# Classifying caesarean section rate using the Ten group classification system

- a descriptive study at Kilimanjaro Christian Medical Centre in Moshi, Tanzania

**Annika Malmborg**
Department of Obstetrics, Sahlgrenska University
Gothenburg 2016
Programme in Medicine 2016

# Classifying caesarean section rate using the Ten group classification system

## - a descriptive study at Kilimanjaro Christian Medical Centre in Moshi, Tanzania

Degree project in Medicine
Annika Malmborg

Supervisors:
Dr Håkan Lilja, Department of Obstetrics, Sahlgrenska University, Gothenburg
Dr Pendo S. Mlay, Department of Obstetrics and Gynaecology, KCMC, Moshi Tanzania

UNIVERSITY OF GOTHENBURG

Programme in Medicine
Gothenburg, 2016

Abstract ..... 4
Abbreviations ..... 6
Background ..... 7
*Maternal mortality* ..... *7*
*Tanzania and maternal health* ..... *7*
*Kilimanjaro Christian Medical Centre* ..... *8*
*Caesarean section – the history:* ..... *8*
*Caesarean section – the technique:* ..... *9*
*Worldwide caesarean section rates* ..... *10*
*Lifesaving procedure or threat to maternal health worldwide?* ..... *10*
*Indications for CS* ..... *11*
*The Ten Group Classification System* ..... *12*
*Medical relevance* ..... *14*
Aims ..... 15
Methods ..... 16
Setting and study population ..... 16
*Department of Obstetrics at KCMC* ..... *16*
*Study population* ..... *17*
*Study design* ..... *17*
Data collection ..... 17
*Data collection procedures* ..... *17*
*Definition of variables needed for classification in the Ten Group Classification System* ..... *18*
*Definition of indications for caesarean section* ..... *19*
*Statistical method:* ..... *20*
Ethics ..... 21
Results ..... 22
*Included vs excluded women* ..... *22*
*The Ten Group Classification system* ..... *24*
*Indication for caesarean section* ..... *27*
Discussion ..... 30
*Study population* ..... *30*
*Caesarean section rate* ..... *30*
*Ten group classification system* ..... *31*
*Indications for caesarean section* ..... *33*
*The domino effect* ..... *37*
*How to move forward?* ..... *38*
*Further studies* ..... *39*
Methodological considerations ..... 40
Conclusion ..... 41
Populärvetenskaplig sammanfattning ..... 42
Acknowledgements ..... 44
References: ..... 45

## Abstract

### Classifying caesarean section rate using the Ten group classification system – a descriptive study at Kilimanjaro Christian Medical Centre, Moshi, Tanzania.



*Degree Project, Programme in Medicine, Annika Malmborg, 2016,*

*Dept of Obstetrics and Gynaecology, Gothenburg University, Sweden and Dept. Of Obstetrics at KCMC, Moshi, Tanzania*



**Background:** Caesarean section (CS) can be life-saving for mother and child but the operation can be followed by instant or longterm complications for both. CS rates are increasing in both high income and low income countries. The WHO recommend no higher CS rate than 15 % but at KCMC the rate exceeds 40 %. To keep the CS rate on an adequate level, the Ten group classification system (TGCS), has been increasingly used to classify women before delivery in ten groups and calculate the CS rate in each group in order to at long sight improve the CS rate by adequate measures. The indications for CS differs a lot in various settings, especially the percentage of maternal request for CS.

**Aims**: To classify the women giving birth at KCMC into the ten groups, to analyse the CS rate in each group and also to describe the main indications for CS.

**Methods:** Retrieve information needed for classification from the delivery book and case files for women giving birth at KCMC during the data collection period.

**Results:** The CS rate was 40.8%. The nulliparous women, and the women who have had a previous CS contribute most to the overall CS rate. Nulliparous women had a higher risk of CS than the multiparous, especially when labour was induced. The main indications for CS were disproportion, poor progress of labour and non-reassuring fetal status (NRFS). For women with one previous CS, with a CS rate of 80%, the leading cause for CS was maternal request.

**Conclusion:** High CS rates among nulliparous is leading to an increase of women with a previous scar, in which group the risk of another CS is substantial - a domino-effect. When trying to lower CS rates, focus should be aimed at improving management of the nulliparous women to avoid the first CS.

**Key words:** *Caesarean section rate, Ten group classification system, main indication, KCMC, Tanzania*

## Abbreviations

| | |
|---|---|
| CS | Caesarean Section |
| CTG | Cardiotocography |
| GA | Gestational age |
| FH | Fundal height |
| FHR | Fetal heart rate |
| KCMC | Kilimanjaro Christian Medical Centre |
| MMR | Maternal Mortality Rate |
| TGCS | Ten Group Classification System |
| WHO | World Health Organization |

# Background

*Maternal mortality*

The risk of maternal mortality during pregnancy is one of the greatest challenges every country in general and low income-countries in particular is facing. In the fifth Millennium Development Goal, established in 2000, the aim was to decrease the maternal mortality rate (MMR) by half until 2015. Worldwide, the MMR decreased by 45% since 1990, from 380/100 000 to 210/100 000, the most improvement seen after 2000 (1).

*Tanzania and maternal health*

Tanzania has 46 million inhabitants of which 43% lives in extreme poverty (<1.25 USD/day)(2). The country is among the least urbanised countries with about 90% of the population living in rural areas (3). Although Tanzania has been mostly at peace since its independence from Great Britain in 1964, it is a great challenge to give the population living in rural areas an improved health care. It's simply too far away for many people to get access to proper health care. The health care for HIV and everything concerning it, maternal care and health care for children <5 years is free, subventioned by the government according to Dr Pendo Mlay, Head of Department of Obstetrics at KCMC.

The maternal mortality rate in Tanzania has improved, from 842/100 000 live births in 2000 to 398/100 000 live births in 2015. It's a 53% decrease in MMR, exceeding the Millennium Goal of 50 % decrease in MMR. Because Tanzania's population lives mostly in rural areas, this results in a coverage of skilled attendance at birth of only 49% in 2010 (36% in 1999), meaning that every second delivery takes place without skilled professionals supervising and access to medical help if complications would occur (4).

*Kilimanjaro Christian Medical Centre*

Kilimanjaro is the fifth most urbanised region in Tanzania (5). The town of Moshi is inhabiting 100 000 people and has a college and University hospital named Kilimajaro Christian Medical Centre (KCMC). It's financed partly by private funds and partly by the government, in addition to patient fees. The Department of obstetrics has 59 beds and admit mothers waiting for delivery, post-delivery and with pregnancy complications. Labour ward has four delivery cubicles, one theatre and one emergency room suitable for handling postpartum haemorrhage. According to Dr Pendo Mlay, each year there are over 3300 deliveries at KCMC and in 2015 the CS rate was 42%, which compared with the CS rate in 2009, 33%, is an almost 30% increase in just six years.

*Caesarean section – the history:*

A caesarean section (CS) is named by the way in which Julius Caesar supposedly was delivered. (6) Even though this wasn't true according to the history books, the name persist and is commonly referred to as C-section. Since the time of Julius Caesar, historical documents has reported the use of CS but the use was primarily to retrieve a fetus from a dead or dying mother in order to try to save the fetal life or to bury mother and baby apart. Early in the 19$^{th}$ century, European doctors travelling to East Africa and the area around Lake Victoria reported that the indigenous people performed a delivery through the abdomen very similar to our modern CS, using banana wine as anaesthesia, closing the uterus using iron needles and covering the wound with a paste of roots (7). The wound healed nicely, and the procedures seemed to have been in use for many generations.

In France during the late 18$^{th}$ century and beginning of the 19$^{th}$ century, CS were tried extensively but, sadly, none of the women survived the surgery (7). The uterine incision

wasn't sutured causing infections and blood loss which made the chance of successful surgery very slim. In the 1880's though, anaesthesia was improved and the surgical techniques were refined in Germany, The U.S. and Italy among others, resulting in the first modern CS including the lower transverse incision of the uterus and afterwards closing the uterus with sutures (8).

*Caesarean section – the technique:*

The surgery requires basic anaesthesia and is possible in many settings with limited resources. If possible, spinal anaesthesia is used for the procedure. Exceptions being some emergency CS where the urgency doesn't allow spinal anaesthesia. Coagulation disorders and spine problems can be other reasons in which case general anaesthesia is used. The abdomen is draped and cleaned and a transverse incision is done three cm above the pubic bone. The incision is widened using blunt technique with the surgeon and the assistant pulling to each side with their fingers. The rectus muscles are spread apart without any incision and the parietal peritoneum is cut open. The uterus is then exposed, and a transverse incision is made in the lower part, the isthmus. If the amniotic sac is still intact, the membrane is opened. The baby is then taken out, in 97 % there is a cephalic presentation (head first) (9). After the delivery, the placenta is carefully removed by gentle traction and inspected to ensure it is intact. The upper, free part of the uterus is then often lifted up on the abdomen and the incision is sutured in two layers. Before putting the uterus back, the surgeon ensures that the uterus is contracting properly. If not, there's a risk of severe postoperative bleeding. The abdominal rectus muscles are often left unsutured, the fascia is sutured and finally, using intracutaneous absorbable sutures, the skin is sutured. This section is verified by Dr Håkan Lilja.

*Worldwide caesarean section rates*

The CS rate varies a lot. Our world has past the days when CS was only for the wealthy countries and the procedure now saves many babies and mothers in low income settings as well. During the last years, increase of CS is seen in many countries. Current rates are for example CS rate of 44% in Brazil (10), 47.5% in Mexico, 47.6% in China, 39.4% in Thailand (11), 42.4% at a rural regional hospital in South Africa (12), 34% in Great Britain, 18.5% in Ireland and 17% in Sweden (13). The CS rate range from 9% in Sollefteå to 23% in Stockholm which shows the diversity of CS rate even within a country like Sweden (13).

*Lifesaving procedure or threat to maternal health worldwide?*

As any medical intervention the caesarean section (CS) can be of great use when performed on the correct indication. It is without a doubt lifesaving for both mother and child in many situations, for example complete placenta praevia where the placenta is covering the cervical opening, transverse fetal lie or threatening fetal asphyxia (14). However, it is also known that repeat CS increases the risk of placenta praevia and placenta accreta (where the placenta is embedded in the myometrium causing post-delivery bleedings). The increased risk is seen especially when the woman has undergone more than 4 CS (15,16). So if a woman has had a CS and is now in her second pregnancy, what should be the mode of delivery? In fact, no difference in the risk of maternal deaths can be found between having another CS or a vaginal delivery after your first CS (17). However, since there is no clear advantage of CS, the guidelines are in general that there should be a trial of vaginal delivery, since repeat CS come with complication previously mentioned. Nonetheless, a vaginal delivery can of course also have severe complications, such as anal sphincter rupture, seen in around 3% of all deliveries in the Nordic countries (18).

In 1985, The World Health Organization (WHO) stated that the optimal caesarean section rate for a country is 10% - 15% (19). A study in 2010 analysed 79 articles concerning increasing CS rates and its impact on maternal and perinatal health and found that CS rates above 10% were *not* associated with improved maternal and perinatal health and some studied showed that increasing CS rates were even associated with increased maternal and neonatal mortality (20). A recent study tried to analyse the optimal CS rate with adjustment for socioeconomic factors, the conclusion being that with 9% to 16% CS rate, the maternal and perinatal mortality decreased but the relationship weakened and disappeared over that threshold (21). However, there are great challenges in conducting and analysing these studies since many CS are performed on high risk pregnancies in which the indication for CS would have been a threat on maternal health irrespective of mode of delivery (20).

*Indications for CS*

Why are caesarean sections performed? There are of course multiple reasons. These can be divided into absolute or relative, maternal or fetal. A common reason for CS is the uterus failing to contract with enough strength during labour or that the cervix does not open enough during labour resulting in prolonged labour. The indications also include fetal asphyxia, bleeding (threatening fetal and/or maternal health) and disproportion (where the baby has an abnormal lie or there is a disproportion between the baby and the pelvis). There are also medical complications to the pregnancy, such as diabetes and pre-eclampsia, and infections such as HIV or other medical conditions reasons the women had before the pregnancy that turns a low risk to a high risk pregnancy.

Lately, two major indications for CS are under discussion. The first is the issue of maternal requests for CS. Maternal requests are a hot topic to discuss. On one hand we have the woman's right to make decisions regarding her body, and sometimes on the other hand

lack of medical reasons for CS. I will not further get into the topic, because there are, understandably, multiple factors involved in a mother's request for CS. It's hard to reach a consensus opinion on whether it should be "allowed" or not. Dr Robson, the founder of the method used for classification in this study, concludes in an article from 2001 the need for first knowing how great this issue of maternal requests is at each specific clinic and then to inform and encourage the woman to make an informed decision where the, not so obvious, disadvantages of a CS should be clearly stated as well as the advantages (22).

The second one is about prolonged labour (named above) which is when the labour continues beyond the recommended time of the second stage of delivery. There are very few studies made about indication for CS in Tanzania, but some has been made on the topic of emergency CS due to prolonged labour (23). The conclusion being that many CS are performed when there was no true prolonged labour. The solution to this problem is to improve the routines and monitoring of the delivery with a more standardized way of using the partograph in order to reduce the misinterpretation and avoid unnecessary CS.

*The Ten Group Classification System*

Due to the increasing CS-rates worldwide, and the WHO stating in 1985 that the optimal caesarean section rate for a country is 10% - 15%, a need for understanding what caused these increases became very important. In 2001, Dr Michael Robson, an obstetrician in Ireland, was concerned that lowering the CS rates without careful consideration could be potentially harmful (22). He expressed the need for standardization and developed a classification system called the Ten Group Classification System (TGCS) (22). The system classifies all women giving birth using four criteria: The category of pregnancy (fetal lie and number of fetuses), the previous obstetric history of the woman, the start of labour and delivery and the gestational age of the pregnancy. The method is mutually exclusive and totally inclusive as

well as *prospective* which makes it possible to classify the pregnancies *before* delivery. This enable improvement in management of certain groups of women during labour which can lead to better outcome regarding CS rate.

The ten groups in the TGCS are described in *methods.*

This classification will give us the total number of CS, the CS rate in each group and contribution made by each group to the overall CS rate. It is used for studying CS rates in general and in the different groups of women over time and thereby gives the possibility to study the effect of changed guidelines by repeated analysis. It also gives a good possibility to compare differences between hospitals in the same region or in different countries.

A review article from 2011 by Torlini et al compared 27 different classification systems and deducted that women-based classification systems in general and The TGCS in particular is the most precise and most applicable method to classify deliveries (24). The strength being its simplicity but the weakness being that it does not include the indication for CS. However, a classification for indications of CS can easily be used together with the TGCS (24).

Since its introduction in 2001, the TGCS is being more and more implicated all over the world, in 2014 there had in total been 73 articles published using the TGCS. In a review article by Betrán et al, they conclude that the users like its simplicity, robustness and that the TGCS also is a great tool for subanalysing different subgroups (25).

Group 1 together with Group 2a contribute most to the diverse CS rates across the globe (26) and consists of the nulliparous women (women in their first delivery) in labour. They are also the second largest contributor to the overall CS rates stated in an article by the WHO from 2009 in Latin America (27). The difference in CS rates for these groups in particular might indicate a difference in maternal care for the nulliparous women.

The largest contributor to the overall CS rate is Group 5, consisting of women with previous CS (27). This is alarming since this group is likely to become larger due to increasing CS rates worldwide. It's also a group in which it's challenging to lower the CS rates. Many clinics, among them KCMC in Moshi, have two previous CS as an absolute indication for CS, whereas one previous CS should result in a trial of vaginal delivery in the next pregnancy. Dividing group 5 into subgroups of 5a (one previous CS) and 5b (≥ two previous CS) makes it possible to establish how many of the women with one previous scars that went through trial of vaginal delivery but still had a CS, and also to establish if any woman with two previous scar had a vaginal delivery. Again, the CS rate alone isn't enough to know if the clinic provides good maternal care, we need to know in which group the CS rates are too high and in which groups it's too low in order to know what to improve.

Group 6-9 is for abnormal fetal lie (breech in group 6 and 7, transverse and oblique in group 9) and twins (group 8) and are usually quite small groups of women. Group 10 is for women in preterm delivery (≤36 weeks). Most articles focus on Group 1-5 because of their relatively large sizes and its diversity in CS rates and treatment among different countries and clinics.

*Medical relevance*

To further understand what is causing the increase in CS rates we have to analyse for what groups of women the CS rate is high and if so, does it have an adequate medical reason?

## Aims

- To classify caesarean sections at KCMC using the Ten group classification system
- To analyse caesarean section rates in the ten groups
- To describe how the main indications for caesarean section are distributed in each group

# Methods

## Setting and study population

*Department of Obstetrics at KCMC*

The department has a maternal ward with 59 beds for women before labour and in labour with < 7 cm dilated cervix, the beds are also for the women after birth, both vaginal and after CS. The labour ward has one big room with four beds for vaginal deliveries, one theatre for CS and one emergency room for postpartum haemorrhage which can be converted into a theatre for emergency cases. Together with the unit for gynaecology, the departments employ 27 obstetricians and resident doctors, 46 midwives and nurses and performs around 3300 deliveries a year. Every delivery is registered in a delivery book and the following information is registered:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date Time | Name Tribe | Age | Previous pregnancie | Previous deliveries | Living Children | FHR at admission | Gest. age | Fundal height | Sex | Baby Weight |
| | | | | | | | | | | |
| Length | Head Circum-ference | Apgar Score | Blood loss | BP post-partum | Baby cond. | Mother cond. | Vit.A | BIMA insurance | Mode of delivery | Name Doctor Nurse |

Each patient has a file containing admission form and a partograph. Additionally, blood test samples, partographs from previous deliveries at KCMC and previous procedures are found if existing. This file is needed for ward rounds, taken to the pharmacy, follows the new-born to the vaccination room and when stored at the ward the file can be at numerous different places. The patient is discharged the day after a vaginal delivery if no complications have occurred, and when the patient is discharged, the file is taken to the medical records. Staff at KCMC has access to medical records but for research purposes it requires additional ethical approval to access it. The ethical approval for this study was not enough to gain access to medical records.

*Study population*

All women giving birth at KCMC during eight weeks on Sundays – Thursdays (n=333) with a gestational age ≥28 weeks at KCMC. Since the women were discharged the day after vaginal delivery and files were taken to the medical records where I had no access, I couldn't get access to the files for all the women giving birth on Friday and Saturday (due to not being at the hospital on week-ends). The delivery book provided some information for all the deliveries but it was insufficient to be able to classify according to the TGCS since information about fetal lie, start of delivery and previous deliveries had to be obtained from each file. Women with missing files or missing information in the file were excluded (n=21).

*Study design*

This study is descriptive. The data was collected at the Department of Obstetrics at KCMC in Moshi, Tanzania, during eight weeks in February- April 2016.

## Data collection

*Data collection procedures*

Every morning, all the patients giving birth for the past 24 hours were registered in the delivery book. There was also information about age, gestational age, fundal height, baby weight, Apgar score 1min and 5 min, blood loss, blood pressure postpartum and mode of delivery.

All the patients case files had to be found at the maternity ward the same day before discharged at 12 o' clock. Information about previous deliveries, fetal presentation, start of delivery and indication for CS were only

to be found in the files.

*Definition of variables needed for classification in the Ten Group Classification System*

*Gestational age***:** According to Dr Pendo S Mlay, head of Department of Obstetrics at KCMC, a majority of women giving birth at KCMC attend antenatal care and early ultrasound is performed establishing gestational age (GA. If not, GA it's calculated using last known menstrual period. In six cases no GA was recorded and then fundal height was used instead.

*Fetal variables*: All multiple pregnancies (twins or more) belong to one group, regardless of other variables. If there is one single fetus, it is then divided according to the lie of the fetus which is recorded in each patient's case file on admission. The lie can be one of the four following (the percentage explains how common they are in the general population): 97 % cephalic (head first), 3% breech (bottom first), <1% transverse (sideways) and <1% oblique (slanting).

*Previous deliveries***:** All deliveries with GA>28 weeks are included, including previous CS and those cases where the baby was stillborn.

*Previous CS:* The different categories are one previous CS or ≥ two previous CS.

*Start of labour*: Assessed from when the woman enters KCMC. If she's a referral from another hospital and already in labour, the start of labour is classified as spontaneous start because of the, in most cases, non existing documentation regarding start of labour in the previous hospital.

There is *spontaneous start* when there is rupture of membrane (ROM) or contractions before any intervention, such as induction or CS. *Induction* is when the labour is started with oxytocin intravenously, BARD catheter, oral misoprostol or vaginal misoprostol. *Caesarean section before labour (CSBL)* occurs when CS is done before ROM, contractions and

induction of any sort.

The groups of the Ten group classification system:

1. Nulliparous, single cephalic, ≥37 weeks in spontaneous labour
2. a. Nulliparous, single cephalic, ≥37 weeks, induced labour
2. b. Nulliparous, single cephalic, ≥37 weeks, induced labour
3. Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, spontaneous labour
4. a. Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, induced labour
4. b. Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, CS before labour
5. All multiparous, previous CS, single cephalic, ≥37 weeks
6. All nulliparous breeches
7. All multiparous breeches (incl. prev. CS)
8. All multiple pregnancies (incl. prev. CS)
9. All transverse or oblique lie, (incl. prev. CS)
10. All single cephalic, ≤36 weeks, (incl. prev. CS)

*Definition of indications for caesarean section*

In this study, the main indication for caesarean section is presented. In many cases, the decision of caesarean section is multifactorial but I've tried to establish the *main* reason for caesarean section with the help of notes in the case files and in communication with doctors and midwives in charge of the patient. In many cases there are several reasons for indication described and my task was to determine which one that was essential for the decision of CS and not another intervention, such as induction.

***Table 1.*** *Definitions of indications for caesarean section; described and categorized in collaboration with Dr Pendo S. Mlay, KCMC, and Dr Håkan Lilja, Sahlgrenska University.*

| Indications for caesarean section | | Definition of indications |
|---|---|---|
| **1.** | NRFS (Non reassuring fetal status) | • FHR outside normal range (120 – 160 [(a)])<br>• No fetal movement |
| **2.** | Disproportion | • Inadequate pelvis or cephalopelvic disproportion<br>• Malpresentation (Breech in prime, face presentation, footling, compound, cord presentation)<br>• Malposition (Persistent occipital posterior position, deep transverse arrest) |
| **3.** | Poor progress | • Prolonged labour not due to disproportion<br>• Failure of induction |
| **4.** | One previous CS | • Valid when no other indication for CS is presented |
| **5.** | Two previous CS or scar in corpus | • Two previous CS<br>• Scar in corpus [(b)]<br>• Myomectomy defined as scar in corpus [(c)] |
| **6.** | Hypertension disorders | • Hypertension<br>• Pre-eclampsia<br>• Eclampsia |
| **7.** | Antepartum haemorrhage (APH) | • Placental abruption<br>• Placenta previa |
| **8.** | Fever and/or infection | • Fever [(d)]<br>• HIV<br>• Other infections |
| **9.** | Psychosocial indication | • Bad obstetric history<br>• Maternal request |
| **10.** | Other | • All other indications |

(a) FHR= Fetal heart rate, measured by fetoscope. The range according to the WHO guidelines according to Dr Mlay. (b) Scar in corpus= Incision in corpus of the uterus, only made in CS in an emergency. (c) What sort of myomectomy that was performed isn't specified in the case files, in this study myomectomy is assumed to cause scar in corpus (the most severe myomectomy) to avoid underdiagnostics. (d) >38$^{o}$ C

*Statistical method:*

IBM SPSS Statistics 23 was used for both data collection and statistical analysis. Categorical comparison was done using Pearson chi-square test and Fisher's exact test when $n<5$. Comparing of means was calculated by independent two-sided t-test. P-value $<0.05$ was considered statistically significant.

## Ethics

Ethical approval for data collection was received from Head of Department of Obstetrics and Gynaecology at KCMC, Pendo S. Mlay, MD. The aim of the study is descriptive in its nature, not causing any difference in treatment of the patients since the data is collected in retrospect. The data has been handled anonymously, protecting each patient's privacy. The study obeys the *Declaration of Helsinki* ethical principles for medical research and the human rights.

## Results

*Included vs excluded women*

A total of 498 patients delivered during the data collection period. Out of these, 354 delivered on Sundays – Thursdays and I could collect all the information needed for classification. On Fridays – Saturdays 144 patients delivered, and for them classification was not possible, but information was collected regarding the variables seen in Table 2.

***Table 2**. Characteristics of the study population; comparison between the included and excluded women to investigate if there is a difference between the groups. Analyses done using independent T-test.*

| Variable | Number of cases Sunday – Thursday (a) | Sunday – Thursday (mean (SD)) (b) | Number of cases Friday – Saturday | Friday-Saturday (mean (SD)) (d) | P-value |
|---|---|---|---|---|---|
| **Age** | 353 | 29.3 (6.1) | 144 | 28.8 (6.1) | 0.39 |
| **Previous deliveries** | 349 | 1.12 (1.29) | 143 | 1.20 (1.15) | 0.53 |
| **Previous CS** | 342 | 0.24 (0.57) | 82 | 0.18 (0.52) | 0.41 |
| **Gestational age** [(e)] | 353 | 38+3 (2+4) | 143 | 38+5 (2+2) | 0.28 |
| **Apgar score 1 min** [(f)] | 367 | 8.0 (2.1) | 149 | 8.3 (1.6) | 0.09 |
| **Apgar score 5 min** [(g)] | 366 | 9.3 (2.3) | 149 | 9.7 (1.6) | 0.07 |
| **Baby weight (grams)** | 366 | 2998 (637) | 147 | 3141 (604) | 0.02* |
| **Blood loss (ml)** [(h)] | 343 | 249 (178) | 138 | 239 (175) | 0.60 |

(a) The number of cases in which this information was registered for the included women Sunday - Thursday. Note: More number of cases regarding the babies since there were fourteen twin-deliveries. (b) The number of cases in which this information was registered for the excluded women Friday - Saturday. Note: More number of cases regarding the babies since there were fourteen twin-deliveries. (c) Women who delivered on Sunday – Thursday and were included in the study. (d) Women who delivered Friday – Saturday and were not included in the study. (e) GA calculated from early ultrasound in a majority of the cases, otherwise with last known menstrual period, or in six cases by fundal height. (f) Apgar score for all new-borns after 1 min. (g) Apgar score for all new-borns after 5 min. (h) Estimated by the doctor or midwife during vaginal delivery and CS. *= significant P-value.

***Table 3**. Percentage CS of all deliveries; comparison between the included and excluded women to investigate if there is a difference between the groups.*

| | Sunday – Thursday (a) | Friday-Saturday (b) | P-value |
|---|---|---|---|
| **CS rate** | 40.8 % | 38.5 % | 0.63 |

(a) The included women giving birth Sunday – Thursday. (b) The excluded women giving birth Friday – Saturday)

There was only a statistically significant difference in baby weight, with the excluded presenting a slightly higher baby weight, exceeding the included women's babies with 143 grams. Concerning all other variables, including CS rate (table 3), there was no statistically significant difference between the groups. No clinically important distinction can be found in these analyses. However, for the

excluded women information on the start of labour and classification in the TGCS was not possible in most cases, and therefore no analyses could be done to reveal a potential difference.

Out of 354 women, 333 could be classified using the TGCS. Twenty-one women were excluded due to missing data or missing files. Of the 333 included deliveries, 136 delivered by caesarean section and 197 by vaginal delivery, resulting in an overall CS rate of 40.8%. Both the women with vaginal delivery and those who had CS had an age distribution that followed the normal curve (Fig. 1).

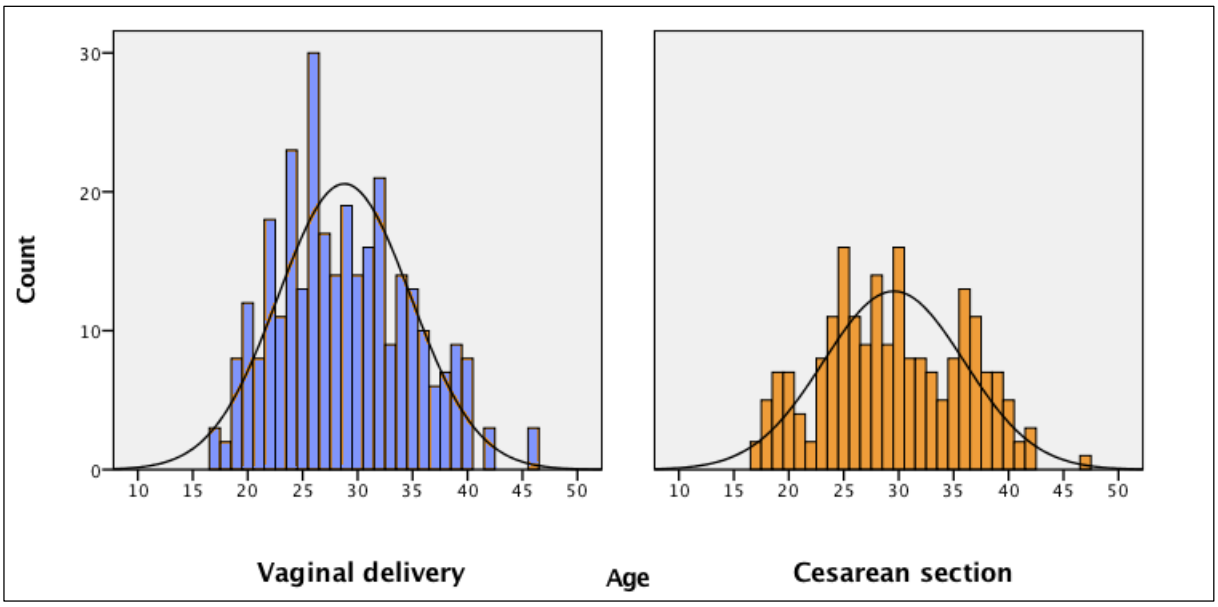


***Fig. 1**. Age distribution among women with vaginal delivery and caesarean section, displayed behind a curve presenting the normal distribution.*

In the group of vaginal deliveries, mean age was 29.0 years, compared to CS where the mean age was 29.7 years (table 4.). There was no statistically significant difference in age. In other words, the women who had a vaginal delivery was neither younger nor older than the women who had CS.

***Table 4.** Comparison of age between the women who had CS and the women who had a vaginal delivery. Analysed with an independent T-test.*

| Variable | Vaginal deliveries (mean (SD)) | Caesarean section (mean (SD)) | P-value |
|---|---|---|---|
| **Age** | 29.0 (6.0) | 29.7 (6.3) | 0.28 |

*The Ten Group Classification system*

Fig. 2 shows the different CS rates for each group with its obstetric characteristics presented in Table 5. The nulliparous in single cephalic, term pregnancy are represented by group 1, 2a and 2b. Group 1 (spontaneous) presents with CS rate of 26%, whereas the rate in group 2a (induced labour) and 2b (CS before labour) is 57.1% and 100% respectively. The multiparous in single cephalic, term pregnancy are found in Group 3 (spontaneous) with CS rate of 10.6%, 4a (induced labour) with 7.7% and 4b (CS before labour) with 100% CS rates. Group 5, women with previous CS, have CS in 86.7% of the cases. Group 1 – 5 together make up 79% of all deliveries.

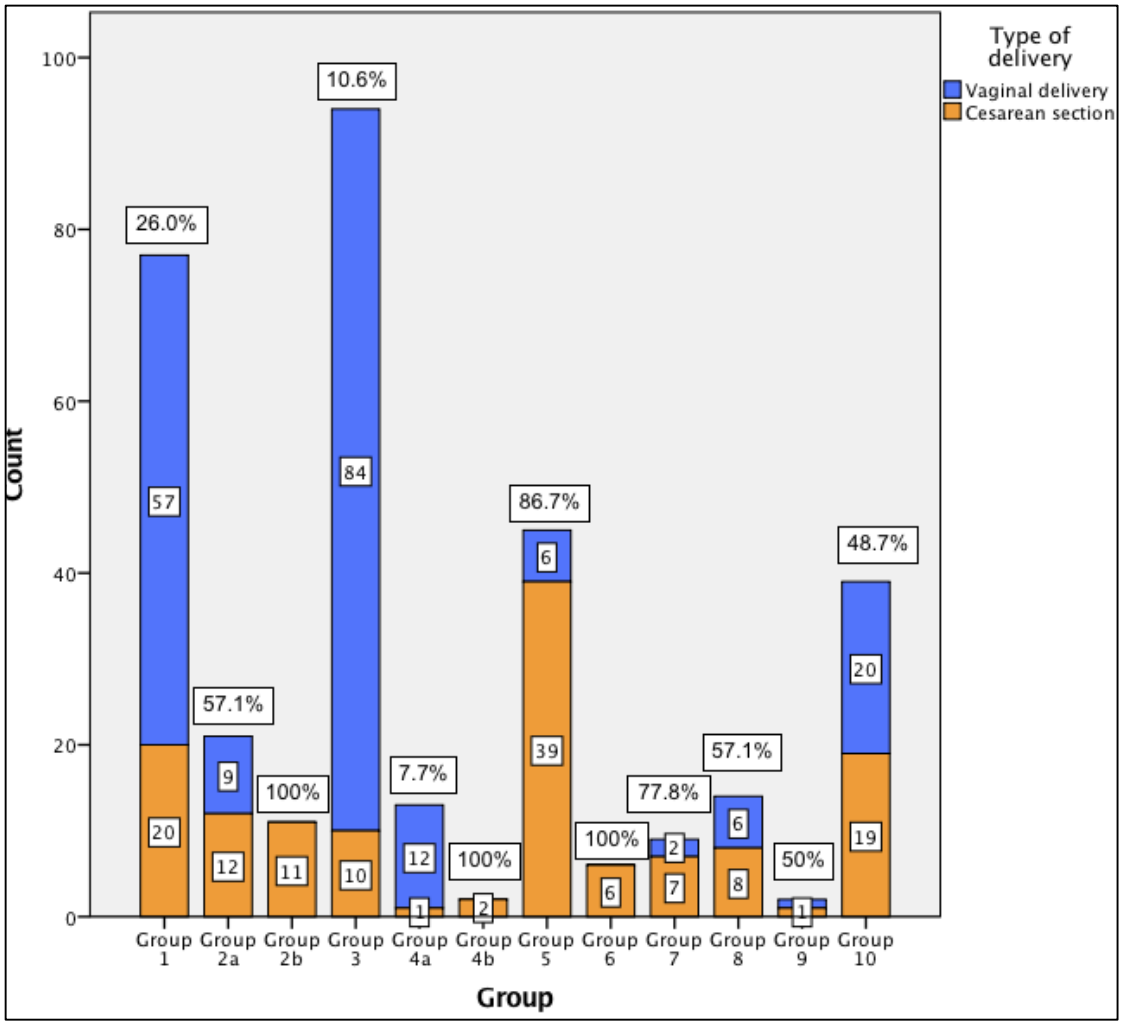


***Fig. 2**. Displaying the proportion of vaginal deliveries and CS in each group classified by the TGCS. Each bar represents the number of vaginal deliveries and CS in each group. Above the bar is the percentage of CS in all deliveries in each group.*

In group 6 and 7 the women with babies in breech lie (bottom first) are found, the former (nulliparous) with 100% CS rate and the latter (multiparous) with 77.8%. In group 8 all twins, regardless of other obstetric characteristics are included. There were fourteen twin deliveries and eight of them by CS (57.1%). The rare oblique and transverse lie are represented in group nine, consisting of two women where one had CS. All single cephalic deliveries in the week 36 or before, belong to group 10, with a CS rate of 14%. In total, group 6-10 represent 21% of all deliveries.

***Table 5.*** *Presenting the groups of the Ten Group Classification system (TGCS): How many deliveries in each group, how each group contributes to the total number of deliveries, the number of CS and the CS rate for each group. Last, showing the percent of the total number of CS that is made up by the CS in each group.*

| Gr | Ten group classification system (TGCS) Obststric characteristics | Delive-ries in each group | Percentage of the total deliveries | Share of CS in each group | CS rate in each group | Contribution to overall CS rate |
|---|---|---|---|---|---|---|
| **1** | Nulliparous, single cephalic, ≥37 weeks in spontaneous labour | 77 | 23.1 % | 20/77 | 26.0 % | 14.7 % (20/136) |
| **2a** | Nulliparous, single cephalic, ≥37 weeks, induced labour | 21 | 6.3 % | 12/21 | 57.1 % | 8.8 % (12/136) |
| **2b** | Nulliparous, single cephalic, ≥37 weeks, CS before labour | 11 | 3.3 % | 11/11 | 100 % | 8.0 % (11/136) |
| **3** | Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, spontaneous labour | 94 | 28.2 % | 10/94 | 10.6 % | 7.4 % (10/136) |
| **4a** | Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, induced labour | 13 | 3.9 % | 1/12 | 7.7 % | 0.7 % (1/136) |
| **4b** | Multiparous (excl. prev. CS), single cephalic, ≥37 weeks, CS before labour | 2 | 0.6 % | 2/2 | 100 % | 1.5 % (2/136) |
| **5** | All multiparous, previous CS or scar in corpus, single cephalic, ≥37 weeks | 45 | 13.5 % | 39/45 | 86.7 % | 28.7 % (39/136) |
| **6** | All nulliparous breeches | 6 | 1.8 % | 6/6 | 100 % | 4.4 % (6/136) |
| **7** | All multiparous breeches (incl. prev.CS) | 9 | 2.7 % | 7/9 | 77.8 % | 5.1 % (7/136) |
| **8** | All multiple pregnancies (incl. prev.CS) | 14 | 4.2 % | 8/14 | 57.1 % | 5.9 % (8/136) |
| **9** | All transverse or oblique lie, (incl. prev. CS) | 2 | 0.6 % | 1/2 | 50.0 % | 0.7 % (1/136) |
| **10** | All single cephalic, ≤36 weeks, (incl. prev. CS) | 39 | 11.7 % | 19/39 | 48.7 % | 14.0 % (19/136) |
| | ***Total:*** | *333* | *100 %* | *136/333* | *40.8 %* | *100 % (136/136)* |
| | | | | | | |

Group 3 is the biggest group, followed by group 1 and then group 5, seen in Fig 1 and Table 5. Group 5 make up 13.5% of the total deliveries, but due to the high CS rates (86.7 %), it represents 28.7% of all CS. The second largest contributor to the overall CS rate is group 1 with 14.7% of the total number of CS whereas group 3 is the largest group of all deliveries but contributes only 7.4% to the total number of CS.

The analyses, seen in Table 6 below, compare two groups and their CS rates.

***Table 6**. Caesarean section (CS) rates; comparison between two groups to investigate if there is a statistically significant difference in CS rate. To the left is the common obstetric characteristic for the two groups. In the next column is the different obstetric characteristics between the groups presented.*

| Obstetric population | Groups in comparison | Number of CS in each group | CS rates (%) | P-value |
|---|---|---|---|---|
| **a) Single cephalic, ≥37 weeks, *spontaneous* labour** | Group 1 *(nulliparous)* | 20/77 | 26.0 | 0.009* |
| | Group 3 *(multiparous)* | 10/94 | 10.6 | |
| **b) Single cephalic, ≥37 weeks, *induced* labour** | Group 2a *(nulliparous)* | 12/21 | 57.1 | <0.01*[(a)] |
| | Group 4a *(multiparous)* | 1/13 | 7.7 | |
| **c) Single cephalic, ≥37 weeks, nulliparous** | Group 1 *(spontaneous labour)* | 20/77 | 26.0 | 0.01* |
| | Group 2a *(induced labour)* | 12/21 | 57.1 | |
| **d) Single cephalic, ≥37 weeks, multiparous** | Group 3 (*spontaneous labour)* | 10/94 | 10.6 | 1.00[(a)] |
| | Group 4a (*induced labour)* | 1/13 | 7.7 | |
| **e) Single cephalic, ≥37 weeks, multiparous** | Group 3 (*no prev. CS)* | 10/94 | 10.6 | <0.01* |
| | Group 5 (*with prev. CS)* | 39/45 | 86.7 | |

*= p<0.05
(a) Fisher's Exact Test (due to cell <n=5)

Row a) compares the nulliparous and multiparous women in spontaneous labour, showing a statistically significant higher CS rate for group 1, the women in their first delivery. In b), a significantly higher CS rate is seen for Group 2a compared to Group 4a, showing there's a greater risk for CS when labour is induced for the nulliparous compared to induction of the multiparous. In d), I further explore how induction affects the risk of CS, comparing nulliparous in spontaneous labour with nulliparous when labour was induced. A higher risk

for CS was seen for the nulliparous with *induced* labour, statistically significant. The same analysis was made for multiparous women, comparing group 3 (spontaneous start) with group 4a (induced labour), but for the multiparous, no higher risk of CS was seen when labour was induced (p=1.00). How does a previous CS affect the risk of CS? For multiparous without previous CS (group 3), the risk of CS (10.6%) was statistically significant lower than for women *with* previous CS (Group 5, 86.7%).

*Indication for caesarean section*

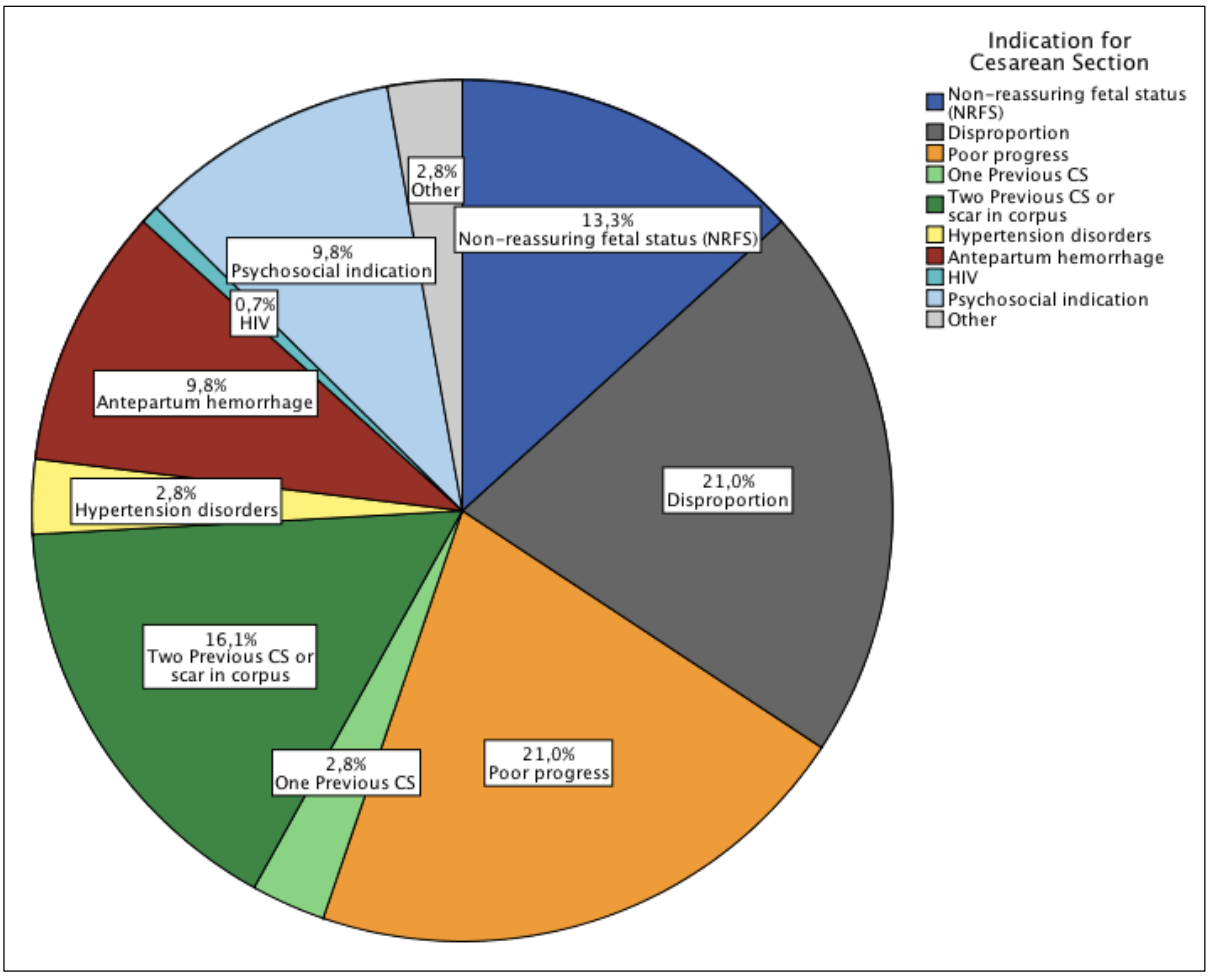


***Fig. 3**. Distribution of main indication for all caesarean sections. A caesarean section can only have one main indication. The definitions of the categories are described under method.*

The distribution of indications for all caesarean section is presented in Fig. 3. The most common indications are disproportion and poor progress, both at 21%. The third most common reason for caesarean section is when the women has had two previous CS (16.1%), this group includes both emergency and elective caesarean section. The following indication is NRFS at 13.3%, this indication is used when the primary reason for caesarean section is threatening fetal health even though other indications also might be present.

One aim of this study was to describe how the indications for CS was distributed among the CS in each group, which is presented in Fig. 4.

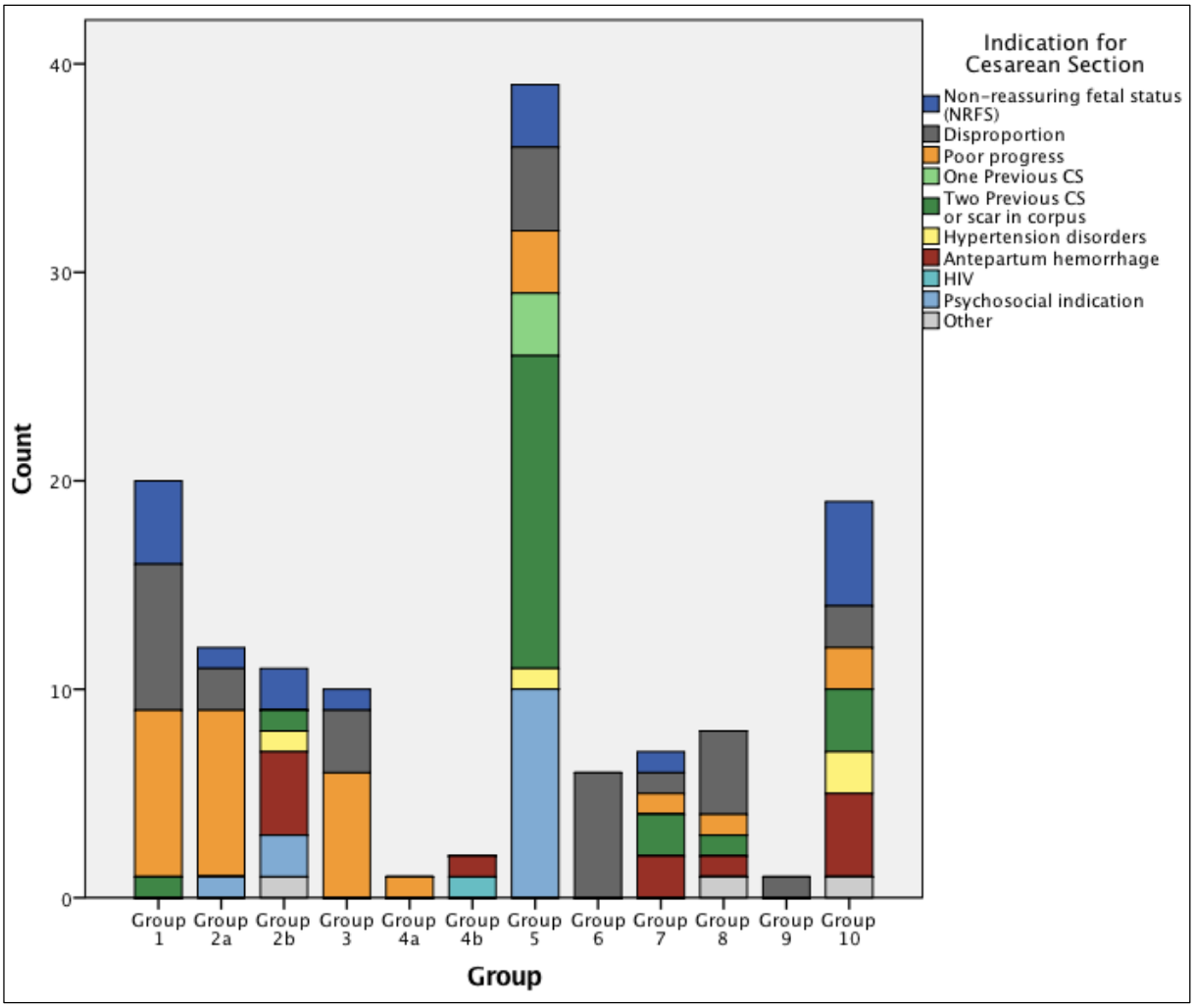


***Fig. 4****.The caesarean sections in each group of the TGCS. Bars defined by the main indication for caesarean section. A caesarean section can only have one main indication. The definition of the categories are described under method.*

Group 1, 2a and 3 shows a similar pattern of indications, where poor progress is the leading cause of CS, followed by disproportion and NRFS. In Group 2b (CS before labour in nulliparous women), antepartum haemorrhage is the main reason for CS.

As previously described, group 5 contributes most to the overall CS rate. Two previous CS and psychosocial indication (mother's wish or bad obstetric history) is the most common reasons for having a CS when you already have had a CS (which constitutes group 5). Group 5 can be divided into 5a (one previous CS) and group 5b (two previous CS) (Fig. 5 and Fig. 6).

When separated into subgroups, group 5a presents with 80.6% CS rate, and 5b 100%. The only indication for CS in group 5b is two previous CS, whereas group 5a is presenting psychosocial indication as the most common reason for CS.

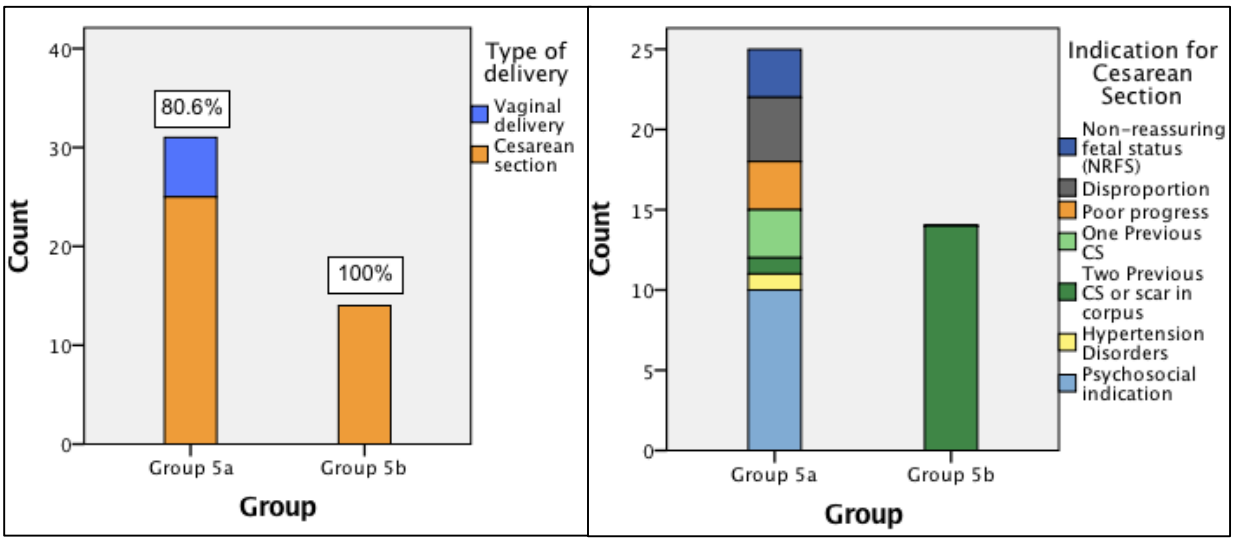


***Fig. 5**. The proportion of vaginal deliveries and CS in each group. The numbers are percentage of CS in all deliveries in each subgroup of group 5: 5a (one previous CS) and 5b (two previous CS).*




***Fig. 6.** The main indication for cesaren section in each subgroup of group 5: 5a (one previous CS) and 5b (two previous CS).*

## Discussion

*Study population*

The aim for this study was originally to include all women giving birth during the data collection period of eight weeks in February – April 2016. However, when I arrived at KCMC I discovered that the ethical approval the study had from the head of department at KCMC did not allow access to the medical records. This was essential to retrieve files for women who were discharged on the days I was not at the hospital but, unfortunately this was not possible. The information provided to me from the delivery book was enough to be able to compare the excluded and included women regarding age and other variables presented in Table 2 and the CS rate displayed in Table 3. The results showed no statistically significant difference in any variable except for a minor difference in baby weight where the excluded women had a mean baby weight of 147 grams more than the included women. This is very unlikely to be clinically relevant. In conclusion, the studied population corresponds to that of all women giving birth at KCMC during the data collection period.

Is an increase in maternal age the cause of rising CS rate? Maternal age >35 years has proven to be associated with increased risk of CS (28). However, when comparing the women who had CS with those who had vaginal delivery in this study, there was no statistically significant difference. Also, both groups of women presented with a normal distribution in age. It is therefore unlikely that a maternal age is the cause of the elevated CS rate at KCMC for the last six years.

*Caesarean section rate*

The overall CS rate in this eight-week study at KCMC was 40.8% among the 333 deliveries, which is remarkably high but corresponds to the CS rate at KCMC of 2015, which was 42%.

However, in 2009 the CS rate was 33%. The CS rate has increased with a remarkable 27% in only six years. Is this an isolated event just at KCMC? The University Hospital of Dar es Salaam, the largest city in Tanzania which resembles to KCMC in resources and what population it serves, has seen an increase in CS rate from 19% in 2002 to 49% in 2011 (29). So what about the rest of Tanzania? It's difficult to estimate the overall CS rate due to the lack of national birth registry for all facilities. In a WHO-report from 2010 the CS rate for Tanzania was 3.2% (19). The discrepancy between 40.8% at KCMC and 3.2% in the nation is reasonably explained by the high number of home deliveries, 49% (4), which are almost exclusively vaginal. Being a referral hospital KCMC has the resources, both materially and in staff, to do many and also complicated CS. However, it raises interesting issues about the attitude towards CS. Is the CS performed because it is medically motivated or because *it is an easy way out*? In other words; are the indications strict enough and are the guidelines followed?

The WHO analysed two major studies on CS rates in both high income countries as well as low income countries, the first one in 2004-2008 and the second one in 2010-2011 (11). The analysis explored the change in CS rate, and the results was documented for five African countries. Their percentage of CS in 2011 is presented, and the percentage in 2008 is displayed in brackets: Kenya 23.7 (16.0), Nigeria 20.4 (14.5), Uganda 20.2 (15.1), Democratic Republic of the Congo 21.4 (13.1), and Niger 9.8 (5.3). The conclusion of the WHO-report is that CS rates are increasing all over Africa. As of KCMC, what might cause the high CS rate of 40.8%? Let us dig deeper to find out.

*Ten group classification system*

When classifying the deliveries in the TGCS (Fig. 2), the great diversity in CS rate of the groups is clear.

In KCMC, group 1 has a CS rate of 26%. Globally, group 1 presents with the most diverse CS rates when data is collected from many countries (26), one study with a range of 15.1% - 30.6%. It is suggested as an indicator of the quality of management of the nulliparous women in the same study, but also as an interesting target of further interventions to lower the CS rate. In group 2a, when the nulliparous women have induced labour, the CS rate instantly rises to 57.1 %, a more than doubled CS rate, statistically significant ($p=0.01$), compared to the nulliparous in spontaneous labour (26%) (group 1). Is it the induction itself that increases the risk of CS? Have the patients elected for induction enough strong reasons? Or had it been better to wait for spontaneous delivery? The questions raise new questions on resources for and knowledge on fetal monitoring.

For the multiparous, the same relationship of induction and high CS rates can *not* be found. When comparing group 2a with group 4a, the CS rate is significantly higher in group 2a ($p<0.01$). In other words, when inducing labour in a nulliparous woman the risk for CS is more than doubled, however when inducing labour in a multiparous woman, there is no increased risk of CS at all compared with spontaneous labour. Because of the few number of women in group 2a (twenty-one) and group 4a (thirteen), this should be confirmed in a study with a larger sample size but even with these small groups, the difference is still statistically significant.

The smallest group, group 4b with only two women, is an interesting marker for how well the clinic takes care of the women in their first delivery. If the first vaginal delivery was traumatic, the number of women tend to increase in group 4b, with mothers requesting CS before labour. However, there are only two women in group 4b, which suggests that the first experience of a vaginal delivery was good enough not be afraid to give birth vaginally again.

The group that contributes most to the CS rate, accounting over a fourth (28.7%) of all CS, is group 5; the women with previous CS. To further understand this group, it was divided

into group 5a (one previous CS) and 5b (two previous CS), shown in Fig. 5 and Fig. 6. It is KCMC guidelines to try vaginal delivery when the woman has had one previous CS. However, this is only successful in 20% the cases, the rest end up having CS after all. The domino-effect of frequent CS resulting in more women in group 5 where over 80% has another CS is an alarming development and discussed in many articles (11,27,29). So what can be done in this high risk group? A study in Australia showed CS rates for women in trial of scar ranging from 12.9% to 71.9%, suggesting that the high CS rates are not an absolute number but differing between clinics (30). Australia has more resources than Tanzania regarding fetal monitoring with cardiotocography (CTG) which monitores the fetal heart rate and the contractions digitally and continuously. This is a crucial tool when proceeding with a high risk vaginal delivery. The proper comparison of CS rate for women with one previous scar, would be between KCMC and that of another University hospital in Tanzania to learn from each other what can be done within the guidelines without risking maternal and perinatal health. For now, this is unfortunately not possible since there are no articles on this particular subject yet. What we *can* conclude at this stage is that there is a need for strategies to avoid repeated CS, since no articles have found evidence of improved outcome with another CS compared to vaginal delivery (17). Lowering the CS rate in this group is however a difficult task and might not result in a large reduction. The WHO expresses instead that focus should be upon avoiding the first CS with improved management of the nulliparous women (11).

*Indications for caesarean section*

When determining the main indication for CS, I looked in each patient's case file and if uncertain, I consulted the obstetrician handling the patient. Despite having a god insight in the patient's history, it was sometimes difficult to distinguish what the *main* reason for CS had

been. My aim was to find the indication that made CS the best choice of action instead of, for example, induction.

The most common indications for CS are disproportion and poor progress, both at 21% each (Fig. 3). Disproportion is a common indication for CS all over the world (31,32) and the term is explained in Table 1. Naming the different conditions of disproportion is challenging, even for experienced obstetricians when no descent of the fetal head is seen even though contractions are good. Instead moulding of the fetal head makes manual examination difficult. To use an ultrasound in this situation is also difficult. In KCMC, as well as other hospitals, some of the doctors in the staff and nurses have less experience and here is a potential source of misclassification. Education and close contact with a more experienced colleague is of great value. In this study, no information was gathered on the level of knowledge of the obstetrician in charge so it remains unclear how it influences the decision to perform a CS.

Poor progress is a vague term with weak definitions at KCMC. The term is used when labour is not progressing as it should according to the partograph, but the term does not define if it was due to cervical dystocia (the cervix does not open but the contractions are good) or weak contractions. According to KCMC guidelines; To use poor progress as an indication for CS, *three* criteria has to be met: Crossing of the action line in the partograph (exceeding the time estimated for the second stage of labour) should have been registered, membranes should have been ruptured and augmentation with oxytocin should have been tried. In many cases, I experienced that these criteria were not met or that the partograph were filled out too late or too early, making the time registered as crossing of the action line inaccurate. However, these are my observations and they are not further elaborated in this report since I have no data confirming this. It does, however, present an interesting topic in which further studies ought to be done.

Non-reassuring fetal status (NRFS) is also a term which lacks a clear definition. In this study, it is defined as FHR documented in the case file below 120 or above 160, or the mother's inability to feel fetal movements. In KCMC, FHR is measured by fetoscope, there are no CTG monitoring available. Monitoring the fetus during labour is challenging with only a fetoscope as monitoring tool and probably explains a part of the CS performed at KCMC. In a setting with more advanced monitoring, equipment and better education in interpretation of the fetal signal, the obstetrician would have been reassured of a normal fetal heart rate and some of the CS would probably be avoidable. This further emphasizes the need of comparing the results of this study with itself in continuous years and not comparing with other countries where the resources might be different.

So, let us explore what is causing the high CS rate in each group (Fig. 4). In group 1 and 2a, the nulliparous in spontaneous and induced labour, the leading cause of CS is poor progress and disproportion. As mentioned before, poor progress is a vague term. It is the leading cause of CS for the groups which contributes a lot to the overall CS rate. Improving the definitions of this indication could potentially decrease the number of CS. In group 3, the same pattern of indications is found, with poor progress being the major cause of CS.

In group 2b and 4b the women have CS before labour – what is the reason for this? First of all, it is more common for nulliparous women to have CS before labour than the multiparous women. The causes of CS are antepartum haemorrhage, psychosocial indication and NRFS. Whether these conditions are more common in nulliparous or not requires a much larger sample size in order to be validated. The CS are probably adequate for the indication of NRFS and antepartum haemorrhage.

The leading cause of CS in group 5a is the psychosocial indication. In a majority of the cases there was documentation that the patient had opted for CS as an informed decision after consultation with the doctor in charge. The discussion on whether to let the mother decide

type of delivery or not requires much more insight on what caused the woman to opt for CS and to analyse what information was provided to her both on antenatal visits and when she was admitted to the labour ward. In group 5b, the only cause for CS was two previous scar or scar in corpus, a correct indication for CS which aligns with the KCMC guidelines.

Group 6 and 7 represent the breech pregnancies. The KCMC guidelines recommend CS for breech in nulliparous women, but vaginal assisted breech delivery for the multiparous women. There is 100% CS in group 6 and 78% in group 7 (Fig. 2) which shows that just 22% of the multiparous has a vaginal delivery in a breech presentation. However, the indications for CS are probably adequate, with antepartum haemorrhage and previous scar in corpus as the major causes (Fig. 4). What seemed like an unnecessary high number of CS in group 7 could now be mostly explained by the adequate indications of CS. It would have been reckless to focus on lowering a CS rate just because of a high percentage of CS without knowing the causes. These groups are a good example of the undeniable need for correct information before changing the management.

For the twin pregnancies in group 8, disproportion explains half of all CS (Fig. 4). This is probably accurate since an abnormal lie in twin pregnancies, for example breech in first twin, is considered to be safer to deliver by CS. This is especially important in a setting like KCMC where fetal monitoring is more challenging.

Group 9, the oblique and transverse lie, is supposed to have CS in all cases since these abnormal lies of the baby is life threatening if tried vaginally. The fact that one woman in this group delivered by vaginal delivery with good outcome for the mother and baby suggests that the definition that the baby's lie was oblique or transverse might have been wrong. This enlightens the challenges in correct naming of the conditions of disproportions. However, due to the small group size (two women), no further conclusions can be made in this group.

In group 10, all preterm deliveries are represented. As shown in fig. 4, antepartum haemorrhage and NRFS are the leading causes of CS. As mentioned previously, NRFS is a vague term and further investigations are needed to fully understand if NRFS is used as a correct indication for CS. According to Dr Lilja, the preterm deliveries are delicate, and the threshold for CS is generally lower than it would have been for a term pregnancy.

*The domino effect*

After considering the CS rate and the indications for CS – what are the consequences? To see the big picture, we have to zoom out and when we do, there is a domino effect. The CS rate for the nulliparous women in term, cephalic pregnancy (group 1, 2a and 2b) is 39%. Most of these women will be pregnant again and when they do, they will belong to group 5a, the group consisting of women with one previous CS. In this group, 80% has another CS which result in an increase of women who has had two previous CS. As we know, this group should not try vaginal delivery and therefore another CS is inevitable in the next pregnancy. I believe this domino effect is what has caused the CS rate to increase at KCMC during the last six years and will be the cause of further increase unless extensive strategies are developed. In Fig. 2 and Fig. 4, group 5 stands out as a major contributor to the overall CS rate. This is true, but nonetheless would it be inaccurate to focus solely on lowering the CS rate for this group since it's a very complex group. Even at Sahlgrenska University, 54% has a CS in group 5 (information by personal communication with the Robson group). The key is instead to focus on the primary cause of many CS, which is the high CS rate for the nulliparous women in group 1, 2a and 2b.

*How to move forward?*

In the early 90's, Dr Robson used the medical audit cycle to lower the CS rate for the nulliparous women in cephalic, term pregnancy (33). The medical audit cycle (Fig. 7) is a standardized way of working with improvement in management by first analysing the situation, plan for changes, implement them, reanalyse the results and find new areas of improvement, and so the circle goes on and on. The key to its success is the evaluation of changes made to see if they were successful or not. In Robson's study, they managed to lower the CS rate from 12% to 9.5%. In this particular study the key to success was, among others, early diagnosis for the women and active treatment of dystocia (weak contractions). These interventions *could* prove successful for KCMC as well but the most important thing is to use the medical audit cycle in *every clinic* to evaluate what changes might work, implement them and evaluate them to see if they were successful.

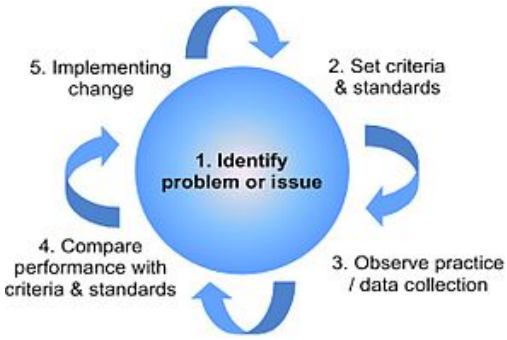


***Fig. 7*** *Schematic picture of the medical audit cycle. Obtained from open access publisher: http://patient.info/doctor/audit-and-audit-cycle*

This study has highlighted some areas where changes can be made but it is important to understand that there are no absolute truths or quick fixes. To decide if a woman should have CS or not is an art form. It takes many years of practice and even a skilled obstetrician and midwife can make mistakes. To lower the risk for this, well-defined guidelines and criteria are a necessity but every case is unique and this must also be taken into consideration.

However, some areas show greater room for improvement than others. For the nulliparous women the CS rate is high when labour is induced. To sharpen the criteria for induction and improve monitoring of the women when labour is induced might improve the rate of women having successful vaginal deliveries. Also, further education regarding the partograph and how to use it is necessary. This is crucial to be able to identify poor progress

in a correct way. Poor progress is the most common indication for CS for the nulliparous women in term, cephalic pregnancy (Fig. 4) where labour is spontaneous (group 1) or induced (group 2a). To apply the medical audit cycle for the women who had CS because of poor progress could enlighten to the problem areas where misusage of the term poor progress might occur. After identifying the problems, interventions can be made along with education of the staff of the criteria for poor progress.

This study has also shown that 10% of the women has CS due to maternal request or/and bad obstetric history. There is a need to discuss how to handle these women, what information and support do they receive? Is this matter of CS discussed at the antenatal care visits and if so, in what way?

*Further studies*

The TGCS is meant to be implemented at a clinic to classify all deliveries continuously and evaluate monthly the CS rate in each group. Continuing this classification can be very useful to KCMC in order to understand what is causing the increasing CS rate.

A study investigating how correctly the partograph is used and how the criteria for poor progress are followed would be an important next step.

In the matter of women opting for CS, there is a need of a qualitative study, rather than another quantitative one, further exploring why women opt for CS and if it is beneficial to the mother and baby.

## Methodological considerations

I was able to review every case file and ask the staff in charge about uncertain information which added credibility to the study.

In this study I had no access to medical records and was therefore unable to retrieve case files after discharge. This resulted in inclusion of the women giving birth at Sundays – Thursdays since I could gather information on them on Monday – Fridays. To include all women would have been better and would have ruled out potential biases about differences concerning giving birth on different days of the week. Although I only included women giving birth on Sundays – Thursdays, I was able to compare several variables between the included and excluded women and rule out potential biases such as CS rate, age difference, outcome in Apgar score and blood loss during delivery (which could have indicated poorer management).

There was no clear definition for induction so I had to assess every case and make up whether induction had been done or not. Since oxytocin was widely used for induction, and used for augmentation in a majority of all labours, it was sometimes hard to determine the purpose of the oxytocin and therefore to classify the woman. KCMC is a referral hospital. The women already in labour when referred to KCMC were classified as spontaneous start of labour because of the difficulty to make up what care had been given before referral. To summarize, the number of women that received induction is probably underestimated.

For the indications of CS, there are no widely used method for categorizing the indications. For this study, the categories of indications were confirmed in collaboration with Dr Mlay and Dr Lilja. More research might have revealed a better way to categorize the indications which would have made it easier to compare with other studies. However, these categories proved to work for this study.

## Conclusion

The CS rate at KCMC is 40.8%, but when classifying in different groups of the TGCS, the enormous diversity between the CS rate in each group becomes clear. There is a higher risk of CS for nulliparous women compared to multiparous women, with an increase of risk seen for the nulliparous who has labour induced. The nulliparous women, and the women who has previous CS contribute most to the overall CS rate and it is also in these groups the biggest changes can be made. Lowering the CS rate for the nulliparous will lower the number of women with previous scar, hence, lowering the total number of CS.

The main indications for CS are poor progress of labour, disproportion, non-reassuring fetal status (NRFS) and psychosocial indication, all of which has the problem of vague definitions. In order to improve the basis for decision-making of mode of delivery, it is essential to define what indications for CS are valid and what criteria that have to be met for each indication. There is a need of strict guidelines, continuous education, strong leadership and continuation of monitoring of the CS rate in each group.

## Populärvetenskaplig sammanfattning

### Fler och fler kejsarsnitt utförs på Universitetssjukhuset KCMC i Tanzania – vad beror detta på  och vad kan vi göra åt det?

Kejsarsnitt har alltid varit en källa till mycket diskussion. Historiskt sett har kejsarsnittet varit ett privilegium för de välbeställda men de senaste decennierna har kejsarsnittet blivit ett alltmer tillgängligt verktyg över hela världen. En förlossning är fortfarande förknippad med mycket risker men kejsarsnitt är ett verktyg som drastiskt kan förbättra säkerheten för både barnet och modern. Så vad handlar diskussionen om?

Kejsarsnitt är i många tillstånd livräddande, men utfört av fel anledningar kan det skapa onödiga risker för en förlossning som annars hade löpt på utan komplikationer. I många länder är snart varannan förlossning gjord med kejsarsnitt och man börjar se vilka problem detta skapar. Efter ett kejsarsnitt ökar riskerna vid nästa graviditet för blödning i livmodern och efter två kejsarsnitt så är livmodern så pass ärrig att det i många fall inte är rekommenderat att försöka föda vaginalt vid nästa graviditet.

På universitetssjukhuset KCMC i Moshi är man oroade över att andelen kejsarsnitt ökar. Det är dock oklokt att försöka göra färre kejsarsnitt utan att veta vad anledningen till ökningen är. För att skaffa sig en bättre uppfattning om detta gjordes denna studie. Där har jag använt mig av ”Tio-grupps-klassifikationen” och även samlat in information om vad anledningen till kejsarsnittet var. Klassifikationen delar upp alla förlossningar i tio olika grupper beroende på om kvinnan är förstföderska eller omföderska, hur långt gången hon är i graviditeten, om förlossningen var spontan eller inte och om barnet låg med huvudet först eller stjärten först.

Resultatet var att andelen kejsarsnitt på KCMC var 41% men det skilde sig mycket åt mellan grupperna. En högre risk för kejsarsnitt sågs om kvinnan var förstföderska än om hon var omföderska. Ännu högre var risken om förlossningen sattes igång på konstgjord väg hos

förstföderskan. Anledningen till kejsarsnitten var oftast att förlossningen inte fortskred som den skulle, att barnet låg på ett olämpligt sätt i livmodern eller att barnet befarades inte må bra. PÅ KCMC har man inte digital övervakning av barnets hjärtslag utan detta sker med att man lyssnar på magen med en aluminiumtratt. Detta gör att det är svårare att förvissa sig om att barnet inte är i fara och leder förmodligen till fler kejsarsnitt.

Den vanligaste anledningen till ett kejsarsnitt var att kvinnan hade gjort ett kejsarsnitt tidigare. Riktlinjerna säger att kvinnan bör föda vaginalt nästa gång men i 80% av fallen blev det ändå ett nytt kejsarsnitt. Hälften av dessa förklarandes av att kvinnan önskade ett kejsarsnitt och i de andra fallen fortskred inte förlossningen som den skulle och ännu ett kejsarsnitt var nödvändigt.

Slutsatsen är att det finns en risk för ännu fler kejsarsnitt med medföljande problem på grund av en dominoeffekt: Om många av förstföderskorna får ett kejsarsnitt så blir det ännu fler i gruppen av kvinnor med tidigare kejsarsnitt. I denna grupp får 80% ett till kejsarsnitt och riskerna med en ny graviditet ökar. Det viktigaste kliniken bör göra är att se över sina rutiner och förbättra mödravården för förstföderskorna för att bryta tendensen med fler och fler kejsarsnitt.

## Acknowledgements

I would like to thank my supervisor Dr Håkan Lilja for the great support during this study. I would also like to thank my supervisor Dr Pendo S. Mlay and the rest of the staff at the Department of Obstetrics at KCMC for making me feel welcome and providing me with the essential help needed to carry out this study. A special thanks to nurse Salome for helping me find all the files!

Further, this study would not have been possible without the financial contribution from the organisation Sida and the scholarship for MFS (minor field study).

Last, but not least, I would like to thank my fellow students in Moshi; Ebba Odbro, Linda Bulmer and Alicia Avdic, for the support and great companionship during this time – thank you!

## References:


1. MDG 2015 Summary web_english.pdf [Internet]. [cited 2016 May 5]. Available from: http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20Summary%20web_english.pdf
2. tanzania-poverty-assessment-05.2015.pdf [Internet]. [cited 2016 May 11]. Available from: http://www.worldbank.org/content/dam/Worldbank/document/Africa/Tanzania/Report/tanzania-poverty-assessment-05.2015.pdf
3. Rural Poverty Portal [Internet]. Rural Poverty Portal. [cited 2016 May 11]. Available from: http://www.ruralpovertyportal.org/country/home/tags/tanzania
4. Tanzania_United_Republic_of_Accountability_profile_2013.pdf [Internet]. [cited 2016 May 3]. Available from: http://countdown2015mnch.org/documents/2013Report/Tanzania_United_Republic_of_Accountability_profile_2013.pdf
5. Latour B. Reassembling the social-an introduction to actor-network-theory. Reassembl Soc- Introd Actor-Netw-Theory Bruno Latour Pp 316 Foreword Bruno Latour Oxf Univ Press Sep 2005 ISBN-10 0199256047 ISBN-13 9780199256044 [Internet]. 2005 [cited 2016 May 11];1. Available from: http://adsabs.harvard.edu/abs/2005reso.book.....L%EF%BF%BD%C3%9C
6. Rabinerson D, Ashwal E, Gabbay-Benziv R. [Cesarean section through history]. Harefuah. 2014 Nov;153(11):667–70, 686.
7. Cesarean Section – A Brief History: Part 2 [Internet]. National Institutes of Health, U.S.; 2009. Available from: https://www.nlm.nih.gov/exhibition/cesarean/part2.html
8. Cesarean Section - A Brief History: Part 3 [Internet]. [cited 2016 May 7]. Available from: https://www.nlm.nih.gov/exhibition/cesarean/part3.html
9. Your baby in the birth canal: MedlinePlus Medical Encyclopedia [Internet]. [cited 2016 May 6]. Available from: https:https://www.nlm.nih.gov/medlineplus/ency/article/002060.htm
10. Ferreira EC, Pacagnella RC, Costa ML, Cecatti JG. The Robson ten-group classification system for appraising deliveries at a tertiary referral hospital in Brazil. Int J Gynecol Obstet. 2015 Jun;129(3):236–9.
11. Vogel JP, Betrán AP, Vindevoghel N, Souza JP, Torloni MR, Zhang J, et al. Use of the Robson classification to assess caesarean section trends in 21 countries: a secondary analysis of two WHO multicountry surveys. Lancet Glob Health. 2015 May 1;3(5):e260–70.
12. Makhanya V, Govender L, Moodley J. Utility of the Robson Ten Group Classification System to determine appropriateness of caesarean section at a rural regional hospital in KwaZulu-Natal, South Africa. S Afr Med J. 2015 Mar 11;105(4):292.
13. Andelen kejsarsnitt varierar kraftigt i landet [Internet]. [cited 2016 Jun 6]. Available from: http://www.socialstyrelsen.se/nyheter/2014december/andelenkejsarsnittvarierarkraftigtilandet
14. Oyelese Y, Smulian JC. Placenta previa, placenta accreta, and vasa previa. Obstet Gynecol. 2006;107(4):927–941.
15. Bakacak SM. Effect of Multiple Repeat Cesarean Sections on Maternal Morbidity: Data from Southeast Turkey. Med Sci Monit. 2015;21:1447–53.
16. Gasim T, Al Jama FE, Sayedur Rahman M, Rahman J. Multiple repeat cesarean

sections operative difficulties, maternal complications and outcome. J Reprod Med. 2013;58(7–8):312–8.
17. Guise J-M, Berlin M, McDonagh M, Osterweil P, Chan B, Helfand M. Safety of Vaginal Birth After Cesarean: A Systematic Review: Obstet Gynecol. 2004 Mar;103(3):420–9.
18. Laine K, Rotvold W, Staff AC. Are obstetric anal sphincter ruptures preventable?– Large and consistent rupture rate variations between the Nordic countries and between delivery units in Norway. Acta Obstet Gynecol Scand. 2013 Jan 1;92(1):94–100.
19. Gibbons L, Belizán JM, Lauer JA, Betrán AP, Merialdi M, Althabe F, et al. The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage. World Health Rep. 2010;30:1–31.
20. Beliz??n JM, Althabe F, Cafferata ML. Health Consequences of the Increasing Caesarean Section Rates: Epidemiology. 2007 Jul;18(4):485–6.
21. Betran AP, Torloni MR, Zhang J, Ye J, Mikolajczyk R, Deneux-Tharaux C, et al. What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. Reprod Health. 2015 Jun 21;12(1):1.
22. Robson MS. Can we reduce the caesarean section rate? Best Pract Res Clin Obstet Gynaecol. 2001 Feb;15(1):179–94.
23. Maaløe N, Bygbjerg IC, Onesmo R, Secher NJ, Sorensen BL. Disclosing doubtful indications for emergency cesarean sections in rural hospitals in Tanzania: a retrospective criterion-based audit. Acta Obstet Gynecol Scand. 2012 Sep 1;91(9):1069–76.
24. Torloni MR, Betran AP, Souza JP, Widmer M, Allen T, Gulmezoglu M, et al. Classifications for Cesarean Section: A Systematic Review. Althabe F, editor. PLoS ONE. 2011 Jan 20;6(1):e14566.
25. Betrán AP, Vindevoghel N, Souza JP, Gülmezoglu AM, Torloni MR. A Systematic Review of the Robson Classification for Caesarean Section: What Works, Doesn't Work and How to Improve It. Bhattacharya S, editor. PLoS ONE. 2014 Jun 3;9(6):e97769.
26. Brennan DJ, Robson MS, Murphy M, O'Herlihy C. Comparative analysis of international cesarean delivery rates using 10-group classification identifies significant variation in spontaneous labor. Am J Obstet Gynecol. 2009 Sep;201(3):308.e1-308.e8.
27. Betrán AP, Gulmezoglu AM, Robson M, Merialdi M, Souza JP, Wojdyla D, et al. WHO Global Survey on Maternal and Perinatal Health in Latin America: classifying caesarean sections. Reprod Health. 2009;6(1):18.
28. W LX and Z. Effect of maternal age on pregnancy: a retrospective cohort study. - PubMed - NCBI [Internet]. [cited 2016 Jun 1]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24931235
29. Litorp H, Kidanto HL, Nystrom L, Darj E, Essén B. Increasing caesarean section rates among low-risk groups: a panel study classifying deliveries according to Robson at a university hospital in Tanzania. BMC Pregnancy Childbirth. 2013;13(1):1.
30. Schemann K, Patterson JA, Nippita TA, Ford JB, Roberts CL. Variation in hospital caesarean section rates for women with at least one previous caesarean section: a population based cohort study. BMC Pregnancy Childbirth. 2015 Aug 19;15(1):1.
31. Liu Y, Li G, Chen Y, Wang X, Ruan Y, Zou L, et al. A descriptive analysis of the indications for caesarean section in mainland China. BMC Pregnancy Childbirth. 2014;14(1):410.
32. Abdel-Aleem H, Shaaban OM, Hassanin AI, Ibraheem AA. Analysis of cesarean delivery at Assiut University Hospital using the Ten Group Classification System. Int J Gynecol

Obstet. 2013 Nov;123(2):119–23.
33. Robson MS, Scudamore IW, Walsh SM. Using the medical audit cycle to reduce cesarean section rates. Am J Obstet Gynecol. 1996 Jan;174(1, Part 1):199–205.