenyatta national hospital, postnatal ward. *Journal of Health, Medicine and Nursing*, 3(4),1-1.
- [3] Cerovac, A., Hudić, I., Softić, D., & Habek, D. (2021). Perimortem Caesarean section because of a live fetus: case report and literature review. *Wiener Medizinische Wochenschrift*, 1-4.
- [4] Kan, A. (2020). Classical cesarean section. *The Surgery Journal*, 6(S 02), S98-S103.
- [5] Salmanov, A. G., Dyndar, O. A., Vdovychenko, Y. P., Nykoniuk, T. R., Maidannyk, I. V., Chorna, O. O., & Holovanova, I. A. (2019). Surgical site infections and antimicrobial resistance in Kyiv City Hospitals, Ukraine. *Wiad Lek*, 72(5), 760-764.
- [6] Burgess, B. A. (2019). Prevention and surveillance of surgical infections: A review. *Veterinary Surgery*, 48(3), 284-290.
- [7] Onwere, C., Gurol-Urganci, I., Cromwell, D. A., Mahmood, T. A., Templeton, A., & van der Meulen, J. H. (2011). Maternal morbidity associated with placenta praevia among women who had elective cesarean section. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, 159(1), 62-66.
- [8] Dégbey, C., Kpozehouen, A., Coulibaly, D., Chigblo, P., Avakoudjo, J., Ouendo, E. M., &

- Hansis-Moevi, A. (2021). Prevalence and Factors Associated with Surgical Site Infections in the University Clinics of Traumatology and Urology of the National University Hospital Centre Hubert Koutoukou Maga in Cotonou. *Frontiers in Public Health*, 9, 77.
- [9] Ferraro, F., Piselli, P., Pittalis, S., Ruscitti, L. E., Cimaglia, C., Ippolito, G., & Puro, V. (2016). Surgical site infection after caesarean section: space for post-discharge surveillance improvements and reliable comparisons. *New Microbiol*, 39(2), 134-8.
- [10] Mpogoro, F. J., Mshana, S. E., Mirambo, M. M., Kidenya, B. R., Gumodoka, B., & Imirzalioglu, C. (2014). Incidence and predictors of surgical site infections following cesarean sections at Bugando Medical Centre, Mwanza, Tanzania. *Antimicrobial resistance and infection control*, 3(1), 1-10.
- [11] Kurigamba, G. K., Namara, D., Nanyanga, I., Nahabwe, H., & Mutahunga, B. R. POST CESAREAN WOUND SEPSIS: Recognizable Risks and Causes at a Rural Ugandan Hospital.
- [12] Gomaa, K., Abdelraheim, A. R., El Gelany, S., Khalifa, E. M., Yousef, A. M., & Hassan, H. (2021). Incidence, risk factors and management of post-caesarean section surgical site infection (SSI) in a tertiary hospital in Egypt: a five years retrospective study. *BMC Pregnancy and Childbirth*, 21(1), 1-9.
- [13] Molla, M., Temesgen, K., Seyoum, T., & Melkamu, M. (2019). Surgical site infection and associated factors among women underwent cesarean delivery in Debretabor General Hospital, Northwest Ethiopia: hospital based cross sectional study. *BMC pregnancy and childbirth*, 19(1), 1-10.
- [14] Mukagendaneza, M. J., Munyaneza, E., Muhawenayo, E., Nyirasebura, D., Abahuje, E., Nyirigira, J., ... & Muvunyi, C. M. (2019). Incidence, root causes, and outcomes of surgical site infections in a tertiary care hospital in Rwanda: a prospective observational cohort study. *Patient Safety in Surgery*, 13(1), 1-8.
- [15] Suarez-Easton, S., Zafran, N., Garimi, G., & Salim, R. (2017). Postcesarean wound infection: prevalence, impact, prevention, and management challenges. *International journal of women's health*, 9, 81.
- [16] Gupta, S., Manchanda, V., Sachdev, P., Saini, R. K., & Joy, M. (2021). Study of incidence and risk factors of surgical site infections in lower segment caesarean section cases of tertiary care hospital of north India. *Indian Journal of Medical Microbiology*, 39(1), 1-5.
- [17] McClelland, S., Gorfinkle, N., Arslan, A. A., Benedetto-Anzai, M. T., Cheon, T., & Anzai, Y. (2017). Factors associated with cesarean delivery rates: a single-institution experience. *Maternal Health, Neonatology and Perinatology*, 3(1), 1-8.
- [18] Ahmad, S. N., & Aggarwal, R. (2018). Surgical Site Infection Prevention. *Indian Obstetrics and Gynaecology*, 8(2).
- [19] Nkurunziza, T., Kateera, F., Sonderman, K., Gruendl, M., Nihiwacu, E., Ramadhan, B., ... &

- Hedt-Gauthier, B. (2019). Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda. *Journal of British Surgery*, 106(2), e121-e128.
- [20] Kawakita, T., & Landy, H. J. (2017). Surgical site infection after cesarean delivery: epidemiology, prevention and treatment. *Maternal health, neonatology and perinatology*, 3(1), 1-9.
- [21] Zejnullahu, V. A., Isjanovska, R., Sejfiya, Z., & Zejnullahu, V. A. (2019). Surgical site infections after cesarean sections at the University Clinical Center of Kosovo: rates, microbiological profile and risk factors. *BMC infectious diseases*, 19(1), 1-9.
- [22] Alfouzan, W., Al Fadhli, M., Abdo, N., Alali, W., & Dhar, R. (2019). Surgical site infection following cesarean section in a general hospital in Kuwait: trends and risk factors. *Epidemiology & Infection*, 147.
- [23] Tartari E., Weterings, V., Gastmeier, P. J. R. B., Rodríguez Baño, J., Widmer, A., Kluytmans, J., & Voss, A. (2017). Patient engagement with surgical site infection prevention: an expert panel perspective. *Antimicrobial Resistance & Infection Control*, 6(1), 1-9.
- [24] He,X., Li, D., Sun, T., dAl, Q., Hu, M., Zhu, Z., ... & Zhou, J. (2021). Risk factors for surgical site infection after cesarean delivery in a rural area in China: A case–controlled study. *Annals of Medicine and Surgery*, 72, 103110.
- [25] Vallejo, M. C., Attaallah, A. F., Shapiro, R. E., Elz Vallejo amzamy, O. M., Mueller, M. G., & Eller, W. S. (2017). Independent risk factors for surgical site infection after cesarean delivery in a rural tertiary care medical center. *Journal of anesthesia*, 31(1), 120-126.
- [26] Nkurunziza, T., Kateera, F., Sonderman, K., Gruendl, M., Nihiwacu, E., Ramadhan, B., ... & Hedt-Gauthier, B. (2019). Prevalence and predictors of surgical-site infection after caesarean section at a rural district hospital in Rwanda. *Journal of British Surgery*, 106(2), e121-e128.
- [27] Mukamuhirwa, D., Lilian, O., Baziga, V., Ingabire, C., Ntakirutimana, C., Mukantwari, J., ... & Umutesi, M. C. (2022). Prevalence of Surgical site Infection among Adult Patients at a Rural District Hospital in Southern Province, Rwanda. *Rwanda Journal of Medicine and Health Sciences*, 5(1), 34-45.
- [28] Moulton, L. J., Munoz, J. L., Lachiewicz, M., Liu, X., & Goje, O. (2018). Surgical site infection after cesarean delivery: incidence and risk factors at a US academic institution. *The Journal of Maternal-Fetal & Neonatal Medicine*, 31(14), 1873-1880.
- [29] Akimana, D., Mpirimbanyi, C., Ituze, O., Uwera, F. F., & Rutayisire, E. Incidence and risk factors associated with surgical site infection following cesarian section at Kibungo Referral Hospital, Rwanda–A prospective cohort study. *Rwanda Medical Journal*, 78(4), 38-45.
- [30] Bizimana, J. K., Ndoli, J., Bayingana, C., Baluhe, I., Gilson, G., & Habimana, E. (2016). 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(6), 631-641