



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. Secondly, 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' 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-cesarean 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., Garmi, 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., Sejfija, 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., dAI, 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