

# Postoperative Complications and Risk Factors among Women Who Underwent Caesarean Delivery from Northern Tanzania: A Hospital-Based Analytical Cross-Sectional Study

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## Abstract

**Introduction:** Caesarean section (CS) causes some complications. We here attempted to determine the rate of CS complications, characterize their timing, and identify their risk factors among women delivered at Kilimanjaro Christian Medical Center (KCMC). **Methods:** Patients who underwent CS in KCMC were interviewed and analysed. Risk factors were expressed with Odds ratio (OR) and 95% CI. **Results:** Of 386 deliveries, 106 (27.5%) had one or more complications. Common early complications (24 - 72 hours after CS) were puerperal sepsis, anaesthesia-related complications, blood transfusion and ICU admission. Longer duration of surgery was significantly associated with all complications (aOR 2.90; 95% CI: 1.02 - 8.50). Grand multiparity was significantly associated with blood transfusion (7.0; 1.40 - 34.35) and PPH (6.4; 1.5 - 24.24) while pre-operative anaemia was significantly associated with blood transfusion (4.34; 1.90 - 9.45). **Conclusion:** Longer duration of surgery, grand multiparity and pre-operative anaemia are associated with complications. Physicians should be aware that these are risk factors for CS-complications.

## Keywords

Caesarean Section, Complications, Risk Factors

## 1. Introduction

Depending on the definition of morbidity following a caesarean section, the method of data collection, duration of follow up and the rate of intra and post-operative complications vary widely across the whole globe. A registry-based cohort study that was done in Finland, on maternal complications and obstetric risk factors for CS reported 27% CS related complications [1] where a complication rate of 21.4% was reported in Norway where a similar study design was used [2]. While a meta-analysis and systematic review that involved six articles from India on maternal-fetal outcomes in elective and emergency CS group reported a complication rate of 55.9% [3] when a retrospective case-control study was done in Tel Aviv, Israel 5.7% CS related complications was reported [4]. Complication rate of 13.3% was reported from a cross sectional study that was done in Nigeria [5] compared to a complications rate of 30.2% that was reported from a similar study design that was done in Rwanda [6].

Severe maternal morbidity and mortality are mostly encountered among women who underwent an emergency caesarean section as compared to the planned caesarean section [2] [3]. Preeclampsia, eclampsia, increasing maternal age, pre-term delivery especially when the gestational age is <30 weeks, previous abdominal surgery (other than CS), type 1 diabetes, multiple pregnancy and uterine rupture have also been documented as risk factors for caesarean section related complications [1]. Maternal obesity (BMI > 35 kg/mm<sup>2</sup>) has also been found to be highly associated with wound complications whereby vertical skin incisions have a 7 times higher chance of wound infection and wound separation compared to the transverse skin incision [7].

After exclusion of pre-existing morbidity, CS births have a 4 - 5 higher fold of morbidity and mortality as compared to vaginal delivery [8] [9]. CS delivery has been found to be related to blood transfusion, endometritis, superficial surgical site infection, haemorrhage, injury to the pelvic organs, thromboembolic disorders and anaesthesia related complications [5] [10] [11] [12] [13] [14]. Whereby Maternal mortality (MM) is related to CS is about 6 - 13/100,000 deliveries in the high resource countries and 7.6/1000 deliveries in low and middle-income countries respectively [10] [14].

In long term, caesarean section delivery is associated with abnormal placentation, uterine rupture in the subsequent pregnancy, adhesions, unexplained still-birth, preterm birth especially when the previous CS was done during the second stage of labour and scar complications which includes postmenstrual spotting, endometriosis, uterine scar pregnancy, numbness and pain [14] [15].

This study aims to determine the rate of caesarean section complications, characterize their timing and identify the risk factors for maternal complications among women delivered at KCMC hospital.

## 2. Methods

### 2.1. Study Design and Area

This was a hospital-based analytical cross-sectional study conducted from Octo-

ber 2018 to May 2019, in the department of Obstetrics and Gynaecology at Kilimanjaro Christian Medical Centre (KCMC).

KCMC is a zonal consultant and a teaching hospital located in Moshi municipality. It serves as a catchment area for facilities in Kilimanjaro, Manyara, Tanga and Arusha regions in Northern Tanzania and some districts in Kenya. The average delivery per year is about 4000.

## **2.2. Study Population**

Pregnant women with an intrauterine pregnancy at a gestation age of  $\geq 28$  weeks, delivered by CS (both elective and emergency) at KCMC hospital and have consented to participate in the study were involved. Women who presented with uterine rupture, or where classical incision, a vertical incision that is confined to the lower segment, inverted “T” incision and inverted “J” incision was used in the index delivery were excluded from the study.

## **2.3. Sample Size and Sampling Technique**

Systematic sampling technique was used in order to get a required sample size of 386 participants.

## **2.4. Data Collection Method, Tools and Procedure**

Face-to-face interview was conducted by the principal investigator or by a trained research assistant who is fluent in both English and Swahili. These interviews were conducted in the ward where these patients were admitted after a caesarean section delivery.

List of women delivered by CS was obtained from the delivery register that is available in the department of obstetrics and gynecology. Detailed information about the research and its purpose was explained to each client who met the inclusion criteria. Then consent was sought from every client before being enrolled in the study. However, the rights of an individual client to be part of the study or refuse to be part of the study were observed. At the enrolment, social-demographic characteristic, detailed past medical, obstetrics, surgical and family social history were sought from every study participant.

Other variables of interest like examination findings, pre-operative diagnosis, indication for CS, duration of surgery, type of anaesthesia used, presence of any incidental intra-operative findings or adverse events and the postoperative diagnosis were retrieved from the patient's files.

A data collection form was used to extract all relevant information about the study, variables from patients and their hospital file records before they are discharged from the hospital. This information was later transferred into a computer database containing all corresponding variables needed for the study. The decision to perform Caesarean section was done by an attending Registrar, resident or a specialist.

Enrolled participants were visited daily until the 3<sup>rd</sup> day to see if they devel-

oped any of the CS-related complications.

## 2.5. Definition of Variables

The main outcome variables included intra-operative complications like visceral injury, high spinal, nausea and vomiting together with post-operative complications like post-partum hemorrhage (PPH), hysterectomy, surgical site infection (SSI), peritonitis, re-laparotomy, endometritis, shock, blood transfusion, post-spinal headache, thromboembolism, ICU admission and death.

Immediate complications have been defined as a disease or health condition developing in the course of caesarean delivery. This unfavourable evolution must occur within 24 hours of the caesarean delivery, while early complications have been defined as a disease or health condition developing in the course of caesarean delivery between 24 - 72 hours of the caesarean delivery.

Haemoglobin < 11 g/dl or haematocrit < 30% was considered as mild Anaemia, 7 - 9.9 g/dl moderate anaemia and Hb < 7 g/dl to be severe anaemia [16]. These values were obtained from Full blood picture results that were done just before the operation for emergency CS and one day before delivery for elective CS.

The duration of surgery (skin incision to the last stitch) was regarded as “prolonged” when it lasted more than one hour (60 minutes).

Blood loss was estimated by counting the number of soaked gauzes, abdominal packs and blood stained on the theatre linens and drapes. The decision to transfuse intra-operatively was made by the attending anaesthetist/anaesthesiologist based on pre-operative haemoglobin/haematocrit levels, intra-operative blood loss and clinical status of the patient. While the decision to transfuse post-operatively was made by the attending doctor. Where the amount of blood loss was not possible to be measured, blood transfusion among patients who had normal Hemoglobin /hematocrit before surgery was used as a marker of massive bleeding during or immediately after surgery. Unit(s) of blood and blood products transfused were recorded in a special blood transfusion services form.

## 2.6. Data Analysis

Data cleaning and error range check to enhance validity and consistency was observed before data analysis. Descriptive statistics were summarized in frequencies and percentages. Bar graphs and pie charts are used to present post-operative complications. Continuous variables have been presented in mean or median.

The risk factors whose independence turned out to be significant by the univariate logistic analysis were analysed further by multivariate logistic regression analysis. Multivariate analysis was done for the most prevalent complications, which were anaesthesia related complications, blood transfusion and PPH to control for confounders. Odds ratio and 95% CI has been used to make an asso-

ciation. A p-value of less than 0.05 (two-tailed) was considered statistically significant. Data analysis was performed by using STATA version 13.0 (Copyright 1985-2017 Stata Corp LLC).

### 3. Results

A total of 2310 deliveries occurred at KCMC during the study period of which 1138 had Caesarean section. This makes a caesarian section rate of 49.1% among those delivered by CS, five women were excluded because uterine rupture was found intraoperatively, thus 386 participants were enrolled in the study. All of them agreed and signed their consent; this gives a participation rate of 100%.

#### 3.1. Baseline Characteristics of the Participant

Majority of the study participants 295 (76.4%) were aged between 20 to 34 years, with a mean age of  $28.6 \pm 5.5$  years, 230 (59.6%) had formal education 210 (54.4%) from rural areas. Majority 298 (77.2%) of participants were term deliveries and 235 (60.9%) were self-referred from home. Out of 386 study participants, 294 (76.2%) had an emergency CS delivery and 92 (23.8%) elective CS delivery, refer to **Table 1**.

#### 3.2. Rate of Caesarean Section Related Complications among Women Delivered at KCMC Hospital

Out of 386 study participants, 106 reported having had one or more complications during the study period. This makes a complication rate of 27.5%. Among study participants with complications, 56 (14.5%) had one complication, 19 (5%) had two complications and 31 (8%) had three or more complications. Refer to **Figure 1**.

#### 3.3. The Immediate Postoperative Complications among Women Delivered by Caesarean Section at KCMC Hospital (N = 386)

Out of 386 study participants, 93 reported one or more complications, in the first 24 hours of the operation ("immediate complication"), this makes immediate complication rate of 24%. Among those with immediate complications 48 (12.4%) of the participants had one complication, 34 (8.8%) had two complications and 11 (2.8%) had three or more complications.

The most common complications reported were anaesthesia related complications 53 (13.7%) followed by blood transfusion 35 (9.1%) and PPH 31 (8%). The least were thromboembolism 1 (0.3%), peritonitis 1 (0.3%) and maternal death 1 (0.3%). There was no significant variation of these complications by type of CS (whether elective or emergency), refer to **Table 2**.

#### 3.4. Early Postoperative Complications Following Caesarean Section

Out of 386 study participants, 37 had one or more complication that was reported

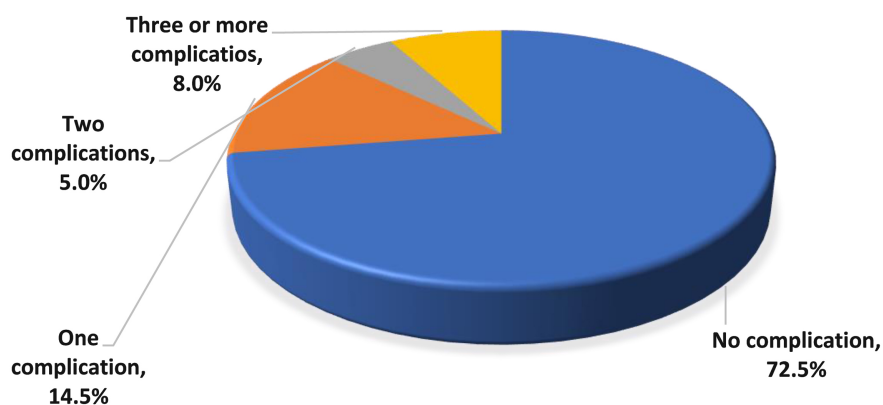
**Table 1.** Characteristics of the study participants (N = 386).

Variables	Number of patients	Percentage
<b>Age in years</b>		
<20	17	4.4
20 - 34	295	76.4
≥35	74	19.2
[Mean, (SD)]	[28.6; 5.5]	
<b>Education</b>		
Non-formal	30	7.8
Primary	126	32.6
Secondary	129	33.4
College and above	101	26.2
<b>Occupation</b>		
Housewife	41	10.6
Peasant/farmer	139	36.0
Business	104	26.9
Employed	89	23.1
Other (student, tailor)	13	3.4
<b>Residence</b>		
Urban	176	45.6
Rural	210	54.4
<b>BMI group</b>		
<18.5	2	0.5
18.5 - 24.9	67	17.4
25.0 - 29.9	125	32.4
≥30	192	49.7
<b>Parity</b>		
Primipara	174	45.1
Multipara	191	49.5
Grand multipara	21	5.4
<b>Gestational age</b>		
Term	298	77.2
Late preterm	51	13.2
Early preterm	37	9.6
<b>ANC attendance</b>		
Never	8	2.1
<4	76	19.7
≥4	302	78.2
<b>Referral case</b>		
Yes	151	39.1
No	235	60.9
<b>CS type</b>		
Elective	92	23.8
Emergency	294	76.2
<b>Anemia</b>		
No	294	76.2
Yes	92	23.8

**Table 2.** The immediate post-operative complications among women delivered by caesarean section at KCMC hospital (N = 386).

Complications (Type)	All CS (N = 386)	Elective CS (N = 92)	Emergency CS (N = 294)	P value
All complications	93 (24.1)	19 (20.7)	74 (25.2)	0.377
Anesthesia complication	53 (13.7)	11 (12.0)	42 (14.3)	0.571
Blood transfusion	35 (9.1)	8 (8.7)	27 (9.2)	0.887
PPH	31 (8.0)	8 (8.7)	23 (7.8)	0.331
Hysterectomy	11 (2.8)	3 (3.3)	8 (2.7)	0.786
Admission to ICU	7 (1.8)	2 (2.2)	5 (1.7)	0.767
Re-laparotomy	4 (1.1)	1 (1.1)	3 (1.0)	0.956
Wound infection	3 (0.8)	0 (0.0)	3 (1.0)	0.331
Wound dehiscence	2 (0.5)	0 (0.0)	2 (1.4)	0.261
Maternal death	2 (0.5)	0 (0.0)	2 (0.7)	0.428
Peritonitis	1 (0.3)	0 (0.0)	1 (0.3)	0.575
Thromboembolism	1 (0.3)	0 (0.0)	1 (0.3)	0.575

\*P value < 0.05 is statistically significant.



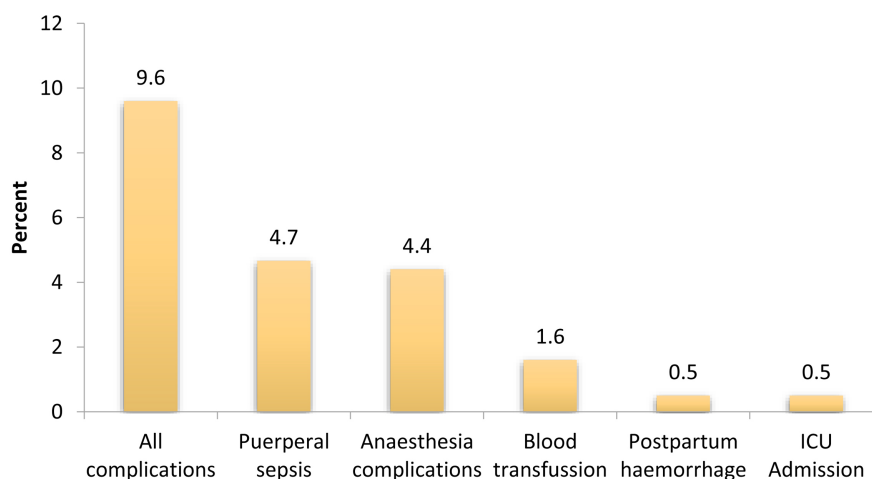
**Figure 1.** Rate of caesarean section related complications (N = 386).

between 24 to 72 hours of the CS delivery (“early complications”), this makes Early post-operative complication rate of 9.6%. Among those with early complications 24 (6.2%) had one complication, 10 (2.6%) had two complications and 3 (0.8%) had three or more complications.

The most common reported complications were puerperal sepsis 18 (4.7%), followed by anaesthesia related complications 17 (4.4%), blood transfusion 6 (1.6%), PPH (0.5%) and ICU admission 2 (0.5%). Refer to **Figure 2**.

### 3.5. The Risk Factors for Postoperative Complications

From our findings, it shows that multiparity (OR = 1.96, 95% CI: 1.20 - 3.20)



**Figure 2.** Early postoperative complications following caesarean section (N = 386).

grand multiparity (OR = 6.9, 95% CI: 2.5 - 14.0), Antenatal clinic attendance of < 4 visits (OR = 1.77, 95% CI: 1.05 - 2.97), longer duration of surgery (OR = 2.44, 95% CI: 1.52 - 3.92) were associated with all the post operative complications.

Anaesthesia-related complications were positively and significantly associated with grand multiparity (OR = 3.1, 95% CI: 1.13 - 8.68) and longer duration of surgery (OR = 2.33, 95% CI: 1.37 - 3.99).

Blood transfusion was significantly related with multiparity (OR = 2.42, 95% CI: 1.18 - 4.93), grand multiparity (OR = 6.75, 95% CI: 2.18 - 20.83), early pre-term delivery (OR = 2.77, 95% CI: 1.19 - 6.46), pre-operative anaemia (OR = 2.92, 95% CI: 1.54 - 5.54), antenatal attendance < 4 visits (OR = 1.96, 95% CI: 1.03 - 3.84) and longer duration of surgery (OR = 2.13, 95% CI: 1.15 - 3.90).

In this study the most prevailing significant factors related to PPH during or after CS included less antenatal visits (OR = 2.23, 95% CI: 1.04 - 4.77) and longer duration of surgery (OR = 3.16, 95% CI: 1.51 - 6.61), pre-operative anaemia (OR = 1.44, 95% CI: 0.66 - 3.14) were found to have positive association to PPH. Refer to **Table 3**.

### 3.6. Multivariable Logistic Regression of the Adjusted Odds Ratio (AOR) for the Risk Factors of Postoperative Complications

After adjusting for maternal age, BMI, cadre of the surgeon, number of previous caesarean deliveries and pre-eclampsia, it was found that longer duration of surgery (>60 minutes) was significantly associated with all types of complications.

Anaesthesia related complications were still found to have positive association to multiparity (aOR = 2.25, 95% CI: 0.42 - 11.90), grand multiparity (aOR = 2.67, 95% CI: 0.12 - 57.60), maternal obesity (aOR = 1.97, 95% CI: 0.24 - 15.90), early preterm (aOR = 2.33, 95% CI: 0.12 - 43.80), anaemia (aOR = 2.22, 95% CI 0.8 - 6.2), and longer surgery (aOR = 2.30, 95% CI: 0.85 - 6.5).

Blood transfusion remained significantly associated with grand multiparity (aOR = 7.0, 95% CI: 1.40 - 34.35), and preoperative anaemia (aOR = 4.34, 95% CI: 1.9 - 9.45).



**Table 3.** The risk factors for postoperative complications among women who deliver by cesarean section (N = 386).

Variables	All complications	Anaesthesia	BT	PPH
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Age (years)</b>				
15 - 19	1.52 (0.54 - 4.25)	0.26 (0.03 - 2.02)	1.76 (0.47 - 6.48)	1.58 (0.33 - 7.35)
20 - 34	ref	ref	Ref	Ref
≥35	1.17 (0.67 - 2.07)	0.81 (0.40 - 1.60)	1.75 (0.86 - 3.55)	1.43 (0.61 - 3.35)
<b>Parity</b>				
Primiparous	ref	ref	Ref	Ref
Multiparous	1.96 (1.20 - 3.20)	1.60 (0.91 - 2.80)	2.42 (1.18 - 4.93)	2.02 (0.89 - 4.62)
Grand multiparous	6.90 (2.50 - 14.0)	3.1 (1.13 - 8.68)	6.75 (2.18 - 20.83)	5.70 (1.65 - 19.84)
<b>BMI (kg/m<sup>2</sup>)</b>				
18.5 - 24.9	ref	ref	Ref	Ref
25.0 - 29.9	1.65 (0.43 - 6.37)	0.82 (0.42 - 1.63)	0.86 (0.34 - 2.19)	1.70 (0.43 - 6.40)
≥30	1.21 (0.64 - 2.25)	1.21 (0.65 - 2.25)	1.21 (0.66 - 2.81)	2.60 (0.75 - 9.20)
<b>Gestation age</b>				
Term	ref	ref	Ref	Ref
Late preterm	1.16 (0.60 - 2.22)	1.16 (0.60 - 2.22)	1.60 (0.68 - 3.72)	1.02 (0.34 - 3.08)
Early preterm	1.33 (0.63 - 2.78)	1.33 (0.64 - 2.78)	2.77 (1.19 - 6.46)	2.31 (0.87 - 6.15)
<b>Anaemia</b>				
No	ref	ref	Ref	Ref
Yes	2.19 (1.33 - 3.63)	1.13 (0.62 - 2.06)	2.92 (1.54 - 5.54)	1.44 (0.66 - 3.14)
<b>ANC visit</b>				
≥4	ref	ref	Ref	Ref
<4	1.77 (1.05 - 2.97)	1.31 (0.72 - 2.39)	1.96 (1.03 - 3.84)	2.23 (1.04 - 4.77)
<b>Cervical Dilation (cm)</b>				
0 - 3	ref	ref	Ref	Ref
4 - 9	0.81 (0.50 - 1.32)	0.81 (0.50 - 1.32)	0.79 (0.4 - 1.54)	0.72 (0.32 - 1.60)
10	0.75 (0.24 - 2.38)	0.75 (0.24 - 2.38)	1.42 (0.39 - 5.20)	1.30 (0.28 - 6.09)
<b>Duration of Surgery</b>				
<60 min	ref	ref	Ref	Ref
≥60 min	2.44 (1.52 - 3.92)	2.33 (1.37 - 3.99)	2.13 (1.15 - 3.90)	3.16 (1.51 - 6.61)
<b>Birth weight (kg)</b>				
<2.5	1.79 (1.03 - 3.11)	0.99 (0.51 - 1.95)	3.60 (1.83 - 7.08)	1.81 (0.79 - 4.15)
2.5 - 3.9	ref	ref	Ref	Ref
≥4.0	1.05 (0.42 - 2.58)	1.03 (0.37 - 2.80)	1.25 (0.35 - 4.46)	1.58 (0.48 - 5.71)
<b>Previous scar</b>				
<2	ref	ref	Ref	Ref
≥2	0.87 (0.38 - 1.96)	1.09 (0.46 - 2.58)	2.62 (0.82 - 8.40)	1.86 (0.58 - 5.91)
<b>Preeclampsia</b>				
No	ref	ref	Ref	Ref
Yes	1.18 (0.60 - 2.31)	1.49 (0.71 - 3.12)	0.45 (0.13 - 1.54)	0.45 (0.1 - 1.97)

**Table 4.** Multivariable logistic regression of the adjusted odds ratio (aor) for the risk factors of postoperative complications (N = 386).

Variables	All complications	Anaesthesia	BT	PPH
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Multiparity	3.80 (0.75 - 19.27)	2.25 (0.42 - 11.90)	2.49 (0.80 - 7.50)	2.1 (0.89 - 5.06)
Grand multiparity	3.00 (0.19 - 47.96)	2.67 (0.12 - 57.60)	7.0 (1.40 - 34.35)	6.4 (1.5 - 24.24)
Maternal obesity	4.20 (0.48 - 37.13)	1.97 (0.24 - 15.90)	0.75 (0.20 - 2.37)	2.9 (0.80 - 10.9)
Early preterm	2.04 (0.58 - 7.15)	2.33 (0.12 - 43.80)	2.04 (0.50 - 7.15)	1.3 (0.43 - 4.13)
Anaemia	2.50 (0.90 - 6.39)	2.22 (0.80 - 6.20)	4.34 (1.90 - 9.45)	1.38 (0.62 - 3.1)
Longer surgery	2.90 (1.02 - 8.50)	2.30 (0.85 - 6.50)	1.04 (0.38 - 2.82)	1.54 (0.4 - 5.01)

Note: Adjustment was done by maternal age, BMI, the expertise of the operating surgeon, number of previous CS, duration of the surgery and pre-eclampsia.

PPH was positively associated with grand multiparity 6.4 (1.5 - 24.24). Refer to **Table 4**.

#### 4. Discussion

During the study period, 49.1% of women were delivered by caesarean section, out of these 27.5% had CS related complications. The most common immediate complications (with 24 hours of CS delivery) were anaesthesia-related complications, blood transfusion and PPH. While the most common “early complications” (within 24 to 72 hours of the operation); were puerperal sepsis, anaesthesia-related complications and blood transfusion. Longer duration of surgery was significantly associated with all the complications.

In this study, the rate of caesarean section related complications among women delivered by CS at KCMC hospital was 27.5%, these findings were the same as the findings from Finland (27%) and Norway (24.1%) [17]. This can be explained by the fact that all these studies were done in large obstetric units in referral centers which receive high risk and complicated patients and the same duration of follow-up was used. The rate of complications that were observed in this study is in contrast to the rate that was observed in India (55.1%), Israel (5.7%) and Nigeria (13.3%) [3] [5] [18]. This can be explained by differences in study designs and methods that were used, for example, a retrospective cross-sectional study that was done in large tertiary hospital in Nigeria, included all CS delivery that was only done during the day where most of the team members are available and very energetic, showed a far much lower complication rate. However, this diversity implies that just like any surgery, CS delivery is prone to complications and this cuts across high income to low-income countries.

Most common complications that were encountered within the first 24 hours of CS (“immediate complications”) were found to be Anaesthesia related complications, blood transfusion and PPH. These complications were more common

in the emergency CS group compared to the elective CS group. These findings were supported by studies from Israel [18] and Nepal and Saudi Arabia [19] [20]. These similarities can be explained by the fact that all these studies were done in referral and tertiary hospitals which receive women from lower facilities with complications like prolonged labour which makes them prone to hemorrhage intra operatively and post operatively.

This study showed that puerperal sepsis, anaesthesia-related complications and blood transfusion were the most common “early complications” encountered after caesarean section. These findings were in line with studies from Israel where endometritis was found to be the most prevalent complication, reported to occur on day two and three [18]. These findings emphasise the benefit of providing prophylactic antibiotic to every parturient that delivers by CS since Caesarean delivery is a known risk factor for endometritis, it also emphasizes that CS should be done only when indicated.

Longer duration of surgery (>60 minutes) was found to be associated with all complications, which was similar to findings from cohort studies that were done in Norway and Nigeria [21] [22]. However, findings from this study contrast with findings from Finland, India, Norway, Israel and South Africa which showed emergency CS, cervical dilatation, maternal characteristics and fetal factor were associated with all complications [17] [18] [23]. However, this serves as a continuous alarm to physicians to modify the already known risk factors before surgery to minimize incidences of complications while optimizing good maternal-fetal outcomes.

Pre-operative anaemia was also found to be significantly related to a blood transfusion during or after surgery, this finding is similar to findings from Nigeria, India and U.S.A [24] [25] [26]. This is because caesarean section is associated with significant blood loss as compared to vaginal delivery. Hence small amounts of blood loss intra-operatively in women with preoperative anaemia can produce symptoms and signs of anaemia which will necessitate blood transfusion. Therefore, care providers should make every effort to optimize the haemoglobin levels of every pregnant woman before delivery.

Grand multiparity was also found to be positively and significantly associated with blood transfusion intra and/or postoperatively. This finding was similar to findings from Nigeria and Saudi Arabia [20] [27]. This can be explained by the fact that grand multiparity has been known to be a risk factor for pre-operative anaemia, abnormal placentation and post-partum haemorrhage (PPH) due to uterine atony. All of these are significant predictors for blood transfusion. However, literature to contrast these findings was not found. Hence continuous education on family planning must be done to reduce risks that are associated with grand-multiparity.

## 5. Strengths and Limitations

This study has highlighted the magnitude of CS delivery-related complications at

KCMC hospital. It also highlights the risk factors for the most prevalent complications.

However, this study was prone to recall bias, especially when participants were supposed to provide information on their past medical and surgical history.

As well there may be under-reporting of the caesarean section related complications since participants were not followed up for other possible early complications following hospital discharge. This is because most of the time our patients get discharged from the hospital on the third-day post caesarean section if there are no complications.

## **6. Conclusion**

During the study period, 27.5% of the study participants had one or more CS-related complications, most of the complications being reported in the first 24 hours of the operation. Longer duration of surgery, grand multiparity and pre-operative anaemia were associated with complications. Therefore, CS should be performed when there is a strong obstetric indication. Health facilities and practitioners should aim at reducing the risks like anemia and grand-multiparity during pre and antenatal visits.

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## **Authors' Contributions**

All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by Glory Mangi. The first draft of the manuscript was written by Glory Mangi, Patricia Swai and Werner Mao-kola. Pendo Mlay and Olola Onoko commented on the previous versions of the manuscript. All authors have read and approved the final manuscript.

## **Ethical Approval and Consent to Participate**

This study was conducted in line with the principles of declaration of Helsinki. An ethical clearance certificate No. 2338 was obtained from Tumaini University College Research Ethical Committee before the initiation of the study. Finger print was used for illiterate women. Codes and hospital numbers were used instead of patient's names. It was emphasized that participation in the study was voluntary and that the woman could withdrawal from the study at any time if she wished.

## **Consent to Participate**

Written informed consent was obtained from all study participants.

## Conflicts of Interest

Authors have no financial or non-financial interest to disclose.

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### List of Abbreviations

APH: Antepartum haemorrhage; CPD: Cephalo-Pelvic Disproportion; CRP: C-Reactive Protein; CS: Caesarean Section; ERCD: Elective Repeat Caesarean Delivery; HDP: Hypertensive Disorders of Pregnancy; HIV: Human Immunodeficiency Virus; MM: Maternal mortality; MNM: Maternal Near Miss; PPH: Post-Partum Haemorrhage; SSA: Sub-Saharan Africa; SSI: Surgical Site Infection; TOLAC: Trial of Labour after Caesarean Section; WHO: World Health Organization.