

# 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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## Research Article

**Keywords:** Caesarean section, complications, risk factors, North-Tanzania

**Posted Date:** February 16th, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1351236/v1>

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**Version of Record:** A version of this preprint was published at Open Journal of Obstetrics and Gynecology on January 1st, 2022. See the published version at <https://doi.org/10.4236/ojog.2022.124023>.

# Abstract

**Background:** Caesarean section is one of the most performed surgeries across the whole globe. However, just like any major surgery, CS is associated with complications like haemorrhage, surgical site infection, Venous thromboembolism and anaesthesia related complications. These associated morbidity and mortality have been there despite improvements in blood transfusion services, the use of prophylactic antibiotics, anaesthesia and surgical techniques. This study aims to determine the rate of caesarean section complications, characterize their timing and identify risk factors to maternal complications among women delivered at KCMC hospital.

**Method:** A cross-sectional analytical study of 386 women who delivered by CS at Kilimanjaro Christian Medical Center(KCMC) hospital from October 2018 to May 2019 was done. Data were obtained from the delivery register, patients, clinical and anaesthesia notes using a structured pre-tested questionnaire. Social-demographic characteristic, past medical, obstetric, surgical and family social history were sought from every study participant. Prevalence of complication was computed as a proportion of women with one or more complications out of all the women delivered during the study period. STATA version 13 was used for multivariable analysis to determine independent risk factors for the most prevalent complications. Odds ratio and 95% CI has been used to make an association. Whereby P-value <0.05 is considered statistically significant.

**Results:** Out of 386 deliveries,106(27.5%) had one or more complications. The most common immediate complications were anaesthesia related, blood transfusion , postpartum hemorrhage(PPH), hysterectomy and ICU admission. While most common early complications (24 -72 hours of the operation) were puerperal sepsis, anaesthesia related complications, blood transfusion and ICU admission. Longer duration of surgery was significantly associated with all the complications (aOR 2.90, 95% CI 1.02-8.50), Grand multiparity was significantly associated with blood transfusion (aOR 7.0, 95% CI 1.40-34.35) and PPH (aOR 6.4, 95%CI 1.5-24.24) while pre-operative anaemia was significantly associated with blood transfusion (aOR 4.34,95% CI 1.90-9.45).

**Conclusion:** Longer duration of surgery, grand multiparity and pre-operative anaemia are associated with complications. Hence, the medical team should be alert of the possible morbidity and mortality that can occur and get prepared beforehand.

## Background

Cesarean section is a surgical procedure performed when a vaginal delivery is not possible or safe, or when the health of the mother or the baby is at risk. Currently, 18.6% of all the deliveries worldwide are through Caesarean section. The lowest rates of CS are being seen in the less developed regions and highest rates seen in the highly developed regions at the rates of 6% and 27.2% respectively.(1) This is irrespective of the World health organization (WHO) recommendation of CS rate of about 10-15% which seems to be the optimal range for targeted provision of this life-saving intervention.(2) The rate of

caesarean section deliveries has been on the rise yearly irrespective of the lack of evidence supporting maternal and perinatal benefits. According to Global, Regional and National estimates on the increasing trends of CS from 1990-2014, global average CS rate increased by 12.4% (from 6.7%-19.1%) with an annual increase rate of 4.4%(3)

Caesarean section is a life saving surgical procedure that is mostly encountered in obstetric practices and it is one of the signalling functions of a functioning Comprehensive Emergency Obstetric Care (CEmOC),CS can be done as a planned or emergency delivery.However, "Every effort should be made to provide caesarean sections to women in need, rather than striving to achieve a specific rate"(4)

This marked increase in the rate of primary elective CS without medical indication and has stimulated debates in the medical community over the past decade whereby, this trend has been based on the evidence that a planned CS reduces the incidences of maternal pelvic disorders that include: faecal,urine incontinence and pelvic organ prolapse, intrapartum hypoxia, intrapartum death, birth trauma, avoidance of anxiety, pain that is associated with vaginal delivery and fear of litigation (5,6).

The most common indications for caesarean section include failure to obstructed labour,fetal distress, fetal malpresentation, cord prolapse, fetal macrosomia, antepartum hemorrhage, uterine rupture (7,8).Other indications are Some fetal bleeding disorders,prior uterine scar that entered the endometrial cavity, a maternal infection that has a significant risk for vertical transmission during labour and delivery, maternal request due to fear of labour and available evidence that delivery by caesarean section decreases risks for pelvic organ prolapse, faecal and urine incontinence(5,9).

Severe maternal morbidity and mortality are mostly encountered among women who underwent an emergency caesarean section as compared to the planned caesarean section.(9,10) Preeclampsia, eclampsia, increasing maternal age, preterm 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 to caesarean section related complications (11,12). Maternal obesity (BMI >35kg/mm<sup>2</sup>) has also been found to be highly associated with wound complications whereby vertical skin incisions have 7 times higher chance of wound infection and wound separation compared to transverse skin incision (13).

Maternal morbidity, mortality and long-term sequel post caesarean section are difficult to deny, related complications encountered are blood transfusion, endometritis, superficial surgical site infection, haemorrhage, injury to the pelvic organs, thromboembolic disorders and anaesthesia related complications(5,14,15).

In long term complications, caesarean section delivery is associated with abnormal placentation, uterine rupture in the subsequent pregnancy, adhesions, unexplained stillbirth, 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 (16,17).

After exclusion of pre-existing morbidity, CS births have a 4-5 higher fold of morbidity and mortality as compared to vaginal delivery (18,19) Maternal mortality (MM) that is related to CS has dropped from 90% in the year 1800s to about 0.1% in 1950. Currently, MM that is related to CS is about 6-13/100,000 deliveries in the high resource countries and 7.6/1,000 deliveries in low and middle-income countries respectively, the highest-burden being reported from SSA (10.9/1,000 deaths. This drop has been explained by improvements in surgical and anaesthesia techniques, antibiotic prophylaxis and availability of blood transfusion services (19,20).

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

## **Methods**

### **Study design and area**

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

### **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.

### **Sample size and sampling technique**

Systematic sampling technique was used in order to get a required sample size of 385 participants.

### **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 were 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 was 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 was 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 developed any of the CS-related complications.

### **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(21). 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. The units of blood and blood products transfused were recorded in a special blood transfusion services form.

## 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 postoperative 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 association. 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).

## 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%.refer figure 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 +/- 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 Table 1

### Table 1: Characteristics of the study participants (N=386)

<b>Variables</b>	<b>Number of patients</b>	<b>Percentage</b>
<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

### **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 figure 2

### 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 Table 2.

**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

### Early postoperative complications following caesarean section

Out of 386 study participants, 37 had one or more complication that was reported 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 3

### **The risk factors for postoperative complications**

From our findings it shows that multiparity (OR=1.96, 95% CI: 1.20-3.20) 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 preterm 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 table 3.

### **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/m2)</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>				
<60min	ref	ref	ref	ref
60min	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)

### 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 type 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: 1.4034.35), and preoperative anaemia (aOR =4.34, 95 CI: 1.9-9.45).

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

**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.

## 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%) (11,22). This can be explained by the fact that all these studies were done in large obstetric units in referral centers which receives 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%) (9,23,24). 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 were 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 (24) and Nepal and Saudi Arabia (25,26). These similarities can be explained by the fact that all these studies were done in referral and tertiary hospitals which receives 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.(24). This findings emphasises the benefit of providing prophylactic antibiotic to every parturient that delivers by CS since Caesarean delivery is a known risk factor to endometritis, it also emphasize that CS should be done only when indicated.

Longer duration of surgery (>60 minutes) was found to associated with all complications, which was similar to findings from cohort studies that were done in Norway and Nigeria (27,28). 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. (11,22,24,29).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(30–32) 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 (26,33). 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 these are a significant predictor 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.

### **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.

## **Conclusion**

Just like any surgery, caesarean section delivery is never without complications. During the study period, 27.5% of the study participants had one or more CS-related complications. With most of the complications being reported in the first 24 hours of the operation where anaesthesia related complication was the leading complication followed by blood transfusion and haemorrhage. Puerperal sepsis, Anaesthesia related complications and Blood transfusion were the most common complication after 24 hours of the operation. Longer duration of surgery was significantly associated with all the complications. Grand multiparity and pre-operative anaemia were significantly associated with blood transfusion while grand multiparity was significantly associated with PPH. Therefore, CS should be performed when there is strong obstetric indication, health facilities and practitioners should aim at reducing the risks like anemia and grand- multiparity during pre and antenatal visits.

## **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

## **Declarations**

### **Ethical approval and consent to participate**

An ethical clearance certificate No. 2338 was obtained from Tumaini University College Research Ethical Committee before the initiation of the study. Written informed consent was obtained and confidentiality was ensured. 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 for publication**

Not applicable.

### **Availability of data and materials**

Data set generated and obtained from the analysis of this study are not publicly available to ensure confidentiality, however, it can be obtained from the corresponding author on a reasonable request.

### **Competing interest**

There is no competing interest in this study.

### **Funding**

No funding was obtained for this study

### **Authors contributions**

GM: Designed the study, participated in data collection, performed data analysis and participated in manuscript writing. PM, PS, OO & WM participated in designing the study, drafting and reviewing this manuscript. All authors have read and approved this final.

### **Acknowledgement**

I would like to acknowledge KCMC hospital administration for allowing me to conduct this study in its hospital. Above all would like to appreciate all women who consented to participate in this study.

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## References

1. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: Global, regional and national estimates: 1990-2014. *PLoS ONE*. 2016 Feb 1;11(2).
2. WHO Statement on Caesarean Section Rates. 2014;
3. Betrán AP, Ye J, Moller AB, Zhang J, Gülmezoglu AM, Torloni MR, et al. Postpartum Maternal Mortality and Cesarean Delivery. *PLoS ONE* [Internet]. 2006;108(2):1–12. Available from: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00006250-200609000-00012>
4. Nyamtema A, Mwakatundu N, Dominico S, Mohamed H, Shayo A, Rumanyika R, et al. Increasing the availability and quality of caesarean section in Tanzania. *BJOG: An International Journal of Obstetrics and Gynaecology*. 2016;123(10):1676–82.
5. Armson BA. Is planned cesarean childbirth a safe alternative? *Cmaj*. 2007;176(4):475–6.
6. Jackson N, Paterson-Brown S. Physical sequelae of caesarean section. *Best Practice and Research: Clinical Obstetrics and Gynaecology*. 2001;15(1):49–61.
7. Chu K, Cortier H, Maldonado F, Mashant T, Ford N, Trelles M. Cesarean Section Rates and Indications in Sub-Saharan Africa: A Multi-Country Study from Medecins sans Frontieres. *PLoS ONE*. 2012;7(9):5–10.
8. Harrison MS, Goldenberg RL. Cesarean section in sub-Saharan Africa. *Maternal Health, Neonatology and Perinatology* [Internet]. 2016;2(1):6. Available from: <http://mhnpjjournal.biomedcentral.com/articles/10.1186/s40748-016-0033-x>
9. Thakur DV, Chiheriya DH, Thakur DAK, Mourya DS. Study of maternal and fetal outcome in elective and emergency caesarean section. *International Journal of Medical Research and Review* [Internet]. 2015 Dec 31;3(11):1300–5. Available from: <https://ijmrr.medresearch.in/index.php/ijmrr/article/view/410>
10. Häger RME, Daltveit AK, Hofoss D, Nilsen ST, Kolaas T, Øian P, et al. Complications of cesarean deliveries: Rates and risk factors. *American Journal of Obstetrics and Gynecology*. 2004;190(2):428–34.
11. Häger RME, Daltveit AK, Hofoss D, Nilsen ST, Kolaas T, Øian P, et al. Complications of cesarean deliveries: Rates and risk factors. *American Journal of Obstetrics and Gynecology*. 2004;190(2):428–34.
12. Pallasmaa N, Ekblad U, Aitokallio-Tallberg A, Uotila J, Raudaskoski T, Ulander VM, et al. Cesarean delivery in Finland: Maternal complications and obstetric risk factors. *Acta Obstetrica et Gynecologica Scandinavica*. 2010;89(7):896–902.

13. Thornburg LL, Linder MA, Durie DE, Walker B, Pressman EK, Glantz JC. Risk factors for wound complications in morbidly obese women undergoing primary cesarean delivery. *The Journal of Maternal-Fetal & Neonatal Medicine*. 2012;25(9):1544–8.
14. Declercq E, Barger M, Cabral HJ, Evans SR, Kotelchuck M, Simon C, et al. Maternal outcomes associated with planned primary cesarean births compared with planned vaginal births. *Obstetrics and Gynecology*. 2007;109(3):669–77.
15. Clement S. Psychological aspects of caesarean section. *Best practice & research Clinical obstetrics & gynaecology* [Internet]. 2001 Feb;15(1):109–26. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/11359318>
16. Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, et al. Short-term and long-term effects of caesarean section on the health of women and children. Vol. 392, *The Lancet*. Elsevier Ltd; 2018. p. 1349–57.
17. Gunes M, Kayikcioglu F, Ozturkoglu E, Haberal A. Incisional endometriosis after cesarean section, episiotomy and other gynecologic procedures. *Journal of Obstetrics and Gynaecology Research*. 2005;31(5):471–5.
18. Zwart JJ, Richters JM, Öry F, De Vries JIP, Bloemenkamp KWM, Van Roosmalen J. Severe maternal morbidity during pregnancy, delivery and puerperium in the Netherlands: A nationwide population-based study of 371 000 pregnancies. *BJOG: An International Journal of Obstetrics and Gynaecology*. 2008;115(7):842–50.
19. Deneux-Tharaux C, Carmona E, Bouvier-Colle M-H, Bréart G. Postpartum Maternal Mortality and Cesarean Delivery. *Obstetrics & Gynecology* [Internet]. 2006;108(3, Part 1):541–8. Available from: <http://content.wkhealth.com/linkback/openurl?sid=WKPTLP:landingpage&an=00006250-200609000-00012>
20. Sobhy S, Arroyo-Manzano D, Murugesu N, Karthikeyan G, Kumar V, Kaur I, et al. Maternal and perinatal mortality and complications associated with caesarean section in low-income and middle-income countries: a systematic review and meta-analysis. *The Lancet*. 2019;393(10184):1973–82.
21. WHO. Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity. Mineral Nutrition Information System, World Health Organization. 2013;1–6.
22. Pallasmaa N. Cesarean Section - Short Term Maternal Complications. 2014.
23. Daniel CN, Singh S. Cesarean delivery: An experience from a tertiary institution in north western Nigeria. *niger j clin pract*. 2016;19(1):18–24.
24. Hadar E, Melamed N, Tzadikévitch-Geffen K, Yogev Y. Timing and risk factors of maternal complications of cesarean section. *Archives of Gynecology and Obstetrics*. 2011;283(4):735–41.
25. Dhakal KB, Dhakal S, Bhandari S. Profile of Cesarean Section in Mid-Western Regional Hospital in Nepal. *Journal of Nepal Health Research Council*. 2018 Mar 13;16(1):84–8.
26. Mohammed AAR, Fahad AA, Mostafa AA. Cesarean section in a high parity community in Saudi Arabia: clinical indications and obstetric outcomes. *BMC Pregnancy and Childbirth*. 2014;14(93).

27. Akinlusi FM, Rabiou KA, Durojaiye IA, Adewunmi AA, Ottun TA, Oshodi YA. Caesarean delivery-related blood transfusion: Correlates in a tertiary hospital in Southwest Nigeria. *BMC Pregnancy and Childbirth*. 2018;18(1):1–9.
28. Kristian Opøien H, Valbø A, Grinde-Andersen A, Walberg M. Post-cesarean surgical site infections according to CDC standards: rates and risk factors. A prospective cohort study. *Acta Obstetrica et Gynecologica Scandinavica*. 2007 Jan;86(9):1097–102.
29. Renuka P. A Comparative Study of Maternal and Foetal Outcomes in Patients Undergoing Elective or Emergency Caesarean Section. *Journal of Medical Science And clinical Research*. 2016 Dec 28;04(12):15059–69.
30. Ahmadzia HK, Phillips JM, James AH, Rice MM, Amdur RL. Predicting peripartum blood transfusion in women undergoing cesarean delivery: A risk prediction model. *PLoS ONE*. 2018;13(12):1–15.
31. Goundan A, Kalra JK, Raveendran A, Bagga R, Aggarwal N. Descriptive study of blood transfusion practices in women undergoing cesarean delivery. *Journal of Obstetrics and Gynaecology Research*. 2011;37(10):1277–82.
32. Eyalade OR, Adesina OA, Adewole IF, Adebowale SA. Blood Transfusion Requirement During Caesarean Delivery: Risk Factors. *Annals of Ibadan postgraduate medicine*. 2015;13(1):29–35.
33. Imarengiaye CO, Ande ABA. Risk factors for blood transfusion during c-section in a tertiary hospital in Nigeria. *Medical science monitor: international medical journal of experimental and clinical research*. 2006 Jun;12(6):CR269-72.

## Figures

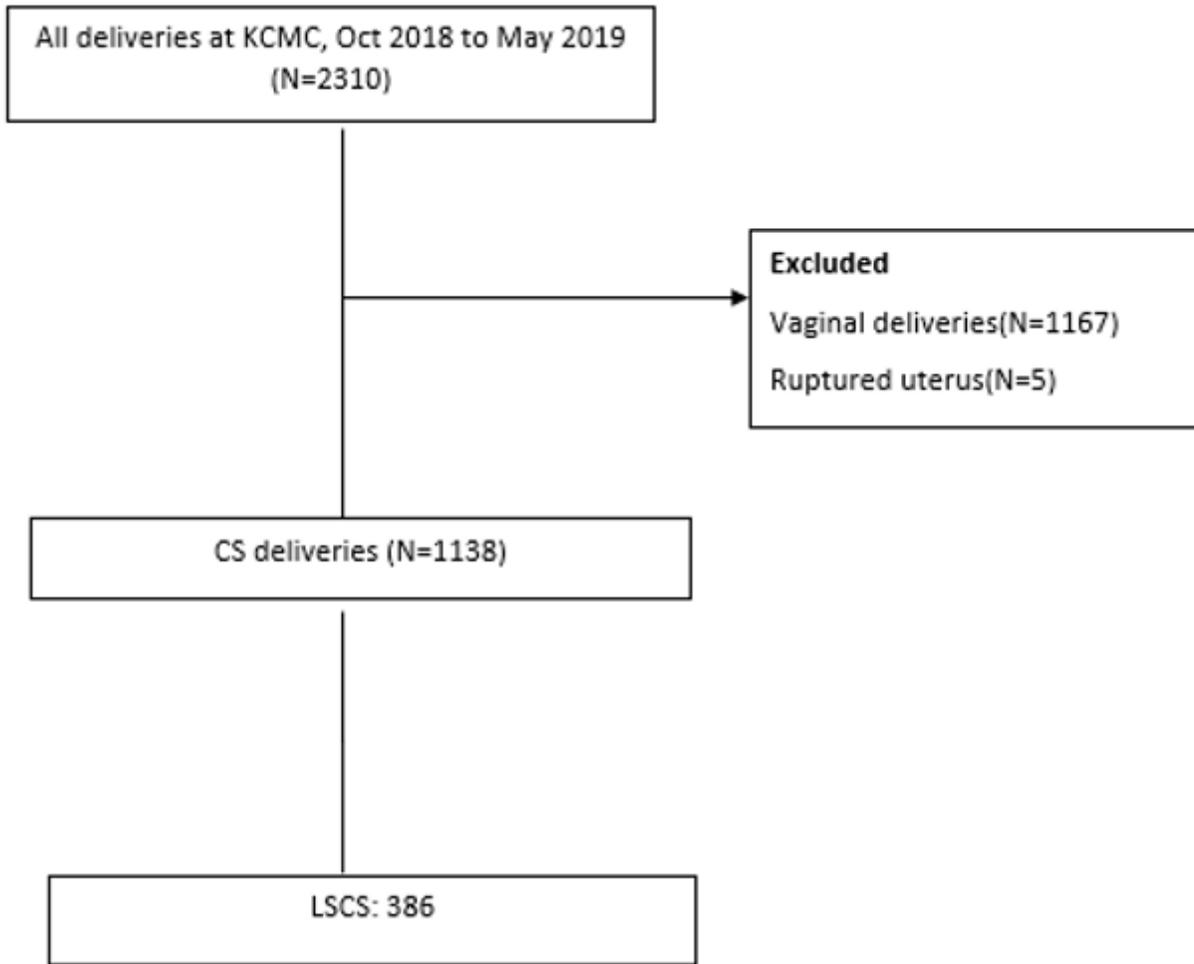


Figure 1

flow chart

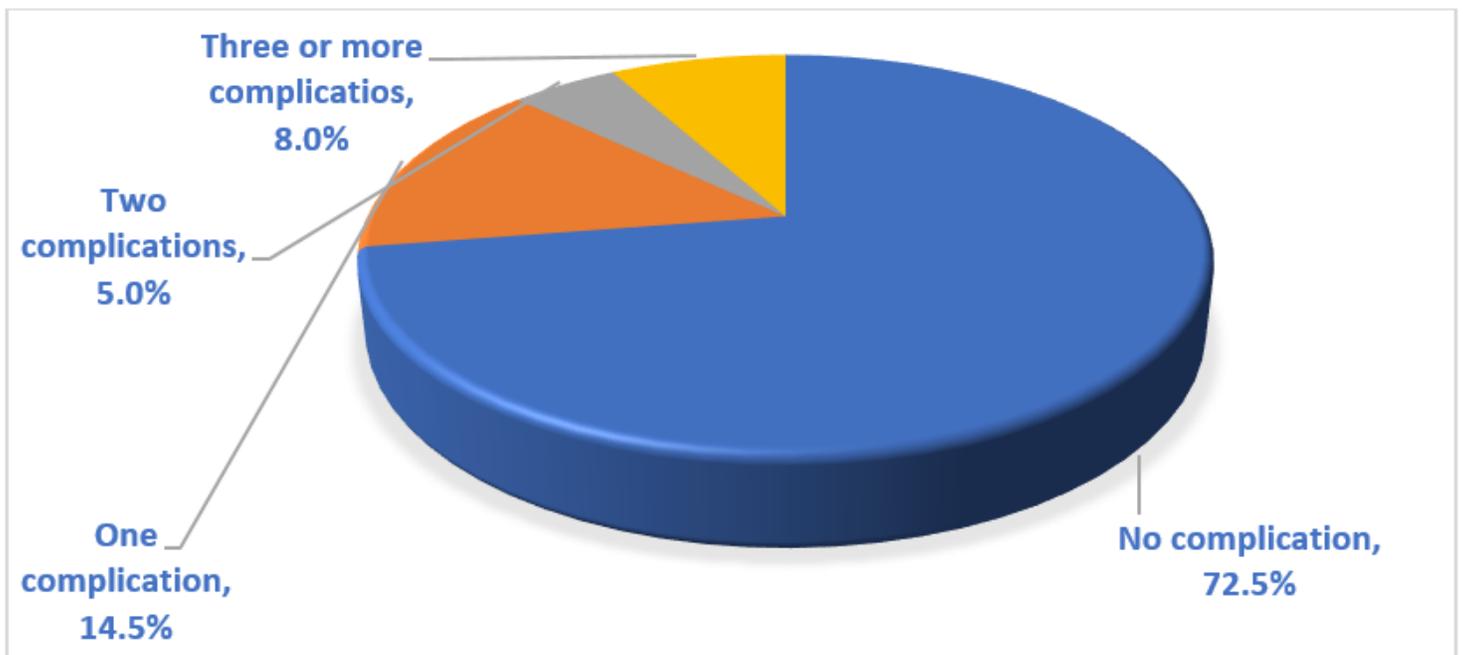


Figure 2

Rate of caesarean section related complications (N=386)

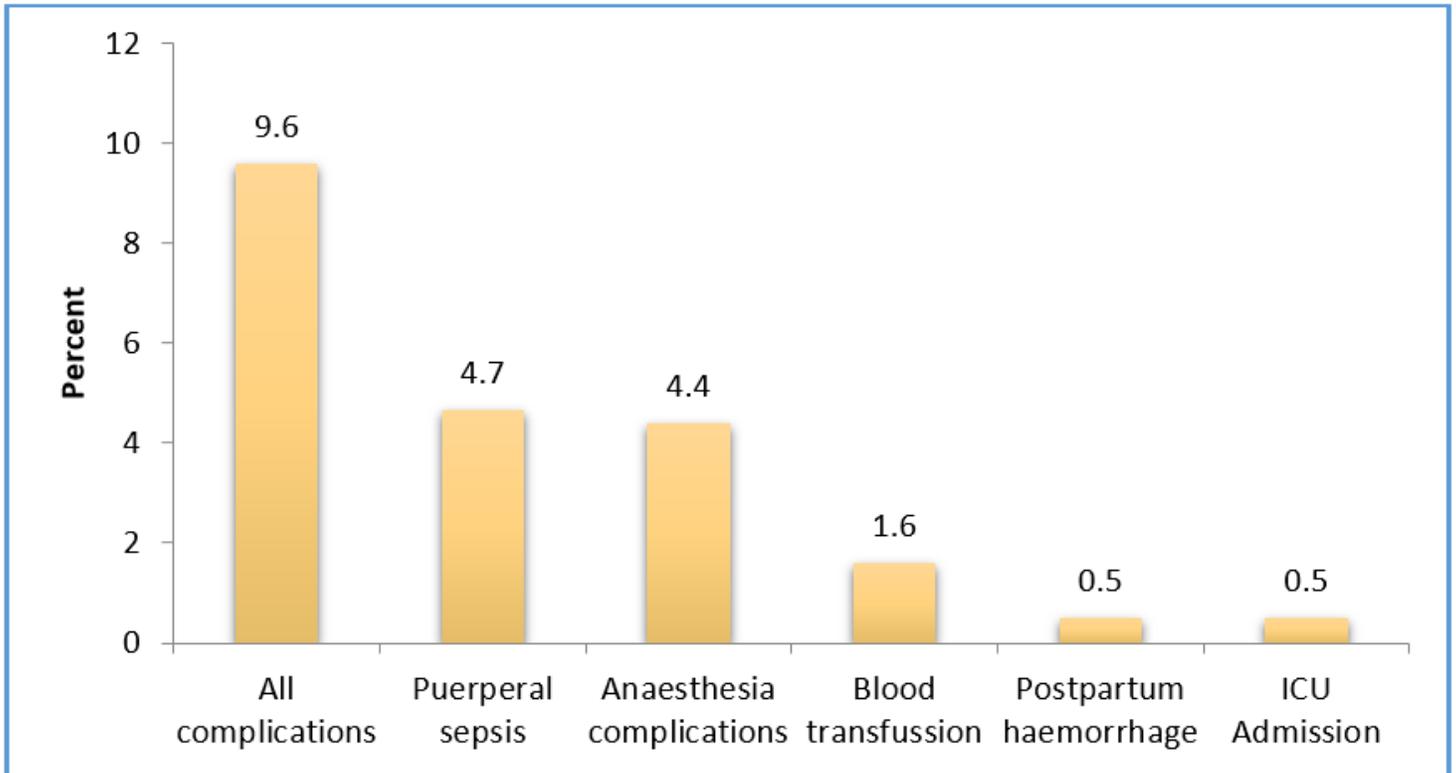


Figure 3

Early postoperative complications following caesarean section (N=386)