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INSTITUTIONAL FACTORS ASSOCIATED WITH SURGICAL SITE INFECTIONS AMONG POST CAESAREAN SECTION IN THIKA LEVEL 5 HOSPITAL
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ABSTRACT

***Objective*: The study aimed at determining the institutional factors that contribute to surgical site infections among post caesarean section in Thika Level 5 Hospital.**
***Materials and Methods*: The study employed a mixed unmatched case-control study design which targeted all mothers who had undergone caesarean section in maternity unit at Thika Level 5 Hospital and who had or did not have Surgical Site Infection from delivery up to thirty days post-delivery and nurse in-charges of maternity unit.**
***Result*: The sample size of the study was made up of 128 women comprising 32 cases and 96 controls. Qualitative results revealed that poor aseptic technique in theatre during C/S operations led to an increase in Surgical Site Infections (SSIs). Respondents highlighted the significance of maintaining a sterile and clean environment in the theatre to prevent contamination of surgical sites by microorganisms. The study found that mothers who stayed in hospital for more than 24 hours before Caesarian Section (CS) were more likely to get Surgical Site Infection (SSI) as compared those that had stayed in the hospital for less 24 hours before CS (OR=13.05 [95%CI=4.10-41.53]; p<0.001). Mothers who shared beds with other patients were more likely to get SSI as compared to those that did not share beds (OR=3.01 [95%CI=1.28-4.19]; p<0.001). Moreover, mothers who spent more than a week in the hospital were more likely to get SSI than those who stayed in the hospital for less than that period (OR=3.41 [95%CI=1.06-11.38]; p<0.001).**
***Conclusion*: The study concludes that there is a potential relationship between the duration of hospital stay prior to CS and the risk of SSI. Also, the institutional factors associated with SSIs are the response of healthcare workers to the needs of the patients, the level of care given at the hospital and facility accessibility.**

INTRODUCTION

Caesarean section is the most common major operation carried out in obstetrics and constitutes about 15% of all deliveries worldwide, with Latin America being the highest at 29.2% (1). This is consistent with the assertions that the incidence of caesarean sections has risen dramatically over the last few decades, with an estimated global number of 22.9 million caesarean section deliveries having been carried out in 2012(2). A caesarean section may be necessary when vaginal deliveries pose a risk to the mother or the baby, when there is prolonged labor, obstructed labor, fetal distress, and malpresentation or on mother's choice (3). Though caesarean section is an essential component in health care, complications after surgery significantly account for maternal morbidity and mortality. Caesarean sections are accompanied by a number of complications which include Surgical Site Infections (SSI) (3).

Surgical Site Infections are infections occurring within thirty days after the surgical operation or within one year if an implant is left in place after the procedure and affecting either the incision or deep tissue at the operation site (1). In Vietnam, it was asserted that 15% to 80% of Surgical Site Infections occurred after initial discharge from the hospital (4). The rate of Surgical Site Infections ranges from 3% to 15% worldwide. Likewise, previous study showed that in 2014, nearly 1.3 million caesarean sections were performed and 32% were associated with Surgical Site Infections (5).

In Sub-Saharan Africa, many mothers who undergo caesarean section deliveries had Surgical Site Infections as a common complication. According to previous study, risks of Surgical Site Infections are more in developing countries due to malnutrition, anaemia, poverty, poor preoperative preparation, wound contamination, poor antibiotic selection or inability of an immune-compromised patient to fight against the infection(6). In Ethiopia, a study on prevalence and root causes of surgical site infection among women undergoing caesarean section in Ethiopia it has been reported that Surgical Site Infections as the commonest cause of nosocomial infection in obstetrics and gynecology with a prevalence rate of 14.8% to 59% (7).

Kenya is no exception with many cases of Surgical Site Infections being reported. For example, a study done on incidence and determinants of Surgical Site Infections after caesarean sections at Kenyatta National Hospital indicated that, despite improvements in professionalism among healthcare providers, operating room practices, instruments sterilization methods, and infection prevention strategies, Surgical Site Infections are still high (5). Similarly, in Thika Level V Hospital, cases of Surgical Site Infections amongst mothers after Caesarean Sections had been reported. Previous study found that the rate of Surgical Site Infections among Caesarean Section mothers is 7.3% (8). Despite this, very few studies have been done in maternity unit at Thika Level 5 Hospital on determinants of Surgical Site Infections among post caesarean section mothers. There was need of a study to assess the labor related factors that contribute to surgical site infections among post caesarean section mothers in Thika Level 5 Hospital.

The risk of postpartum infections is five to twenty times higher after Caesarean Sections than vaginal birth. The rate of surgical site infections following caesarean section ranges

from 3% to 15% worldwide (2). These infections are associated with higher maternal morbidity and mortality rates. In Thika Level 5 Hospital the mortality rate was reported to be 2% in the year 2019 (8). Cases of Surgical Site Infections had been on the rise among mothers who had undergone Caesarean Section in Thika Level V Hospital. It has been established that the rate of Surgical Site Infections among Caesarean Section mothers was 7.3% (2). The development of a Surgical Site Infection causes an increase in the clinical, economic and financial burden of surgery increases due to direct costs and indirect costs incurred (8).

Surgical Site Infections negatively impact on patients' physical and mental health. Increased patient morbidity, mortality and loss of jobs during recovery are some of the indirect costs associated with Surgical Site Infections (9). Thika Level 5 hospital has an average of 200 caesarean sections per month which is a rate of approximately 30 per cent of total deliveries. Despite the relatively high Caesarean Section in the facility, there are few documented evidences for determinants contributing to Surgical Site Infections among post caesarean section mothers. The study therefore set out to assess the institutional related factors that contribute to surgical site infections among post caesarean section mothers in Thika Level 5 Hospital.

MATERIALS AND METHODS

The study design was a mixed unmatched case-control study. In a mixed study design both quantitative and qualitative data is collected. A case control study compares patients who have a disease or outcome of interest (cases) with patients who do not have a disease or outcome (controls) and looks back retrospectively to compare how frequently the exposure to a risk factor is present in each group to determine the relationship between the risk factor and the disease (10). Cases included mothers who have been exposed to factors that contribute to Surgical Site Infections while the controls were made up of mothers who had undergone caesarean section but did not develop surgical site infection after the exposure to the risk factors.

Study Selection

Study Area

The study was carried out at Thika Level Five Hospital reproductive health unit. Thika Level Five Hospital is strategically located at Thika Town, Kiambu County. The hospital has an average of 200 caesarean sections per month which is a rate of approximately 30 per cent of total deliveries. (Health Information System, Thika, 2019). Thika Level five hospital reproductive unit has daily average occupancy of one hundred patients. It consists of antenatal ward which is on the ground floor right wing, labor ward on the first-floor right wing, postnatal ward on the left wing, maternity theatre on the second-floor left wing, newborn unit on the right wing and gynae ward on the third floor (11).

Population

The study population was made up of all mothers who had undergone caesarean section in maternity unit at Thika Level 5 Hospital during the study period and nurse in charges of reproductive health unit.

Sample Size

The study used Kelsely *et al.,* (1996) formula to arrive at a sample size for the cases. Thus, based on the formula of Fleiss (1981) sample size for cases was 32, whereas for the control was 32*3=96. But to take care of the spoilt questionnaires, ten percent of the sample of cases was added to the control to give 96. Therefore, the total sample size was 128 mothers.

Inclusion Criteria

The inclusion criteria were as follows; Cases, which included all mothers who had undergone caesarean section at Thika Level 5 Hospital and had Surgical Site Infection from delivery up to thirty days post-delivery and the Controls, which included all mothers who had undergone caesarean section at Thika Level 5 Hospital but had no Surgical Site Infection from delivery up to thirty days post-delivery.

Recruitment

Study participants who met the inclusion criteria were recruited consecutively into the study as they sought the routine clinical care services in the clinic. Once the client had been attended to at the clinic, and had received all the services they came for, the investigator approached and invited her for participation in the study.

Data Extraction

On the third day post caesarean section or during discharge, socio-demographic/maternal characteristics, labor factors and institutional factors were filled in the questionnaires (12). Dressings were opened to ascertain whether the study participants had surgical site infections. Those who had surgical site infection were recruited as cases and dressing management commenced while those who did not have surgical site infection were explained to on how to identify signs of surgical site infections to include swelling on the operation site, oozing of pus, fever. They were advised to come back in two weeks for a check-up or before two weeks if there were signs of surgical site infections.

At two weeks the mother was assessed for any signs of surgical site infections after routine blood pressure check and assessment of the baby. Those found to have surgical site infections were taken for treatment while those without surgical site infections were given a phone number to call in case of any inquiries. The researcher made weekly follow up calls to find out the progress of study subjects. The return date was given on the sixth week for routine services for all the mothers. After the return on the sixth week, mothers were evaluated again for signs of surgical site infections, and for mothers who had been identified with surgical site infections, their treatment progress was reviewed, and adjustments made as needed.

Data extraction form and semi-structured questionnaire were used to collect quantitative data from the participants. Data extraction form was used to collect maternal and labor-related factors associated with SSIs from the mother's file. Semi-structured questionnaire was designed to collect institutional related factors. The key-informant guide was used to collect qualitative data from the nurse in charges working in the reproductive health unit on institutional related factors associated with SSIs.

Ethical consideration

Informed consent was obtained from study participants and confidentiality was maintained. There was no risk or direct benefits to the participants participating in the study. Ethical approval was sought for the study, with reference number. However, an ethical review waiver was granted due to minimal risk to participants and the use of anonymized data. This decision was based on the nature of the research, which did not involve direct patient interventions or sensitive information collection.

Data Synthesis

Qualitative data was analyzed using content analysis while Quantitative data from the field questionnaires was double entered into a designed computer database. Data cleaning

and validation was performed in order to achieve a clean dataset that was exported into Statistical Package for Social Sciences (IBM SPSS) software version 26 ready for analysis. Regular file back-up was done to avoid any loss or tampering of data. Qualitative data captured using notes and verbatim expressions were transcribed into MS-Word into various areas and categories. All questionnaires and interview records were stored in lockable drawers.

RESULTS

The study distributed 128 questionnaires to the mothers and 127 were returned hence achieving 99.2% response rate. Descriptive analysis results as presented in Table 1 revealed that slightly more than half of the respondents (n=65; 51.2%) indicated that the duration of stay before CS was more than 24 hours. Similarly, most (n=87; 68.5%) of the respondents indicated that they did not share a bed with another patient after CS, with 107 (84.3%) of them stating that the duration of hospital stay after CS was 7 days or less. On the same aspect, the majority of the respondents (n=95; 74.8%) stated that health workers responded to their concerns appropriately. Consequently, more than half (n=71; 55.9%) of the respondents said that they were satisfied with the level of care given at the hospital. Majority of the respondents (n=90; 70.9%) indicated that the facility was accessible. Finally, more than half (n=69; 54.3%) of the respondents indicated that there was an active warming device used during the procedure.

Table 1

Descriptive Analysis on Institutional Related Factors

	Cases		**Controls**		**Total**	
Variables	**N**	**%**	**N**	**%**	**N**	**%**
Duration of stay before CS						
Less than 24 hours	15	48.4	47	49.0%	62	48.8
More than 24 hours	16	51.6	49	51.0%	65	51.2
Share a bed with another patient after CS						
No	25	80.6	62	64.6%	87	68.5
Yes	6	19.4	34	35.4%	40	31.5
Duration of hospital stay after CS						
7 days and less	28	90.3	79	82.3%	107	84.3
More than 7days	3	9.7	17	17.7%	20	15.7
Health workers respond to concerns appropriately						
No	8	25.8	24	25.0%	32	25.2
Yes	23	74.2	72	75.0%	95	74.8
Level of satisfaction with care given in the hospital						
Satisfactory	16	51.6	55	57.3%	71	55.9
Unsatisfactory	15	48.4	41	42.7	56	44.1
facility accessible						
No	6	19.6	31	32.3%	37	29.1
Yes	25	80.4	65	67.7%	90	70.9
Active warming device used during the procedure						
No	12	38.7	46	47.9%	58	45.7

Yes	19	61.3	50	52.1%	69	54.3

The findings were presented in Table 2. The results showed that three variables were significantly associated with SSI. The study specifically established that mothers who stayed in hospital for more than 24 hours before CS were more likely to get SSI as compared those that had stayed in the hospital for less 24 hours before CS (OR=13.05 [95%CI=4.10-41.53]; p<0.000). Similarly, mothers who were sharing beds with other patients were more likely to get SSI as compared to those that did not share beds (OR=3.01 [95%CI=1.28-4.19]; p<0.001). Moreover, mothers who spent more than a week in the hospital were more likely to get SSI than those mothers who stayed in the hospital for less than that period (OR=3.41 [95%CI=1.06-11.38]; p<0.001).

Table 2

Association between Institutional Related Factors and Surgical Site Infections

Variables	**Cases**		**Controls**			**95%CI**		
	n	**%**	**N**	**%**	**OR**	**Lower**	**Upper**	**P-Value**
Duration of stay before CS								
Less than 24 hours	15	48.4	47	49.0	Ref			
More than 24 hours	16	51.6	49	51.0	13.05	4.10	41.53	0.000
Shared a bed after CS								
No	25	80.6	62	64.6	Ref			
Yes	6	19.4	34	35.4	3.01	1.28	4.19	0.001
Duration of stay after CS								
7 days and less	28	90.3	79	82.3	Ref			
More than 7days	3	9.7	17	17.7	3.41	1.06	11.38	0.021
Health workers respond to concerns appropriately								
No	8	25.8	24	25.0	Ref			
Yes	23	74.2	72	75.0	0.92	0.75	1.12	1.923
Level of satisfaction with care given in the hospital								
Satisfactory	16	51.6	55	57.3	Ref			
Unsatisfactory	15	48.4	41	42.7	1.33	0.32	1.82	1.023
Facility accessible								
No	6	19.6	31	32.3	Ref			
Yes	25	80.4	65	67.7	0.22	0.12	1.139	0.193
Active warming device used during the procedure								
No	12	38.7	46	47.9	Ref			
Yes	19	61.3	50	52.1	0.97	0.76	1.41	0.201
OR= Odds Ratio, CI= Confidence Interval, Ref = Reference								

Three themes emerged from the Key Informant Interviews (KIIs) as institutional related factors associated with SSIs. These were poor aseptic technique, prolonged labour and early rupture of member, presence of medical conditions (HIV/AIDs and DM).

Theme 1: Poor aseptic technique

Majority of KIs mention poor aseptic technique during surgery and wound care as an institutional factor that contributed to SSIs among mothers who had undergone c/s. One of the respondents reported that:

"Lack of proper IPC practices in the operating room during a Caesarean section led to a higher rate of surgical site infections. The theatre needs to be sterile and clean during any operation to avoid contamination of surgical site with micro-organism". [KII, 3].

Another respondent supported the above by stating that:

"In my ward we lack sterile gloves and dressing packs. This makes us not follow aseptic technique when doing wound dressing and as such many clients end up with SSIs" [KII, 8].

DISCUSSION

The study found a strong relationship between various institutional factors and the likelihood of surgical site infections (SSIs) among mothers who had Caesarean sections at Thika Level 5 Hospital. This was found to be consistent with the conclusion made by a study conducted by previous study that, when analyzing type of caesarean section, an unplanned procedure, especially if it occurred after the onset of labor, and it was associated with an increased risk of Surgical Site Infection (9). A high caesarean section rate among primiparous women is extremely important because of the subsequent increased risk of caesarean section, compared to vaginal delivery, in future pregnancies.

Descriptive analysis results showed that a longer duration of hospital stay before the operation and sharing a bed after the Caesarean section were linked to a higher incidence of SSIs. Additionally, the study highlighted that most respondents felt health workers addressed their concerns appropriately, and the majority were satisfied with the care received at the facility. This concurs with the conclusion made by previous study that caesarean sections are accompanied by a number of complications which include Surgical Site Infections (3).

In-depth interviews further elaborated on these institutional factors. Inadequate IPC practices during surgical procedures were frequently identified as a key factor leading to surgical site infections. This is consistent with the observation by one study that, in Thika Level 5 Hospital the mortality rate was reported to be 2% in the year 2019 (8). Cases of Surgical Site Infections had been on the rise among mothers who had undergone Caesarean Section in Thika Level V Hospital (2).

Shortages of essential supplies like sterile gloves were noted as barriers to maintaining aseptic techniques. Other factors identified included prolonged labor and early rupture of the membrane. These results suggest that both logistical issues, like bed sharing and duration of stay, and clinical practices, such as sterile techniques, play a significant role in the prevalence of SSIs among post-Caesarean mothers.

CONCLUSION

Based on the findings, it is evident that both hospital conditions and medical practices significantly influence the risk of Surgical Site Infections (SSIs) following Caesarean sections. The issue is multi-faceted, involving both logistical concerns such as bed sharing and length of hospital stay, as well as clinical procedures like maintaining a sterile environment. Additionally, improving the supply chain for essential sterile materials, such as gloves and dressing packs, is critical in the facility. By ensuring that health workers have the resources they need, the hospital will encourage better adherence to the IPC practices as this is a significant step towards lowering the SSIs rate. Concurrently, administrative changes are necessary to minimize bed sharing and prolonged hospital stays before surgery, as these were identified as key risk factors for SSIs.

Training health workers on the importance of timely responses to patient concerns, and the role of this in preventing SSIs, proves invaluable. Additionally, educational programs for incoming patients prepare them better for what to expect during their hospital stay, empowering them to take a more active role in their own health and potentially reducing the risk factors related to SSIs.

RECOMMENDATIONS

This study recommends that the management of Thika Level 5 Hospital should revise their patient-flow protocols to minimize the duration of hospital stays before surgical procedures whenever medically possible. Likewise, efforts should be made to limit bed-sharing, and increasing the number of available beds, to reduce the risk of SSIs.

The management of Thika Level 5 Hospital should therefore prioritize a reliable supply chain for these materials and hold regular training sessions for healthcare workers to reinforce the importance of aseptic techniques. This will not only help maintain a sterile environment but also encourage the healthcare workers to consistently adhere to best practices.

Finally, the study found that a majority of the respondents felt healthcare workers responded to their concerns appropriately, and yet SSIs remain a problem. Implementing these recommendations requires a combined effort from both administrative and clinical sides of healthcare delivery and will significantly reduce the incidence of SSIs.

Limitations

Some of the limitations of the study included working with a relatively small sample size of 128 mothers, with 32 cases and 96 controls. This limits the generalizability of the findings to a larger population. The researcher acknowledges the fact that surgical site infections can be influenced by various factors, and a larger sample size would provide more robust results. Additionally, the study recruited participants who sought routine clinical care services at the hospital. This had a possibility of introducing selection bias. This is because mothers who experience surgical site infections are more likely to return for care, potentially skewing the results. However, the study mitigated this limitation by ensuring that both mothers with less severe and very severe infections were included in the study.

Suggestions for Further Research

The study is not exhaustive and so there are gaps. For instance, the study was only conducted at Thika Level Five Hospital in Kiambu County and therefore the findings presented in this study may not give the exact picture of the prevalence of SSI among mothers delivering in hospital in other parts of the country. This study therefore suggests that

similar studies be carried out in other major referral hospitals in Kenya such as Moi Teaching and Referral Hospital, Kenyatta University Teaching and Referral Hospital and others, so that the findings can be compared with those of the current study.

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