



Stillbirths and associations with maternal education.

A registry study from a regional hospital in north eastern Tanzania.

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Master's thesis in Public health

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Spring 2012

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Abstract

Background: Every year 2, 6 million women experience a stillbirth. The vast majority occur in Sub-Saharan countries.

Education is a commonly used proxy for socioeconomic status (SES) and is closely linked to health.

We wanted to investigate the associations between education and stillbirths in a regional referral hospital in north eastern Tanzania (Kilimanjaro Christian Medical Centre, KCMC). In addition, we wanted to identify sociodemographic differences between stillbirths and live births.

Material and methods: Since 2000, all details of every birth at KCMC has been collected and entered into an electronic file. We used data of 32252 deliveries between 2000- 2010. Outcome measure was stillbirth. We also investigated educational levels and sociodemographic factors.

Results: The share of stillbirths was three times higher in none educated mothers than in high educated mothers (6,9 % vs. 2,3%). The major difference was seen between no education and primary education. Stillbirths were significantly associated with known risk factors like multiparity and few antenatal care visits.

Conclusion: Mothers with no education were associated with higher share of stillbirths. A huge decline in numbers of stillbirths between no education and primary education, underline the importance of global effort to enroll more girls in school.

..my life took a shocking turn with my obstetrician uttering three simple but devastating words: no fetal heartbeat. Several attempts to induce labor finally led us to my first and only daughter's stillbirth at dawn..'

The quote is by the south African author Malika Ndlovu. In her book 'My invisible earthquake- a mother's journal through stillbirth ' she describes her own experience .

1. Introduction

'Make every mother and child count', was the name of a WHO report from 2005 (1). The Millennium Development Goals (MDG) 4 and 5 aim to reduce child deaths and improve maternal health by 2015. Paradoxically stillbirths have for many years not been 'recognized in the Global Burden of Disease or counted as missed lives in disability – adjusted life years' and have consequently been invisible also here (2).

Thus, one of the first systematic global reports of estimates of stillbirths was published as late as 2000. Only in recent years, more systematically and larger reviews have been published (2).

Every day more than 7200 babies are stillborn, and a total of 2,6 million stillbirths occurred worldwide in 2009. The number is a small decline of 1,1% per year over the previous years (3). In comparison, focus on the under five mortality has led to greater results during the last years. 98% of all stillbirths occur in low and middle income countries. This number exceeds all deaths of HIV/AIDS. Probably the real number is even higher due to all non registered stillbirths (4).

Focus on stillbirths also varies greatly between countries. Countries with less knowledge on preventing stillbirths, give stillbirths low national priority (5).

The majority of all stillbirths occur in a minority of low-income countries, where stillbirths often are seen as a stigma and believed to be the woman's fault or belong to evil spirits. In such societies visible grief is not accepted. Still, behind every story of a stillbirth there are shuttered dreams and hopes - a devastating loss for the woman and her family.

Low socioeconomic status brings poor health and several studies show associations between socioeconomic status (SES) and perinatal outcomes (6, 7). Education is an indicator by proxy of SES. Focus on education as a health contributor has led to increased awareness on educational inequity, especially in low-income countries, where disparity is greater and the possible gain higher. Education is for many, the only way to social advancement and the way out of poverty. MDG 2 and 3 aim to give all children a full course of primary school and eliminate gender inequity in all educational levels before 2015 (8).

In many ways, education is more important to girls and women in low resource settings, where more boys than girls attend school. Two-thirds of all illiterate are females, one in five girls fail to complete primary education and dropout rates are at least 30% due to adolescent pregnancies (9, 10). Increased female enrollment in schools can lead to long term decrease in child mortality in low resource settings and should be emphasized (11).

The aim of this thesis was to look at stillbirths in a regional hospital in the Kilimanjaro region in north eastern Tanzania between 2000- 2010, and investigate their associations to education and other socio-demographic factors.

The thesis starts with introducing important definitions relevant to stillbirth. Then risk factors and strategies to reduce the stillbirth rate are illuminated.. This is followed by a presentation of Tanzania and its education and health system and the study site; the Kilimanjaro region. Aims of the study are presented, following material and methods used. The main results are presented and discussed. In light of these findings possible actions to optimize the gynecology and obstetric services are recommended with suggestions for further research.

2. Background

2.1 Stillbirth

A stillbirth is defined as the death of the fetus in uterus before birth at or after 28 weeks' gestation. Intrauterine death can occur either before or during labour (12). Following the development in neonatal intensive care, the definition has changed, and varies between countries. In high income countries, like Norway, a newborn can survive after 25 weeks' gestation, compared to 28-32 weeks' gestation in low resource countries. In many low resource countries, preterm babies with no life expectancy outside the womb, therefore die intrauterine without any attempt of rescue (4).

The International Classification of Diseases (ICD-10) use the term fetal death defined by a birth weight of 500 g or more, gestational age ≥ 22 weeks or birth weight ≥ 500 g. For international comparison WHO recommends reporting of third trimester stillbirths at ≥ 1000 g, ≥ 28 gestational age, or ≥ 35 cm body length (13). The stillborn rate (SBR) is defined as stillborns/total births X 1000. The term perinatal mortality describes stillbirths and neonatal deaths within the first week of life. The perinatal mortality rate (PMR) is the number of perinatal deaths /total births X 1000.

Stillbirths are often not registered systematically in many low-income countries. This leads to underestimation of stillbirths in these countries, in which 98% of all stillbirths occur. Reliable registrations exist only in countries with minor number of deaths (4).

India, Pakistan, Nigeria, China, Bangladesh, Democratic Republic of the Congo, Ethiopia, Indonesia, Tanzania and Afghanistan are ten countries that account for two-thirds of all third semester stillbirths (Figure 1). Tanzania is ranked number nine out of these ten (4). The total burden of all stillbirths is obviously imbalanced. Additional unfairness is

observed within each country. The poorest of the poor in a country are more likely to experience stillbirth than the well- to-do. The stillbirth rate in lower classes compared to upper classes within the same country can increase to over 50-fold (2).

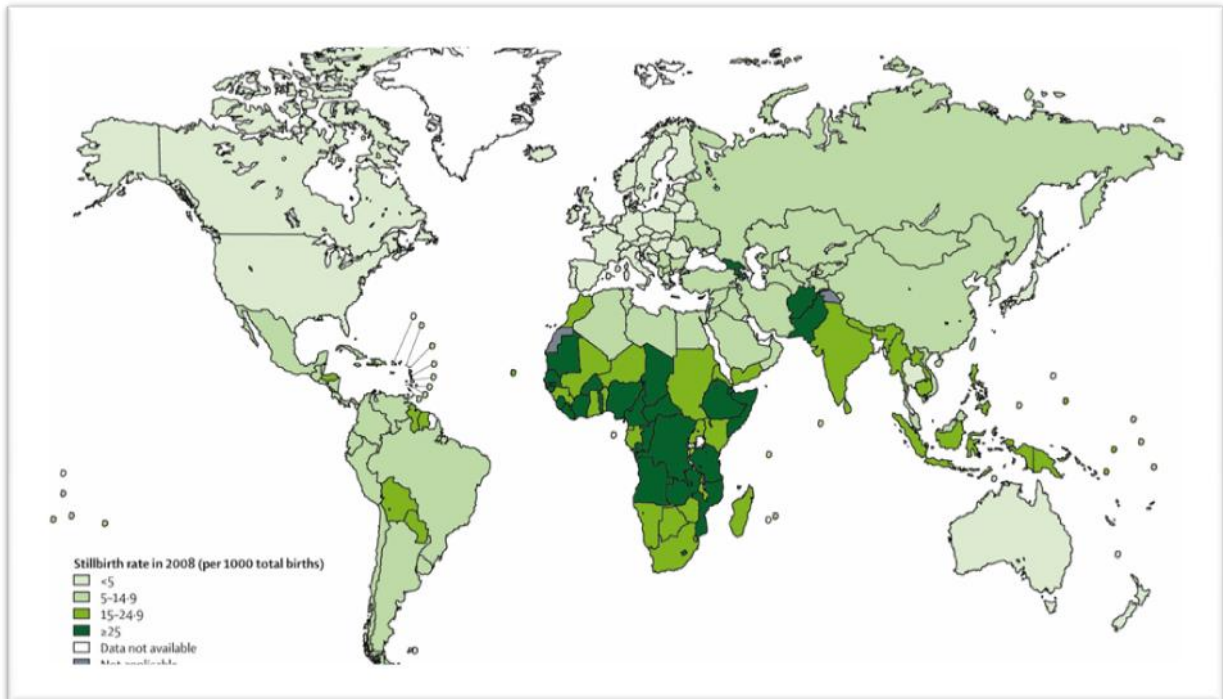


Figure 1. Density of stillbirth rates in the world (4).

2.2 Risk factors of stillbirth

2.2.1 Direct causalities

The five main causes of stillbirth are maternal infections in pregnancy, maternal sicknesses like hypertension and diabetes, childbirth complications, fetal growth restriction and congenital abnormalities (4). They could be related to either time before delivery (during pregnancy) or during delivery (childbirth complications) (Figure 2).

At least half of all stillbirths in low income countries are associated with a maternal condition before delivery. Maternal health and the wellbeing of the fetus cannot be separated. In many cases good or bad health during pregnancy draws the line between life and death for the unborn child.

Syphilis, malaria and HIV/AIDS are common in low income settings and are maternal risk factors for all pregnancies. Numbers from South Africa show that infections are the direct cause of 5% of the stillbirths and that maternal infection are associated with 3% of all stillbirths. Pregnancy related hypertension is common in both high and low resource countries. Whereas hypertension in pregnancy in rich countries seldom have lethal outcome, pregnancy related hypertension in low income settings is involved in 10% of all stillbirths before delivery and 20% during delivery (4, 14). Other health factors like anemia and nutritional status factors are also associated with higher stillborn rates (2, 4, 15).

In Tanzania, 50% of all births happen at home, often assisted by a traditional birth attendant (TBA) or a relative (16). Perinatal mortality is described to be three times higher in home births with traditional birth attendants compared to those with skilled help (17). Stillbirth rates during labour in high resource countries are 0,5 per 1000 births (4). In comparison the number is 50% in Tanzania and other sub-Saharan countries and could be related to the high number of home births (16).

Even with skilled attendants at homebirths, two-thirds of all stillbirths in low income countries occur in rural areas. Access to emergency obstetric care (EmOC) in these settings is often limited. The caesarean section (CS) rate in rural areas in Africa is only 1%, in total 3% in Tanzania. This is by far not enough to offer necessary acute obstetric care (4, 18).

Like many sub-Saharan countries, Tanzania provides a national referral system, but only 40% of health care facilities provide emergency transport. When a referred birthing woman finally gets to the hospital, it could be too late. Delays are common and represent a severe risk factor to maternal health and pregnancy outcome. A three-delay model has been introduced to identify possible delays to emergency obstetric care. First delay.: Delay in identifying an obstetric problem and seeking help. Second delay: Delay in transportation to a health facility. Third delay: Delay in receiving adequate obstetric care at the facility (2, 19). One study from western Tanzania revealed that 70% of perinatal deaths were connected to third delays (21).

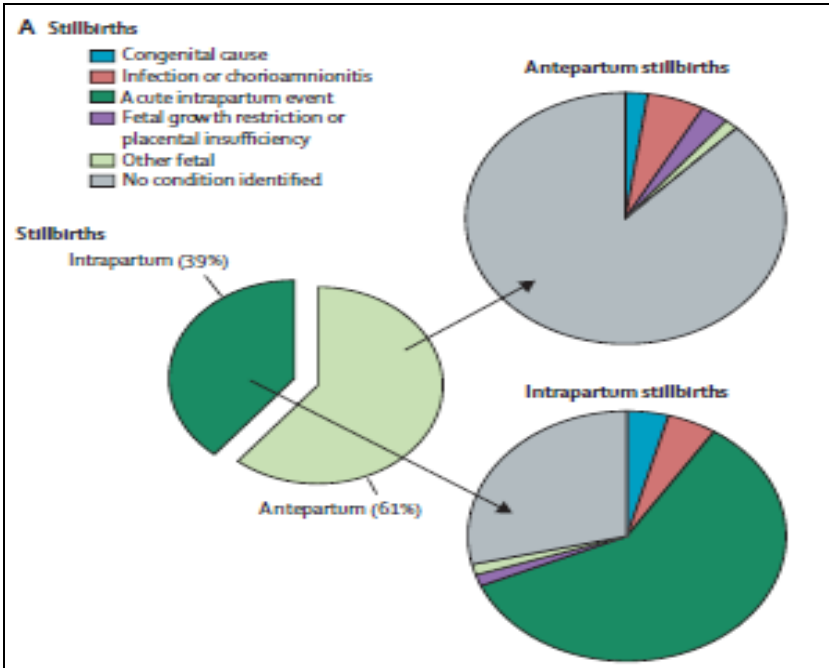


Figure 2. Causes of ante- and intrapartum stillbirths (4).

2.2.2 Why is education important?

Among socio-economy and socio-demographic factors are age, occupation, education, income, parity, living conditions etc. Differences in socio-economic status (SES) are

important factors to health disparity in both high- and low income countries. This is illuminated in several studies of perinatal mortality (7, 21). Underlining the impact SES has to health, the huge decrease in perinatal mortality by 72% in Norway, is largely explained with improved socio-economy (22).

Socio-demographic factors like, high maternal age, high parity and living in rural areas have shown to correlate with higher perinatal and maternal mortality (23, 24). Of great interest are also findings that paternal characteristics like education, age or ethnicity could have even higher impact on the perinatal outcome (25).

During the last years, the primary school enrollment has increased to 89% in low income countries. According to a recent comparison of 915 national surveys, one additional educational year has led to a decrease in child mortality by 9,5% between 1970 and 2009 (11).

Other studies show similar results where maternal education correlates with health and stillbirth numbers (23). In a population based study from Sweden, blue collar workers had a two-fold higher risk of stillbirth than white-collar workers (21). The impact of maternal education is also shown for neonatal mortality in Bangladesh and for Nordic stillbirths (23, 26). Secondary school is in some studies described to be the border between high and low stillbirth rate (27).

The impact of education can only be explained to some extent. Some findings could be linked to increased health consciousness, access and use of maternal health services etc., still many results could be interpreted as independent risk factors (21). It is easy to envision that an educated woman will have higher self determination; she will avoid high risk adolescent pregnancies, and marry later. More educated women seek antenatal

and health care. It is more likely that she will improve her nutritional status, which among other things has positive effects on her pregnancy. Educated women have smaller families, which allow them to send all or more children to school. Thus, their children are more likely to send their children to school. There are more educated than non-educated women working, and contribution to the family income will increase her co-determination in a patriarchy (28).

2.3 Strategies to decrease stillbirths

The majority of all stillbirths are avoidable and 1,1 million stillbirths could be prevented each year with minor efforts (29). It is interesting to note that Europe had similar high mother-child mortality in the 19th century compared to many sub-Saharan countries today. From the mid-1930s the maternal mortality rates have declined rapidly in high resource countries (30).

The Millennium Development Goal number 5 is to improve maternal health and to bring down maternal mortality by three quarters before 2015. The mortality goal will not be reached by far, but a decline in maternal sicknesses will reduce the number of associated stillbirths.

Efforts to decrease the stillbirth rate could be separated into two groups: 1. Before labour (ante partum), and 2. During labour (intra partum). The mothers' health before and during pregnancy could be detrimental for the fetus. As 42% of all stillbirths occur intrapartum, the time at birth is described to be 'of greatest risk of mortality and morbidity for both mother and baby' (2). Several interventions to decrease the numbers

of stillbirths are tried out in low resource countries, and several evidence based reviews are written.

Prevention before conception

Maternal nutritional status could influence the future pregnancy outcome. In low-resource countries, under-nutrition and malnutrition are common. A balanced energy-protein intake could reduce stillbirths by 45%. In addition, a small part of stillbirths are due to neural tube defects. Supplement with folic acid before and in the first three months of pregnancy could decrease the prevalence with 41%. An alternative to folic acid supplement is fortified food, like fortified wheat flour (31).

Antenatal care

During pregnancy antenatal care visits (ANC) plays an important role. WHO recommends four ANC visits for healthy women, where the first visit should be as early as possible (32). Early visit is important for the woman to be prepared for the delivery and be motivated to deliver in a health facility. Many women in low-income countries discover their pregnancy late, due to short inter-pregnancy space. Further, in some cultures the pregnancy should be hidden for a long time, which contributes to late first ANC visit (32).

In the ANC visits pregnancy related conditions and warning symptoms should be identified and adequate help given. If necessary, the pregnant woman should be referred for more advanced treatment.

High ANC coverage is not equal to low stillbirth rates. The overall coverage of ANC is relatively high also in low income countries, but inadequate screening of high risk

pregnancies, lack of diagnosing or treating complications, are often seen. Numbers from Tanzania show that 82 percent of facilities offer antenatal care services and at least 62 percent make 4 visits or more (16). At the same time only 45 percent of the facilities have the essential supplies for basic ANC and only 24 percent of the pregnant women received information about pregnancy related warning signs (16).

Maternal medical sicknesses and infections

Screening and treatment of syphilis, HIV or anemia, are important for the women and for preventing stillbirths. Estimates show that identification and treatment of infectious diseases like malaria and syphilis could reduce the stillborn rate in low income countries by 6%. Syphilis during pregnancy has prevalence between less than 1% to over 10% in low resource countries and can be treated with antibiotics. Randomized trials with treatment of syphilis are unethical and therefore missing. However, other studies show a reduction of stillbirths by 80% in pregnant women with syphilis (31). Malaria in endemic areas causes numerous maternal deaths. Approximately 50 million pregnant women are exposed every year. Insecticide-treated bed nets or intermittent prophylaxis are efficient measures during pregnancy (31).

The increasing number of pregnancy related diabetes and hypertension have consequences also for a number of stillbirths. According to a large review of stillbirth interventions, treatment of pregnancy related hypertension would only have an insignificant reduction of perinatal mortality. However, calculations of an intervention package consisting of screening for hypertension, treatment and induction of labour or cesarean section could reduce the number of stillbirths by 20% (4, 31, 34).

Skilled delivery services

One of the main causes for the huge decline of maternal deaths has been the use of skilled birth attendants. Close follow-up from midwives, giving birth at hospital with access to blood transfusion, antibiotics and operative delivery, lowered the maternal mortality (30).

Several studies with training of traditional birth attendants (TBA) or community health workers (CHW) show positive results (2,31,34). In another review, a reduction of stillbirths by 25% was calculated when skilled birth attendants were used (31). However, this should be seen in connection with access to a health facility if an obstetric emergency. As an example, a reduction in stillbirths in low resource countries was seen when births of caesarean section from 0% to 10% (31).

Most obstetric emergencies are unexpected and could not be foreseen (35). Access to a health facility with emergency obstetric care is life saving. A birthing woman in a rural home meets several challenges if an acute obstetric emergency occur. Limited finances and no available transportation are two possible obstacles. Some sub-Saharan communities have tried community based emergency loans for emergency transportation. In case of an obstetric emergency, a private driver gets a set fee, funded by the emergency loan. Although positive results, further studies are recommended (36).

To increase facility based deliveries, maternity waiting homes close to a health facility is recommended by WHO to reduce maternal mortality and show promising results for stillbirths in a Cochrane review (36).

Since 2005, India has implemented a cash transfer program to motivate women to deliver in health facilities. Four fewer perinatal deaths for every 1000 pregnancy, was

one of the results. Another finding was that more educated women received the cash-back. This could be partly explained by rural living and difficult transportation for the non-educated women (37).

A national referral system is essential in an obstetric emergency. Thus, many low-income countries have an official referral system; several observations indicate that they are not optimal. Midwives or birth attendants must recognize any delivery at risk, and be able to refer to next level of care. The birthing woman must comply with referral advice and have the financial capacity to pay for services required. Additionally, an available transport system and good road conditions are recommended (38,39). A follow up study in rural Tanzania showed that compliance for referred women to hospital was less than 50%. Financial obstacles were given as main motive (38).

Educational programs

MDG 2 and 3 put education and gender equity on the agenda. This has led to an increased prioritization in low income countries. All projects run by governmental and non-governmental organizations (NGO) are an acknowledgement of the far-reaching impact education could have.

For families of low or 'none' income, school fees can be a barrier for sending their children to school. Consequently, free primary school is emphasized. Free school has doubled the school enrollment in Tanzania between 1999 and 2008 (40). An increased number of teaching facilities and motivation of girls with 'girl-friendly schools' with separate latrines for boys and girls and are two initiatives to increased school

enrollment, especially for girls. In some countries a girl cannot go to school without being afraid for her life or being raped (41).

In unstable or fragile settings like DRC Congo or Sudan, UNICEF offers cash vouchers to families as 'compensation' for sending their children to school (even in absence of school fees). In this way the family themselves can decide what they need to buy and the children are sent to school (42).

When larger parts of a population live in rural areas, an available school is crucial. Use of 'tent schools' in these areas have shown good results in both Botswana and Tanzania (43). In light of the major dropouts due to pregnancies, encouragement to return to school after childbirth is also important.

2.4 Study setting

2.4.1 Tanzania

Tanzania is a large east African country bordered by Kenya and Uganda to the north, Rwanda, Burundi, and the Democratic Republic of the Congo to the west, and Zambia, Malawi, and Mozambique to the south (Fig.1). The country's eastern borders lie on the Indian Ocean. Dar es Salaam is the capital and the country consists of 26 regions with a population of nearly 43 Million people. There are more than 120 different tribes in Tanzania. About 30% are Christian, 35% Muslim and 35% have indigenous beliefs (44).



Figure 3. Map of Tanzania



Figure 4. Map of Kilimanjaro region.

Demographic factors for Tanzania are listed below:

Demography Tanzania 2010	
Total population (million)	43
Total fertility rate/1000	5,4
Median age at first birth	19,5
Life expectancy at birth(years)	51
Stillbirth rate:	26
Perinatal mortality rate/1000	36
<5 mortality rate/1000	81
Maternal mortality /100.000	454

Numbers from Tanzania Demographic and health survey (DHS) 2010 and WHO.

Household composition, Tanzania		
	Urban	Rural
Household population, age	%	%
<15	40,2	49,0
15-64	57,0	46,4
≥65	2,9	4,6
Household headship		
male	76,6	75,2
female	23,4	24,8
Number of household members		
<4	43,3	29,8
≥4-9	51	59,6
9+	5,7	10,5
Education, years(female/male)		
None	12,2/7,8	31,0/21,6
Primary	64,4/62,9	63,2/69,9
Secondary	22,4/27,0	5,4/8,0
Higher	0,8/2,2	0,1/0,2

Numbers from DHS 2010.

2.4.2 The Tanzanian health system

Tanzania has a public health system, which is one of the priority sectors of the government (16). Even though a national referral system in Tanzania exists, almost 50% of all deliveries are rural home births. Confidence in traditional medicine is strong, and it is estimated that about 60% get alternative remedies alone or additional to traditional medicine (16)

The structure of the national health system is showed in the overview below:

Health system, Tanzania		
Health care level	Facility	Services offered
Level 1	Dispensary services	ANC and primary health services.
Level 2	Health centre services	Outpatient and in patient services, maternity care. Be able to refer and transport patients to district hospitals.
	District hospital	Perform general surgical and obstetric operations.
	Regional hospital	Receive referrals from level one hospital, specialized treatment in obstetrics, gynecology and pediatrics.
Level 3	National hospitals	National referral hospitals. Services at higher specialist level.

In addition to public health care facilities, a private health care system exists for a financial privileged minority.

2.4.3 Tanzanian school system

Today the Tanzanian educational systems consist of 7 years of primary school, 4 years of secondary school, 2 years high school and 4 years university. Both Kiswahili, as the official language, and English are taught in school. All textbooks in primary schools are in Kiswahili (45).

After Tanzania got their independence in 1961, focus was brought to secondary and higher education, to fill the gap after the Europeans. The Arusha declaration in 1967 put mass primary education on the agenda which led to increased primary enrolment. From having a high primary enrolment, school fees made the numbers fall rapidly. In 2002, Tanzania had a net enrollment less than 50%. The Net attendance ratio (NAR) is the percentage of the primary-school-age children that is attending primary school. After implementation of Primary Education Development Programme (PEDP) and free primary school in 2001, NAR rose to 79, 7% in 2010 (46).

There are huge disparities within the country and between rich and poor. Whilst 88% in urban areas go to primary school, the same number is 78% for rural areas (46, 47). Comparing rich and poor, show that 46% of less fortunate females and only 7% of wealthy females have never been to school (46).

Compared to primary education, secondary education has become 'forgotten'. This has led to an educational pyramid, with a high NAR at the bottom for primary education, and a low NAR for secondary education at the top of the pyramid.

NAR for secondary school is slightly higher for men than females, with 26% vs. 25% (46). And great disparity is seen also here- whereas secondary school NAR is 49% for the wealthiest quintile, it is only 9% for the poorest quintile (46).

2.4.4 Kilimanjaro Region and the Kilimanjaro Christian Medical Centre (KCMC)

Kilimanjaro region is located in the north-eastern Tanzania. Moshi is the capital of the region with 144 793 inhabitants (Fig.2). The main ethnic groups in the region are Chagga and Pare, in addition to 50 other ethnic groups (Habib). Most people are farmers or traders (46).

The Kilimanjaro region belongs to one of the most literate regions, together with Dar es Salaam, where literacy rate is >90% for both men and women (46). Median years completed at school are 6,7 for women and 6,8 for men (46). Only 12% men and 15% females have never attended school (47).

Approximately 90% of all births in the Kilimanjaro region and in Moshi are facility based (18, 46). 86% of all deliveries are with a skilled provider (46).

The Kilimanjaro Christian Medical Centre (KCMC) is a regional hospital and a university teaching hospital, which receives local patients from Moshi area and referred women from the six regions Arusha, Kilimanjaro, Manyara, Tanga, Dodoma and Singida with a total of 15 million inhabitants. 20% of all deliveries at KCMC are 'referrals' and from women with conditions that cannot be taken care of in the local health clinic or by the traditional birth assistant.

KCMC is a public/private partnership in which a cost-sharing policy for maternity services was implemented in 2005. Referred women are in addition charged an extra registration fee. 5-15 USD is the price for a normal delivery, and 25-30 USD is the minimum for a caesarean section (18). This is a barrier for many poor women, which leads to a rather selected group of birthing women coming to KCMC. Some local poor women will seek more affordable delivery services, or homebirths. Other referred women may not comply with referral advice, due to the financial burden.

3. Aims of the study

The main aim of this study was to investigate to which degree educational level is associated with stillbirths among women delivering at a zonal hospital (KCMC) in north eastern Tanzania.

In particular we wanted to estimate stillbirth differences in women with no education compared to women who had been to school.

In addition we wanted to identify other socio-demographic factors contributing to stillbirth differences.

Specific objectives:

1. To study associations between maternal education levels and stillbirths.
2. To describe socio-demographic characteristics of women delivering at the KCMC.
3. To describe socio-demographic differentials between stillbirths and live births at the KCMC.

4. Materials and Methods

4.1 Study sample

Since 2000, KCMC has registered detailed information about every birth in an electronic medical birth registry. This registry is financially supported from The Norwegian Council for Higher Education's Program for Development Research and Education (NUFU). It is collaboration between the University of Bergen, Norway and the Kilimanjaro Christian Medical College in Moshi, Tanzania.

The data are obtained from the mothers by specially trained midwives and supplied with data from the medical records and ANC files with information collected during pregnancy.

For every delivery a form is filled out with questions concerning personal data of the mother and father, mothers' area of residence, health before and during pregnancy, any complications during delivery and status of the child, among others. A secretary enters the data into an electronic file (48). All data are collected with the woman's consent. The response rate is >98% (18).

Since 2004, information about children transferred to neonatal intensive care, is added to the original form.

4.2 Inclusion criteria

We extracted information from 34090 deliveries from the Medical birth registry at KCMC between 2000- 2010. Mothers between 13-59 years and singletons \geq 500 g were included. Due to some uncertainty around the women's age, the top level age was set relative high.

If the mother was listed twice with information about two babies during the same period, this was interpreted as a multiple birth and excluded from the material. The final sample consisted of 32252 births.

4.3 Study variables

4.3.1 Demographic variables

Educational level was the main exposure variable and was categorized in four categories based on tick-off boxes in the original form into 'none', 'primary (1-7 years)', 'secondary (8-11 years)' or 'higher (12+)'.

We registered maternal characteristics such as age, parity, number of antenatal care visits, current residence, education, tribe and referral status. Among infants, we registered vital status at birth and birth weight.

Maternal age was categorized as <20, 20-24, 25-29, 30-35 or ≥ 35 years.

Parity was categorized as 0, 1-3 and ≥ 4 .

All women had one or more antenatal care visits (ANC). The number of visits was therefore categorized into '1-3 visits' and ' ≥ 4 visits'.

Current residence was categorized as 'rural', 'urban' or 'semi urban', based on tick-off boxes in the original form.

Tribe was categorized as 'Chagga', 'Pare' 'Masai' or 'others'.

The baby's birth weight was categorized into 'less than 2500g' or more than or equal to '2500g'.

Missing data on socio-demographic variables were less than 1%, except for parity (3%) and number of ANC visits (2,4%). Missing data on maternal education were less than 1%.

Referral status was categorized as 'referred' or 'self-referred'. Women referred from another health facility or from health personnel elsewhere (included home), were

classified as 'referred'.

Local women who wished to deliver at KCMC and women bypassing other referral facilities were recorded as 'self-referred'. Women with previous caesarean section are encouraged to deliver at KCMC next time, and if they return, they were also categorized as 'self-referred'.

If referred, the referral location was categorized as 'home', 'regional hospital', 'district hospital' or 'other'. Many self-referred women were falsely ticked off as referred 'from home', while they actually were not referred. Analysis with referred 'from home', should therefore be interpreted in this context. Missing data of referral status were 6%.

4.3.2 Outcome variables

Stillbirth Yes or No was the main outcome of the study. If inconsistent and/or missing Apgar scores, these were classified as missing stillbirths. Missing data for stillbirths was less than one percent.

Stillbirths were further categorized in 'dead before' or 'dead after admission' by tick-off boxes in the form. Similarly, cases were categorized into 'dead before labour', 'dead during labour' or 'unknown' based on tick-off boxes. We also had information on status of the stillborn as 'fresh' or 'macerated'. For these last three categorizations, there were substantial proportions of missing data: 'Dead before or after admission' 33,6% (387), 'dead before labour', 'during labour' or 'unknown' 57,2% (660) and 'macerated or fresh' 28,7% (331).

4.4 Statistical analysis

Analysis were performed by SPSS version 19 (SPSS Inc., Chigaco, Ill., USA). The average age, parity, and number of antenatal care visits are given as mean. Stillbirth rate (SBR) was calculated as the proportion of stillbirths among all live births and stillbirths (expressed as per 1000 births). Associations with categorical data were analyzed with bivariat cross tabulations with Chi square. Statistically significant differences were defined as $p < 0.05$.

4.5 Ethical approval

The study was approved by the KCMC IRB. Approval date 21.12. 2010.

5. Results

All mothers

Characteristics of all 32252 women are listed in Table 1.

The mean age was 28,6 years and mean parity 1,6. The majority of all women had primary school as highest educational level (61,5%) and only 1,9% had no education. Most women (69,6%) had ≥ 4 antenatal visits. Within residency, urbanites were the largest group (52,5%) compared to rural living (42,7%).

In 77,6%, the mothers were self-referred. Referred women were in most cases ticked off as referred from 'home' (78,3%). As mentioned in methods section, this is interpreted as actually self-referred women coming from home. Referred women were in the majority of cases send from The Regional hospital.

Table 1. Characteristics of 32252 women delivering at KCMC, 2000-2010

	n= 32252	%
Age		
<20	2934	9,1
20-24	8651	26,9
25-29	9317	29,0
30-35	7995	24,8
≥35	32174	10,2
Total		<u>100</u>
Parity		
0	12591	40,2
1-4	17775	56,8
≥5	931	3,0
Total		<u>100</u>
Antenatal care		
1-4	9569	30,4
≥4	21923	69,6
Total		<u>100</u>
Current residence		
Rural	13720	42,7
Urban	16856	52,5
Semi urban	1559	4,8
Total		<u>100</u>
Maternal education		
None	638	1,9
Primary	19804	61,5
Secondary	1587	4,9
Higher (12+)	10130	31,5
Total		<u>100</u>
Tribe		
Chagga	17982	55,8
Pare	4031	12,5
Masai	321	1,0
Other	9918	30,8
Total		<u>100</u>
Referral status		
Referred	6789	22,4
Sel-referred	23509	77,6
Total		<u>100</u>
Referred from:		
Home	22686	78,3
Regional Hospital	3508	12,1
District Hospital	1170	4,0
Other	1593	5,5
Total		<u>100</u>
Birthweight		
<2500	3473	10,8
≥2500	28640	89,2
Stillbirth rate per 1000	1153	36

Characteristics of stillbirths and live births

The total number of stillbirths was 1153 (3,6%). This gives a stillbirth rate (SBR) of 35,7 per 1000 births.

Characteristics for stillbirths and live births are shown in Table 2. There was a higher percentage of women >30 years among stillbirths. There was a twofold share of parity five or more in the stillbirth group compared to live births (6,8% vs. 2,8%). More stillbirths had only 1-3 ANC visits compared to live births (50,9% vs. 29,7%).

Primary education was the largest educational group for both groups, but the share of no education was twofold for stillbirth mothers compared to live birth mothers (3,9% vs. 1,9%).

There were twofold referred mothers in the stillbirth group compared to the live birth group. Approximately twice as many stillbirths were referred from the regional hospital, compared to live births (21,1% vs. 11,8%). All findings were significant, $p < 0.01$. For more details, see Table 2.

Table 2. Characteristics of live born and stillbirths

	Stillbirths n=1153 %	Live births n=31089 %	
Age			p<0.01
<20	7,5	9,2	
20-24	22,1	27,1	
25-29	26,4	29,1	
30-35	28,4	24,7	
≥35	15,7	10	
Total	<u>100</u>	<u>100</u>	
Parity			
0	34,4	40,5	p<0.01
1-4	58,8	56,7	
≥5	6,8	2,8	
Total	<u>100</u>	<u>100</u>	
Antenatal care			p<0.01
1-3	50,9	29,7	
≥ 4	49,1	70,3	
Total	<u>100</u>	<u>100</u>	
Residence			p<0.01
Rural	54,4	42,3	
Urban	38,7	53	
semi urban	6,9	4,8	
Total	<u>100</u>	<u>100</u>	
Educational level			p<0.01
None	3,9	1,9	
Primary (1-7)	70,5	61,3	
Secondary (8-11)	4,6	4,9	
Higher (12+)	21	31,9	
Total	<u>100</u>	<u>100</u>	
Tribe			p<0.01
Chagga	46,9	56,1	
Pare	15,5	12,4	
masai	2,3	0,9	
others	35,3	30,6	
Total	<u>100</u>	<u>100</u>	
Referral status			p<0.01
Referred	44	21,6	
Self-referred	56	78,4	
Total	<u>100</u>	<u>100</u>	
Referred from			p<0.01
Home	56,3	79,1	
Regional Hospital	21,1	11,8	
District hospital	9,8	3,8	
others	12,8	5,3	
Total	<u>100</u>	<u>100</u>	
Birth weight (g)			p<0.01
<2500	52,9	9,3	
≥2500	47,1	90,7	
Total	<u>100</u>	<u>100</u>	

Figure 5 illustrates the associations of education and number of stillbirths. The stillbirth number for no educated mothers is approximately three times the number of high educated mothers.

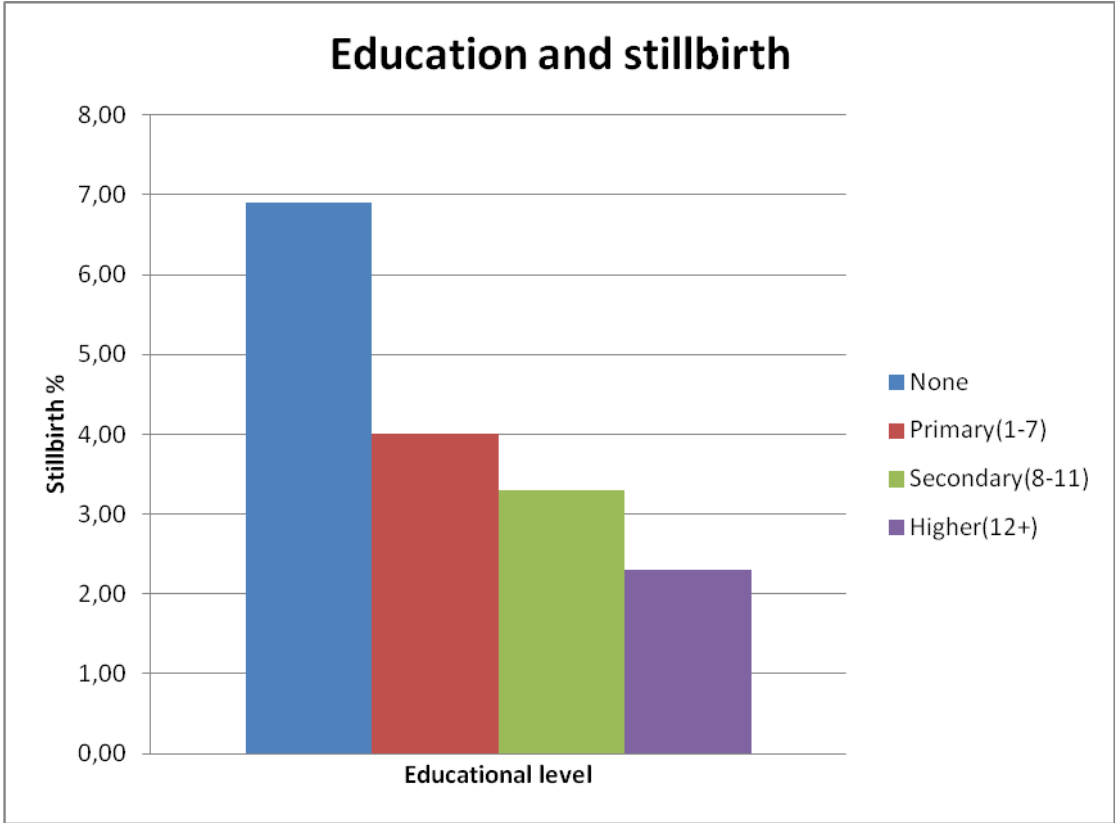


Figure 5. Association between maternal education and stillbirth

Characteristics of place, time and condition of stillbirths, are shown in Table 3. Most stillbirths occurred before admission to KCMC and before labour. This is consistent with most stillbirths described as macerated. Due to large missing data, the results are uncertain.

Table 3. Characteristics of 1153 stillbirths at KCMC, 2000-2010

	n=	%
Stillbirths	1153	3,6
Place of death	766	
Dead before admission	563	48,8
Dead after admission	203	17,6
Missing	387	33,6
Time of death	493	
Dead before labor	174	15,1
Dead during labour	110	9,5
Unknown	209	18,1
Missing	660	57,2
Condition	822	
Fresh	390	33,8
Macerated	432	37,5
Missing	331	28,7

Associations between stillbirths and socio-demography are shown in Table 4.

We found significant associations between higher age, multi-parity, no education and stillbirth. The urban and semi-urban population were stronger represented than the rural population (4,5%/ 5,0% vs. 2,6%). The share of referred mothers, were more than twice as many compared to self referrals (7,0% vs. 2,6%). Further, a higher percentage of stillbirths were referred from District hospital compared to other referral places.

Table 4. Associations of other demography and stillbirths

n=1153		
	%	
Age		p<0.01
<20	2,9	
20-24	2,9	
25-29	3,2	
30-35	4,1	
≥35	5,5	
Parity		p<0.01
0	3,1	
1-4	3,7	
≥5	8,2	
Antenatal care		p<0.01
1-3	5,7	
≥ 4	2,4	
Residence		p<0.01
Urban	2,6	
Rural	4,5	
Semi urban	5,0	
Tribe		p<0.01
Chagga	3,0	
Pare	4,4	
Masai	8,2	
Others	4,1	
Referral status		p<0.01
Referred	7,0	
Self referred	2,6	
Referred from		p<0.01
Home	2,6	
Regional Hospital	6,3	
District Hospital	8,7	
Other	8,2	
Birth weight (g)		p<0.01
<2500	16,9	
≥2500	1,8	

Characteristics of educational levels

Associations between educational levels and socio-demography are shown in Table 5. There was a higher percentage of young women <20 years with no education compared to other educational levels. The share of multiparas was higher in mothers with no education than in other educational levels. Opposite, the shares of nullipara were higher among secondary and higher educated women, compared to no education. As shown in Table 5, 40,9% of the no educated mothers were Masais. In comparison, only 9,1% of no educated mothers belonged to the Chagga or Pares tribes.

Among none educated, referred mothers were twice as many than self referred mothers.

All findings were significant, $p < 0.05$.

Table 5. Sociodemography in all educational levels

	Education (n=1153) %				
	None	Primary	Secondary	Higher	
Age					p<0,01
<20	18,6	7,1	17,3	4,7	
20-24	20,9	22,9	34,6	17,4	
25-29	20,9	25,1	21,2	32,6	
30-35	9,3	30,4	21,2	27,5	
≥35	30,2	29,3	52,9	45,6	
Parity					p<0,01
0	35,7	29,3	52,9	45,6	
1-4	45,2	62,3	47,1	53,5	
≥5	19	8,4	0	0,9	
Antenatal care visits					p<0,01
1-3	74,4	51,7	43,8	46,1	
≥4	25,6	48,3	56,3	53,9	
Residence					p<0,01
Rural	79,5	59,6	43,1	33,6	
Urban	13,6	34,2	51	56,6	
Semi Urban	6,8	6,2	5,9	9,8	
Tribe					p<0,01
Chagga	9,1	48,9	34,6	53	
Pare	9,1	15,9	13,5	15,3	
Masai	40,9	0,8	0	0,4	
Other	40,9	34,5	51,9	31,4	
Birthweight					p<0,01
<2500	51,2	51,2	54,9	58,1	
≥2500	48,8	48,8	45,1	41,9	
Referral status					p<0,01
Referred	70,0	47,7	49,0	26,5	
Self-referred	30,0	52,3	51,0	73,5	
Referred from					p<0,01
Home	30,8	52,7	54,2	74,8	
Regional hospital	33,3	23,9	22,9	8,6	
District hospital	23,1	10,5	6,3	5,2	
Others	12,8	12,5	16,7	11,4	
Condition of stillbirth					p=0,032
Fresh	58,1	47,4	65,8	41,6	
Macerated	41,9	52,6	34,2	58,4	

There were a higher share of 'fresh' stillbirths among none educated women, compared to high educated (58,1% vs. 41,6%). Contrary, a higher share of macerated stillbirths were found among high educated (58,4% vs. 41,9%). Further, as shown in Table 6, there are more stillbirths during delivery among none educated women compared to high educated.

Table 6. Associations between education and information on stillbirths

Educational level		None	Primary	Secondary	Higher
1.					
Dead before admission		71	77,1	73	62,7
Dead after admission		29	22,9	27	37,3
2.					
Dead before labour		18,8	33,8	37,5	37,4
Dead during labour		37,5	21,5	33,3	20,6
Unknown		43,8	44,7	29,2	42,1
3.					
Fresh		58,1	47,4	65,8	41,6
Macerated		41,9	52,6	34,2	58,4

1.p=0.005, 2.p=0.421, 3. 0.032

6. Discussion

6.1 General discussion

The main aim of the study was to investigate to what extent maternal education and stillbirth are associated at the Kilimanjaro Christian medical Centre (KCMC) in Tanzania.

The stillbirth rate was 36 per 1000 births. As expected, there was a significant association between stillbirths and maternal education. Non educated mothers had three times as many stillbirths than high educated mothers. Figure 5 illustrates the major gap of stillbirths between women with no education and primary educated women. A more discreet decline was seen between primary education and the other educational levels. The result indicates a possible major reduction of stillbirth by elevating educational level from none to primary.

Our study also showed significant associations between stillbirths and socio-demographic factors like age, parity, antenatal care visits, maternal tribe, residence, and referral information.

Tanzania has one of the highest stillbirth rates in the world, accompanied by Nigeria and Pakistan with even higher rates of 42 and 47 per 1000 births respectively. In comparison the stillbirth rate in Norway was 2,2 per 1000 births in 2009 (29). The stillbirth rate at KCMC of 36 per 1000 births is higher than the national number of 26 from 2009 (29). KCMC is a regional, tertiary referral hospital and receives severe obstetric cases from other hospitals or health personnel elsewhere. The number of stillbirths in KCMC will therefore be higher than on national basis.

There was a threefold proportion of stillbirths in women with no education compared to women with higher education of 12 years or more. We found an inverse gradient

between the level of education and proportion of stillbirths. This is in line with other studies (23, 27). A recent study from Canada, showed positive associations between maternal education and stillbirths at all gestational ages (49). Access to gestational ages was not available for comparison in this study.

Education in Tanzania could be seen as a scarce resource, where the most privileged have greater access to higher education. This leads to a huge economical gradient between educational levels. Numbers from Tanzanian Demographic health survey confirm how education increases with wealth (46).

Educational level is a commonly used proxy for socioeconomic status in epidemiologic research. We choose education as main indicator in this study, due to known associations to health.

Women with no education were under-represented in urban areas, with four times less the percentage of high educated mothers. Obviously, there were opposite findings for rural residency. Work opportunities could play a role here. Urban regions have a higher affinity to financial privileged and more educated people. Contrary, the less educated more often live rural closer to agriculture. Women in rural areas are more likely to meet obstacles concerning transport, costs, access to emergency of obstetric care (EmOC) etc. (19). These obstacles are summarized in 'The three delays theory' of Thaddeus and Maine, based on home births in low resource countries. The theory describes the key time periods for a birthing woman on her way to obstetric emergency care. The first delay occurs when seeking help. The unskilled birth attendant or a relative recognize the emergency too late. The second delay is reaching the health facility. Rural living without transportation could end lethal for both mother and child. The present study confirms

the association of residency and pregnancy outcome, as significant more stillborns were found among rural women.

In addition to all obstacles, rural mothers are also more likely to give birth at home with unskilled attendance (46). In this study, they may have reached KCMC too late. Another study from KCMC, confirm rural and semi urban living as risk factors for perinatal mortality (25). Although Kilimanjaro area is urban, it is obvious that rural, less educated women have great challenges on the way to KCMC.

An additional aspect of residency is access to antenatal care (ANC). In the present study there were two times more stillbirths among women with <4 ANC visits. The majority of these women did not have any education and assumable many lived rural.

Additional analyses showed that as much as 26,5% of all mothers with stillbirth had visited the ANC facility only once or twice. This means that for far too many women the recommended number of four visits was not fulfilled.

Regular ANC visits are emphasized to decrease perinatal mortality. Still, antenatal care visits alone are not preventive- competent ANC staff and adequate material standard are essential (32, 38). Numbers from Tanzania showed that the time used for first ANC visits was 6 minutes (32). In a hospital based study of maternal deaths in rural Gambia, substandard ANC was identified in 50% of all maternal deaths. Urine was tested only once in 95% of all cases and blood pressure in eclamptic women was checked every time in 75% (50).

In Tanzania, transportation is a major challenge, both due to costs and rural road conditions. As a result, rural health facilities are more vulnerable to interruptions in supply of drugs and medical equipment and for employees to get to work, especially in

the rainy seasons. One could speculate that insufficient quality of ANC regarding risk detection, treatment of diseases etc., in combination with less ANC visits, were contributing factors for stillbirths in our study.

Less ANC visits could be interpreted as late first visits. Opposite, many ANC visits could be seen as an early ANC start in pregnancy. According to WHO, the first visit is recommended as early as possible in the first trimester (32). Early ANC visit increases the detection of sicknesses which need closer follow-up. However, time for first ANC visit was not available in this study for further interpretation.

More women ≥ 35 years experienced a stillbirth in this present study. Both young and high maternal ages are known risk factors for stillbirth of medical and unknown reasons (2, 51). An additional explanation for the higher share of older mothers among stillborns could be increased consciousness of 'safe' facility based delivery. The majority of highly educated women in study, were in fact >35 years, which could support this theory.

Multiparity is a known risk factor of stillbirths, and in our study multipara had 2,6 times higher proportion of stillbirths compared to nulliparas (2). The majority of multipara did not have any education. This finding is consistent with national numbers, where the ideal number of children in none educated women was 6,0 compared to 3,7 in secondary level (46). The finding is linked to family planning, as use of contraceptive was twofold among women with secondary education compared to no education (46).

Even if a national referral system exists, emergency transport in Kilimanjaro is only provided between the regional birth center and KCMC (18). A significant association between referral status and stillbirth was therefore not surprising in our study. The share of referred, none educated mothers with a stillbirth were 2,6 times higher

compared to high educated mothers. Opposite numbers were seen for self-referrals. In-depth interviews with women in a hospital in Gambia illustrate why referrals in many cases come too late. Often danger signs in home births were not recognized and traditional beliefs, costs and or lack of transportation prevented the woman of seeking help (39).

Connecting the stillbirth data to the 'three delay model' is useful to make recommendations for further improvement. In our study approximately 50% of all stillbirths were already dead when admitted to KCMC. If this was due to first delays (delay in seeking help) or second delays (delay in reaching hospital), cannot be determined with our data. Most stillbirths are though described as 'macerated', which indicate the time of death to be >12 hours before birth. Our finding is not consistent with numbers from another regional hospital in western Tanzania, where third delays (in-hospital deaths) were found in 72,5% of all intrapartum deaths or deaths within first week of life (20).

Stillbirths in hospital during labour are in high resource countries a sign of medical malpractice. In our study the number was 9,5% but consists of stillbirths during labour both in- and outside KCMC as some babies die on the way to KCMC. Numbers of stillbirths during labour in KCMC, would have given important information about the quality of care in the hospital KCMC. It is important to notice that many preterm babies in poor countries are deliberately not saved during labour, as they are not viable in the present setting. The fact that the majority of all stillbirths were <2500 g underlines this.

A higher proportion of women with no education had a stillbirth during delivery compared to other educational levels. However, this finding is not significant. It raises on the other hand an interesting question about interpersonal influence. Are non educated

mothers more often met by prejudice or substandard quality of care from health personnel?

In another study from KCMC, low paternal education was associated with higher perinatal mortality (25). Further, it was questioned if these men are more traditional or conservative and whether this could have negative influences. In light of this hypothesis, one could speculate that non-educated women are more likely to have husbands with low education, which again influence their pregnancy outcome. On the other hand, 81,5% of all women in the Kilimanjaro area claimed to make decisions concerning own health care alone or jointly with their husband. Only Approximately 54% of women with no education and women with secondary level claimed the same (47).

The study showed that the Masais had a significant higher share of stillbirths. Masai mothers were also overrepresented among not educated. The Masais are a semi nomadic tribe and count one million persons in Kenya and Tanzania (52). Having many children is important for the Masai, and education is usually not prioritized as the children have to herd the cattle. However, during recent years more schools are built for Masai children. Attending ANC during pregnancy is rare, and home births with unskilled attendant are common (53). Traditional beliefs are strong and could prevent the Masai women to seek early obstetric help. For example, stillbirth is seen as a bad sign in the community and this may keep the birthing woman away from the hospital if the trust in traditional medicine is stronger (53).

In a doctoral thesis about the Masais, dietary 'rules' for pregnant women are described. In the first six months of pregnancy the Masai woman should not eat fatty food, and the last trimester she should only have maize, water and soured milk (53). One reason is to deliver smaller babies. Higher child mortality and 10% smaller babies among Masais

were found in one study (53). The effect to stillbirths is unclear, but negative outcome for pregnancy and the baby is easy to envision.

In 2002, the primary education development plan (PEDP) was implemented in Tanzania to enroll all primary school aged children. The United Nations girls' education initiative (UNGEI) was launched in the country at the same time. Tanzania was also one of the countries where intensive effort was done to reach the MDG 3 of gender equity in education. The plan was to get almost full coverage of primary enrollment within 2006. However, the numbers for 2010 show a still increasing net attendance ratio of 78% (46). Abolishing school fees, communication with local community, training of teachers and improve the school facilities are some initiatives taken to increase the primary school attendance. Although primary school enrollment is increasing, secondary school has low attendance especially from girls. This is confirmed in a study from rural Tanzania, where high female drop out numbers from secondary school were found. Adolescent pregnancies, early marriage and need for hostel services were some of the reasons for drop out (54). The secondary school enrollment was approximately 25% for both boys and girls in 2010 (46). And the work for higher enrollment also for secondary school should be continued. In the meantime the African proverb 'if we educate a boy, we educate one person. If we educate a girl, we educate a family' should not be forgotten. This is the foundation to improve a family's socio-economic status and further to improve the future perinatal outcome.

6.2 Limitations and strengths

The study is register based with referred or self-referred women to KCMC. Other studies have shown that most women delivering at KCMC come from the Kilimanjaro area, where approximately 30% deliver at home (DHS 2010). The study data cannot be seen as representative for the population in the area, due to referrals from other regions and, the number of homebirths. Due to registration fees and extra fee for extended treatment, it is probably that the study sample consists of rather wealthier women.

The register data consist of huge valuable information, but at the same time, this data could contain several errors. The data are noticed by different persons, both day and night and tick-off mistakes are unavoidable. For some variables there were a large proportion of missing values, which make these data unreliable.

Additionally, data from 32252 women during 10 years could contain data from the same women giving birth several times in this timeframe. The numbers can therefore not be interpreted as 32252 different women, just different births.

Earlier investigation has shown a great underreporting of maternal deaths at KCMC. The same problem can be assumed for stillbirths.

7. Conclusion and recommendations

7.1 Conclusion

KCMC is a regional, referral hospital in north eastern Tanzania. The stillbirth rate at KCMC in north east Tanzania is 36 per 1000 births. Women without formal education had a higher stillbirth rate than women with higher levels of education. The greatest

difference in stillbirth numbers was found between women with no education and women with some (primary) education.

Maternal socio-demographic factors like age, parity, tribe, residence and number of antenatal care visits (ANC) were also associated with stillbirths. In addition maternal referral status was linked with stillbirth.

The majority of all stillbirths occur in Sub-Saharan Africa. Education is a door opener to better health and living conditions for many women in low-income countries.

To decrease the stillbirth numbers, a multifaceted approach is necessary. Continuous attention to girls' education is warranted. Health education is shown to increase consciousness about pregnancy, antenatal care, and skilled attendance at birth and family planning. Improved rural living conditions and an extended referral system are also known to be crucial.

7.2. Recommendations

Birth registrations are crucial for preventive strategies of stillbirths. Improved data concerning time and place of all stillbirths would contribute to increased consciousness among health personnel and hopefully less tragic in-hospital stillbirths. A large number of in-hospital deaths tell us that hospital routines should be revised. Implementation of routine perinatal audit could be the first step.

First and second delays were the major delays in this study. More health education for everyone and available transportation in remote areas are strongly emphasized.

Mothers, who cannot afford hospital treatment at KCMC, would benefit from decreased user-fees.

The study highlights the importance of education. Even more effort to increase school enrolment in rural areas and motivation to take secondary and higher education, would give several positive effects beside health improvement.

8. Further research

Further studies about factors contributing to third delays after admission to KCMC could reveal useful information for implementation of strategies to reduce stillbirths. Further investigation of the role of socio-economic factors in stillbirths is also necessary. Of particular interest are the Masai women. More knowledge about conceptions about pregnancy and pregnancy related risk behavior among Masai women could reveal important information to inform preventive strategies to reduce stillbirths.

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