Trends in and socio-demographic factors associated with caesarean section at a large Tanzanian hospital, 2000 to 2013

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Abstract

Introduction: Caesarean section (CS) can prevent maternal or fetal complications. Sub-Saharan Africa has the lowest CS levels in the world but large variations are seen between and within countries. The tertiary hospital, Kilimanjaro Christian Medical Centre (KCMC) in Tanzania has had a high level of CS over years. **Objectives:** To examine trends in the socio-demographic background of babies born at KCMC from year 2000 to 2013, and trends in the CS percentage, and to identify socio-demographic factors associated with CS at KCMC during this period. **Method:** This is a registry-based study. The analyses were limited to singletons born by women from Moshi urban and rural districts. The Chi square test for linear trend was used to examine trends in the CS percentage and trends in the socio-demographic background of the baby. The association between different socio-demographic factors and CS was assessed using logistic regression. The analyses were stratified by the mother's residence. **Results:** The educational level of mothers and fathers and the age of the mothers of singletons born at KCMC increased significantly from year 2000 to 2013 both among urban and rural residents. Among 29,752 singletons, the overall CS percentage was 28.9%, and there was no clear trend in the overall CS percentage between 2000 and 2013. In the multivariable model, factors associated with higher odds of CS were: having been referred for delivery, maternal age above 25 and no- or primary education level of the baby's father. Among rural mothers, no- or primary education, being from the Pare tribe and para 2-3 were also associated with higher odds of CS. Being from the Chagga tribe and high parity were associated with lower odds of CS compared to other tribes and parity 1. **Conclusion:** The CS percentage remained high but stable over time. Large variations in CS levels between different socio-demographic groups were observed. The educational level of the parents of babies born at KCMC increased over time, possibly reflecting persistent inequitable access to

the services offered at the hospital. However, it seems like those who really need CS have some access to it at KCMC.

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Abbreviations

CS - Caesarean section

TDHS - Tanzania Demographic and Health Survey

KCMC - Kilimanjaro Christian Medical Centre

KCMC-MBR - KCMC Medical Birth Registry

MDG - Millennium Development Goal

SSA - Sub-Saharan Africa

WHO - World Health Organization

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1.0 Introduction

1.2 Caesarean section

Skilled care at birth is essential to reduce maternal and perinatal mortality (1, 2), and to achieve the Millennium Development Goals (MDG) 4 and 5: to reduce the under five-mortality rate by two thirds and to reduce the maternal mortality ratio by three quarters. Approaching 2015, the target year of the MDGs, it is well documented that MDGs 4 and 5 are not likely to be achieved, especially in Sub-Saharan Africa (SSA) (3-5). One effective obstetric service that can be offered is caesarean section (CS) on medical indication (6). CS is performed for maternal or foetal complications such as obstructed labour, mal-presentation, hypertensive disorders, uterine rupture, antepartum haemorrhage and foetal distress (7, 8). Prolonged labour is seen as frequent indication for CS in some settings in SSA, particularly if skilled staff or equipment to conduct forceps- and vacuum extractor-assisted delivery is absent (6, 9).

Population-based levels of CS have been promoted as an indicator of access to emergency obstetric care (10). However, levels of CS might include life-saving interventions as well as cases with no clinical indication for a CS (11, 12). Like other major surgery, CS carries the risk of complications and even death for the woman (13). In high income countries, the leading causes of maternal mortality are related to complications of anaesthesia and CS (3). Another negative aspect of CS as compared to vaginal delivery is the higher cost, both for the health facility/health system and for the patient and the family. The health facility/health system spends more human resources, equipment and other resources than on a vaginal delivery (14). The patient recovers more slowly and runs a higher risk of needing blood transfusion and developing different complications like wound infections, sepsis and endometritis (12, 15). This might influence the economic situation of the family, especially if the patient has no health insurance, because of increased hospital bill, but also because the woman and possibly the caretakers are prevented from contributing to income generation and other duties for a longer period. In addition, a caesarean section causes a scar in the uterus, which increases the risk of uterine rupture in future pregnancies (10). Taking the above into consideration, the risks should be weighed against the benefits of the surgical procedure. The World Health Organization (WHO) published guidelines in 1985 suggesting that the level of CS should not exceed 15% and revised the guidelines in 1994, stating that the level should range between 5% and 15%. This interval represents assumptions about effective use of CS concerning saving lives of the mother and the baby (16). However, the limits have been debated by several researchers (17-19). It is argued that maternal deaths from causes responsive to CS can be dealt with at a level lower than 2% (20), whereas for neonatal health, levels of 5-10% are suggested to be sufficient to attain better outcomes (21, 22).

1.3 Caesarean section globally

The global level of CS was estimated to about 15% in 2007. The level was found higher in high income countries and South America and lower in low income countries, of which SSA had the lowest levels (23). This inequality has been confirmed by other international studies (18, 19). In Africa, the average level of CS deliveries was 3.5%. One study finds a positive correlation between increased CS percentage and reduction in maternal and new-born mortality rates, although some countries such as Brazil and Mexico have a discrepancy between relatively high mortality rates and much higher CS percentages than the range recommended by WHO (18, 19, 23). Another study supports these findings; an increase in CS percentage of 0% to a percentage of 10-14% is found to be associated with decrease in maternal and stillbirths, but higher percentages than this do not show this association (24). However, from a WHO survey on maternal and perinatal health in Africa, no association was seen between the overall CS levels and maternal and perinatal outcomes. Amongst the facilities that participated in this study, many of them were referral facilities, and the overall stillbirths and maternal mortality were high. It is therefore speculated that the interventions may have been performed too late to reduce the level of mortality. In contrast, elective CS was associated with fewer perinatal deaths compared to emergency CS (25). These findings are supported by other studies from SSA (26, 27). In women with severe obstetric complications (any acute condition severe enough to cause foetal loss or near-miss maternal death), increased risk of stillbirth is seen in vaginal deliveries compared to CS deliveries (28).

Ronsmans et al. found that inequity in access to maternal health care is high in low-income countries, especially in SSA (11). Women of higher socio-economic background have better access to maternal health services, and hence a higher likelihood of a caesarean birth. Urban population-based levels of CS are on average three times higher than rural levels in most low-income countries (11, 18). Both lower and higher maternal age have been shown to be associated with increased likelihood of CS. Higher maternal age is associated with medical conditions like hypertension and diabetes in addition to different adverse birth outcomes. The higher CS percentages found among adolescents could be caused by higher incidence of obstructed labour due to an immature birth canal. However, it is also discussed that the higher CS percentages could be attributed to the unfavourable socio-demographic characteristics of young girls (29-33).

1.4 Caesarean section in Tanzania

There are major unmet obstetric needs in different parts of Tanzania, especially in rural areas (34-37). Tanzania has had a low national level of CS over the last decade, estimated to be 3% in 2004-05 and 5% in 2010 with large regional differences (38). Increasing levels of CS, up to 49 percentage, are seen at some Tanzanian hospitals, and negative effects of these trends have been observed (39, 40), such as increased levels of uterine rupture, while improvements in the stillbirth rate and maternal mortality ratio are not seen (40).

The 2010 Tanzania Demographic and Health Survey (TDHS) shows that CS is more common in women living in urban compared to rural areas, and that women with secondary education have a much higher CS percentage (14.7%) than women with no education (2.2%) (38). This is in line with the finding that women with completed primary school or higher education are more likely to use health services than those with no education, and hence have a higher probability of CS (41). In the Kilimanjaro region in the Northern Zone of Tanzania, the CS level is more than double the national level, and increased from 7.5% in 2005 to 11% in 2010 (38).

1.5 Cost and other barriers to maternal health care in Tanzania

The Tanzanian government aims to reach the MDG 4 and 5 within 2015 and has an ambitious vision: *'A healthy and well-informed Tanzanian population with access to quality maternal, new born and child health services, which are affordable, sustainable and accessible through an effectively functioning health system'* (42). Several challenges must be overcome to fulfill this. In the 2010 TDHS, 26% of the women reported that lack of money was a major barrier to accessing health services (38). Several groups in Tanzania are exempted from paying user fees, including children under 5, pregnant women, and those below a certain income level (if certified) (43). However, this system is incompletely implemented (42), and private and faith-based hospitals minimize their number of exempted patients (43). Surveys published from rural parts of Tanzania found that more than 73% of the birthing women paid for deliveries and more than 30% were selling personal assets to be able to pay for delivery (44, 45). Costs incurred by the poorest women were not significantly different from those paid by the wealthiest women, showing that exemptions to support the poorest may be ineffective in Tanzania (44). Different health insurance mechanisms have been established to target different populations (e.g. rural population and civil servants) but so far only a minority of the Tanzanian population is covered by insurance (43). Unexpected health care costs exceeding 15% to 40% of monthly household income constitute a potentially catastrophic economic burden that may result in or exacerbate poverty (46-48). However, there is no exact cut-off point and even lower expenditure levels may be catastrophic for very poor households. In addition, it is not only the level of expenditure, but also the timing of health care expenses can determine whether or not there are severe consequences for the family. The health expenses usually have to be paid in full at the time of hospitalisation. This could be in a period when the income is lower than usual and this would influence the economic situation more than if the expense had come during a period with higher income (47). Even in countries where user fees for emergency maternal health care are removed, some affordability barriers may still remain, for instance costs associated to transport and purchase of delivery supplies (49).

Long distance to health facility, lack of transport, not wanting to go alone, and unfriendly health staff are other reported barriers to health services in the two previous TDHSs (38, 50). Approximately 90% of the Tanzanians live within five kilometres of a primary health care unit. Nevertheless, many of the facilities are not functioning appropriately, and some are understaffed or not staffed at all. The overall quality of health services is also negatively affected by low staff motivation due to excessive work load (43). Many lower level facilities do not recognize danger signs and symptoms in pregnant women (43, 51, 52), an essential skill in identifying patients needing referral. Lack of quality care at the lower-level health facilities are important barriers to maternal health care (36, 53, 54). A consequence is that many women do not seek health care at the nearest facility when in birth. A study found that more than 4 in 10 women in rural districts in Tanzania bypassed the nearest health facility to deliver (55).

Hospital fees are known barriers to seeking care (56-60). However, free health care and skilled maternal health professionals do not alone lead to improved access. Other suggested challenges in Tanzania is poor patient compliance with recommended referral to other facility, mainly due to lack of money for transport or hospital bills (61), and lack of birth preparedness. Most pregnant women (96%) in Tanzania receive some antenatal care from a health professional, also in rural areas, but only half of the women receive information about the danger signs of pregnancy complications (38). Low public awareness of patients' rights and the obligations of service providers and socio-cultural barriers such as gender inequality and lack of women empowerment are also highlighted as challenges. Myths and misconceptions related to health issues can be other difficulties to overcome (43).

2.0 Study setting

The United Republic of Tanzania is situated on the eastern shores of Africa and is the largest country in East Africa (62). Tanzania is bordered by Kenya and Uganda to the north, Democratic Republic of Congo, Rwanda, Burundi and Zambia to the west, and Malawi and Mozambique to the south. The health status in the country is slowly improving, but health indicators such as childhood mortality and maternal mortality are still high. The last TDHS measured an infant mortality rate of 51 deaths per 1000 live births, and a maternal mortality ratio of 454 maternal deaths per 100,000 live births (38). Approximately 12 million Tanzanians (2012) live below the poverty line (63).

Health facilities in Tanzania are organized like a pyramid (Figure 1), with primary health care services at the base, located throughout the country. The district- and regional hospitals are found in the middle of the pyramid and take referrals from lower level facilities. The national/tertiary hospitals are on top of the pyramid and serve health care on a zonal level. The health care system includes both governmental and private health care institutions. Approximately 40 percent of the health facilities in Tanzania are private sector (including for-profit and faith based providers) (43).

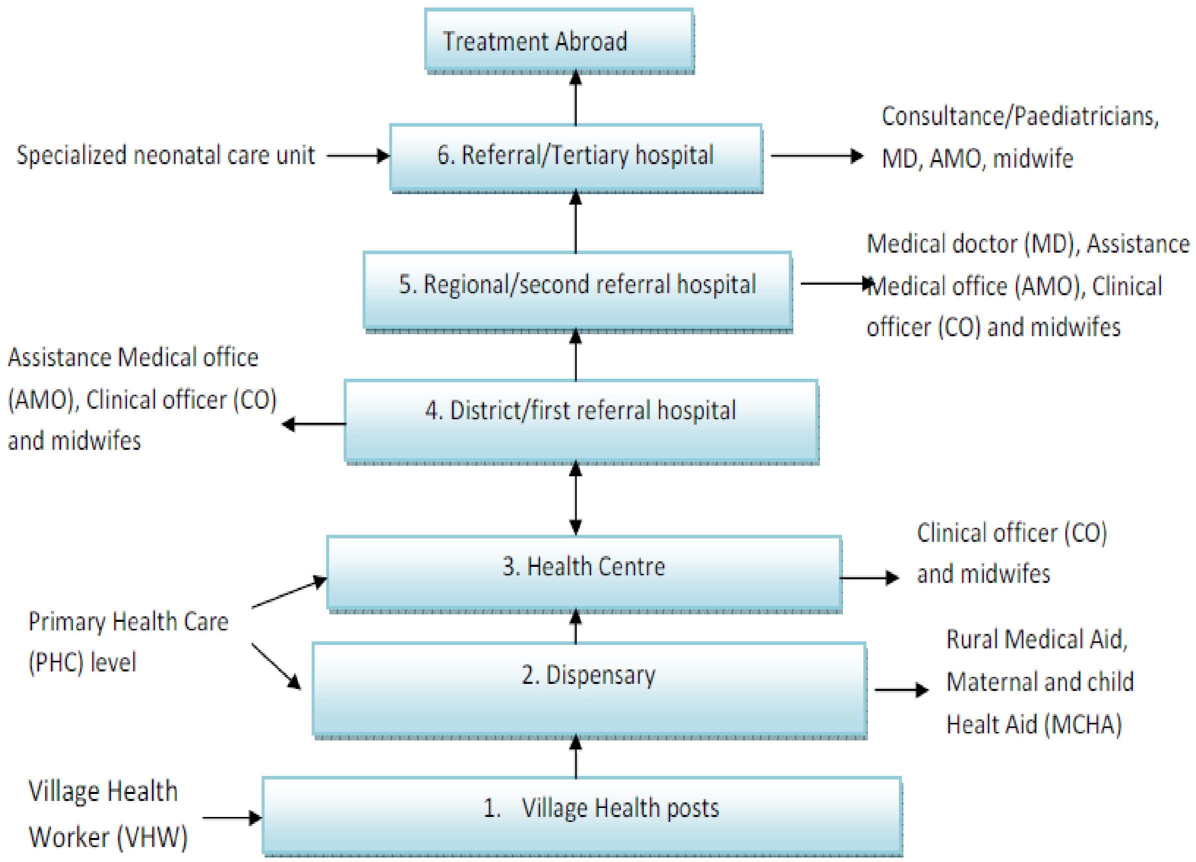

Figure 1: Health facility pyramid, Tanzania.

Kilimanjaro region is one of the four regions of the Northern Zone of Tanzania, with a population of more than 1.6 million inhabitants (62). One of Tanzania's four national/tertiary referral hospitals, Kilimanjaro Christian Medical Centre (KCMC), is located in in Moshi town, and serves the Northern Zone of Tanzania (64). The KCMC hospital was established in 1971 by the Good Samaritan Foundation, and operates today as a private/public partnership with a cost sharing policy. The fee for delivery has increased twice the last decade and has more than doubled since 2004. Payment is requested after delivery and it is claimed that nobody is denied emergency help upon entering the hospital. The regional hospital, Mawenzi, is located in the same city as KCMC and offers obstetric care free of charge. Due to lack of resources, Mawenzi hospital closed the operation theatre in 2010, and CS is no longer available there.

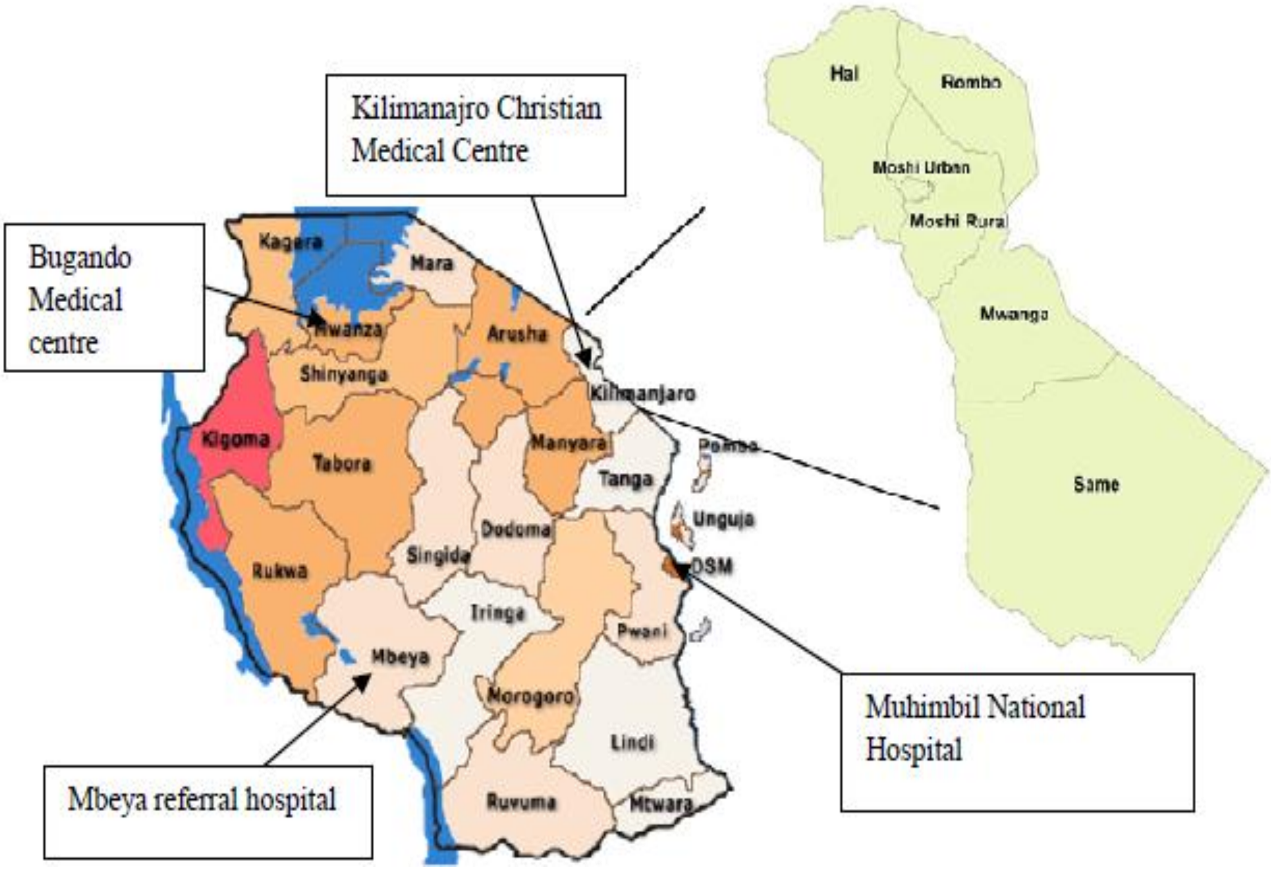

Figure 2: Map of Tanzania with location of the 4 national/tertiary hospitals and Kilimanjaro region (with 6 districts) where KCMC is located.

3.0 Rationale and objectives

Tanzania has high maternal mortality ratios and child mortality rates, though some improvements are seen in the last TDHS as compared to earlier TDHSs (38). Studying CS trends and socio-demographic factors associated with CS at KCMC during a period of contextual changes (increased user-fees, closure of operation theatre at the regional hospital) has importance due to the large proportion of the population living in poverty (63). Access to high quality obstetric care is essential to reduce maternal and perinatal mortality and to achieve the MDG 4 and 5 (3-5). One effective obstetric service that can be offered is CS upon medical indication (6). This study aimed to examine trends in the socio-demographic profile of babies born at KCMC from the year 2000 to 2013, and trends in the CS percentage, and to identify socio-demographic factors associated with CS at KCMC during this period. This was to assess whether it is likely that the increases in user fees and closure of a regional hospitals' operation theatre have affected the socio-demographic background of the women seeking care at KCMC and to see if the CS percentages and the socio-demographic predictors of CS were affected.

4.0 Methodology

This thesis is based on data from the KCMC Medical Birth Registry (KCMC-MBR). Data from the official start of the registry in July 2000 to June 2013 was included in the study. Information in the KCMC-MBR is recorded using a questionnaire (see appendix) designed specifically for this purpose. The nurse-midwifes at KCMC request verbal consent to gather the personal information and additional information is recorded from the patient files. A secretary then enters the data into an electronic file. Quality of the KCMC-MBR has been ensured by periodic instruction sessions (65). A detailed manual for the interviewers was printed in 2005. Prior to this, the nurse-midwifes received instructions verbally. Validation and quality checks of the database have been done and the database information has been judged to be largely accurate (64). However, one weakness of the registration is that electronic data entry is done only once, limiting the possibility of detecting data entry errors. Information on self-reported conditions such as tuberculosis often lacks written medical verification. Regarding age, most women seem to know their year of birth but not the exact date (64).

For this study, the data was transferred to Statistical Package for Social Science (SPSS) version 20. Prior to analysis, data was cleaned for obvious data entry errors. Frequencies were run for each of the variables to see if any unexpected values had been entered in the data set. Unexpected values were cross-checked with other information in the dataset and corrected if wrong. An example is the date of birth of the baby: A suspected wrong date entered was checked against admission and discharge dates. The variable *'year of birth'* was cross-checked with date of admission, date of birth and date of discharge. The variable *'plurality'* (singleton, twins or more) was cross checked with the variable *'sequence'* (number of babies born). If any mismatch was found, the variables were double-checked with the id variable of the mother and the date of birth to check if the babies had the same mother and the same date of birth. Mother's and fathers' education were recoded from four to two categories, grouping *'no education'* and 'primary *education'*, and *'secondary'* and *'higher education'* together. Father's education was included as a socio-demographic variable because men's educational level is closely related to the wealth in a Tanzanian family (38). Semi-urban residents were categorized together with urban residents, as semi-urban areas are more similar to urban areas than to rural areas. Since multiple pregnancies constitute a higher risk of CS, such deliveries were excluded from the analyses.

KCMC is a referral hospital covering a big area, and women traveling from areas that are far away can be expected to be a selected group at higher risk than women living closer to the hospital. Thus all deliveries among women that originated from outside Moshi urban- and Moshi rural districts were excluded from the study in order to have a study population that would be as representative as possible for facility deliveries in general. All analyses were in addition stratified by residence (urban/rural) because the proportion of all expected births in the two districts took place at KCMC differed substantially: about 25% for Moshi urban district, compared to less than 5% for Moshi rural district. We also stratified by referral status when analyzing the levels of CS at KCMC because medically referred women are high risk pregnant women (66), whereas not referred women are a mix of women who delivered by CS in a previous pregnancy (recommended to register at KCMC for next birth) and women that for whatever reason decided themselves to bypass lower level facilities to deliver at KCMC. Methods are further explained in the article.

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6.0 Article

Trends in and socio-demographic factors associated with caesarean section at a large Tanzanian referral hospital, 2000 to 2013.

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ABSTRACT

Introduction: Caesarean section (CS) can prevent maternal or fetal complications. Sub-Saharan Africa has the lowest CS levels in the world but large variations are seen between and within countries. The tertiary hospital, Kilimanjaro Christian Medical Centre (KCMC) in Tanzania has had a high level of CS over years. **Objectives:** To examine trends in the socio-demographic background of babies born at KCMC from year 2000 to 2013, and trends in the CS percentage, and to identify socio-demographic factors associated with CS at KCMC during this period. **Method:** This is a registry-based study. The analyses were limited to singletons born by women from Moshi urban and rural districts. The Chi square test for linear trend was used to examine trends in the CS percentage and trends in the socio-demographic background of the baby. The association between different socio-demographic factors and CS was assessed using logistic regression. The analyses were stratified by the mother's residence. **Results:** The educational level of mothers and fathers and the age of the mothers of singletons born at KCMC increased significantly from year 2000 to 2013 both among urban and rural residents. Among 29,752 singletons, the overall CS percentage was 28.9%, and there was no clear trend in the overall CS percentage between 2000 and 2013. In the multivariable model, factors associated with higher odds of CS were: having been referred for delivery, maternal age above 25 and no- or primary education level of the baby's father. Among rural mothers, no- or primary education, being from the Pare tribe and para 2-3 were also associated with higher odds of CS. Being from the Chagga tribe and high parity were associated with lower odds of CS compared to other tribes and parity 1. **Conclusion:** The CS percentage remained high but stable over time. Large variations in CS levels between different socio-demographic groups were observed. The educational level of the parents of

babies born at KCMC increased over time, possibly reflecting persistent inequitable access to the services offered at the hospital. However, it seems like those who really need CS have some access to it at KCMC.

INTRODUCTION

Providing high quality obstetric care can save the lives of mothers and newborns when complications arise during pregnancy and childbirth (1, 2), and caesarean section (CS) is one such essential service. Population-based estimates of CS percentage have been used as an indicator of access to emergency obstetric care (3). However, CS levels include life-saving interventions as well as cases with no clinical indication (4), and like other major surgery, CS carries the risk of complications and even death for the woman (5). The World Health Organization (WHO) suggests that the level of CS should range between 5% and 15% (6) although both the upper and the lower limits have been discussed critically by several researchers (7-12). The average global level of CS is estimated to be about 15% (13), and the lowest levels are found in sub-Saharan Africa (SSA) (10, 12, 13). The median CS percentage in facilities which performed CS in SSA in 2004/05 was 13.4% (14). However facility-based estimates are quite different from population-based estimates as many women do not deliver in facilities in this region (15).

There are large variations in access to maternal health care in SSA, both between and within countries, and between different population subgroups. High levels of CS are no guarantee for equity in access to obstetric care (16). CS tends to be more common among women in urban than rural areas, and financially better off and higher educated women have considerable higher levels of CS than poorer and lower educated women. In addition, both lower (<16 years) and higher (>35 years) maternal age have been shown to be associated with increased levels of CS (12, 17-22). Marital status and ethnic affiliation are other factors that influence the utilization of maternal health services (21, 23, 24). Since men are important decision-makers, paternal socio-demographic characteristics are also important in relation to health seeking behaviors and might influence the birth outcome (25-27).

According to the population-based Tanzania Demographic and Health Surveys (TDHS), Tanzania has had a low national CS level over the last decade, estimated to be 3% in 2004/05 and 5% in 2010. However, in the Kilimanjaro region in the Northern Zone of Tanzania, the CS level is more than double the national level, and it increased from 7.5% in 2005 to 11% in 2010 (27). The Zonal tertiary hospital, Kilimanjaro Christian Medical Centre (KCMC) had a CS level of 33% in the years 2000 to 2007 (28).

Admittance and surgical procedures at KCMC involve user fees, and in the last decade the cost of delivery and CS have gradually increased (28). More than 26% of all Tanzanians (2012) live below the poverty line (29) and difficulties in paying treatment is the most frequently reported barrier to health care in the Kilimanjaro region (27). Although several groups in Tanzania are exempted from paying user fees, including those below a certain income level, this system is incompletely implemented, and private and faith-based hospitals often attempt to minimize the number of patients that are exempted (30). Thus, although the CS percentage at KCMC is high, access may still be inequitable. Increasing user fees, combined with the closure of the operation theatre at the regional public hospital Mawenzi in 2010 may have resulted in poor women in the area having less access to CS than earlier. The aim of the study was to examine trends in the socio-demographic background of babies born at KCMC from the year 2000 to 2013, and trends in the CS percentage, and to identify socio-demographic factors associated with CS at KCMC during this period.

METHODOLOGY

Study design and data collection

This is a registry based study. The medical birth registry at KCMC was established in 1999 in collaboration with the University of Bergen, Norway. It has been in operation since July 2000 (31). Information on birth outcome, delivery mode, obstetric history as well as socio-demographic factors is recorded in the registry (32). Information is recorded by specially trained nurse-midwives using a questionnaire designed specifically for this purpose. The mothers are interviewed soon after recovery from the birth, usually within the first 24 hours, but later if complications occur. Supplementary information is collected from case files. Registration of this information is done every day, including weekends and holidays. A secretary then enters the data into an electronic file (31).

Study area

The United Republic of Tanzania is the largest country in East Africa with about 45 million inhabitants (2012). Almost 75% of the inhabitants live in rural areas (33). KCMC is one of four zonal/tertiary hospitals in Tanzania (34). It is operated as a private/public partnership and located in Moshi town in the Kilimanjaro region. The region has more than 1.6 million inhabitants. Moshi rural district has a total population of 466,737 inhabitants whereas Moshi urban district has a population count of 184,292 (33). KCMC has approximately 3300 deliveries per year, and the obstetric ward at KCMC receives high risk cases from seven regions in northern Tanzania and from some Kenyan districts (35). In total the hospital thus serves more than 13 million people (36). About 50% of the birthing women at KCMC come from Moshi urban district as they come for ordinary deliveries too (26). About 20% of the birthing women come from Moshi rural district. The regional hospital, Mawenzi, also located in Moshi town, is supposed to offer emergency obstetric care for free, CS included, but the operation capacity has been relatively poor for a long time, and since December 2010, no CS have been conducted because the operation theatre closed. Thus KCMC has been the only referral institution that has offered CS after 2010 in Moshi.

The direct cost of normal delivery and CS at KCMC used to be minor for the patient. Before 2005, the minimum price for CS was 20,000 TZS (=25.3 USD based on 01.01.2000 rates) but in 2005 a "cost sharing" policy was introduced and the out-of-pocket payment for CS was raised to a minimum of 50,000 TZS (=47.2 USD based on 01.01.2005 rates). It further increased to 100,000 TZS in 2011 (=58.4 USD based on 01.12.2011 rates) (37). In addition to this the patients pay a per night fee, and pay for drugs and other costs associated with the hospital stay.

Study population

There were a total of 45,871 births at KCMC in the period July 2000 to June 2013 of which 31,287 of the deliveries were among women residing in Moshi urban and Moshi rural districts. The majority of the deliveries, 29,752 (95.1%), were singleton births. We restricted the analyses to singletons born by women from the two Moshi districts (urban and rural) at KCMC hospital in the period July 2000 to June 2013.

Description of variables

The main outcome variable was CS. The independent variables included education of the mother and the father, age of the mother, tribe of the mother, marital status of the mother, referral status, parity and year of delivery. Mother's and father's education completed were categorized into two categories: 'no education/primary education' (0-7 years) and 'secondary/higher education' (8 years or more). The variable maternal tribe was recoded as: 'Chagga', 'Pare' (which were the two most common), and 'Other', including more than 120 different tribes. Marital status was dichotomized as 'married' (i.e. monogamous and polygamous marriages or cohabitation) and 'not married' (i.e. separated/divorced, widowed or never-married). Age of the mother was included as a categorical variable with 4 categories: '13-17' years, '18-25' years, '26-35' years and '36 to 47' years. Women less than 13 years or more than 47 years of age were excluded in analyses including age as a variable. Parity was categorized in four: 'para 1', 'para 2-3', 'para 4-6' and 'para 7+'. Referral status was divided into two categories: 'medically referred' (i.e. referred by qualified health personal for medical reasons) and 'not referred'. Time of birth was included in most of the analyses as a continuous variable (called 'year of birth'). However, in some of the analyses, time of birth was included as a categorical variable (called 'time period'), with the categories representing three time periods associated with different levels of user fees at KCMC: Period 1: July 2000 to December 2004; period 2: January 2005 to November 2011; and period 3: December 2011 to June 2013.

Statistical analysis

The data was analyzed using Statistical Package for Social Science (SPSS) version 20. All the analyses were stratified by mother's residence (urban/rural). Frequency tables and graphs were used to describe changes in all births and CS deliveries year by year. Changes over time in the socio-demographic background of the babies born (all deliveries and CS) were tested using Chi square test for linear trend for each of the socio-demographic factors (with time both as a categorical variable with three time periods and as a continuous variable: ‘year of birth’). Trends in the level of CS were examined using the Chi square test for linear trend, both overall and stratified by referral status. The likelihood of CS during the whole period was assessed using logistic regression. We started with bivariate analyses. We then developed models with interaction terms between each of the independent variables (socio-demographic factors and referral status) and time of birth as continuous variable. Finally, we developed a multivariable model with all the independent variables and significant interaction terms. Odds ratios with 95% confidence intervals s were calculated. Babies with missing data on any of the independent variables (referral status, father`s and mother`s education level, marital status, mother’s tribe, mother`s age and parity) were excluded from the multivariable analyses.

Ethical aspects

No person-identifiable information is available in the electronic birth registry handled by the researchers. Participation is based on verbal informed consent from the mothers. The birth registry at KCMC obtained ethical clearance from the Tanzania Ministry of Health, Commission for Science and Technology, from the KCM College and from the Norwegian National Ethics committee in 1999 (32). The protocol for this study obtained ethical approval from Kilimanjaro Christian Medical University College of Tumaini University Makumira, in December 2013.

RESULTS

Study population

The majority of the babies included in the analyses, 20,995 (71%), had mothers from urban areas. Most mothers were married and not medically referred. A higher proportion of fathers than mothers had secondary or higher education (Table 1). From time period 1 to time period 3, the proportion medically referred decreased amongst urban mothers and increased among rural mothers. The level of education of mothers and fathers increased, the proportion of single mothers increased, the age of mothers increased, the proportion Chagga mothers decreased and the proportion of mothers with high parity decreased significantly for all singleton babies born. Among babies born by CS, fathers' and mothers' educational levels increased, age of mothers increased, the proportion of married mothers decreased and the proportion medically referred decreased (Table 2). The same significant trends were found when using time of birth as a continuous variable (results not shown).

Table 1: Characteristics of the study population and CS percentage, Moshi urban and rural districts

Singleton births	Moshi urban			Moshi rural		
	All births 2000-2013 n (%)	CS deliveries 2000-2013 n (%)	CS %	All births 2000-2013 n (%)	CS deliveries 2000-2013 n (%)	CS %
Referral status						
Medically referred	2269 (11%)	1062 (19%)	47%	2423 (28%)	1187 (41%)	49%
Not referred	17938 (85%)	4318 (77%)	24%	5882 (67%)	1675 (54%)	29%
Missing	788 (4%)	211 (3.8%)		452 (5%)	137 (4.6%)	
Father's education level						
No/primary education	8720 (42%)	2516 (45%)	29%	5192 (59)	1995 (67%)	39%
Sec/higher education	12223 (58%)	3063 (55%)	25%	3524 (40)	984 (33%)	28%
Missing	52 (0.2%)	12 (0.2%)		41 (0.5%)	20 (0.7%)	
Mother's education level						
No/primary education	11362 (54%)	3125 (56%)	28%	6104 (70%)	2273 (76%)	37%
Sec/higher education	9602 (46%)	2460 (44%)	26%	2639 (30%)	722 (24%)	27%
Missing	31 (0.1%)	6 (0.1%)		14 (0.2%)	4 (0.1%)	
Mother's marital status						
Married	18382 (88%)	4967 (89%)	27%	7623 (87%)	2607 (88%)	34%
Single	2562 (12%)	615 (11%)	24%	1084 (12%)	369 (12%)	34%
Missing	51 (0.2%)	9 (0.2%)		50 (0.6%)	23 (0.8%)	
Mother's tribe						
Chagga	11613 (55%)	2905 (52%)	25%	5695 (65%)	1729 (58%)	30%
Pare	2299 (11%)	690 (12%)	30%	918 (11%)	419 (14%)	46%
Other	7058 (34%)	1991 (36%)	28%	2131 (24%)	845 (28%)	40%
Missing	25 (0.1%)	5 (0.1%)		13 (0.1%	6 (0.2%)	
Mother's age						
13-17y	398 (2%)	97 (2%)	24%	280 (3%)	78 (3%)	28%
18-25y	7998 (38%)	1851 (33%)	23%	3416 (39%	1126 (38%)	33%
26-35y	10635 (51%)	3008 (54%)	28%	3954 (45%)	1405 (47%)	36%
36-47y	1931 (9%)	628 (9%)	33%	1092 (13%)	383 (13%)	35%
<13y, >47y	29 (0.1%)	7 (0.1%)		12 (0.1%)	5 (0.2%)	
Missing	4	0		3	2 (0.1%)	
Mother's parity						
1	8843 (42%)	2152 (39%)	24%	3309 (38%)	998 (33%)	30%
2-3	9692 (46%)	2756 (49%)	29%	3725 (42%)	1410 (47%)	38%
4-6	2351 (11%)	663 (12%)	28%	1556 (18%)	544 (18%)	35%
7+	109 (0.5%)	20 (0.4%)	18%	167 (2%)	47 (1.6%)	28%
Missing	0	0		0	0	

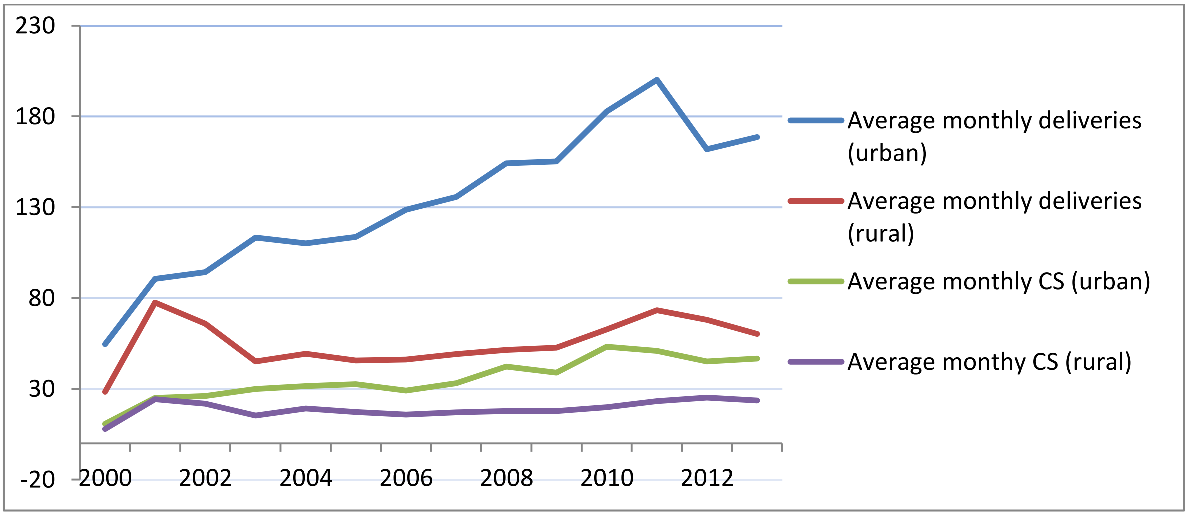
Table 2: Characteristics of all births and CS deliveries in each period and linear trends, Moshi urban and rural districts

Singleton births	Urban Moshi				Rural Moshi			
	% of all births (% of CS deliveries)			P-value* all births (CS deliv.)	% of all births (% of CS deliveries)			P-value* all births (CS deliv.)
	Period 1	Period 2	Period 3		Period 1	Period 2	Period 3	
Referral status								
Medically referred	14% (32%)	11% (17%)	9% (12%)	<0.001 (<0.001)	26% (44%)	30% (41%)	34% (39%)	<0.001 (0.096)
Not referred	86% (68%)	89% (83%)	91% (88%)		74% (56%)	70% (59%)	66% (61%)	
Father's education level								
No/primary education	51% (55%)	40% (44%)	32% (33%)	<0.001 (<0.001)	64% (70%)	60% (69%)	50%(55%)	<0.001 (<0.001)
Sec/higher education	49% (45%)	60% (56%)	68% (67%)		36% (30%)	40% (31%)	50% (45%)	
Mother's education level								
No/primary education	63% (65%)	54% (55%)	42% (43%)	<0.001 (<0.001)	76% (80%)	69% (77%)	57% (61%)	<0.001 (<0.001)
Sec/higher education	37% (35%)	46% (45%)	58% (57%)		24% (20%)	31% (23%)	43% (39%)	
Mother's marital status								
Married	89% (89%)	88% (89%)	86% (88%)	<0.001 (<0.481)	89% (89%)	87% (88%)	84% (84%)	<0.001 (0.002)
Single	11% (11%)	12% (11%)	14% (12%)		11% (11%)	13% (12%)	16% (16%)	
Mother's tribe								
Chagga	57% (51%)	55% (52%)	53% (53%)	<0.001 (0.228)	68% (60%)	64% (58%)	61% (54%)	<0.001 (0.015)
Pare	11% (12%)	11% (12%)	12% (13%)		11% (14%)	10% (14%)	11% (13%)	
Other	32% (37%)	34% (36%)	35% (34%)		21% (26%)	26% (28%)	28% (33%)	
Mother's age								
13-17y	3% (3%)	2% (2%)	2% (1%)	<0.001 (<0.001)	3% (3%)	3% (3%)	2% (2%)	<0.001 (0.002)
18-25y	42% (40%)	37% (31%)	35% (29%)		42% (43%)	37% (34%)	39% (37%)	
26-35y	47% (49%)	52% (55%)	52% (56%)		43% (43%)	46% (49%)	47% (47%)	
36-47y	8% (8%)	9%(12%)	11% (14%)		11% (11%)	14% (14%)	12% (14%)	
Mother's parity								
1	39% (39%)	43% (39%)	42% (37%)	<0.001 (0.653)	37% (34%)	37% (31%)	42% (40%)	<0.001 (0.116)
2-3	46% (48%)	46% (49%)	49% (51%)		42% (47%)	43% (49%)	42% (43%)	
4-6	14% (13%)	11% (12%)	9% (11%)		19% (17%)	18% (20%)	15% (17%)	
7+	1.1% (0.5%)	0.3% (0.4%)	0.3% (0.1%)		2.5% (2.4%)	1.7% (1.3%)	1.2% (0.6%)	

*** linear trend**

The lowest average monthly number of singleton births from Moshi was recorded in year 2000 with 83 deliveries. The monthly number of deliveries from the urban area increased from 55 in year 2000 to it peaked with 200 in year 2011. The monthly number of deliveries from the rural area remained stable (ranging from 45 to 53) from 2003 till year 2009. It then increased in year 2010 and peaked in 2011 with 73 deliveries. The average monthly number of rural babies born by CS was stable in the period 2001 to 2013 (mean of 21). The average monthly number of urban babies born by CS increased gradually from year 2000 to year 2010, ranging from 24 to 53 (Figure 1).

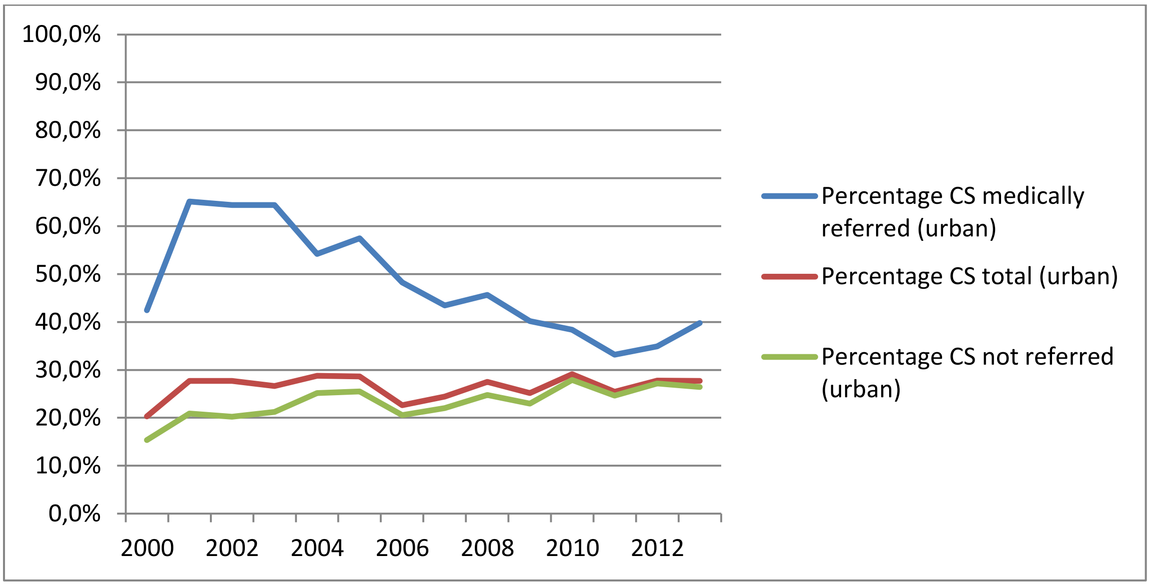
Figure 1: Monthly average number of recorded singleton births and CS deliveries from July 2000 to June 2013. Moshi urban and rural districts



Levels of caesarean section

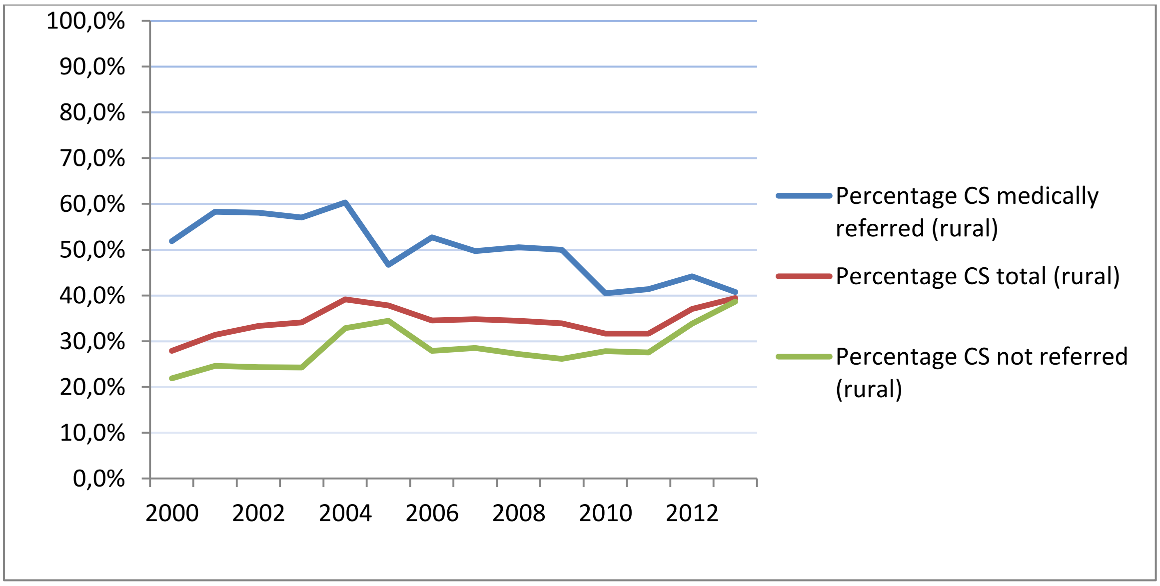
During the study period there were 8590 singleton deliveries by CS, giving an average percentage of CS of 28.9%. The annual level of CS ranged between 20.3% and 29.1% for urban mothers and 27.9% and 39.4% for rural mothers (Figure 1). Stratification by referral status showed that the percentage of CS for both urban- and rural mothers decreased in the medically referred group (P-value for linear trend < 0.001) and increased in the group not referred (P-value for linear trend < 0.001) (Figures 2a and b). There was no linear trend in the overall CS percentage between 2000 and 2013. However, in the bivariate analyses, among urban babies there were significant two-way interactions between year of birth and the following variables: father's education level (the likelihood of CS increased over time if father had no/primary education compared to if father had secondary/higher education), mother's tribe (the likelihood of CS increased over time for Chagga mothers compared to mothers from other tribes), mother's age (increasing likelihood of CS among those aged >25 years compared to those aged 18-25), parity (increasing likelihood of CS among para 4-6 compared to para 1) and referral status (decreasing likelihood of CS among medically referred compared to non-referred mothers). Amongst rural babies, there were significant two-way interactions between year of birth and referral status (decreasing likelihood of CS among medically referred compared to non-referred mothers). In the multivariable analysis, there were interactions between year of delivery and referral status for both urban and rural mothers. The odds of medically referred mothers having CS decreased with 12% (95% CI 10-15%) per year for those from urban Moshi and with 8% (95%CI 6-11%) for those from rural Moshi compared to non-referred mothers. Urban babies with fathers who had no or primary education had a relative 2% (95% CI 0.1%-4%) decrease in the odds of being born by CS per year compared to babies with fathers who had secondary or higher education. Urban Chagga mothers had a relative 3% (95% CI 1-5%) increase in the odds of CS per year compared to other tribes. Urban para 4-6 had a relative increase in the likelihood of CS per year of 6% (95% CI 2-10%) compared to para 1. Rural mothers had a 3% (95% CI 1-4%) increase in odds of CS per year (Table 3).

Figure 2a: Percentage of births that ended with CS among all mothers, medically referred and not referred mothers, 2000-2013 (urban Moshi).



Total percentage CS (urban mothers): linear trend: p value = 0.640, percentage CS among medically referred linear trend: p value < 0.001, percentage CS among not referred: linear trend: p value < 0.001

Figure 2b: Percentage of births that ended with CS among all mothers, medically referred and not referred mothers, 2000-2013 (rural Moshi).



Total percentage of CS (rural mothers): linear trend: p value = 0.527, percentage of CS among medically referred: linear trend: p value < 0.001, percentage CS among not referred: linear trend: p value < 0.001

Socio-demographic factors associated with caesarean section

Having been medically referred, low levels of father's and mother's education, para 2-6 and higher maternal age were associated with higher likelihood of CS for both urban and rural residents in the bivariate logistic regression analyses. Amongst urban mothers, being married was associated with higher odds of CS compared to being single. In the multivariable model, having been medically referred for delivery was the factor which was most strongly associated with CS for both urban and rural babies. Low levels of father's education and mother's age 26-47 were also associated with higher likelihood of CS. Rural mothers with no- or primary education had higher odds of CS and mothers aged 13-17 had decreased odds of CS compared to mothers with secondary or higher education and age 18-25, respectively. Being Chagga and high parity (7+) were associated with lower likelihood of CS for both urban and rural mothers. Among rural mothers, being from the tribe Pare and para 2-3 were associated with higher odds of CS compared to other tribes and para 1, respectively (Table 3).

Table 3: Bivariate and multivariable regression analyses of CS by background characteristics in pooled data from 2000-2013

Variable name	Caesarean section (urban)				Caesarean section (rural)			
	Crude OR	95% CI	Adjusted OR	95% CI	Crude OR	95% CI	Adjusted OR	95% CI
Year	1.00	0.99-1.01	1.00	0.98-1.02	1.01	1.00-1.02	1.03	1.01-1.04
Referral status								
Medically referred	2.79	2.55-3.05	7.62	6.15-9.43	2.43	2.20-2.68	4.39	3.53-5.46
Not referred	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Medically referred*year	0.87	0.85-0.89	0.88	0.85-.090	0.92	0.89-0.94	0.92	0.89-0.94
Not referred*year	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Father's education level								
No/primary	1.22	1.14-1.29	1.36	1.15-1.60	1.61	1.47-1.77	1.37	1.23-1.53
Secondary/higher	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
No/primary *time	0.98	0.96-0.99	0.98	0.96-0.997				
Secondary/higher *time	Ref.	Ref.	Ref.	Ref.				
Mother's education level								
No/primary	1.10	1.04-1.17	0.96	0.89-1.04	1.58	1.43-1.75	1.17	1.04-1.32
Secondary/higher	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mother's marital status								
Married	1.17	1.06-1.29	1.11	0.99-1.23	1.01	0.88-1.15	0.87	0.75-1.01
Single	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mother's tribe								
Chagga	0.85	0.79-0.91	0.71	0.60-0.85	0.66	0.60-0.73	0.76	0.68-0.85
Pare	1.09	0.99-1.21	0.96	0.74-1.26	1.28	1.09-1.49	1.26	1.07-1.49
Other	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Chagga*time	1.04	1.02-1.06	1.03	1.01-1.05				
Pare*time	1.01	0.98-1.04	1.01	0.98-1.04				
Other*time	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Mother's age								
13-17y	1.07	0.85-1.35	0.90	0.54-1.50	0.79	0.60-1.03	0.61	0.45-0.82
18-25y	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
26-35y	1.31	1.22-1.40	1.23	1.02-1.49	1.12	1.02-1.23	1.26	1.12-1.42
36-47y	1.60	1.43.1.78	1.93	1.37-2.73	1.10	0.95-1.27	1.40	1.16-1.69
Parity								
1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2-3	1.24	1.16-1.32	1.03	0.85-1.24	1.41	1.28-1.56	1.35	1.20-1.53
4-6	1.22	1.10-1.35	0.57	0.42-0.78	1.25	1.10-1.42	0.98	0.83-1.17
7+	0.70	0.43-1.14	0.35	0.13-0.99	0.90	0.64-1.28	0.60	0.40-0.91
1*time	Ref.	Ref.	Ref.	Ref.				
2-3*time	1.01	0.99-1.03	1.01	0.98-1.03				
4-6*time	1.05	1.02-1.08	1.06	1.02-1.10				
7+*time	1.03	0.91-1.17	1.03	0.89-1.19				

DISCUSSION

In this registry based study of 29,752 singleton deliveries from July 2000 to June 2013 at a large referral hospital in northeastern Tanzania, the average percentage of CS deliveries was 28.9%. There was no linear trend in the overall level of CS. During the 13 year period, the proportion of urban mothers who were medically referred for delivery decreased. The educational level and the age of the mothers went up for both urban and rural residents. As expected, the CS percentage was higher in the medically referred group than in the group not referred. For both urban and rural mothers low levels of education and maternal age 26-47 years were associated with higher likelihood of CS, whereas Chagga mothers and para 7+ had lower likelihood of CS compared to mothers from other tribes and para 1. Among rural residents, Pare mothers and para 2-3 had higher likelihood of CS compared to other tribes and para 1. There was no significant association between time and CS in the multivariable analysis for urban mothers but rural mothers had an increase in the odds of CS of 3% per year (95% CI 1-4%). There were significant two-way interactions between time and father's education level, mother's tribe and parity for urban mothers.

A CS percentage ranging from 20.3% to 29.1% for babies born by urban mothers, and 27.9% to 39.4% for babies born by rural mothers within a 13 year period is much higher than the Kilimanjaro region's estimated population estimate of 11% (2010). The majority of women, 88%, give birth in a health facility in Kilimanjaro (27). Health facilities range from dispensaries to tertiary hospitals such as KCMC (30) and the high percentage of CS at KCMC might reflect the fact that few CSs are being done at other health facilities in the region, implying that many women are referred to KCMC from lower level facilities due to medical complications. Several studies from Tanzania show that the quality of care in lower level facilities is insufficient (38-42) and that symptoms are often not acted upon properly at the stage of labour (43, 44). This might lead to an overutilization of CS (43) because it might be the only option left when the women arrive late at the referral facility. This would be in line with Worjoloh et al's finding that labour dystocia and fetal distress are the second most common indications of CS at KCMC (34). It is also likely that the high percentage of CS at KCMC includes unnecessary interventions as the leading cause of CS is reported to be previous CS (35). Studies from SSA show that vaginal birth after one CS is safe if the health personnel have proper monitoring resources, knowledge and access to emergency CS (45-47). Forceps and vacuum deliveries are less invasive and less expensive than CS, and carry lower risk in future pregnancies (14). However, a low prevalence of operative vaginal delivery at KCMC (28) indicates that CS is the preferred solution when there is a high risk of complications during labour.

Different contexts make it difficult to compare the proportion of CS at institutions directly (1), but nevertheless, before year 2000, facility CS levels in countries in SSA were reported to range from 5.0% to 21.8% (9). Referral hospitals in East-African countries have more recently reported higher and increasing facility CS percentages than those seen at KCMC (48, 49). Little change was seen in the percentage of CS at KCMC in the study period even though there have been contextual changes. With the closure of the operating theatre at the regional hospital Mawenzi, one could have expected increased levels, especially among the medically referred group. This was not seen, probably reflecting that few CSs were conducted at Mawenzi before the closure of the operating theatre. Similarly, the increases in user-fees in 2005 and in 2011 do not seem to have affected the overall percentage of CS. We did find that the likelihood of CS among referred women decreased with time, but this is difficult to explain without knowing whether referral practices have changed.

The finding that referral for delivery and low educational attainment were associated with CS, indicates that those in need and the relatively disadvantaged do have some access to CS when judged to be in need for it. It is logical that the level of CS among medically referred women is higher since they have been found to have a higher obstetric risk profile than those women that appear at the hospital without referral (28). At the same time, high costs of services at KCMC may contribute to birthing women at KCMC being from more educated families than the average in the region: in period 1 (before 2005), 49% of all babies born and 45% of babies born by CS by urban mothers at KCMC were registered to have fathers with secondary or higher education, whereas in urban areas in the Kilimanjaro region the percentage of men age 15-49 with secondary or higher education was 15% in 2004/05 (unpublished data). The proportion of babies with lower educated mothers and fathers decreased significantly over time, possibly reflecting increasing economic barriers to seeking services at KCMC. The findings that babies with fathers who had no or primary education had a relative decrease in the likelihood of being born by CS per year compared to babies with fathers who had secondary or higher education could possibly also reflect that fewer poor families seek health care at KCMC even when experiencing complications. However, changes in the socio demographic characteristics of the babies born at KCMC could also reflect transformations in the overall population. Repeated population-based surveys indicate that certain changes have occurred: the 2004/05 TDHS showed that 16.2% of the

Kilimanjaro women had secondary or higher education (50), whereas this percentage increased to 27.7% in the 2010 TDHS (27). Rural mothers are less represented at KCMC than urban mothers but have, like lower educated mothers (or their partner), higher likelihood of CS. The higher levels of CS in these sub-groups might thus also reflect that women with little education or with partners with little education and rural women do not deliver at KCMC if they do not have or are expected to have complications. The finding that the likelihood of CS for rural mothers increased with 3% per year after adjustment for socio-demographic factors, despite the number of CSs from rural Moshi remaining stable, could reflect that birthing women from this district coming to KCMC were increasingly those with a high risk of more complicated delivery.

Further investigation is needed to identify obstetrical risk factors in the different tribes to understand why Chagga women have lower likelihood of CS than other tribes. Unpublished data from KCMC indicate that Chagga women are normally of a higher stature and have lower BMI than Pare, and this might partly explain the lower CS percentage among Chagga. It is, however, difficult to explain why the likelihood of CS increased with time for urban Chagga mothers and not for rural Chagga mothers.

Advanced maternal age is associated with different adverse pregnancy outcomes and higher risk of medical conditions like hypertension and diabetes (51) and this could explain why higher maternal age was associated with increased CS percentage at KCMC. It is difficult to explain why only mothers aged 13-17 from rural Moshi had lower probability of CS. The finding that the women giving birth at KCMC are getting older is probably reflecting a national trend (a higher age of first birth was reported in the TDHS in 2010 compared to 2004/05 (27, 50). Second and third time rural mothers (para 2-3) had a higher likelihood of CS compared to first-time mothers and this may reflect that rural women that delivered by CS in a previous pregnancy are asked to register at KCMC for the next birth to have a new CS. The lower likelihood of CS among urban mothers of para 4 or more in the multivariable model could reflect that many women with three CSs do not get pregnant again, in accordance with the standard medical advice given at KCMC: to avoid further pregnancies after three CSs. To understand why para 4-6 had an increased likelihood of CS over time, it would have been useful to investigate the indications of CS. Very few women delivered for the seventh or more time, and the low OR of CS in this group may indicate that this is a highly selected group of low risk women.

Strengths and limitations

A strength of this study is that the data was retrieved from a large birth registry where the data is collected systematically on a daily basis. Validation and quality checks of the database have been done, and the information has been deemed to be largely accurate (32). The study sample was relatively large and covered a long time span. Because of the completeness of the data and the information on socio-demographic factors provided in the dataset, both regarding the mother and the father, we could assess how socio-demographic factors are related to CS in hospital settings over time. To our knowledge, very few studies in in SSA have done this before.

By using hospital based data, the study was limited to babies born at KCMC. There is a potential selection bias towards babies born by financially better off- and poor parents because of the cost sharing policy and the exemption system at KCMC. About 25% of all expected births from Moshi urban and only 4% of expected births from Moshi rural took place at KCMC in the period. The study is therefore not fully generalizable to all birthing women in Tanzania. We did not study medical indications for CS or reasons for referral which could have helped understanding the levels of CS better.

CONCLUSIONS

The level of CS at KCMC remained high, but did not show the increasing tendency seen in similar hospitals in East Africa. Medical referral, lower educational attainment, and higher maternal age, were associated with higher likelihood of CS. Women giving birth at KCMC, and their partners, are more educated than women and men of reproductive age in the Kilimanjaro region in general, and the educational level of the parents of babies born at KCMC increased over time, possibly reflecting inequitable access to the services offered at the hospital. We cannot determine the relative differences in access to CS among all birthing women in the population from this hospital-based study, but despite the high costs, it seems like those who really need CS have some access to it at KCMC.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

CN: Conceived the idea for the study, analysed the data, interpreted the findings and wrote the manuscript. IFS and TØ: Assisted with data analysis, interpreted the findings and revised the manuscript.

AKD: Co-establisher of the registry and reviewed the manuscript. BTM: Gave advice on data analysis and reviewed the manuscript. All authors read and approved the final manuscript.

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7.0 Appendices

KCMC medical birth registry questioner

K.C.M.C KCMC Medical Birth Registry

Version 5 - November 2004

1 Basic information concerning mother

1.1 Mothers date of birth: ☐ **Age:** ☐ **1.2 Mothers name:** ☐

1.4 Hospital number: ☐ **1.3 Address:** ☐

1.6 Birth number: ☐ **1.5 Date of interview:** ☐

1.8 Date of admission: ☐ **1.7 Interview by:** ☐

Referred for delivery: ☐ 1 Yes ☐ 2 No (*self referral*)

If yes: ⇒ **Referred from:** ☐ 1 Home ☐ 2 Regional hospital ☐ 3 District hospital ☐ 4 Other, specify: ☐

Referred during labour: ☐ 1 Admitted in labour ☐ 2 Admitted before labour

Reason for referral: ☐

1.9 Official date of discharge: ☐ **1.10 Date leaving hospital:** ☐

1.11 Current residence: ☐1 Rural ☐2 Urban ☐3 Semi urban

1.12 Mothers childhood residence: ☐1 Rural ☐2 Urban ☐3 Semi urban

Area of mother's residence: ☐ Area of mother's childhood residence: ☐

1.13 Highest educational level: ☐1 None ☐2 Primary (1-7) ☐3 Secondary (8-11) ☐4 Higher (12+)

1.14 Current occupation: ☐ 1 Housewife ☐ 2 Farmer ☐ 3 Service ☐ 4 Business ☐ 5 Professional ☐ 6 Student ☐ 7 Others ⇒ ☐

1.15 Current marital status: ☐1 Married Age at first marriage: ☐ ☐2 Single ☐3 Widowed ☐4 Remarried ☐5 Divorced ☐6 Polygamous family Add wife number: ☐

No of previous pregnancies ☐

1.16 Regular menstrual periods: ☐1 Yes ☐2 No Age at menarche: ☐

1.17 Genital mutilation *(Circumcision)* ☐ 1 Yes ☐ 2 No If yes, at age: ☐ If yes, type: ☐ 1 Type one ☐ 2 Type two ☐ 3 Type three ☐ 4 Other types

1.18 Mother's tribe: ☐01 Chagga ☐02 Pare ☐03 Masai ☐ Other ⇒ ☐

1.19 Religion: ☐ 1 Catholic ☐ 2 Protestant ☐ 3 Muslim ☐ 4 Others ⇒ ☐

2 Questions concerning the father of the child:

2.1 Father's name: ☐ **2.2 Father's age:** ☐

2.3 Current occupation of father:
☐ 01 Farmer ☐ 02 Business ☐ 03 Skilled worker ☐ 04 Unskilled worker ☐ 05 Service
☐ 06 Official ☐ 07 Professional ☐ 08 Student ☐ 09 Unemployed ☐ 10 Other ⇓ ☐

2.4 Father's educational level: ☐ 1 None ☐ 2 Primary (1-7) ☐ 3 Secondary (8-11) ☐ 4 Higher (12+)

2.5 Father's tribe: ☐ 1 Chagga ☐ 2 Pare ☐ 3 Masai ☐ 4 Others ⇒ ☐

3 Questions concerning home conditions:

3.1 Source of drinking water: ☐1 Tap water ☐2 Well ☐3 River ☐4 Spring ☐5 Other, specify

3.3 Distance to water, if not tap: ☐1 Less than 1 km (less ½ hour walk) ☐2 More than 1 km, specify in km: ☐

3.4 Home toilet: ☐1 Pit latrine ☐2 Flush ☐3 Others ⇒ ☐

3.2 Boiling of drinking water: ☐1 Yes ☐2 No

4 Mothers health before and during present pregnancy

4.1 Body weight (kg): (before pregnancy) [ ]

4.2 Body height (cm): [ ]

4.3 Blood transfusions ☐ 1 Yes ☐ 2 No

4.4 Serious diseases
- ☐ 01 Diabetes
- ☐ 02 Hypertension
- ☐ 03 Heart diseases
- ☐ 04 Epilepsy
- ☐ 05 Malaria
- ☐ 06 Anaemia
- ☐ 07 Gynaecological disease
- ☐ 08 Liver disease (jaundice)
- ☐ 09 Kidney disease
- ☐ 10 Lung disease
- ☐ 11 Tuberculosis
- ☐ 12 Sickle cell
- ☐ 13 Other, specify ⇓ [ ]

4.5 Have you ever practised family planning: ☐ 1 Yes ☐ 2 No

Months trying to get pregnant: [ ]

If yes, what kind of prevention
- ☐ 01 Pills
- ☐ 02 Injections
- ☐ 03 IUD
- ☐ 04 Condoms
- ☐ 05 Implant
- ☐ 06 Lactation
- ☐ 07 Withdrawal
- ☐ 08 Natural
- ☐ 09 Abstinence
- ☐ 10 Traditional
- ☐ 11 Other specify ⇓

4.6 Antenatal care in this pregnancy: ☐ 1 Yes ☐ 2 No

If yes: First medical appointment date: [ ]

If date unknown, estimate first appointment :
- ☐ 1 0-12. week of gestation
- ☐ 2 13-20. week
- ☐ 3 21-30. week
- ☐ 4 After 31. week

Number of visits: [ ]

4.7 L.M.P: [ ]

4.8 Ultrasound ☐ 1 Yes ☐ 2 No

4.9 E.D.D. based on clinical estimate: [ ]

4.10 Do you smoke? ☐ 1 Yes ☐ 2 No

If yes: how many cigarettes per day: [ ]

Smoking during this pregnancy: ☐ 1 Yes ☐ 2 No

Chewing tobacco ☐ 1 Yes ☐ 2 No

Chewing tobacco during this pregnancy: ☐ 1 Yes ☐ 2 No

4.11 Do you drink alcoholic beverages? ☐ 1 Yes ☐ 2 No

If yes: ☐ 1 Every day ☐ 2 More than once a week ☐ 3 Once a week ☐ 4 Occasionally

Did you also drink alcoholic beverages during this pregnancy? ☐ 1 Yes ☐ 2 No

If yes: ☐ 1 Every day ☐ 2 More than once a week ☐ 3 Once a week ☐ 4 Occasionally

4.12 Drugs on regular basis? ☐ 1 Yes ⇒ [ ] ☐ 2 No

If yes: ☐ 1 Modern ☐ 2 Traditional

Did you take any drugs during this pregnancy: ☐ 1 Yes ⇒ [ ] ☐ 2 No

If yes, specify: ☐ 1 Modern ☐ 2 Traditional

Did you take any drugs at time of conception or during first trimester: ☐ 1 Yes ⇒ [ ] ☐ 2 No

Drugs for infertility: ☐ 1 Yes ☐ 2 No [ ]

4.15 Blood group (AB0) [ ] **Rh:** [ ]

Anti-D in previous pregnancies: ☐ 1 Yes ☐ 2 No ☐ 3 Unknown

VDRL status ☐ 1 Positive ☐ 2 Negative ☐ 3 Unknown

Hb [ ]

Hb measurement done: ☐ 1 On Admission ☐ 2 Last visit to ANC

HIV test recorded ☐ 1 Yes ⇒ ☐ 2 No

If yes, result:. ☐ 1 Negative ☐ 2 Positive

Treatment during this pregnancy: ☐ 1 Yes ☐ 2 No [Specify]

4.16 Diseases and complications during present pregnancy, including accidents:
- ☐ 1 Yes (specify below)
- ☐ 2 No
- ☐ 01 Gestational diabetes
- ☐ 02 Diabetes
- ☐ 03 Hypertension
- ☐ 20 Preeclampsia, mild
- ☐ 21 Preeclampsia, severe
- ☐ 05 Eclampsia
- ☐ 06 Epilepsy
- ☐ 07 Bleeding
- ☐ 08 Anaemia
- ☐ 09 Hyperemesis
- ☐ 10 Malaria
- ☐ 11 Jaundice
- ☐ 12 Schistosomiasis
- ☐ 13 Gynaecological disease
- ☐ 14 Tromboembolic disease
- ☐ 15 Heart disease
- ☐ 16 Tuberculosis
- ☐ 17 Lung disease
- ☐ 18 Infections, specify
- ☐ 19 Others, specify ↓ [ ]

5 Questions concerning the delivery

5.1 At birth ☐ 1 Single birth ☐ 2 Multiple birth⇒ If multiple, add no. of children: ☐

Weight on admission: ☐

5.2 Complications during delivery ☐ 1 PROM ☐ 2 Bleeding > 500 ml ☐ 3 3-4. degree tear ☐ 4 Abruption of placenta ☐ 5 Placenta previa ☐ 6 Other complications

Specify type other type of complication

5.3 Induction of labour ☐ 1 Yes ☐ 2 No — If yes: ☐ 1 Amniotomy ☐ 2 Oxytocin ☐ 3 Prostaglandin

5.4 Others ☐ 1 Episotomy ☐ 2 Symphysiotomy

5.5 Analgesia: ☐ 1 Yes ☐ 2 No

5.6 Anaesthesia: ☐ 1 General ☐ 2 Spinal/Epidural

5.8 Blood Loss (ml) ☐

5.9 Mother's health after delivery ☐ 1 Good ☐ 2 Fair ☐ 3 Bad ☐ 4 **Maternal death**

Cause of death:

Post mortem: ☐ 1 Yes ☐ 2 No

5.7 Gestational age at birth clinical estimate ☐

6 Status of 1. child (Always fill inn)

6.1 Date of delivery ☐

6.2 Time of delivery ☐

6.3 Sex ☐ 1 Male ☐ 2 Female ☐ 3 Unknown, unspec.

6.4 Birth weight (gram) ☐

6.5 Length (cm) ☐

6.6 Head circum ☐

6.7 Presentation: ☐ 1 Cephalic ☐ 2 Breech ☐ 3 Transverse ☐ 4 Other

6.8 Status ☐ 1 Live born ☐ 2 Live born transferred to paediatrics dept ☐ 3 Stillborn ☐ 4 Neonatal death

Cause of death

6.9 If stillborn: ☐ 1 Dead before labour ☐ 2 Dead during labour ☐ 3 Unknown, unspec.

If stillborn, also specify: ☐ 1 Dead before admission ☐ 2 Dead after admission

And: ☐ 1 Fresh ☐ 2 Macerated

Post mortem: ☐ 1 Yes ☐ 2 No

6.10 Apgar score: 1min ☐ 5 min ☐ 10 min ☐

If neonatal death: ☐ 1 Died within first 24 hours ☐ 2 Died within first week

Date of death:

6.11 Mode of delivery: ☐ 1 Spontaneous ☐ 2 Vacuum, vaginal ☐ 3 Forceps, vaginal ☐ 4 CS elective ☐ 5 CS others ☐ 6 Assisted breech ☐ 7 Destructive operative

Indication when caesarean section: Primary / Secondary

6.12 Failed intervention ☐ 1 Vacuum ☐ 2 Forceps

6.13 Does the child have any of these conditions? ☐ 1 Birth defects ☐ 2 Injuries ☐ 3 Diseases ☐ 4 HIV Positive

Status on 2. child (For multiple births – not for singletons, if more than twins add extra copy of this page)

6.1 Date of delivery ☐

6.2 Time of delivery ☐

6.3 Sex ☐ 1 Male ☐ 2 Female ☐ 3 Unknown, unspec.

6.4 Birth weight (gram) ☐

6.5 Length (cm) ☐

6.6 Head circum ☐

6.7 Presentation: ☐ 1 Cephalic ☐ 2 Breech ☐ 3 Transverse ☐ 4 Other

6.8 Status ☐ 1 Live born ☐ 2 Live born transferred to paediatrics dept ☐ 3 Stillborn ☐ 4 Neonatal death

Cause of death

6.9 If stillborn: ☐ 1 Dead before labour ☐ 2 Dead during labour ☐ 3 Unknown, unspec.

If stillborn, also specify: ☐ 1 Dead before admission ☐ 2 Dead after admission

And: ☐ 1 Fresh ☐ 2 Macerated

Post mortem: ☐ 1 Yes ☐ 2 No

6.10 Apgar score: 1min ☐ 5 min ☐ 10 min ☐

If neonatal death: ☐ 1 Died within first 24 hours ☐ 2 Died within first week

Date of death:

6.11 Mode of delivery: ☐ 1 Spontaneous ☐ 2 Vacuum, vaginal ☐ 3 Forceps, vaginal ☐ 4 CS elective ☐ 5 CS others ☐ 6 Assisted breech ☐ 7 Destructive operative

Indication when caesarean section: Primary / Secondary

6.12 Failed intervention ☐ 1 Vacuum ☐ 2 Forceps

6.13 Does the child have any of these conditions? ☐ 1 Birth defects ☐ 2 Injuries ☐ 3 Diseases ☐ 4 HIV Positive

7 Previous pregnancies including abortions in chronological order

C1 Preg. no	C2 Year	C3 Outcome	C4 Months	C5 Birth weight	C6 Sex	C7 Lact.ation months	C8 Delivery where	C9 Attended by	C10 Mode	C11 ANC	C12 Alive/ Death	C13 Cause of death	C14 Age
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14

C1 Pregnancy number.
C2 Year of pregnancy. (Birth or other termination) PP: Present pregnancy.
C3 Outcome of pregnancy: (L) Live born, (S) Stillborn, (A) Spontaneous abortion, (I) Induced abortion, (E) Ectopic, (M) Molar, (T) Twins or other multiples *, (O) Other
C4 Months of gestation at birth or other termination.
C5 Birth weight in grams
C6 Sex: (M) Male, (F) Female, (U) Unknown
C7 Lactation: In months
C8 Delivered where: (1) At home, (2) At hospital, (3) At health post, (4) During transport) , (5) Other / unknown
C9 Attended by whom: (R) Relative, (N) Nurse, (M) Midwife, (D) Doctor, (T) Traditional birth attendant
C10 Mode: (S) Spontaneous, (V) Vacuum, (F) Forceps, (C) Cesarean section, (B) Breech, (O) Other, (9) Unknown
C11 Antenatal care: (Y) Yes, (N) No
C12 Child's current status: (A) Alive, (D) Dead
C13 Cause of death: Specify
C14 Age: (1) Less than one week, (2) Less than one month, (3) Less than one year, (4) More than one year

* Multiple births (Twins, Triples...) are filled in on subsequent lines

Clearance certificate for conducting medical research in Tanzania, Tanzania Ministry of Health

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THE UNITED REPUBLIC OF
TANZANIA

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NIMR/HQ/R.8a/Vol. IX/126

5th May, 2003

Prof J Mlay.
KCMC.
P o Box 3010.
Moshi, Tanzania

CLEARANCE CERTIFICATE FOR CONDUCTING
MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: "Registry based reproductive health research: Medical Birth registration at KCMC" Mlay J et al, Principal Investigator, has been granted clearance to be conducted in Tanzania. The PI of the study must ensure that the following conditions are fulfilled:

[v] Progress report is made available to MoH and NIMR every six months.
[v] Permission to publish the results is obtained from NIMR (manuscript being attached to the request) before any publication is made.
[v] Copies of final publications are made available to MoH and NIMR for action and records.

CHAIRMAN
NATIONAL MEDICAL RESEARCH COORDINATING COMMITTEE

This is to certify that Permission is hereby granted for the conduct of the study entitled: "Registry based reproductive health research: Medical Birth registration at KCMC" Mlay J et al Principal Investigator, within the health services and/or communities in Tanzania.

CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH

Letter from Regional Committee for medical research (REC), Norwegian and English

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Regional komitè for
medisinsk forskningsetikk
Helseregion III

Bergen, 07.09.99
Jnr.: 334799-64.99

Professor Rolv Terje Lie
Seksjon for medisinsk statistikk og data
Det medisinske fakultet, UiB
5021 BERGEN

Ad. Prosjekt: Medisinsk fødselsregister ved Kilimanjaro Chrisitan Medical Centre (KCMC), Tumaini University, Moshi, Tanzania.
Strategisk satsing for u-landsorientert forskning og utdanning - ledd i Utenriksdepartementets strategi for u-landsstøtte, 1999 (64.99)

Det vises til Deres søknad om etisk vurdering datert: 07.07.99.

Komiteen behandlet saken i sitt møte den 26.08.99.

Oppretting av et fødselsregister er ikke et forskningsprosjekt i seg selv og følgelig faller det utenfor vårt mandat å foreta en etisk vurdering av saken.
Som en kommentar vil vi allikevel si at vi ikke ser noen etiske problemer med å opprette et slikt register dersom innsamling av nødvendig informasjon skjer på grunnlag av det informerte samtykke og at dataene oppbevares forsvarlig slik at ikke uvedkommende får adgang til opplysninger i registeret. Den endelige tillatelse til å opprette fødselsregisteret må innhentes av landets egne myndigheter.

Vi ønsker dem lykke til med prosjektet.

Vi vil for øvrig gjøre Dem oppmerksom på at REK nå har tatt i bruk et nytt skjema for etisk vurdering, som vi ber Dem benytte ved eventuelle seinere prosjektsøknader. Opplysninger om dette finner De på vår side på verdensveven: http://www.etikkom.no/NEM/REK/rek.htm.

Vennlig hilsen
Olav Dahl
leder

Arne Salbu
sekretær

Certified translation from Norwegian

UNIVERSITY OF BERGEN

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Regional committee for medical research ethics Health region II

Bergen, 7 September 1999
Journal no.: 334799-64.99

Professor Rolv Terje Lie
Section for medical statistics and data
Faculty of Medicine, University of Bergen
N-5021 BERGEN

Dear Sir,

Re Project: Medical Birth Registry at Kilimanjaro Christian Medical Centre (KCMC), Tumaini University, Moshi, Tanzania
Strategic concentration for research and education oriented towards developing countries – part of the Ministry of Foreign Affairs' strategy for support for developing countries, 1999 (64.99)

We refer to your application for an ethical assessment dated 7 July 1999.

The Committee considered the matter at its meeting on 26 August 1999.

The establishment of a birth registry is in itself not a research project and it is therefore not within our remit to perform an ethical assessment of the matter.
To comment on the application, however, we do not see any ethical problems in establishing such a registry provided the necessary information is collected on the basis of informed consent and the data is stored securely so that unauthorised persons are unable to gain access

to the information therein. The final permission to establish a birth registry must be obtained from the country's own authorities.

We wish you the best of luck with your project.

Incidentally, we would point out that REK have now introduced a new form for ethical assessments, and we would ask you to use this in subsequent project applications. You will find information about this on the worldwide web:
http://www.etikkom.no/NEM/REK/rek.htm.

Yours faithfully,

(s.) Olav Dahl
Committee Chairman

(s.) Arne Salbu
Secretary

True translation certified:
Bergen, 26 March 2003

BRYGGEN TRANSLATØRBYRÅ A/S

Memorandum of understanding

Memorandum of understanding Moshi/Bergen/Date: 11.10.13

Use of registry data in the project: "Trends in caesarean section rates and socio-demographic predictors of caesarean section among birthing women at KCMC hospital in Tanzania, from year 2000 to 2013".

For the purpose of a master thesis on: "Trends in caesarean section rates and socio-demographic predictors of caesarean section among birthing women at KCMC hospital in Tanzania, from year 2000 to 2013," at Department of Global Public health and Primary Care at the University of Bergen. Data from the Kilimanjaro Christian Medical Centre (KCMC) Medical Birth Registry, Moshi, Tanzania will be transferred to Cecilie Nilsen. Ingvild Fossgard Sandøy, Anne Kjersti Daltveit and Blandina Mbaga will also have access to the data.

The aim of the project is to examine trends in the caesarean section rates and socio-demographic predictors among birthing women at KCMC hospital in Tanzania, during a period with increasing user-fees and closure of the operation theatre at a regional hospital. For specific objective, see attached protocol.

Outcome variable: Mode of delivery (caesarean section is the outcome of interest).

Main exposure variables: Educational level of mother and father, age mother, tribe of the mother, marital status of the mother, current residence of the mother, referred for delivery (referral status), at birth (single birth, multiple birth, no. of children).

Other variables: maternal health before and during pregnancy and single/multiple birth.

The following persons are collaborators on the project:

Supervisor: Ingvild Fossgard Sandøy, Department of Global Public Health and Primary Care, University of Bergen

Co-Supervisors: Anne Kjersti Daltveit, Department of Global Public Health and Primary Care, University of Bergen

Blandina Theophil MMbaga, Kilimanjaro Christian Medical Centre

Truls Østbye, Department of Community and Family Medicine, Duke University Medical Center

This memorandum assumes that use of the data for the project has been approved by KCMC by the head of the Department of Obstetric s and gynecology, Dr. Gileard Masenga as owner of the data and by Dr. Rolv Terje Lie who is acting as scientific advisor.

SPSS datafiles will be transferred from Bergen to Cecilie Nilsen, Department of Global Public Health and Primary care/Centre for International Health, University of Bergen, who will be responsible for the data.

Use of data for scientific purposes outside KCMC will require economic compensation to the KCMC registry. For master projects the compensation is stipulated to NOK 10 000, for PhD-projects a total of NOK 60 000 and for single papers 30 000.

Gileard Masenga   Rolv Terje Lie   Cecilie Nilsen

Research ethical clearance certificate, Tumaini University Makumira, KCMU college

CRERC FORM 07

TUMAINI UNIVERSITY MAKUMIRA

KILIMANJARO CHRISTIAN MEDICAL UNIVERSITY COLLEGE
P. O. Box 2240, MOSHI, Tanzania

RESEARCH ETHICAL CLEARANCE CERTIFICATE

No 662

Research Proposal No. 590

Study Title: CHANGES IN THE USE OF CAESAREAN SECTION AND MATERNAL AND CHILD OUTCOMES DURING A PERIOD OF INCREASING USERFEES IN TANZANIA

Study Area KCMC

P. I Name: BLANDINA MMBAGA

Co-Investigators: Cecilie Nilsen, Ingvild Fossgard Sandoy, Anne Kjersti Dalteveit, Truls Ostbye

Institution (s): KILIMANJARO CHRISTIAN MEDICAL CENTRE AND UNIVERSITY OF BERGEN

The Proposal was approved by CRERC on: 6TH DECEMBER, 2013

Duration of Study: FROM: 6TH DECEMBER, 2013 TO 6TH DECEMBER, 2014

Name: BEATRICE Z. TEMBA
Signature..................
Secretary – CRERC

Name PROF. MRAMBA NYINDO
Signature..................
CHAIRMAN – CRERC