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Impact of a Newborn Community Health Project in rural Kenya

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Acronyms and Definitions

Acronyms

AIC	African Inland Church
AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
CHEW	Community Health Extension Worker (of the Kenyan government)
CHW	Community Health Worker (of the Kenyan government)
CI	Confidence Interval
HIV	Human Immune deficiency Virus
KEPH	Kenya Essential Package for Health
MDG	Millennium Development Goal
NCH	Newborn Community Health
NCHF	Newborn Community Health Facilitator (of the “Newborn Community Health Project”)
NHIF	National Hospital Insurance Fund
NMR	Neonatal Mortality Rate
OR	Odds Ratio
PNC	Postnatal Care
UNICEF	United Nations Children Fund
WHO	World Health Organization

Definitions

- Under-five mortality rate
Probability of dying between birth and under five years of age per 1,000 live births ⁷³
- Infant mortality rate
Probability of dying during the first year of life per 1,000 live births ⁷³
- Neonatal mortality rate
Probability of dying between birth and 28 days of age per 1,000 live births ⁷³
- Early neonatal mortality
Probability of dying between birth and the first week of life per 1,000 live births ⁵⁸
- Perinatal mortality
Probability of dying in the first week of life per 1,000 live births plus stillbirths (>22 weeks gestation) ⁸⁰

- Sub-Saharan Africa
Eastern and Southern Africa; West and Central Africa; Djibouti and the Sudan ⁷³
- Eastern and Southern Africa
Angola; Botswana; Burundi; Comoros; Eritrea; Ethiopia; Kenya; Lesotho; Madagascar; Malawi; Mauritius; Mozambique; Namibia; Rwanda; Seychelles; Somalia; South Africa; Swaziland; Uganda; United Republic of Tanzania; Zambia; Zimbabwe ⁷³
- West and Central Africa
Benin; Burkina Faso; Cameroon; Cape Verde; Central African Republic; Chad; Congo; Côte d'Ivoire; Democratic Republic of the Congo; Equatorial Guinea; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Liberia; Mali; Mauritania; Niger; Nigeria; Sao Tome and Principe; Senegal; Sierra Leone; Togo) ⁷³

1. Introduction and Background

1.1. Millennium Development Goals

In September 2000, heads of 193 United Nation states and 23 international organizations came together in New York for the United Nation Millennium Summit. They developed and agreed to achieve the eight Millennium Development Goals (MDG) by the year 2015. Baseline data for comparing the final achievements in 2015 was assessed to be the year 1990. The goals of the MDGs are as follows:

1. Reduce extreme poverty and hunger by half
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce under-five mortality by two-third
5. Reduce maternal mortality by three-quarters
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

A certain amount of progress has been made in a number of areas. The global poverty rate in developing regions has halved from 47% in 1990 to 22% in 2010 ⁷⁷. School fees have been abolished in several sub-Saharan African countries with a dramatic increase in school attendance ⁷². Between 1990 and 2011, the literacy rate of children ages 15 to 24 increased from 83% to 89% worldwide ⁷⁷. In 2011, the gender parity index was already 96% or higher in most developing regions ⁷⁷. Due to health programs and vaccination, despite population growth, the number of deaths in children under five declined worldwide from 12.6 million in 1990 to 6.6 million in 2012 ⁷⁴. The maternal mortality ratio was nearly halved worldwide between 1990 and 2010 ⁷⁷. Within the last decade, more than one million deaths from malaria were prevented, with a reduction in malaria cases of 25% worldwide ⁷⁷. Worldwide, the Human Immune deficiency virus (HIV) incidence rate declined by 21% between 2001 and 2011, and access to HIV treatment continues to increase ⁷⁷. Between 1990 and 2011, 2.1 billion people have gained access to clean drinking water ⁷⁷. In 2005, fewer than 50 countries were offering mobile broadband services commercially; in 2010, this service was available in 143 countries ⁷⁶.

These facts should not give the wrong impression that all eight MDGs will be reached. Despite some optimistic changes and achievements, it is evident that many of the goals will not be achieved by 2015 and achievements will not be equal in all areas of the world. Some significant progress has been made to change the situation of many people for the better, but programs are failing to target the most vulnerable of society. As experts are thinking about new goals such as “universal health coverage” beyond 2015, it is time to reflect critically on why some of the goals have not been reached and what would be needed to achieve them.

1.2. Situations of newborns and mothers

Searching for new interventions and intervention packages to achieve MDGs makes it necessary to take a closer look at the situations people face worldwide. Since this thesis deals with the analysis of a project whose intention is to reach MDG 4 and 5, the perinatal situation of neonates and their mothers will be described and summarized in the following passages of the introduction.

1.2.1. Situation of newborns and mothers worldwide

1.2.1.1. Situation of children worldwide

There are 2.2 billion children in the world; 1.9 billion (86.4%) of them are living in developing countries and half of them live in poverty on less than \$ 1.25 a day ⁷⁰. Economics and the University of Bristol revealed that more than one billion children are deprived of at least one of their rights to education, water and sanitation, access to information, essential health care, nutrition and shelter ⁷¹.

Data published by the United Nations Children Fund (UNICEF) in 2005 confirm these facts: one in seven children (270 million) has no access to health services and the situation is even worse in South Asia and Saharan Africa, where one in four children neither receives any of the principal immunizations nor has access to treatment if suffering from diarrhea ⁷⁰.

The total number of under-five deaths was 6.6 million children in 2012, which means that every minute 13 children under five die worldwide! Almost half of these deaths (3.2 million) happen in sub-Saharan Africa, followed by South Asia (30%) ⁷⁴.

Over the last two decades, progress in lowering under-five mortality accelerated with the global annual rate of reduction increasing from 1.2% in 1990-1995 to 2.3% in 1995-2000 and 3.8% in 2000-

2012. Worldwide, the under-five mortality rate has halved from 90 deaths per 1,000 live births in 1990 to 48 in 2012 as illustrated in Figure 1.^{31 74}

When looking at this encouraging trend in more detail, there is a big difference between the under-five mortality rates of developed and developing countries:

In 1990, 15 under-five children

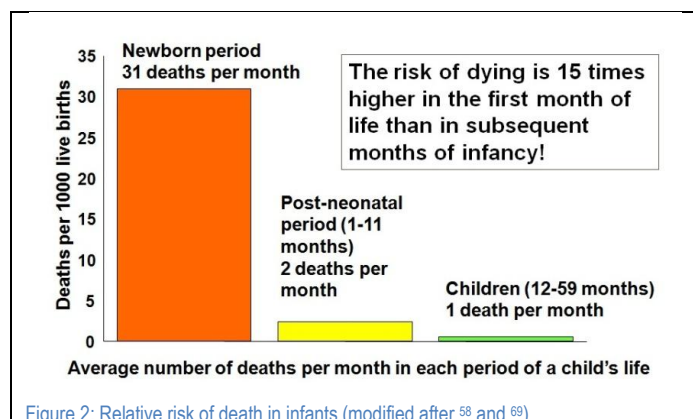
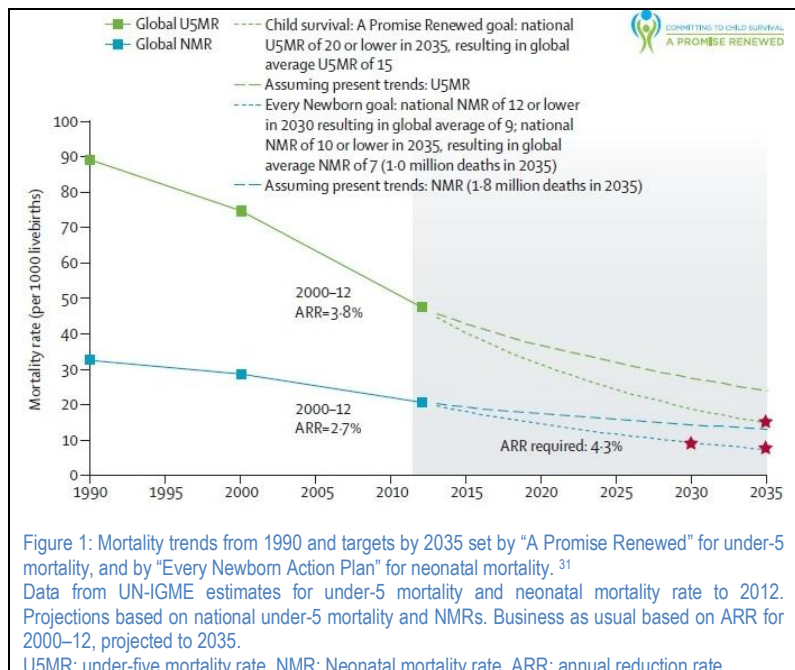
out of 1,000 live births died in developed countries; this number declined to 6 in 2012 – a decline of 57%⁷⁴. In Germany under-five mortality has been very stable for many years and as low as 4 per 1,000 live births⁷³.

However, in developing countries, the under-five mortality rate dropped from 99 deaths in 1990 to 53 in 2012, a total reduction of 47%. While some poor countries like Bangladesh, Eritrea, Malawi, Nepal, and Tanzania managed to reduce their under-five mortality by two-thirds, other countries like Swaziland, Somalia, and Equatorial Guinea have seen no, or hardly any progress^{74 76}. In 2010, among the 67 countries with under-five mortality rates above 40 per 1,000 live births, only ten countries were on track to meet MDG 4⁷⁵.

Compared to under-five mortality rates, there is a much slower reduction of only 2.7% per year for newborns in their first month as illustrated in Figure 1³¹. This trend leads to an increase of the proportion of neonatal deaths among under-five mortality worldwide from 36% in 1990 to 44% in 2012.^{17 31 32 74 77}

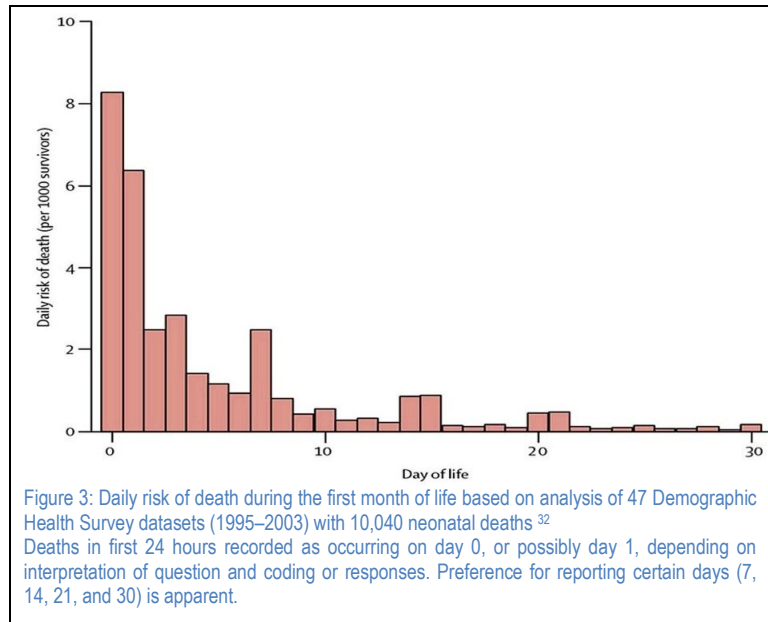
As illustrated in Figure 2, out of 1,000 live births, 31 children die within the first 28 days of life (newborn period), whereas only two children die between the ages of two months to one year

(post-neonatal period). Only one child out of 1,000 live births dies between the ages of one to five



years. These numbers imply that the risk of dying is 15 times higher in the first month of life than in any subsequent month of infancy and that the neonatal period represents the most vulnerable time for a child's survival! Therefore, special attention has to be given to the neonatal period in order to reduce child mortality.⁵⁸

Of all children who die in the neonatal period, 50% die within the first 24 hours of life and 75% within the first week, as shown in Figure 3³². As a consequence of this, the hours and days immediately after birth are the most dangerous times for a newborn, and have the highest risk for death.



Through multicausal proportionate

mortality models, Black et al. analyzed the reasons for deaths in under-fives. 68% of these are due to infectious diseases (e.g. pneumonia 18%, diarrhea 15%, malaria 8%). Within the neonatal period, children die due to preterm birth complications (29%), birth-related complications (e.g. asphyxia 21%), neonatal infections (sepsis 15%, pneumonia 10%), congenital abnormalities (7%) or other reasons (18%).¹¹

1.2.1.2. Situation of mothers worldwide

Giving birth is said to be a natural process. Nevertheless, more than half a million women die from causes related to pregnancy and childbirth every year⁷¹. In 2010, 210 maternal deaths happened per 100,000 live births with a lifetime risk of one in 180⁷³. Lifetime risk of maternal death takes into account both the probability of becoming pregnant and the probability of dying as a result of pregnancy, accumulated across a woman's reproductive years. This risk is 300 times greater for women living in the least developed countries than it is for those from industrialized countries⁷¹.

There are various reasons for this phenomenon (Table 1): early marriages, including pregnancy and delivery while still young, which lead to school drop-out resulting in low education; staying in rural areas where there is lack of access to health facilities and lack of good nutrition leading to malnutrition and underweight; female genital mutilation/cutting; and unsafe delivery methods.

UNICEF global databases, accessed in 2010, which included data from 31 countries in South Asia and sub-Saharan Africa, showed that most marriages take place between the age of 15 and 18 ⁷². Being young is in itself a potential risk for every pregnancy. In Latin America, for example, a study demonstrated that girls who give birth before the age of 16 are three to four times more likely to suffer maternal death than women in their twenties ¹⁴.

Table 1: Reasons for high maternal deaths worldwide

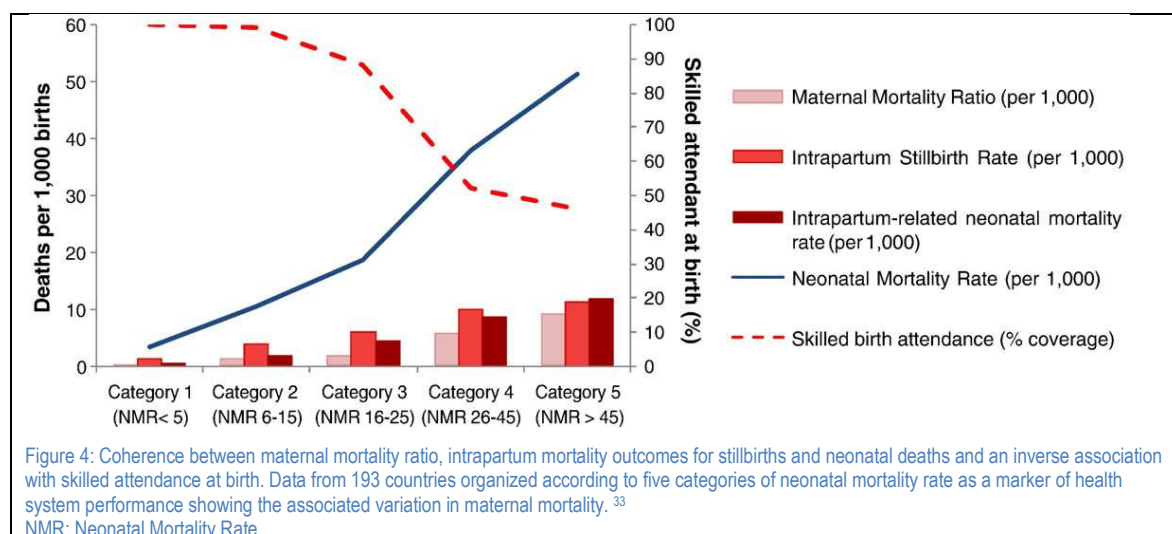
Reasons for high maternal deaths worldwide:

- Early marriage
- Early pregnancy and delivery
- Low education
- Living in rural areas
- Lack of access to health facilities
- Unsafe delivery methods
- Malnutrition
- Female genital mutilation/cutting

Complications related to pregnancy and childbirth account for the majority of deaths for adolescent girls between the ages of 15 and 19 in low- and middle-income countries ⁸¹.

The younger a mother is, the higher the risk for early school drop-out. The level of education of the mother can be a powerful determinant of both the mother and her child's survival: educated women are less likely to die during childbirth ⁷¹. The United Nations revealed that the under-five mortality rate of children in developing countries is 1.3 times higher for mothers with no education compared to those who attended primary school, and 2.1 times higher compared to those mothers who attended secondary school ⁷⁶.

During delivery, the main causes of maternal death are obstetric hemorrhage, hypertensive disorders, sepsis, complications of unsafe abortions and complications from delivery ⁵⁹; these causes can be addressed by skilled attendants, who significantly lower the risk for maternal and newborn death. Based on systematic researches and meta-analysis addressing various aspects of intrapartum care, Figure 4 illustrates the direct coherence between maternal mortality, newborn mortality, and skilled attendance.



A skilled attendant is defined to be a competent health care professional who has the required equipment, drugs and supplies and who has an adequate referral system in place. It is well recognized that skilled attendance is far more than just the presence of a doctor, nurse or midwife at delivery. Skilled attendance at delivery also means developing an “enabling environment” in the community to connect women with existing health services. In addition, the term “enabling environment” implies providing adequate supplies and equipment, transport, effective communication systems, political will, socio-cultural influences, and sufficient training of skilled attendants. ¹

1.2.1.3. Interventions to improve perinatal mortality

Through different approaches, an attempt is being made to respond to the perinatal situation of mothers and newborns. In the last decade evidence from over 100 interventions was tested worldwide in different countries – over 40 of them in randomized controlled trials ³⁴. In the future, the implementation and effectiveness of different intervention packages will need to be tested at different levels of the health system. A summary of interventions to reduce neonatal mortality is given in Figure 5.

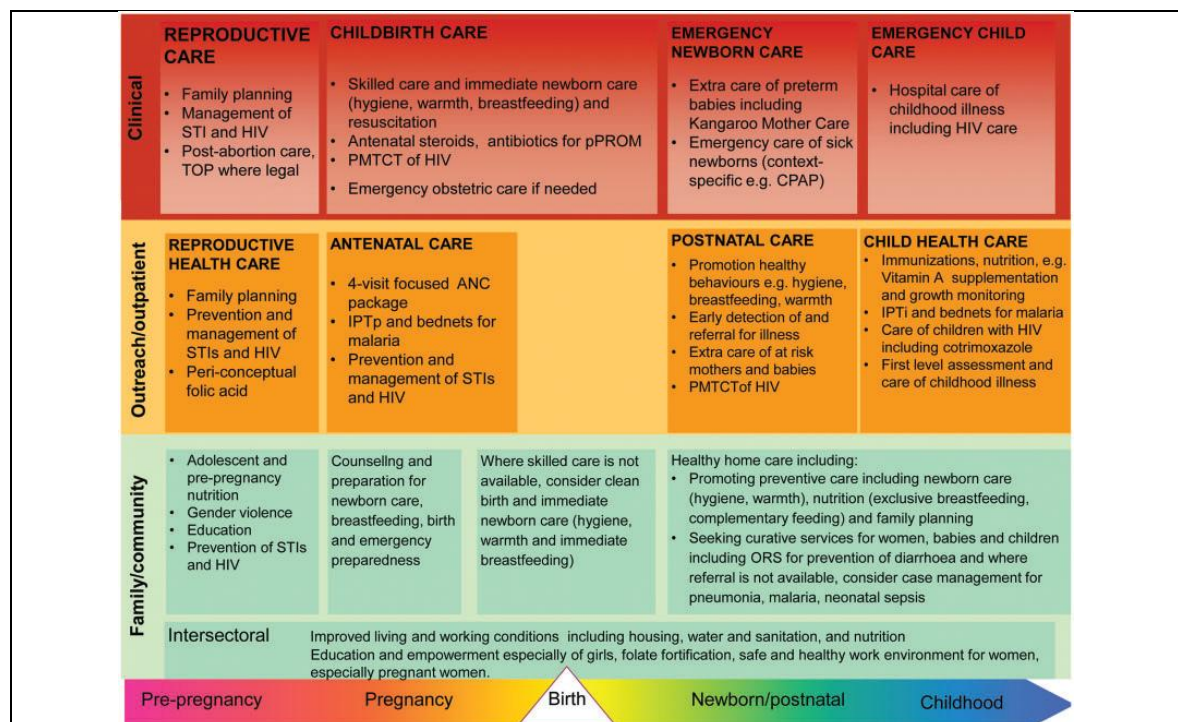


Figure 5: Integrated service delivery packages for maternal, newborn and child health

Source: Kerber et al. (2007), first published in Disease Control Priorities in Developing Countries chapter (Lawn et al. 2006b), then revised and specific adaptation for Africa. This figure has been updated with newborn health interventions ³⁴

ANC: Antenatal Care; CPAP: continuous positive airway pressure; HIV: human immunodeficiency virus; IPTi: intermittent preventive treatment in infants; IPTp: intermittent preventive treatment during pregnancy for malaria; ORS: oral rehydration solution; PMTCT: prevention of mother-to-child transmission of HIV; pPROM: prelabor premature rupture of membranes; STI: sexual transmitted infection; TOP: termination of pregnancy

Five of the major intervention packages at the community level are presented in the following paragraphs:

From 1996 to 2003, the Society of Education, Action, and Research in Community Health (SEARCH) with Bang and colleagues carried out a controlled, not randomized trial in Gadchiroli district, rural India. The emphasis of this trial was to evaluate the effect of home-based neonatal care and management of sepsis on neonatal mortality. Home-based neonatal care, including the health education and training of birth attendants, and the institution of supervised village health workers who carried out home visits on newborns, identified danger signs, and managed sepsis with antibiotics, reduced neonatal and infant mortality by nearly 50% as well as maternal mortality by 80% after three years of intervention.^{5 57}

In 2004, the Saksham Study Group with Darmstadt carried out a cluster-randomized controlled trial in Shivgarh, Uttar Pradesh, rural India, the purpose of which was to analyze the effect of community-based behavior change management on neonatal mortality. A behavior change management approach promoting interventions to prevent high-risk newborn care practices at the community level led to substantial behavior modification and reduction of neonatal and perinatal mortality by over 50%. The study highlights the importance of understanding the existing socio-cultural context when translating scientific evidence into effective and sustainable delivery strategies at the community level.²⁸

From 2003 to 2005, the Projahnmo Study Group, together with Baqui and Darmstadt, carried out a cluster-randomized controlled trial in Sylhet district, Bangladesh. In the home-care arm, community mobilization and behavior change communication was offered. In addition, female Community Health Workers (CHW) helped identify pregnant women, made two antenatal home visits to promote birth and newborn-care preparedness and also made three postnatal home visits, in which they referred or treated sick neonates. Neonatal Mortality Rate (NMR) was reduced in the home-care arm by 34% during the last six months of intervention versus that in the comparison arm. No mortality reduction, however, was noted in the community-care arm, where birth and newborn-care preparedness and care-seeking from qualified providers were promoted solely through group sessions.^{6 57}

From 2001 to 2003, Costello and colleagues carried out a cluster-randomized control trial in 24 clusters in rural Nepal analyzing the effect of a participatory intervention on birth outcomes with women's groups. Participatory learning was emphasized over giving instructions at the monthly women's groups, which were convened by a local woman facilitator who had no health background

but solely a grasp of perinatal issues. Interventions reduced neonatal mortality by 30%, even though only 8% of married women of reproductive age ever attended a group. However, the groups attracted 37% of newly pregnant women, and members raised awareness of perinatal issues outside the groups themselves. ⁴²

In 1997, Kidane and Morrow carried out a cluster randomized controlled trial in Ethiopia with the aim of establishing a satisfactory strategy for reducing high child mortality from malaria in tropical Africa. Findings of this study showed that a decline in under-five mortality by 40% can be achieved by training mothers to recognize symptoms of malaria and promptly start with treatment. ^{27 57}

1.2.2. Situations of newborns and mothers in sub-Saharan Africa

1.2.2.1. Situation of children in sub-Saharan Africa

The highest levels of under-five mortality in the world continue to be found in sub-Saharan Africa, where one in 11 children dies before the age of five (98 deaths per 1,000 live births): nearly twice the average in developing regions overall and around 16 times the average in developed regions ⁷⁴. Based on reports from UNICEF, in 2011 there were still 31 countries with over 100 deaths per 1,000 live births in under-fives ⁷⁶; two years later, in 2013, there are now only 16 countries in the world with over 100 deaths per 1,000 live births – all of them in sub-Saharan Africa ⁷⁴.

In sub-Saharan Africa, the under-five mortality rate decreased from 178 in 1990 to 109 in 2011; infant mortality rate decreased from 107 in 1990 to 69 in 2011, and NMR was 34 in 2011. ⁷³

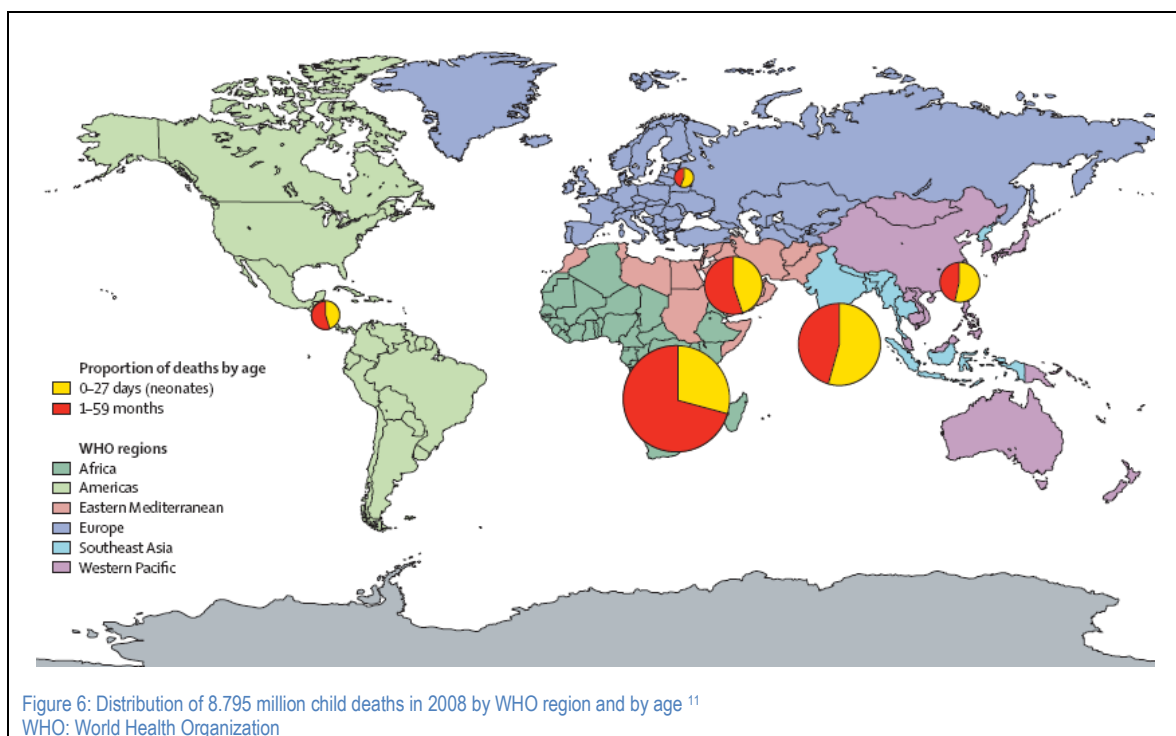
But there are differences between the diverse parts of the African continent: West and Central Africa have the highest under-five, infant and neonatal mortality rates (132; 83; 39) of the continent where one in seven children dies before the fifth birthday. The lowest rates on the continent are found in North Africa (36; 28; 16). ⁷³

Almost half the reasons for the high numbers of deaths, particularly in sub-Saharan Africa, can be attributed to diarrhea, malaria and pneumonia; malnutrition is an underlying cause of a third of these deaths ¹¹. In addition to that, HIV plays an important role, because 91% (3.1 million) of the 3.4 million HIV-positive children under age 15 in the world live in sub-Saharan Africa. 15.2 million children have been orphaned by AIDS (Acquired Immune Deficiency Syndrome) in sub-Saharan Africa. ⁷³

Another risk factor for child death is poverty: Data from 66 countries in 2008 have shown that children from the poorest 20% of households have a far higher risk (up to 2.9 times higher) of dying before their fifth birthday as children from the richest 20% of households ⁷⁶. Worldwide, the poorest

people are found in sub-Saharan Africa, where 53% live below the international poverty line of \$ 1.25 per day ⁷³.

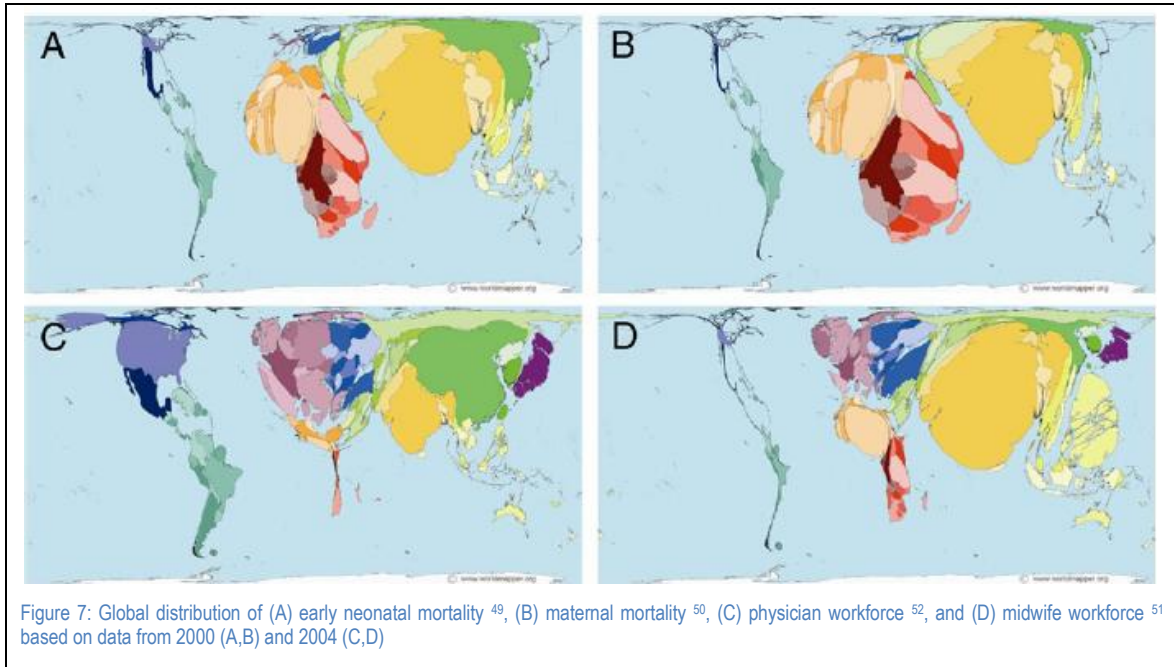
In 2008, 4.299 million deaths occurred in children under five in Africa. 29% of these children (1.224 million) died within the first month of life. In South Asia, 2.390 million children under five years died in 2008, with 54% (1.295 million) dying within the neonatal period. This means that neonatal deaths occurred in more or less equal numbers in both regions, but more children between the ages of two months and five years were dying in sub-Saharan Africa than in South Asia (see also below Figure 6). The higher proportion of infant deaths in sub-Saharan Africa are due to malaria (16%, 0.677 million) and AIDS (4%, 0.181 million), whereby these two causes combined determined only about 1% (0.024 million) deaths in South Asia. Despite great interventions that took place in South Asia, as already mentioned above, the NMR is still very high. Programs have to address that issue to sustainably reduce the under-five mortality rate by a significant amount. ¹¹



1.2.2.2. Situation of mothers in sub-Saharan Africa

The Ethiopian model and maternal health advocate Liya Kebede said: “How many of us realize that in much of the world, the act of giving life to a child is still the biggest killer of women in child-bearing age?” In sub-Saharan Africa, maternal death dropped from 870 deaths per 100,000 live births in 1990 to 500 deaths in 2010 ^{73 76}. This means that in 2008, one out of 200 mothers did not survive

pregnancy or delivery! “Maternal deaths are concentrated in sub-Saharan Africa and South Asia, which together accounted for 87% of such deaths globally in 2008.”, as revealed by the United Nations ^{76(p29)}. This statement is impressively illustrated in diagram B of Figure 7.



Compared to South Asia where steady progress led to a 53% reduction in maternal mortality between 1990 and 2008, the ratio dropped by only 26% in sub-Saharan Africa ⁷⁶.

Even though the prevalence of female genital mutilation/cutting is declining, there are globally still more than 70 million girls and women aged 15 to 49 who have undergone this practice, which can do significant long-term damage and heightens the risk of complications during childbirth for both mother and baby ⁷². The UNICEF global database accessed in September 2010 declared that 28 out of the 29 countries of the world where the prevalence of female genital mutilation/cutting is higher than 1% are located in Africa ⁷². According to data collected from 2002 to 2011, 40% of women in sub-Saharan Africa underwent female genital mutilation/cutting; 21% of women aged 15 to 49 years believe that this practice should continue ⁷³.

Compared to 1990, many more pregnant women are offered at least minimal health care services globally. In 2011, 81% of pregnant women in developing countries have been tended to at least once by skilled health personnel during pregnancy ⁷⁷. Basic Antenatal Care (ANC) provides women with a package of preventive interventions, including training them in the skills they will need as a mother (for example about the importance of exclusive breastfeeding for six months preventing sudden

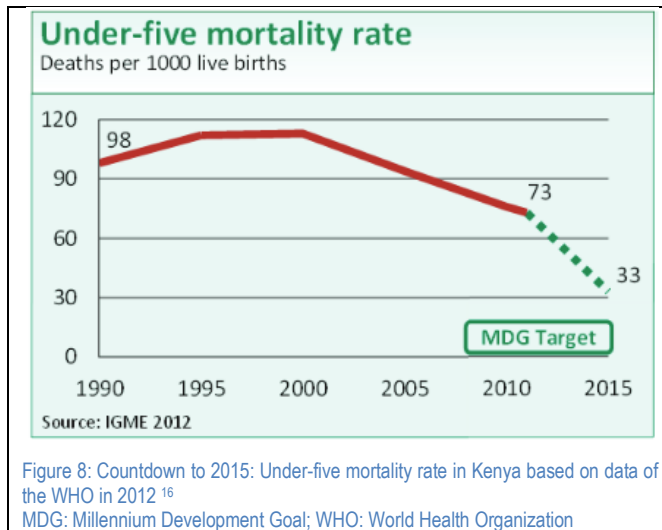
infant death), educating them about strengthening their immune systems and bodies (for example by eating a balanced diet, taking additional vitamins (folic acid) and drugs (malaria-prophylaxis)), strengthening their compliance in regard to living a healthy life and encouraging them to consider developing a birth plan ahead of time (for example choosing a birth partner and health facility where they want to give birth, collecting money for paying the bill for delivery at the health facility), and teaching them about possible danger signs in pregnancy (for example premature labor and decrease of fetal movements). Furthermore such an ANC-visit gives chances to detect and address complications in both mothers and unborn children (for example eclampsia, pelvic presentation of the child inside the womb, antiretroviral therapy during pregnancy in order to prevent transmission in HIV-positive mothers). At least four of these ANC-visits are recommended for pregnant mothers, but only 49% of pregnant women in sub-Saharan Africa received that care in 2011 ⁷⁷.

Family planning methods support maternal health by avoiding unsafe abortions and unintended and closely spaced pregnancies. Worldwide, about 140 million women who are married or in unions do not use contraception even though they would like to delay or avoid pregnancy. Globally, the prevalence of contraception is by far the lowest on the African continent; maternal mortality is lower in those African countries where levels of contraceptive use and skilled attendance at birth are relatively high. Sub-Saharan Africa as a whole has the world's highest maternal mortality ratio, with a contraceptive prevalence of only 25%, and only 46% made use of a skilled attendant. Comparing different regions of the world, where skilled attendants are present at delivery, sub-Saharan Africa is the tail end of the world ^{76, 77}.

1.2.3. Situation of newborns and mothers in Kenya

1.2.3.1. Situation of children in Kenya

As in many developing countries, many newborns in Kenya are not registered right after birth. Sometimes this happens a few months or even years later, when parents need official documents for their child. In 2009, the annual birth rate in Kenya was expected to be 1.529 million, but birth registration was 76% in urban areas and only 57% in rural areas. Currently, there are 43.178 million people living in Kenya, with 6.956 million (16.1%) of them under the age of five years. Life expectancy for a child born in Kenya in 2012 is on average 61 years. ⁶⁶



As illustrated in Figure 8, the under-five mortality rate in Kenya was 98 per 1,000 live births in 1990, rose to 110 in 2000 and declined to 73 with a total of 108,000 under-five deaths in 2012. 37% of all under-five deaths occurred during the neonatal period.⁷⁴

The average annual rate of reduction between 1990 and 2011 was 1.4%.

Compared to 1990, the under-five mortality rate was reduced by 26% and by 36% since 2000. In 2011, the infant mortality rate was 48 per 1,000 live births and the NMR 27.⁷³

There was hardly any change in the NMR in the last two decades^{72 73}.

Looking at the situation of newborns in Kenya, 8% of infants were born with low birth weight. A bit more than half (58%) of all newborns were breastfed within the first hour of life and about a third (32%) of them were exclusively breastfed for less than the recommended six months.⁷²

16% of children under-five are underweight (below minus two standard deviations from median weight for age of the World Health Organization (WHO) Child Growth Standards) and 35% of all children in Kenya suffer from moderate or severe stunting! Stunting is a measure of low height for age and is caused by poor nutrition and diarrhea; the life-long and severe consequences of stunting include, for example, poor cognitive and educational performance.⁷³

In sub-Saharan Africa, Kenya is one of the leading countries with very high immunization rates: For many years, rates between 87% and 92% have been found in Kenya. The rates of medical care of under-fives in Kenya do not exceed the average of other countries of sub-Saharan Africa to such an extent: in Kenya, 56% of under-fives with suspected pneumonia have been taken to an appropriate health-care provider (49% in sub-Saharan Africa) and only 39% of all under-fives with diarrhea receive oral rehydration and continued feeding (32% in sub-Saharan Africa).⁷³

In 2011, approximately 1.6 million people were infected with HIV in Kenya, which means that about 5% of all people infected with HIV in this world come from Kenya. Of them, 0.22 million children below 14 years lived with the virus. There are 2.6 million orphans below 17 years in Kenya, about half of them (42%) due to HIV/AIDS.⁷³

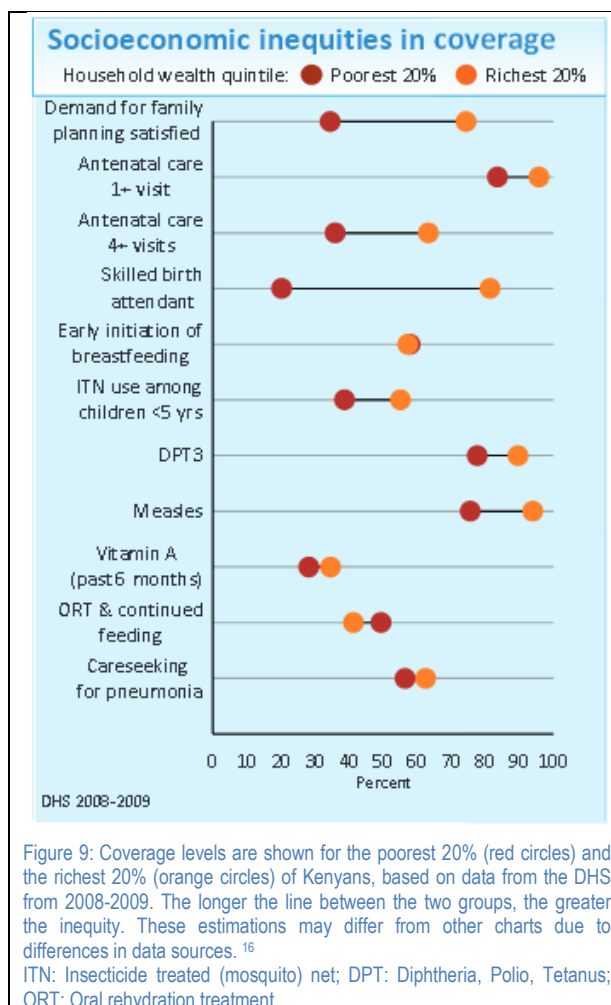
1.2.3.2. Situation of mothers in Kenya

The adjusted maternal mortality ratio was 490 per 100,000 live births in 2010. In 2010, a Kenyan woman gave birth to 4.7 children with a lifetime risk of maternal death of one in 55! ⁷³

The high maternal mortality can be attributed, for example, to high numbers of teenage pregnancies, low education, very high poverty rates combined with the great socioeconomic inequities in coverage of perinatal related aspects, and the inadequate level of emergency obstetric care in Kenya.

According to recent data from UNICEF, 26% of women in Kenya give birth before the age of 18 and 75% of girls in Kenya attend primary school, but only 42% attend secondary school. ⁷³

92% of all pregnant women attended at least once before giving birth, but only 47% of them attended the ANC-clinic at least four times, as generally recommended. ⁷³



43% of Kenyans live below the international poverty line of \$ 1.25 per day ⁷³.

As illustrated in Figure 9, multiple aspects of perinatal- and health-related issues depend on one's economic situation: in particular, the rates of skilled attendance at birth show the greatest inequity: Among the richest 20% of Kenyans, 81% of pregnant women deliver under skilled attendance, but only 20% of pregnant women who belong to the 20% poorest people in Kenya deliver under supervision of a skilled attendant. ⁷²

6% of women in Kenya give birth to their children through cesarean-section ⁷³. Cesarean-section rates between 5 and 15% are considered to be an indicator for an adequate level of emergency obstetric care. Although Kenya seems to (just) reach this

average level of obstetric care, accessibility to obstetric emergency care is not equally distributed all over the country: in urban areas, 9% of women deliver through cesarean-sections, whereas in rural

areas only 3% have cesarean-section according to global databases 2010 ⁶⁸. Other numbers underline the low coverage of inadequate medical care: in 2011, 0.2 physicians provided medical care for 1,000 Kenyans (in comparison: 3.8 physicians in Germany provided care for the same amount of people in 2011) ⁶³.

1.2.3.3. Interventions to improve perinatal mortality in Kenya

The Kenyan government recognized the alarming situation of pregnant women and newborns and responded to it in 2006: Kenya's second National Health Sector Strategic Plan defined a new approach to the way the sector will deliver health care services to Kenyans, which is called the "Kenya Essential Package for health" (KEPH). This plan introduced six life-cycle cohorts ensuring that each age cohort receives health services according to its needs that are likely to result in health improvement in the overall population ⁴⁶.

One of the key innovations of KEPH is the recognition and introduction of level one service, which is aimed at empowering households and communities to take charge of improving their own health. Level one service intends to provide Kenyans with basic community health services which focus on effective communication aimed at behavior change, disease prevention, access to safe water and basic care ⁴⁶.

The objectives of KEPH are to establish a level one care unit to serve a local population of 5,000 to 10,000 people with community health care. Community Health Workers (CHWs) should be trained, each providing that service to 20 households. Every 25 CHWs are supported with a Community Health Extension Worker (CHEW). Recruitment and management of CHWs is carried out by village and facility health committees and strengthens the health facility and community linkages through providing level one services. ⁴⁶

KEPH includes training of CHWs, which is in general a highly accepted strategy in many sub-Saharan African countries. Experts, who did research about the performance of CHWs in Kenya, stated: "Compared with health facilities, CHWs are geographically closer and available when health facilities are closed; moreover, CHWs are community members, and therefore cultural and linguistic barriers that may be present at health facilities are overcome." ^{24(p1)}.

In general, CHW programs focus on educational efforts about topics like sanitation, hygiene, prevention of malaria, family planning services, and improving immunization for children and care for pregnant women ³⁹. Training of the CHWs consists of a five day 9am to 5pm seminar and certificates of completion are given. KEPH defined the objectives for the two life-cycles of mothers and young children as follows:

1. Introduction and Background

Table 2: Service activities and requirements of Kenya's second National Health Sector Strategic Plan at level one, by cohorts in a population of 5,000 ⁴⁶
CHEW: Community Health Extension Worker (by the Kenyan government)

Life cycle	Service activities:	Human resource
Pregnancy, delivery and newborns (first two weeks of life)	• Provide exclusive breast feeding education • Provide information, education and communication on current knowledge, attitude and practice on safe pregnancy and delivery of a healthy newborn • Advocate for community leadership support for safe pregnancy and delivery of a healthy newborn • Promote safe delivery through pregnancy monitoring, establishment and timely referral • Disseminate key messages to support safe pregnancy and delivery of a healthy newborn • Promote or provide professional supervised home delivery • Safe delivery kit • Antenatal care equipment • Information, education and communication with key messages to promote early childhood care • Preventive materials and supplies (Insecticide treated nets, nutritious foods) • Family planning pills, condoms	• 1 CHEW • 50 Communities' own resource persons
Early childhood (two weeks to five years)	• Promote community level integrated management of childhood illnesses activities • Conduct de-worming • Mobilize and organize for early childhood development • Disseminate key early childhood development health messages • Support nutrition awareness and support for orphans and vulnerable children • Promote food and nutrition security • Monitor growth and development Minimum kit: • Expanded program of immunization equipment • Intermittent residual spray equipment • Essential drugs and supplies for common conditions, e.g., antimalarials, oral rehydration salts/solution, deworming tablets • Nutritious food supplements	• 1 CHEW • 50 Communities' own resource persons • Trained Caregivers

The time available in the curriculum for emphasizing newborn care in the initial basic training is very limited in scope. Little research about perinatal community health interventions have been carried out in Africa so far compared to other countries like India ^{5 28}, Bangladesh ⁶ or Nepal ⁹. Studies in these settings have shown great potential to address the persistently high neonatal mortality in developing countries. Unfortunately the duration of the CHW-training is a substantial obstacle to widespread implementation. It would entail a large and unsustainable cost to the Kenyan Government, if the length of the training program used in the Bangladesh and India studies (six weeks to six months training) cited above would be adopted in the CHW program of Kenya.

To reduce financial barriers to the access of the health care system, the Government of Kenya introduced in 1966 the National Hospital Insurance Fund (NHIF), which was reviewed over the years to accommodate the changing health care needs of the Kenyan population. NHIF covers the majority of over 400 accredited government facilities, mission health providers, and some private health providers across the country. In private and expensive hospitals, it provides in-patient services on a

co-payment basis. Expenses for comprehensive maternity care and cesarean-sections in government hospitals, most mission hospitals and some private hospitals are covered, too. Furthermore, prescribed laboratory tests, X-rays and ultrasound diagnosis, drugs, treatment of sexual transmitted infections, family planning, ANC and Postnatal care (PNC), clinic counseling services, health education and general consultation with general practitioners are included in the service provided by the NHIF. Unfortunately, not all health services are yet accredited and accept NHIF cards. In the last decades, corruption with the NHIF system negatively influenced the peoples' trust in the system. Furthermore, in rural areas, making regular payments into the NHIF system was difficult for farmers and for people without regular employment. In recent years, corruption was fought and the system reformed significantly to regain the trust of the people.

In four rural districts and two informal urban settlements in Kenya, reproductive health voucher programs were established, and provided service from 2006 to 2011. These vouchers were one form of demand-side financing, since providers from the public and the private sector were reimbursed based on the number of services they delivered. Community-based distributors sold vouchers to poor pregnant women for KSh 200; the voucher services provided vouchers on safe motherhood (ANC, facility-based deliveries, and PNC) and long-term modern family planning methods. Therefore, these vouchers were an effective method of decreasing financial barriers to health access. In Kenya, a household survey carried out among 2,527 women in voucher and comparable non-voucher sites proved that in areas where reproductive health vouchers were distributed, significantly increasing numbers of facility deliveries and deliveries under skilled attendance were found; PNC-services were accepted more, but no increase in ANC-visits could be detected ⁵³.

In 2002, Guyatt and Ochola evaluated the effect and use of insecticide treated mosquito nets in Kenya, which were distributed for free to pregnant women attending ANC-clinic. They showed that ANC-visits are an important delivery system in increasing access to and use of insecticide treated mosquito nets in vulnerable groups. ²²

Based on five randomized controlled trials, a Cochrane review revealed in 2004, that the widespread use of insecticide treated nets can lower overall mortality by about a fifth in Africa. It was further concluded that for every 1,000 children sleeping under a net, on average about 5.5 lives per year can be saved in children younger than five years. ³⁶

Due to various widespread campaigns in Kenya like mentioned above, the rate of under-fives sleeping under a mosquito net raised from 3% in 2000 to 47% in 2009 ¹⁵.

1.3. “Newborn Community Health Project” in rural Kenya

In 2008, the “Newborn Community Health Project” (NCH-project) was founded in Kenya at “African Inland Church (AIC) Kijabe Hospital”, a tertiary level hospital at the edge of the rift valley, located about 60 km north-west of Nairobi in the Lari division of Kiambu District.

The NCH-project is a multicomponent intervention that aims to reduce neonatal and maternal morbidity and mortality by empowering rural communities with accurate information on safe motherhood and newborn care. The project is based on evidence-based interventions with contextual adaptation to the Kenyan context, the Kenyan strategic plan for achieving MDG 4 and 5, the context of Kijabe and the context of the three intervention-sites where the project was started.

The objectives of the NCH-project are as listed in Table 3:

Table 3: Objectives of the NCH-project in rural Kenya
NCH-project: “Newborn Community Health Project”; ANC: Antenatal Care

Objectives of the NCH-project:

- Analysis of the situation of newborns in regions around “AIC Kijabe Hospital” in Kenya
- Evaluation of socio-cultural risk factors with regard to newborn health at community level
- Development of teaching materials and standards for the improvement of the care of newborns
- Creating awareness about neonatal health and safe motherhood in the community
- Enhancing referrals and decreasing neonatal morbidity and mortality
- Improvement of ANC-attendance and vaccination rates of pregnant women and infants

The local need was evident in the “AIC Kijabe Hospital” catchment area given the numbers of pregnant women who presented with delayed recognition of danger signs, resulting in high morbidity and mortality for both mothers and newborns. Information about the extent of the problem was gathered through interviews with patients, village pastors and examination of publically available health information to identify areas of high need. Socio-cultural risk factors concerning newborn health at community level were evaluated prior to the start of the project.

A pediatrician and neonatologist at “AIC Kijabe Hospital” trained four Kenyan nurses (teaching staff), who had clinical experience in hospital based maternal and newborn care and were acquainted with best practices. They established a teaching manual and standards for the improvement of the care of newborns and mothers. This knowledge was then disseminated by the teaching staff to the community.

Two different approaches were used to accomplish this:

On one hand, community groups were educated through short presentations of about ten minutes’ length and additional discussion with the audience about the presented topic (Figure 10). These

community groups were already existing groups (e.g. women's groups, people meeting at church for prayers, groups of people discussing agriculture and nutrition in the village and groups of community leaders).



Figure 10: Teaching a community group of the "Newborn Community Health Project" in rural Kenya, 2011

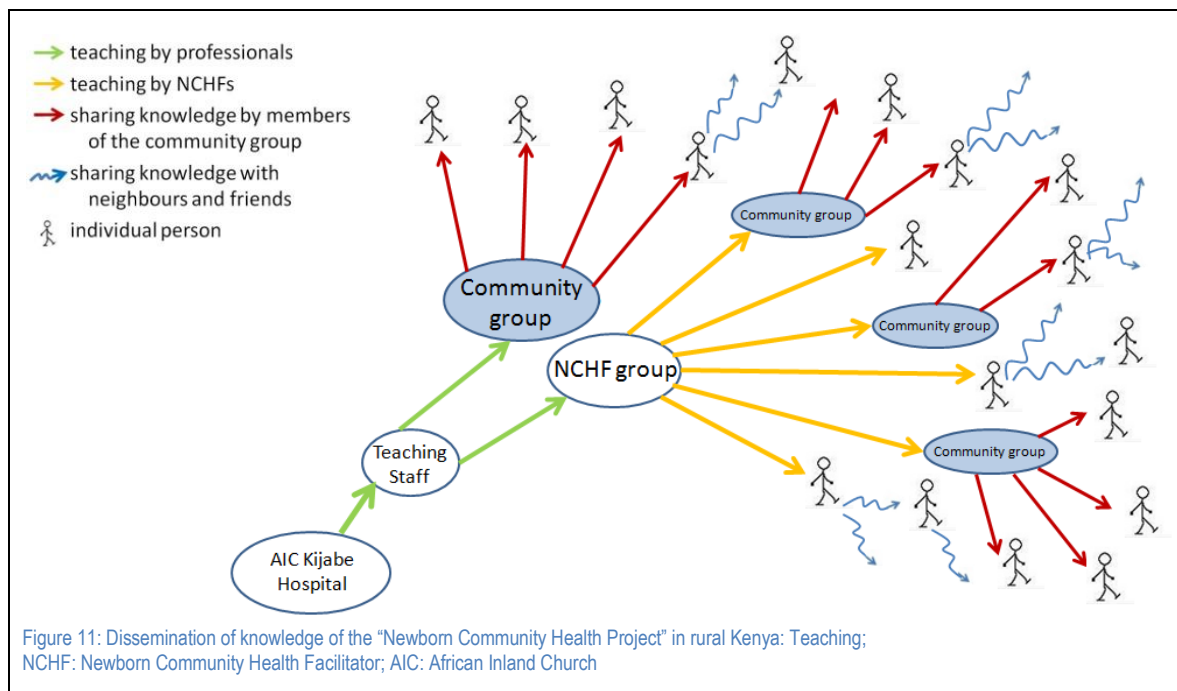
In the beginning of the project, the NCH-team asked for allowance to make a short presentation at their meetings, but later, as the project became known more and more, various community groups invited the teaching staff on their own accord.

On the other hand, Newborn Community Health Facilitator groups were trained. These groups consisted of highly motivated and interested women and men of the community, who wanted to learn more about maternal and newborn issues and to volunteer after the training by dispersing the learnt topics to others. Members of these groups therefore received an intensive training for about six months, gave presentations about the learnt topics under supervision and were nominated to be Newborn Community Health Facilitators (NCHF) after successfully having finished the entire training. In contrast to CHWs of the government, NCHFs were volunteers, who were chosen by the community and who did not receive a regular salary. The NCHFs infiltrate the community independently and continuously. Regular meetings, feedback-sessions, and re-teaching of NCHFs by the NCH-team assure a high quality and level of education of all NCHFs. The meetings furthermore make sure that motivation of NCHFs keeps on being high to further infiltrate the community with health related messages. In addition, the NCH-intervention measures the competency of each trainee in sharing the teaching, in doing home visits, in data collection and reporting, and in building linkages. Each trainee is supported until they are able to build a habit of promoting accurate health messages in their local context, using a lifestyle integration of what they teach.

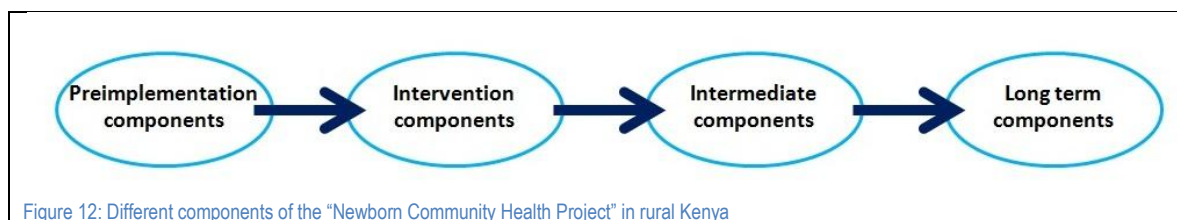
1. Introduction and Background

The core intervention content was a compilation of evidence-based practices in maternal and newborn health including the importance of ANC and having a birth plan, the value of delivery with a skilled attendant, danger signs in pregnancy, danger signs in the newborn, kangaroo care, the importance of exclusive breast feeding for six months, and maternal and infant nutrition. Optional further topics were about HIV/AIDS, family planning, and breast cancer.

The dissemination of knowledge about safe motherhood and newborn care into the community is illustrated in Figure 11.



As already mentioned, the teaching is not the only component the project uses to reduce neonatal and maternal mortality and morbidity. The different components of the intervention address multiple areas creating an "enabling environment" (see Chapter 1.2.1.2. p.4). These components are illustrated in Figure 12 and will be explained below.



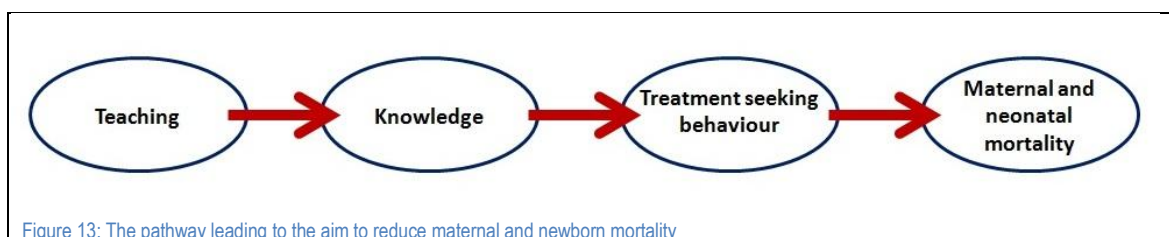
Before the start of the NCH-project, needy areas were identified in a preimplementation phase and contacts with chiefs, health facilities and district public health nurses were established. The NCH-

team first engaged with community stakeholders in community meetings to seek their approval, sensitize them towards the importance of their role in newborn survival, encourage shared learning, and create a supportive environment for the start of the project. It was furthermore important to get to know other non-governmental organizations or governmental interventions and their aims within the community.

Subsequently intervention components were brought into action. Surveys and medical camps were carried out in order to raise awareness of health care need and resource availability in the community. Community and NCHF groups were taught. Health facilities were networked and empowered to continuing medical education. Cell phones were used to link people to health facilities and medical personnel. Barriers to health care access, including long distance, lack of transport, financial problems, cultural beliefs, accessibility, affordability, availability and acceptability, were addressed and decreased. Home visits were made by the teaching staff and NCHFs. A community dialogue using guided dialogue was supported in order to build community capacity for problem solving. Collaboration with community based organizations like churches and already existing community groups took place.

The intermediate component manifested itself rather in thoughts and in the minds of people than in actions. The intermediate component of this project was the knowledge about pregnancy, delivery and neonatal care and it could be understood as the beginning of a change in action of people.

Finally, long term components reflected the extent to which the changed attitude of people based on raised awareness and gained knowledge could already be found in the community. This could be measured by the number of ANC and PNC-visits and the number of deliveries at health facilities. This was also visible in the number of health facility staff, their working time, and the number of people using NHIF. People sharing knowledge about the learnt topics with others is an important long term component as well as the number of home visits and referrals done by NCHFs and their monthly report about measures of message dissemination. The very last long term components were decline of mortality and morbidity rates in neonates and mothers.



Each phase involved feedback loops, where input from key stakeholders, members of the target population, and the lay community volunteers who were being trained, was elicited and integrated into the intervention adaption process. This level of community participation is known to enhance the success of the behavior change process, drive the credibility of the participants, facilitate the diffusion of the innovation and form the core elements of community based participatory research.

1.4. Theoretical background and curriculum of the NCH-project

The curriculum of the NCH-project was iteratively developed. The content was based on evidence of effective interventions in the published literature and WHO recommendations about providing health care to women and newborns in developing countries.

At the same time, the Ministry of Health Services and the Ministry of Public Health and Sanitation in Kenya were also repositioning their emphasis and engagement in the community using these WHO strategies. Since this was happening at the policy level, the specifics were unknown by the NCH-team. During the first year of the project, Kenya's Strategic Plan for community health was revised and strengthened to mirror the WHO evidence-based key concept already present in the NCH-curriculum (see Chapter 1.3. p.17).

The NCH-project used an iterative approach to curriculum development, however the final product highlights several well established theories of behavior change that form the foundation for understanding the proposed mechanisms of action of the intervention. The theories form the foundation of the curriculum and will be explained in the following paragraphs.

Individuals will hardly adopt an innovation, if they are not in need for a change to occur. As a result, any intervention is noticed by individuals only if it is relevant, meeting a personal need or a felt need of the community, and if it goes together with the value judgment of the individual. The project was launched in areas where community leaders saw a need and wanted to see change. The NCH-project also assessed readiness by use of an early survey to understand the state of maternal and newborn health. The initial assessment identified issues and therefore increased awareness of maternal newborn health needs within the community. This preliminary assessment reinforced the community awareness of the needs and opened doors for the innovation.

The NCH-project curriculum reflects important theoretical elements from “Dissemination of Innovation” theory ⁵⁶. This theory was implemented by Everett Rogers, an American professor of rural sociology. “Dissemination of Innovation” theory seeks to explain how, why, and at what rate new ideas spread through cultures. According to Rogers, it is a five-step process leading the individual along the path of decision making.

In the first step called “Knowledge” the individual gets confronted with the innovation for the first time, but lacks information about it ⁵⁶. The NCH-project was first introduced to pastors and chiefs. Most of them were men who did not show up in this survey, but they were important key players in the implementation of the innovation within their area. They promoted and announced the project and consequently paved the way for the NCH-project, which was subsequently warmly welcomed by the inhabitants and generously incorporated by the community. In the next step, the project was presented to women and men within the community, who were members of regular meeting groups. Of them individuals emerged, who showed special interest in the topics of the project and who received intensified training to become NCHFs. Finally, the core topics were spread through the community: attentive listeners of teaching-sessions told their neighbors about the teaching-session and community groups received teaching-sessions by either the newly employed NCHFs or the NCH-team itself. Some individuals, by the way, received several teachings, while others attended only one. The first step along the pathway of decision-making therefore took place and continues to take place, whenever awareness about newborn and maternal issues is raised in communities.

In the second step called “Persuasion” the individual is interested in the innovation, seeks information about it and develops an attitude towards it ⁵⁶. Referring to the NCH-project, this stage reflects the time when an individual receives several teachings, does research about the content of a performed session, and actively gets in contact with others, discussing pros and cons of the innovation. Relative advantages, compatibility, and complexity or simplicity play a tremendous role in this stage and may influence the attitude of every individual. Most women cannot spend too much time at a teaching-session due to local duties, and the capability of absorbing input is limited in a woman who is not used to regularly receiving lectures or teaching-sessions. Therefore interactive teaching methods, frequent repetition and review of key concepts were used. Teaching-sessions were limited to three to four hours, which allowed for the participants to do other work, too. Topics were presented in short sections and reviewed. Subsequent time for discussion with the audience encouraged the individuals to grapple with the content of the session and to apply it into their own circumstances. The audience was actively supported and encouraged by the speaker. Topics addressing problems of a particular region raised concern and highlighted the resulting advantages

of changes for every individual. The survey cannot point out to what extent this second step along the pathway of decision-making took place or is taking place. Persuasion is assumed, but no clear measurements are available.

The third step along decision-making process is called “Decision”. It includes the consideration of advantages and disadvantages of the innovation and the decision whether to adopt or reject it ⁵⁶. Related to the NCH-project, this step happens in the minds of people and is not objectively observable, but may become visible in the survey, which is designed to show the individual range of knowledge about the teaching topics.

In the fourth stage called “Implementation,” the innovation comes into action and the individual employs it by varying some aspects, depending on the situation ⁵⁶. This stage can be found in the NCH-project, for example, in raising numbers of deliveries under skilled attendance in health facilities. In this stage the individual checks the usefulness of the innovation.

The last step is called “Confirmation” and implicates the completion of the decision of the individual by either continuing to use the innovation or refusing to use it in the future, due to disappointment or replacement of the innovation by another innovation ⁵⁶. Referring to the NCH-project, this stage can be found in the actions of people who received the teachings a longer time ago, and have already made their decision. For example: The NCH-intervention distributes the message of taking premature babies to the next health facility by using Kangaroo-care, which implicates skin-to-skin-contact between the mother and the newborn in maintaining cardiorespiratory stability and thermal retention of the baby ^{7 10 40}. A meta-analysis of randomized controlled trials reveals that Kangaroo-care significantly decreases neonatal mortality amongst preterm neonates in hospitals and reduces severe infections and sepsis ³⁵. Mothers, who brought their babies to the nursery carrying the child in close skin-to-skin contact, reflect the step of “Confirmation”. Referrals to hospitals done by NCHFs who recognized dangerous situations are another example of how to get a picture of the extent of completing the final step of the decision-making pathway within the community. The last example mentioned here is the change of rate of deliveries under skilled attendance before and after the beginning of teaching-sessions in intervention-sites. The change reveals the dissemination of innovation within the community, even if there was not yet an increase in knowledge within the intervention-site.

“Dissemination of Innovation” theory forms part of the theoretical basis for measurement of program outcomes. The project tracks numbers of women accessing skilled attendance at birth as well as the

number of messages shared as an indicator that the final step in the “Dissemination of Innovation” theory was accomplished.

The theory of “Dissemination of Innovation” notes that individuals choose to adopt innovations more likely if brought by a person with beliefs, education, and social status similar to him or herself, than innovations brought by people with a different background ⁵⁶. The NCH-project deploy as teaching staff, people with the same cultural background as the community, since they speak the same language, so to say, and their similarities lead to greater knowledge gain as well as attitude or behavior change. Hence, the highest and fastest diffusion of innovation occurs, if two individuals have the same background and are very similar in every way, except in knowledge of the innovation ⁵⁶.

Within the rate of adoption there is a point at which an innovation reaches critical mass: Enough highly respected individuals within a social network have adopted the innovation so that the continued adoption is self-sustaining, because an instinctive desire was created for it within the community ⁵⁶. For example: Memorandums of Understanding were signed with the local district health teams prior to beginning the intervention, so that government services would be aware and supportive of the project. After teaching-sessions took place, extensive engagement of the project happened and the NCH-team continued to encourage linkages to health facilities. The local district Ministry of Health of Kenya began to become more involved with the project as the strategy for training CHWs evolved and as needs identified by the NCH-team were brought to the attention of the district Ministry of Health. The Ministry supported the maternal newborn needs through capacity building, increasing staff and buildings to ease the accessibility of health care on the community level as soon as the Ministry received promising facts and details from the NCH-team including crucial details about the status of the facilities.

The theoretical framework of the NCH-curriculum and the measurement items in the survey furthermore reflect aspects from social cognitive theory, which is a learning theory based on the idea that people do not develop new behavior, but learn by watching what others do, anticipating similar outcomes to their imitated behaviors ⁴. The theory relies heavily on outcome expectancies, which are influenced by the environment and the surrounding of the observer. Important parts of any NCH-teaching intervention are role-plays and little sketches in front of the audience, and personal testimonies of individuals who have already changed their behavior in line with the teaching-sessions. These interludes give concrete examples of how to live and behave according to the core

topics taught by the NCH-team. They illustrate and exemplify these truths, and invite the audience to imitate these actions.

After a new action and behavior was implemented, individuals needed social modeling. Social modeling refers not just to observing behavior, but also to receiving instruction and guidance in how to complete a behavior. For example: One of the core-topics of the NCH-project deals with healthy nutrition in pregnant women and newborns under normal circumstances. But if a mother gave birth to triplets, who are less developed and who had low birth weight, she needs further teaching even though she participated in the teaching-session about healthy nutrition. This further training is given by NCHFs who do home-visits and follow-ups. They model these messages and help women to adopt them in their specific surroundings and circumstances. NCHFs regularly receive feedback and modeling through the NCH-team, too. NCHFs first teach single topics under supervision of the teaching-staff so that coherency of the message to be spread can be guaranteed.

Further development in social cognitive theory posits that learning will most likely occur if the observer has a good deal of self-efficacy ⁴. Self-efficacy is, according to the psychologist Albert Bandura, a central set of proximal determinants of motivation, affect and action of individuals ³. Teaching-sessions do not only offer new input, but also encourage the audience to believe in themselves. NCHFs help the recipients of teachings to focus on positive experiences they have already had when delivering in a health facility. Recipients of teachings and NCHFs grow in self-confidence through the positive feedback they receive from the NCH-team, which spurs the community members to take responsibility for their own lives, families and other members of the community.

2. Methods

2.1. Primary and secondary objectives of this study

The primary aim of the intervention was to improve the communities' knowledge of maternal and newborn care and secondarily to promote delivery with a skilled birth attendant.

Primary objectives:

- Analyze the impact of the multicomponent intervention of the NCH-project with special focus on knowledge dissemination
- Evaluate trends in facility deliveries and deliveries under skilled attendance

Secondary objectives:

- Evaluation of treatment seeking behavior (especially of women) in the community
- Describe and analyze correlations between contextual factors (education, age, number of deliveries, economic status, ...) and utilization of skilled birth attendance and related birth outcomes
- Describe differences between the study-sites after the intervention
- Critically summarize the important steps of the project
- Publish the results to
 - plan further community health activities in the study-sites
 - advise authorities in how to improve health care delivery in rural Kenya
 - introduce evidence based findings on perinatal community health interventions into national curricula for community health training
 - multiply effective interventions in other countries

2.2. Hypotheses

Prior to data collection and analysis, 13 hypotheses have been defined:

Table 4: Hypotheses of this survey defined prior to data collection and analysis
WHO: World Health Organization; ANC: Antenatal Care

1. Women who have participated in the teaching have more knowledge about safe delivery, pregnancy and neonatal care, than those who have not attended the teaching.

2. The more perinatal-related knowledge a woman has, the higher the rates of facility deliveries.
3. Women who participated in the teaching deliver more often at a health facility than women who did not participate.
4. The more teaching-sessions a woman received, the higher her knowledge score about safe motherhood, delivery and the neonatal period is, compared to a woman with less or no teaching.
5. Women achieve a higher knowledge score when they live within an area where teaching-sessions have been offered, than in those where no teaching was offered.
6. The more years a woman has gone to school, the higher total knowledge score she achieves.
7. The more years a woman has gone to school, the higher the rates for deliveries at a health facility.
8. Women who attend ANC-clinic at least four times, as recommended by the WHO, deliver their children more often at a health facility compared to those who attend ANC-clinic less often.
9. Women of a good economical status deliver more often in health facilities than those of a bad economical status.
10. Women who live less than one hour from the health facility deliver more often in a facility, than those who live farther away.
11. Most women deliver the first child in a health facility.
12. The more children a woman has, the higher the possibility for home delivery.
13. A married woman delivers more often in a health facility than a not-married (separated, divorced, widowed, single) woman.

2.3. Sampling and Study-sites

The primary and secondary objectives of this study shall be reached mainly through a cross-sectional survey in the form of oral interviews in three intervention-sites (Eburru, Kinale, Nyakio) and three comparable control-sites (Escarpment, Karati, Koinange).

2.3.1 Sampling

2.3.1.1. Sampling size

In total, data from 2,600 women were collected. Table 5 shows the dissemination of the interviewed women according to the study-site.

Table 5: Dissemination of interviewed women according to each study-site in rural Kenya, data collected in September 2011

Study-site	Number of interviews carried out	Number of questionnaires brought back to the study coordinator for data entry and analysis
Eburru	400	398
Escarpment	500	500
Karati	500	500
Kinale	501	501
Nyakio	499	499
Koinange	200	200
Total	2600	2598

In every study-site, 500 women were interviewed except for Eburru and Koinange.

Eburru is a very vast and sparsely populated area (see Chapter 2.3.2.1. p.30). A survey carried out in

400 households in Eburru covers a bigger geographical catchment area than in any other study-site, all of which had higher population densities. This justified the decision to interview only 400 women in Eburru.

Koinange was added to the control-sites of this survey in order to compare the influence of an area where only CHWs were working so far and no influence of the NCH-project was yet seen (see Chapter 2.3.2.2. p.33). The sample was 200 because of costs and time frame.

2.3.1.2. Inclusion and exclusion criteria

Table 6 shows inclusion and exclusion criteria of the survey. Criteria were followed strictly.

Table 6: Inclusion and Exclusion criteria of this survey

Inclusion criteria: • Ages of 15 to 49 years • At least one delivery while living in the study-site • Voluntary informed consent is obtained
Exclusion criteria: • Immediate immigrants • Relatives and friends of the interviewers

An immediate immigrant is defined as a person who moved to this area less than six months previous to this study.

2.3.1.3. Data collection

Previous to this survey, the study-sites were mapped indicating routes, villages, health facilities, and the population density of the region. Mapping was done by a team of supervisors and researchers, who had no role in the implementation of the study.

As the people in all six study-sites do not travel around much, it is assumed that dissemination of knowledge happens in a radius of approximately 10 km around the location where NCH-teaching took place. 400 to 500 women were interviewed in each intervention-site. They all lived within a radius of 10 km from the teaching-sites. Because of this, an imaginary circle of 10 km was drawn in the three control-sites. Before the survey, each of the imaginary circles was divided in equal pieces to make sure that the survey was carried out in the entire region.

Field-workers met with their regional coordinator every day in the morning at a central point within the study-site of data collection, who then randomly distributed an area or street of collecting data to every field-worker (see Chapter 2.4.2. p.40). Besides that, exchange of field-workers to interview different villages of the area took place in order to avoid bias in asking the questions.

All interviewed women were randomly chosen. By tossing a coin, it was decided which side of the road the field-worker had to follow, right or left. The field-worker then picked the very first house on that particular side of the distributed street to be house number one and went to every third house to interview a woman. In case that no person was available at a selected house, the field-worker went to the immediate next house/neighbor on the same side of the road and looked for a suitable interviewee there. Every barrack, house and hut was counted as a "house".

After data collection, the regional coordinator collected the surveys and brought them back to Kijabe, where the study coordinator also counter checked the surveys again and called for clarification or correction if necessary. Any question that needed clarification was clarified on site or through mobile phone. This increased validity and credibility of the answers. Errors identified at any level were referred back to the field for correction.

In the beginning of data-collection, regional coordinators observed field-workers frequently, reducing the number of observations more and more as data collection proceeded, by spot checking on the field-worker's work. 15% or more of all household data was randomly subjected to back checks and spot checks. In order to observe the work in their area, regional coordinators hired motorbikes or used other public transport to drive to all the villages, roads and settings where field-workers were collecting data.

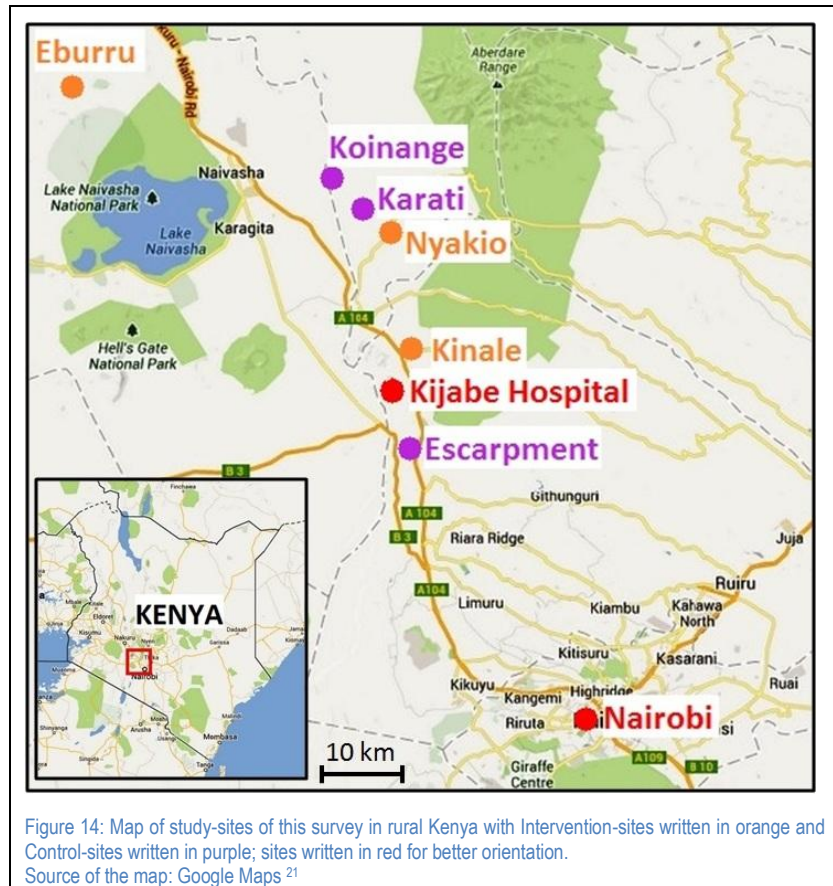
Field-workers were not able to collect the required number of at least ten interviews every day, due to various reasons: Heavy rains leading to interruptions of data collection, unforeseen cultural events that led to absence of community members, long distances from the main road to some settings of data collection, and poor means of transport to the villages by motorbikes: half to one hour on rough roads were only some of the challenges with which the field-workers had to cope. In Nyakio, for example, burials of people within the area took place due to customs of the village, which led to the absence of many people in their homes on two days of data collection.

2.3.2. Study-sites

The NCH-project was launched in Nyakio and Eburru in 2008 and in the third intervention-site, Kinale, in 2010. The three intervention-sites were chosen due to previously existing connections to key players within the community (see Chapter 1.3. p.17). Base line data on knowledge about safe motherhood aspects and perinatal mortality were obtained through interviews of 400 women in Nyakio and Eburru in 2008, prior to the start of the intervention and analysis of the locally available birth statistics.

After three years (one year in Kinale) of intervention in these three areas, the impact of the NCH-project was measured and the findings of the three intervention-sites were compared with three similar demographic control-sites, where no teaching has yet taken place, but an extension of the NCH-program to these sites is possible.

To examine within-intervention-site variation, the exposure to the project was measured. This was necessary, since the scope of the project did not allow for complete penetration of the CHF's in any region. The control-sites were chosen due to comparability of similar populations. Escarpment is located in Lari District east of "AIC Kijabe Hospital". Nearby, northwest of Kijabe are Kinale, Karati and Koinange, which are located close to Nyakio in



South Kinangop District. For illustration see also Figure 14.

2.3.2.1. Intervention-sites

Nyakio region is located 45 min. northwest of Kijabe. In 2008, the NCH-project was implemented in three sub-locations of this region (Karangatha, Rwanyambo, and Mukeyu). In 2011, the project extended to two more areas: Githabai and part of Njabini. According to data from the 2009 Census, Nyakio has 37,342 inhabitants, which are predominantly Kikuyu, and covers 112 square km ²⁵. The main economic activity of Nyakio is subsistence crop farming, but farmland productivity varies within this region. The northern side with Githabai is less productive, sparsely populated and poorer. Mothers walk for about 25 km to go to the nearest health post for delivery.

In Githabai, there is only one dispensary that opened in November 2011, while in Karangatha and Rwanyambo, many dispensaries are close together. Linked to the local AIC church, Kijabe was

already operating a health center at Karangatha, before the NCH-project came to that area. There are five more places conducting deliveries in the region, an increase from the three that existed when the project was started. One is a small private clinic next to the AIC health center, another one at Githabai center called “Uzima and Kinaba”, two government dispensaries on the border of Lari division (“Ragia forest” and “Kamae”), and two government health centers (“Karangatha” and “Njabini Health Center”). Mukey has no clinic for deliveries, but many people use the health facilities of Karangatha. A small clinic in Rwanyambo conducting deliveries was open in former times. This clinic was run by a pharmacist with no formal training as a birth attendant. The clinic was closed after the government opened a dispensary at Rwanyambo in 2011. No health facility in Nyakio accepts NHIF cards.

In total, 34 NCFs were trained in Nyakio, but no training from the government took place in this area. The NCH-project and its activities were very much supported by the area chief and sub chiefs since the beginning.

In 2008, the NCH-project was started in the Eburru region. Eburru is a community covering 246 square km, with a population of 7,161, including 1,553 households ²⁵. The area is inhabited mainly by Kikuyu, Kisii and a few Maasai. Eburru is located one hour west of Kijabe at an altitude of around 2,500 m in the mountains above Lake Naivasha. Despite being only 35 km away from the town of Naivasha, this community is very poor and isolated. There are very few daily public transport vehicles to Naivasha. The government health center was the only health facility of the region. The hours of operation and quality of care were often unpredictable.

At the same time, with the beginning of the NCH-project in Eburru, improved health services became available with the “Camp Bretheren Clinic” which also has a maternity facility available 24 hours a day and is staffed with three nurses. There is also an expansion of the government health facility in Eburru in progress, with a government public health officer responsible for the area. Neither “Camp Bretheren Clinic” nor the local government clinic take NHIF cards and increased utilization of NHIF verbal reports indicates that women are electing to travel to facilities in Naivasha that do accept NHIF.

Since the project began in 2008, infrastructure in the area has improved with the installation of electricity. The electric company employs some people, adding economic diversity to the previous subsistence farming and employment in the flower farms in Naivasha. Water availability has improved, with water pipes delivering water from a reservoir. Previously the only water source was from geothermal steam.

Many of the seven villages of the area are named after white settlers that used to own the land decades ago. The villages Songoloi and Cedar are located at the far east of Eburru. They are sparsely populated, not easily accessible, and over 20 km away from the main health facilities in Eburru. There is no health care delivery point in this area. X-Major and X-Lewis have the highest population of the area. The crop farming of this area is the back-bone of Eburru for food production. X-Peter, at the central part of Eburru, includes Eburru “shopping center”, the Eburru government health center and “Camp Brethren Clinic”. There is also a small clinic run by a non-professional. Thome with four sub-villages is a vast region south of Eburru. People at Thome are mainly Kikuyu and Turkana. Because this region is very dry, inhabitants depend on casual labor in other regions. Jica is similar to Thome and also located in the south 23 km away from the Eburru health facilities. It does not have its own health care delivery point.

After a period of three years of intervention, the NCH-project has satisfactorily trained 42 CHFs, who are spreading the maternal and newborn health messages to the households. These CHFs were absorbed in the government community health strategy in 2011.

In 2010, the NCH-project was brought to Kinale region. Kinale is situated northwest of “AIC Kijabe Hospital” about 7 km. It is an area surrounded by forest and all roads are rough. It has a population of 14,589, predominantly Kikuyu, and covers 112 square km ²⁵. Administratively, this area has two locations and five sub-locations.

Travelling to the main tarmac road is challenging unless one hires a motorbike, the main means of transport. There are two government health facilities: “Kamae Dispensary” with two nurses and “Kinale Health Center” with four nurses. “Kinale Health Center” started conducting deliveries in September 2010. The two health facilities offer immunization and ANC only on two days per week, but none of the facilities accept NHIF cards. In this area, some women need up to two hours to walk to health facilities.

Kinale has no community unit and there are no trained CHWs in this area. The NCH-project was working in this area for 18 months, before this study took place. Seven of ten volunteers completed the first NCHF-training and are independently reaching out to their community and reporting on their progress monthly. A second set of 12 volunteers is in training.

Based on the needs assessment survey done in January 2010, 56% of women delivered with unskilled birth assistance. This is approximately the national average. The District Medical Officer in Lari strongly supports the NCH-project and promised her continuous support, including staffing in the health center and dispensary.

The three intervention-sites differed in the number of volunteers trained to disseminate information (Table 7). The number of trained volunteers, who were working in each intervention-site, was based on time and resources of the project during the study period. The range of trained volunteers to number of households in the intervention-sites was 1:37 to 1:460. This variability in dosage of intervention, while increasing the difficulty of assessing intervention outcome, is consistent with the variability of implementation of the community health strategy and the training of CHWs in Kenya.

Table 7: Density of NCHFs of the “Newborn Community Health Project” in the intervention-sites in rural Kenya according to population; status as of September 2011.

NCH-project: “Newborn Community Health Project”; NCHF: Newborn Community Health Facilitator

		Time of exposure to the NCH-project	Number of trained NCHFs	Density of NCHFs: ratio
Intervention-site	Eburru	3 years	42	1 NCHF per 37 households
	Kinale	1 year	7	1 NCHF per 460 households
	Nyakio	3 years	34	1 NCHF per 252 households

2.3.2.2. Control-sites

Escarment region is located on Nairobi-Naivasha highway, one hour walk south of Kijabe. Escarment can be divided into three villages. There are 3,688 inhabitants living in 867 households; the area covers 17 square km and has a population density of 221, predominantly Kikuyu ²⁵. The main economic activity of Escarment is subsistence crop farming. The road is poor and inaccessible for pregnant mothers who have to go for delivery; they have to hire a taxi to the main hospital.

Escarment residents access their health care from “Lari Health Center”, where 14 nurses are working seven days a week. This facility provides ANC and immunization of children and pregnant women. Furthermore women in labour can deliver their children at this place. “Lari Health Center” accepts NHIF cards. The closest hospital is “AIC Kijabe Hospital”, which is one hour walk away from Escarment.

Neither NCH-teaching took place nor did the government of Kenya train CHWs. In Escarment, the reproductive health voucher system got implemented in 2006. This addressed the health of mothers and newborns (see Chapter 1.2.3.3. p.14). Escarment is about 25 km away from the next place, where NCH-training took place and where the closest CHFs are living. This distance makes a dissemination of knowledge about the core topics of the NCH-teaching into Escarment quite unlikely.

Karati area is a sub-location in Magumu, South Kinangop District. It is located 2 km off Njambini-Engineer road, a junction of Nairobi-Nakuru highway. Karati is situated 50 km north of Kijabe and has nine sub-villages. 7,283 people live in Karati in 1,670 households, predominantly Kikuyu. Karati covers 30.5 square km ²⁵. Residents of this area are subsistence farmers.

The road to this area is dirty with no tarmac. It is favorable for transport with motorbikes, which is the only possibility for travel. The six northern villages are very dry and not as productive as the others. The distance from the main road also restricts the carrying out of their activities.

Karati has one government dispensary with three nurses working eight hours for six days a week. ANC and immunization of children and pregnant women is available in this facility, in contrast to safe delivery service, which is not provided. The government dispensary does not accept NHIF cards. The nearest hospitals are “North Kinangop Hospital” and “Naivasha District Hospital”, but both facilities are more than 40 km away from Karati.

In Karati, neither CHW-training took place nor did any other non-governmental organizations dealing with maternal and newborn issues engage in this area. The next areas where NCH-training took place are about 15 km farther away from Karati and because there is no big movement in this area it was not expected that the teaching messages had reached the inhabitants of Karati.

Koinange is geographically located in South Kinangop District. It is one of five administrative sub-locations in Nyakio division of South Kinangop district. The Koinange community shares one chief, who oversees all five administrative sub-locations. Data from the 2009 Census shows that Koinange has 1,405 households in a 25 square km area; the population is 6,323, and predominantly Kikuyu ²⁵.

The main income of this area is crop farming, though the land is dry and Koinange is often hit by droughts.

In terms of health care access, there is no health center or dispensary in the Koinange geographic area. However, there are plans to open a dispensary, and the physical building is currently under construction. People in Koinange must travel about 8 km to “Heni Dispensary” in Karati to get to the closest health facility. They can also travel a distance of about 10 km to “Maraigushu Health Center”, which is the next closest facility, and that is in Naivasha District.

Koinange was identified as underserved and in 2009 South Kinangop District Ministry of Health tried to support the area with the development of a Community Health Unit. Approximately 50 individuals were trained as CHWs – it is uncertain how many of them are still working. The CHWs indicated that Koinange is remote and more difficult for CHEW to access so support and retraining of the CHWs by

CHEWs was difficult. Distance also made ongoing interaction with the government health structures a challenge.

The basic data of the six study-sites are summarized in Table 8.

Table 8: Demographic characteristics and basic data of each study-site of this survey in rural Kenya

Source: based on data from the 2009 Census ²⁵

NCHF: Newborn Community Health Facilitator (of the "Newborn Community Health Project"); CHW: Community Health Worker (of the Kenyan government)

Study-site	I (= Intervention site) C (= control site)	Number of sub-villages	Expanse (square km)	Total population	Total number of households	Population density per square km	Average of people living in one house	Tribes	Main source of income: crop farming	Number of health facilities	Number of NCHFs	Number of CHWs
Eburru	I	7	246	7161	1553	29	4.6	Kikuyu, Kisii, Maasai, Turkana	yes	2	42	42*
Escarpment	C	3	17	3688	867	217	4.2	Kikuyu	yes	1	0	0
Karati	C	9	30	7283	1670	243	4.4	Kikuyu	yes	1	0	0
Kinale	I	5	112	14589	3222	130	4.5	Kikuyu	yes	2	7	0
Nyakio	I	5	112	37342	8571	333	4.4	Kikuyu	yes	6	34	0
Koinange	C	5	25	6323	1405	253	4.5	Kikuyu	yes	0	0	50

* In Eburru, there are 42 trained health workers only, because NCHFs are CHWs at the same time.

2.4. Study design and survey fielding

2.4.1. Questionnaire and variable description

2.4.1.1. Questionnaire

The questionnaire which was used in this study, can be found in the annex 1. The questionnaire had five parts: informed consent with inclusion and exclusion criteria; demographics (question 1-12); a retrospective review of information about previous pregnancies, deliveries, and the children of the interviewee (the questionnaire concerning the children of a woman); questions testing the knowledge of the interviewee about safe pregnancy, delivery and neonatal care (question 13-24) and a question to determine exposure to the intervention (question 25). Demographic questions were patterned after questions in the Kenya Demographic Health Survey. The retrospective review of previous pregnancies contained questions commonly asked in a complete prenatal history. Knowledge

questions were developed based on material taught to the trainees, and were vetted by a panel of experts in maternal and newborn care.

The field-worker read one question after the next to the interviewee without telling her the single options and answers. The field-worker waited until the interviewee answered the question with her own words and then marked the mentioned options on the questionnaire with “X”. Italicized comments in the questionnaire were

Table 9: Keys and their meanings used in this survey

Keys	Meaning
X	Yes
I	No
?	Interviewee cannot remember
M	Missing data; interviewee refused to answer
N	No data/no option marked on the questionnaire

not meant to be read to the women, but as information and help for the field-worker to write down the answers given by the women. A question mark (“?”) written down on the survey means that the woman cannot remember well. Capital letter M (“M”) symbolizes missed data and shows that the mother refused to answer that question. If data was missing at the stage of data entry, a capital letter “N” was entered into the data base, which means that no information or answer was marked on the survey. So “N” symbolizes that the interviewer forgot to ask that question or forgot to mark the answer of the interviewee on the questionnaire. See Table 9.

Every interviewed woman got her own questionnaire-file and ID-code, which was noted in the right corner of each single sheet of the questionnaire. Mass-interview (e.g. by raising hands) was not acceptable.

The interviewed women may have asked questions because of language problems, but no explanation concerning single topics or aspects related to the questions was allowed.

In spring 2011, the questionnaire was pilot tested by two interviewers at “AIC Kijabe Hospital” in Kenya. It took each interviewer 20 to 30 minutes to do all the questioning and a small individual teaching at the end of it. Data collection of the history of deliveries takes this amount of time since some women gave birth to more than five children. Another time-consuming aspect is the fact that free answers from an interviewee are desired. This provides the ability to eliminate leading questions which result in desired responses instead of true responses, and should help to reduce bias.

2.4.1.2. Variable description

The age of every interviewee was recorded during the interview (question number 1). Age was recorded as a categorical variable defined as follows: 15-20, 21-25, 26-30, 31-35, 36-40, 41-45, and 46-49 years.

The educational background (question number 2) of each interviewee was recorded as a categorical variable based on years of school attendance as follows: no school-attendance at all, 1-6 years of school attendance corresponding with some primary-schooling, 7-8 years of school attendance corresponding with complete primary-schooling, 9-10 years of school attendance corresponding with Form 1 and 2, 11-12 years of school attendance corresponding with Form 3 and 4, and above 12 years of school attendance corresponding with college. The educational skill level of women who had gone to primary school is split to reflect the increased skill level of the last two years of primary school.

The economic background of the interviewee was assessed by the kind of house a mother lives in (question number 5). As shown in Table 10, a permanent house was defined to have an iron sheet covering walls made out of stones or bricks. A semi-permanent house was defined to be covered by an iron sheet, too, but the walls were made out of wood or iron sheet. Finally, a temporary house was covered by grass or iron and the walls consist of mud or grass. In addition, it was asked if the family owns that house or if they rent it. It was assumed that the verifiable information about the materials with which a house was built, was a good indication of economic assets.

Table 10: Definition of permanent, semi-permanent and temporary house

Type of house	Definition
Permanent house	walls: stones/bricks; roof: iron sheet
Semi-permanent house	walls: wood/ iron sheet; roof: iron
Temporary house	walls: mud/grass; roof: grass/ iron

The social background of a mother was assessed through two questions: In question number 3, the mother was asked about her marital status; in question number 6, she was asked at what age she delivered her first child.

Table 11: Categories of the family status in the questionnaire

Family status
• Married or living together • Widowed • Divorced or separate • Single or never been married

The marital status of a woman was comprised of four categories as shown in Table 11: married or living together, widowed, divorced or separate, and single or never been married. It was assumed that the family status plays a potential influential role in health care decision-making since a single woman living alone has to carry all difficulties on her own resulting in less potential to cope with problems; a widowed woman is also on her own but her dead husband's family might still strongly support her; the father of joint children with his separate woman is still alive and so he probably cares about the health of his children so there is probably more support and better chances to cope with problems; a married mother has the most advantages, because there are two grownups in the family who care about the children. The strength of family support may vary within each category.

The age of the mother at first delivery was the other added information about potential medical risk. The best reproductive age is between 20 and 35 years. Both early pregnancy and pregnancy after 35 are potentially higher risks.

Polygamy is legal and common in parts of Kenya (question number 4). In the study-sites, this was a very rare occurrence. Therefore this variable is not retained in the analysis.

The distance a mother has to walk to the next place where health care is available has been discussed in the literature as a potential barrier to accessing health care. Question 8 in the survey recorded the responses in the following categories: below 15 minutes, 15-30 minutes, 30 minutes to 1 hour, 1-1.5 hours, 1.5-2 hours, 2-3 hours, and above 3 hours. This categorical variable is important, because the longer a mother has to walk to the next health facility, the higher the risk that she will not reach it in time in case of an emergency.

The attitude towards the closest health care facility (question number 10) and the attitude towards the closest hospital (question number 11) are factors that could influence a mother's decision-process on where to seek for health care. Her attitude towards health facilities could have been either positive or negative.

The intention concerning where to deliver in the future was asked at question number 7. It was the aim to distinguish which mother has the intention to deliver a child at a health facility in the future and who has the plan to deliver at home. The theory of reasoned action defined by Ajzen and Fishbein says that intentions are determined by attitudes, perceived societal norms, and beliefs. Intentions are proximal to behavior in the decision-making process. Therefore increases in intentions to deliver at a health facility reflect a change in attitudes and beliefs that may predispose a woman to delivering at a facility in the future.

The number of total pregnancies of a mother was calculated including live births, intrauterine deaths and current pregnancies.

The birth order of a child addressed the chronology of the deliveries of each mother.

On question number 2 and 4, the interviewee had to list the years and places of birth for each child. Responses regarding the place were recorded into two categories: delivery at a health facility including at an AIC hospital/health center, at a government hospital/health center, at a private hospital/health center) and delivery on the road or at home.

The interviewee was asked about attendance at the delivery of each child (question number 5). As shown in Table 12, attendance at birth was defined as follows: a skilled attendant was defined to be a skilled nurse, midwife or a

Table 12: Definition of skilled attendance, semi-skilled attendance, unskilled attendance and no attendance at birth

Attendance at birth	Definition
Skilled attendance	a skilled nurse, midwife or medical doctor
Semi-skilled attendance	a traditional birth attendant
Unskilled attendance	a neighbor, friend or relative
No attendance at all	nobody else present at delivery

medical doctor; semi-skilled attendance is given by a traditional birth attendant; unskilled attendance is delivery in the presence of a neighbor, friend or relative; no attendance is defined as giving birth alone without any other person being present. It was assumed that this categorical variable would strongly correlate with the place of birth, since all births at a facility automatically receive skilled attendance at birth.

Both the numbers of ANC and PNC-visits were recorded on the questionnaire (questions number 7 and 8). Whenever a mother was not able to remember the correct number of visits, she was asked to estimate the number of visits.

The mother was asked about the immunization-status of each of her children (question number 9); it was recorded, whether the child was fully, partly or not immunized, according to his or her age.

For each recorded birth, complications during or right after deliveries were recorded (question number 6). Complications included: cesarean-section, needed resuscitation through skilled attendant, convulsions in the first three days of life, breastfeeding started more than 24 hours after birth, and a child who did not start to cry immediately after delivery. Multiple answers were possible. It was furthermore investigated as to whether the child is mentally or physically disabled or both (question number 10).

Every mother was asked, if the child is still alive (question number 3). In the case that the child died, it was asked how old the child was when it died (question number 11). Responses were categorized as follows: the child died within the first 24 hours, within the first week, within the first month, within the first year of life, before the fifth birthday, above five years of age, and age at death unclear.

A knowledge score was compiled utilizing the participants' responses to question 13 to 24. All valid responses indicating correct knowledge of maternal or newborn care were given a credit. A woman was not limited in the number of correct responses she could give, because the interview was done using open-ended questions. Members of the research team who also had clinical experience in this

area reviewed responses, so that incorrect answers would not receive knowledge credits. Every mother could achieve a particular number of credits for each question she answered during the interview. The range of credits varied, according to the range of every particular question, between 1 and 11 credits. In addition, a mother was able to mention other meaningful comments, which were critically checked before data analysis. Extra credits were given if the comments were meaningful and made sense. The range of extra credits varied between 0 and 3 credits for each question. If the comment did not make sense or was wrong, the mother received no extra credit. However, wrong answers were not subtracted from the amount of credits. Extra credits were added to the “usual” credits a mother got, giving the “Total knowledge score” of a mother. In total, it was possible to achieve 88 credits (69 credits plus 19 extra credits).

Each interviewee was asked if she had participated in at least one teaching-session of the NCH-project (question number 25). This question divided the interviewees into participants of at least one teaching, and those who had never participated in a teaching-session (non participants). Interviewers had no knowledge of the interviewees’ exposure to the intervention until the last question of the interview, where participants reported exposure or no exposure.

2.4.2. Selection and training of field-workers and regional coordinators

Interviewing was carried out through 34 field-workers. Field-workers were predominantly NCFs, who were familiar with the study-sites and the teaching objectives of the NCH-project. The remaining field-workers were carefully selected according to whether they were willing to volunteer in the community (as the remuneration was not very high), whether they had some knowledge about health care or education in the broadest sense, and whether they had finished Form 4 at secondary school.

In all study-sites except Eburru, five field-workers carried out the survey. In Eburru, nine field-workers were trained due to the big area and the long distance between single households.

All field-workers were carefully trained, supervised, and systematically evaluated and rewarded (details below). Prior to the start of the study, they were trained in a highly interactive two day session by the study coordinator. This training included didactic sessions and observed skill practice in all interview procedures including: how to choose randomly, in a specific area, eligible woman for standardized interview; how to obtain informed consent and husband assent; how to not ask leading questions, not prompting answers from the interviewee; and how to implement the sampling strategy.

By walking through the interview it was explained how to fill in the questionnaire (Figure 15). Case-examples were roll-played in front of the group of field-workers, training them how to behave in both common and difficult situations. Scheduling was made clear. In addition, all field staff was directly observed during several complete interviews prior to being allowed to do interviews independently.



Figure 15: Teaching the field-workers of this survey how to do the interview; August 2011

Every question of the questionnaire was explained in English and in vernacular language in order to enhance understanding. The mode of asking every single question in vernacular language was demonstrated to the field-workers including also the positioning of the client. Some field-workers

wrote the question in vernacular language to avoid changing the meaning of the question in the field.

The training also included repetition and pilot testing in small groups under supervision of the study coordinator to enhance assimilation and understanding (Figure 16). Personal evaluation and re-training after detailed analysis of filled questionnaires took place on day one, two, and four of data



Figure 16: Personal evaluation and re-training of field-workers by the study coordinator; August 2011

collection in the community, and spot checking at any further day of data collection.

In the end of the training, every field-worker was equipped with an interviewer's kit, which contained materials listed in Table 13. These materials were put in a water-resistant plastic folder.

Table 13: Content of materials of an interviewer's kit of this survey

Content of materials of an interviewer's kit:

- 1 name tag with name of, and position held by, the field-worker
- 1 pen
- 1 rubber
- 1 sharpener
- 1 questionnaire in English
- 1 questionnaire in Swahili
- 1 letter from local chiefs and sub-chiefs of the particular region with allowance to carry out this survey in this area
- 1 checklist with the most important items explaining how to fill in the questionnaire
- 1 list containing the immunization chart of a child according to his/her age in Kenya and telephone numbers of all "regional coordinators" and the study coordinator

The field-workers of one study-site worked together with one regional coordinator, who was the supervisor of the study-site. Regional coordinators were the four members of the NCH-staff and one recently graduated medical doctor, who was fluent in Kikuyu and who was willing to volunteer to this study. Regional coordinators were acting as the coordinator

for the field-worker group of a particular site: they received daily instruction about the allocation of study-sites from the study coordinator. In addition to the interviewer's kit, they carried maps of their supervising area and every day repartitioned each field-worker a small location where he/she would collect data on that particular day, and marked on the maps where data collection took place. To avoid any bias, field-workers were not allowed to carry out any interviews in their immediate neighborhood or to interview relatives or friends (see Chapter 2.3.1.2. p.28). After data collection, the group of field-workers met again with their regional coordinator and went through the filled questionnaires to verify and discuss challenges of the day. If problems occurred, regional coordinators were the first persons to be contacted by the field-workers of their supervising site. The regional coordinators collected the filled questionnaires in the evening and brought them back to Kijabe after every working day. Regional coordinators played a tremendous role in re-training field-workers after re-evaluation and feedback from the study coordinator (see Chapter 2.4.2. p.40). Last but not least, they encouraged the field-workers on the ground, if they were refused by households, chased away by rude husbands of interviewees, or if they were rain-drenched.

2.4.3. Working times and Payment of the field-workers

A field-worker was available, if possible, to interview women for about three hours in the morning and three hours in the afternoon, five days per week for about four weeks in August and September 2011 (see Chapter 2.4.5. p.43). In between, field-workers were free to return to their home place or to work on their job. If somebody was not able to cover the whole time, he or she worked part-time as a field-worker, since it was not intended to keep people away from daily business or family obligations.

Every field-worker received KSh 100 once for mobile phone calls. Furthermore expenses for transport were paid ranging from KSh 350 to 1,000 per day according to distance and charges. A small salary of KSh 500 was paid for every working day. (In August 2011, the currency rate was 100

KSh = 0.7807 €⁸².) The group of field-workers of one study-site had to finish data collection of the area together as a team. If data collection was completed before the estimated time of ten days, payment was given for the entire ten days. No group took more than ten days for data collection.

2.4.4. Language

Oral language competency in the tribal language Kikuyu was a requirement of all field-staff. Written proficiency in Swahili and English was obligatory, too. Less than 5% of field-staff required additional training in data recording due to being less comfortable with the written English needed for completing the data entry forms. The questionnaire and consent documents were developed in English and then translated into Swahili by three independent native speakers to ensure accuracy. Trained field-workers administered the survey through face-to-face interviews conducted in Kikuyu, or in Swahili if the interviewee belonged to another tribe than Kikuyu.

The interview training process gave field-staff training in Kikuyu word use to allow all field staff to completely conduct interviews in Kikuyu, the preferred language for oral communication in this area. Word use training included specific words for female reproductive anatomy and Kikuyu terms related to pregnancy and delivery. This was necessary, since the languages of school instruction are English and Swahili and therefore some terms specific to maternal and newborn health in Kikuyu were not familiar to all field-staff. Formal education is not conducted in Kikuyu in any of the areas where the interviews were done. However, the language utilized in day-to-day life is primarily Kikuyu or Swahili. This complicated both the interview process and the recording process.

All interviews were recorded on English forms. Some field-staff were more comfortable with writing responses to open ended questions in Swahili, because the translation from Kikuyu to Swahili made more sense, and it was acceptable to do so.

2.4.5. Time schedule

The time schedule for the survey was fixed as mentioned in Table 14.

Table 14: Time schedule of the survey

Time	Planned activity
01.01.11 – 01.05.11	Designing of the questionnaire in English and translation into Swahili; pretesting of the questionnaire in Kenya
02.05.11 – 30.06.11	Choosing three control-sites and mapping of all six study-sites
01.07.11 – 31.07.11	Ethical approval and agreement of local authorities
01.08.11 – 14.08.11	Printing the questionnaire, stapling, and writing ID numbers on each page of a questionnaire-file

15.08.11 – 16.08.11	Training of 29 independent field-workers plus five regional coordinators how to do the interviewing, how to fill in the forms and how to randomly select the women to be interviewed; pretesting of the questionnaire in small groups in the community
17.08.11 – 18.09.11	Data collection and data entry
19.09.11 – 31.03.12	Data cleaning and closing of database
01.04.12 – 31.08.12	Sorting and statistical analysis of the collected data
from 01.09.12 on	Publication and dissemination of results; discussion of results with co-investigators

2.5. Data entry and Statistical analysis

2.5.1. Data entry

A person fluent in English, Swahili and Kikuyu screened all data records. Translations of any Kikuyu statements into English or Swahili were done prior to handing data entry staff the interview recording forms. All data entry was done using EXCEL and done using mainly English for answers to open ended questions.

The data entry staff was an independent evaluation team recruited and trained for this purpose. Each data entry staff member was given training in the content of the data recording forms as well as the purpose of the research study. Every data entry form was double-entered during at least the first two days of data entry training, in order to ensure accuracy of data entry. After data entry staff achieved approximately a 99% accuracy rate, they were considered trained. Double entry was performed by research staff, who examined the data record item by item for any inconsistencies. At the time of second entry, research staff corrected any discrepancies identified.

After the training period, approximately 14% of surveys were double entered to ensure accuracy. The error rate remained very low and was estimated to be less than 1%.

2.5.2. Statistical analysis

The primary outcome measure was the impact of the NCH-project on the knowledge score. A knowledge score was constructed for each interviewee on the basis of the fourth part of the questionnaire intended to analyze the theoretical knowledge of the woman concerning safe motherhood, delivery, and neonatal care. Trends in facility deliveries and deliveries under skilled attendance were also defined to be primary objectives of this study.

The secondary outcome measures were treatment-seeking behavior (coverage of ANC, fully immunized children rate), analyzing factors which influence the place of birth (education, economical background, distance to next health facility, birth order, family status, and previous experiences and

attitudes), and analyzing the deaths and mortality rates in this study (neonatal, infant, and under-five mortality rates).

Dependencies of two different characteristics of the subjects were analyzed using the Chi-square test of independence ²³. When sample sizes were very small (e.g. when study-sites were analyzed separately), the distribution of the test-statistic (i.e. the Chi-square distribution) was approximated using Monte-Carlo-techniques ²³.

In the special case that both characteristics can attain only two different values, the exact Fisher test was preferred ²³.

Note that these tests can only detect deviations from the expected result in case of stochastic independence, which serves as null hypothesis. If the null hypothesis is rejected, one cannot deduce a linear correlation.

The Welch two sample test was applied for detecting differences of the mean values of different samples. This test was applied due to the large sample size of this study, although most of the data deviated from the normal distribution. This approach is mathematically justified by central limit theorem. ²³

The exact binomial test was used to detect significant deviations of the probability of special events from hypothetical probabilities ²³.

A p-value <0.05 was considered statistically significant.

In order to quantify the vagueness of empirical mortality rates of this study, exact confidence intervals (CI) have been calculated. Thereby, well established procedures for binomial distributed values have been used. ²³

Odds-ratios (OR) were used to analyze the magnitude of potential factors of influence concerning facility deliveries; corresponding confidence intervals were calculated using methods `fisher.test` of the R-program ²³.

The probability of success of a dichotomous variable in dependence of an interval scaled variable was analyzed via logistic regression. The resulting curves can only provide information about trends. Due to the descriptive character of corresponding passages, an exact analysis of the model fit was dispensed. ²³

The distribution of the total knowledge score was visualized by fitting appropriate density functions using the method of moments ²³. These densities were used only for descriptive purposes. Further applications were dispensed in order to obtain results, which are independent of the assumption of a parametric model.

Further tools for data visualization were box plots, bar plots, and pie charts ²³.

Data was analyzed with the Statistical Package for Social Sciences (SPSS) version 20.0, and with R (version 2.14.1).

2.6. Ethical clearance

Approval for research with human subjects was obtained from the nationally accredited Kijabe Hospital Ethics Committee in Kenya and from the University of Ulm Ethics Committee in Germany. All study participants gave voluntary informed consent.

After having given detailed explanations about the objectives of this research, the chiefs and sub-chiefs of all study-sites welcomed the idea of carrying out an evaluation research. Furthermore, letters asking for support and collaboration were taken to the District Medical Officer of respective districts (Lari, Njambini and Naivasha) and signed by the authorities, previous to data collection.

Before starting with an interview, the goal of the study was explained to the woman, and she was assured that her participation is voluntary and she can withdraw at any point or refuse to answer certain questions. The woman had to agree to participate voluntarily in this study. No monetary or other rewards were given to the interviewee. Her verbal consent was documented on the first page of the questionnaire; in addition, 2,378 (91.0%) interviewees confirmed their verbal consent with their signature on the first page of the questionnaire, which was only used for written confirmation about their agreement to participate. Strict confidentiality was imposed for all field-workers involved in this survey and discretion was observed through the entire accomplishment of this study. 148 only gave verbal consent; most of them due to illiteracy or privacy.

A personal ID helped to identify the single pages of the questionnaire and that the questionnaire, with the data of the children, was related to one person. Collected data was entered in the computer by using only the ID-number. To guarantee anonymity, data was entered by other persons than the field-workers. Confidentiality was guaranteed.

3. Results

From 17.08.2011 to 18.09.2011, data from 2,598 women were collected in all study-sites. Two questionnaires got lost in the field – both in Eburru region.

57 women (22 in Eburru, 2 in Escarpment, 13 in Karati, 10 in Kinale, 9 in Nyakio, and 1 in Koinange) did not meet either inclusion or exclusion criteria or both, or did not agree to participate in the interview (9 out of 57) and were withdrawn from the interview.

15 women withdrew their consent at the beginning of the interview.

Data from 2,526 women were valid and included in the analysis of this survey.

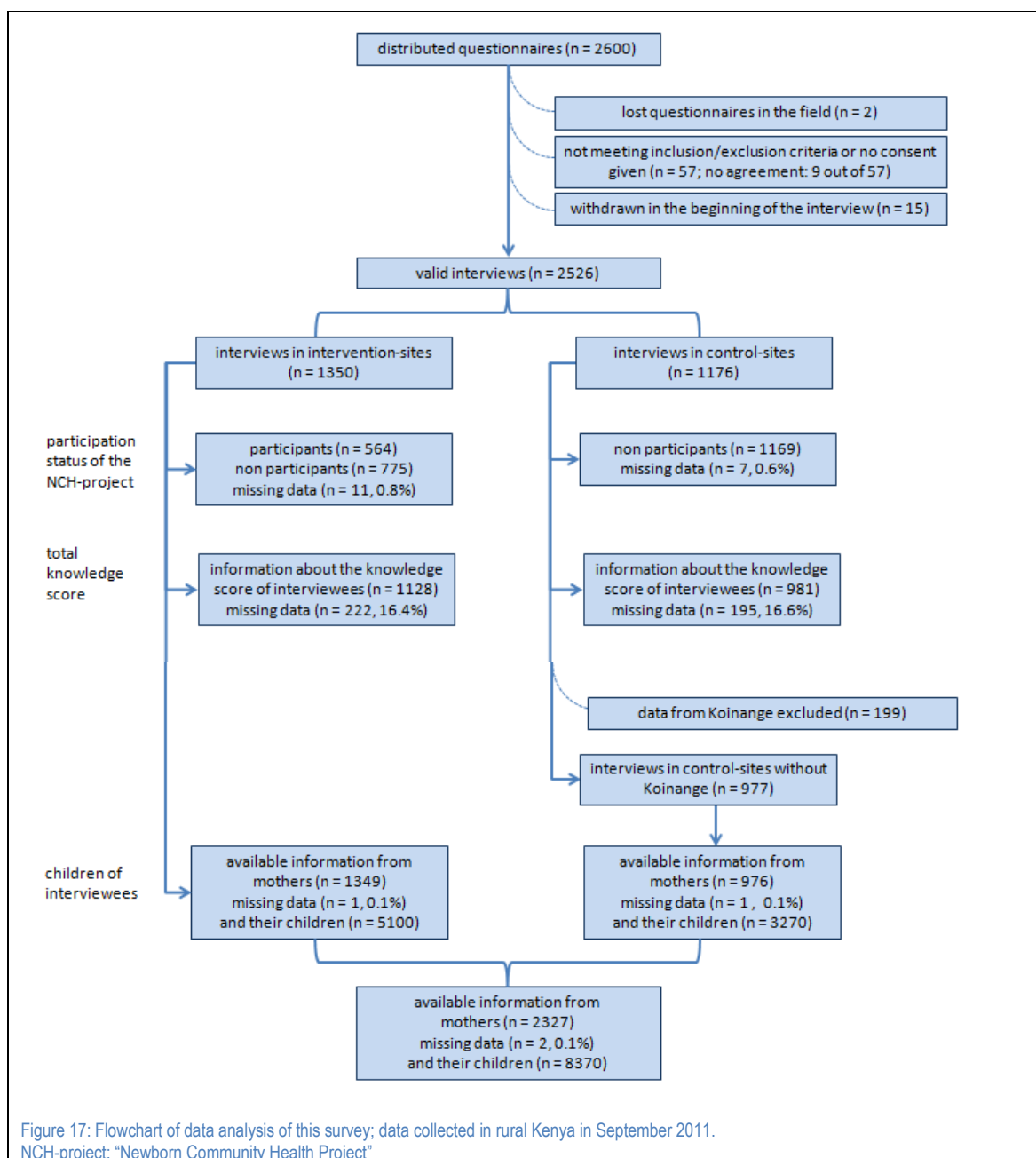
Table 15: Number of valid interviews of each study-site in rural Kenya; data collected in September 2011.

	Study-site						Total
	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange	
Number of filled questionnaires	398	500	500	501	499	200	2,598
Total number of those, who did not meet either inclusion or exclusion criteria or both or who did not agree to participate	22	2	13	10	9	1	57
Number of those, who did not agree to participate in the interview	6	1	0	0	2	0	9
Number of those, who withdrew during the interview with information less than 20% of the questionnaire	1	3	5	3	3	0	15
Number of valid interviews	375	495	482	488	487	199	2,526

The flowchart of data analysis of this survey is illustrated in Figure 17. It gives an overview of the number of valid information from interviewees regarding three important variables: participation status, total knowledge score, and information about the children of an interviewee.

The numbers of missing data regarding the total knowledge score are quite high with 16.4% and 16.6% respectively, because total knowledge scores were calculated for only those interviewees who answered all 24 questions of the knowledge-section of the survey. If a mother skipped one question, no knowledge score was calculated; she was counted as “missing data”. This procedure was justified, since a separate analysis of smaller parts of the knowledge-section including all women, regardless of the percentage of answered items, did not show statistically different results.

Data of the children of the interviewees in control-sites were only collected in Escarpment and Karati and not in Koinange (n=199), where no data about pregnancies, deliveries, and children of a mother were recorded due to lack of training in how to collect data for this part of the questionnaire.



3.1. Demographics

Some demographic characteristics were already mentioned above. Additional demographic findings of this survey are summarized in Table 16 and Table 17. In the annex 2 of this thesis, tables with p-values are given comparing each demographic variable of the study-site with each other.

3. Results

Table 16: Demographic characteristics of each study-site in rural Kenya; based on data collected in September 2011

		Study-site						Total
		Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange	
Age	Mode age in years	31-35	31-35	26-30	31-35	31-35	31-35	31-35
Education	Mean number of years of school attendance	7.38	8.41	8.42	8.06	8.26	8.17	8.15
	No schooling*	2.9% (11)	1.6% (8)	0.8% (4)	1.0% (5)	1.6% (8)	0.0% (0)	1.4% (36)
	Some primary*	36.8% (138)	31.3% (155)	25.7% (124)	35.2% (172)	32.9% (160)	32.7% (65)	32.2% (814)
	Completed primary*	44.5% (167)	34.5% (171)	42.3% (204)	41.4% (202)	37.4% (182)	42.2% (84)	40.0% (1010)
	Some secondary or more*	13.1% (49)	32.1% (159)	31.1% (150)	22.1% (108)	27.1% (132)	25.1% (50)	25.7% (648)
Economic status	Permanent house*	3.5% (13)	6.3% (31)	18.7% (90)	10.9% (53)	25.1% (122)	7.0% (14)	12.8% (323)
	Semi-permanent house*	35.7% (134)	73.1% (362)	55.4% (267)	87.5% (427)	68.4% (328)	11.6% (23)	61.0% (1541)
	Temporary house*	58.9% (221)	19.6% (97)	25.7% (124)	1.6% (8)	6.4% (31)	81.9% (161)	25.4% (642)
Family status	Married or living together*	83.5% (313)	83.2% (412)	82.6% (398)	77.7% (379)	78.0% (380)	75.4% (150)	80.4% (2032)
	Widowed*	1.6% (6)	1.0% (5)	0.8% (4)	4.3% (21)	4.1% (20)	4.0% (8)	2.5% (64)
	Divorced or separate*	4.8% (18)	2.0% (10)	2.7% (13)	6.4% (31)	6.2% (30)	6.5% (13)	4.6% (115)
	Single or never been married*	9.3% (35)	13.7% (68)	13.7% (66)	11.3% (55)	10.9% (53)	13.6% (27)	12.1% (304)
Number of pregnancies	Mean number of carried pregnancies per woman	3.99	3.41	3.25	3.87	3.44	N/A**	3.57
Age of the mother during first delivery	<18 years*	37.6% (141)	28.9% (143)	26.1% (126)	31.6% (154)	25.5% (124)	29.6% (59)	29.6% (747)
	19-22 years*	46.9% (176)	50.1% (248)	50.0% (241)	50.4% (246)	49.5% (241)	56.8% (113)	50.1% (1265)
	23-30 years*	12.5% (47)	18.8% (93)	22.0% (106)	16.8% (82)	23.6% (115)	13.1% (26)	18.6% (469)
	>31 years*	0.3% (1)	0.8% (4)	1.5% (7)	0.8% (4)	0.6% (3)	0.0% (0)	0.8% (19)
Distance to next health facility by foot in time	<1 hour*	42.3% (158)	53.7% (266)	67.8% (327)	71.9% (351)	84.4% (411)	29.1% (58)	62.2% (1571)
	1-2 hours*	32.5% (122)	36.0% (178)	26.1% (126)	26.6% (130)	12.7% (62)	34.2% (68)	27.2% (686)
	>2 hours*	24.8% (93)	9.7% (48)	5.8% (28)	1.0% (5)	1.4% (7)	36.7% (73)	10.1% (254)
	Mode distance in minutes	60-90	30-60	30-60	30-60	30-60	60-90	30-60

* If not otherwise specified, percentage is given with the total number in brackets.

** N/A: data not applicable

Table 17: Demographic characteristics of intervention- and control-sites in rural Kenya; based on the data collected in September 2011

		Intervention-sites	Control-sites	Total
Age	Mode age in years	N/A**	N/A**	31-35
Education	Mean number of years of school attendance	7.94	8.37	8.15
	No schooling*	1.8% (24)	1.0% (12)	1.4% (36)
	Some primary*	35.2% (470)	29.3% (344)	32.2% (814)
	Completed primary*	41.3% (551)	39.1% (459)	40.0% (1010)
	Some secondary or more*	21.7% (289)	30.6% (359)	25.7% (648)
Economic status	Permanent house*	14.1% (188)	11.5% (135)	12.8% (323)
	Semi-permanent house*	66.5% (889)	55.8% (652)	61.0% (1,541)
	Temporary house*	19.4% (260)	32.7% (382)	25.4% (642)
Family status	Married or living together*	79.9% (1072)	81.8% (960)	80.4% (2032)
	Widowed*	3.5% (47)	1.4% (17)	2.5% (64)
	Divorced or separate*	5.6% (79)	3.1% (36)	4.6% (115)
	Single or never been married*	10.7% (143)	13.7% (161)	12.1% (304)
Number of pregnancies	Mean number of carried pregnancies per woman	3.75	3.33	3.57
Age of the mother during first delivery	<18 years*	31.4% (419)	28.1% (328)	29.6% (747)
	19-22 years*	49.7% (663)	51.6% (602)	50.1% (1265)
	23-30 years*	18.3% (244)	19.3% (225)	18.6% (469)
	>31 years*	0.6% (8)	0.9% (11)	0.8% (19)
Distance to next health facility by foot in time	<1 hour*	68.7% (920)	55.5% (651)	62.2% (1571)
	1-2 hours*	23.5% (314)	31.7% (372)	27.2% (686)
	>2 hours*	7.8% (105)	12.7% (149)	10.1% (254)
	Mode distance in minutes	N/A**	N/A**	30-60

* If not otherwise specified, percentage is given with the total number in brackets.

** N/A: data not applicable

The mode age of the interviewees, reflecting the most frequently mentioned age, was the same in all regions, but the majority of interviewed women in Karati were five years younger than in the other study-sites. Data of the age of 3 interviewees was missing (0.1%).

The mean number of years of school-attendance varied with more than one year between the sites. On average, Eburru region was the region with the lowest education (7.38 years of school-attendance) while people from Karati went to school for 8.42 years. On average, interviewees of intervention-sites went to school for 7.94 years and interviewees of control-sites for 8.37 years. 66.1% of all interviewees completed at least primary school. The missing data regarding the years of school-attendance of 18 women equals 0.7% of interviewees.

The economic status differed significantly ($p < 0.001$) between all sites: In Eburru and Koinange region people lived mostly in temporary houses (58.9% and 81.9% respectively) whereas the economic status (quality of houses) of inhabitants of

the other study-sites was in general better. 260 interviewees (19.4%) of intervention-sites lived in temporary houses while 382 interviewees (32.7%) of control-sites stayed in this type of house.

Approximately the same percentage of interviewees of intervention-sites and control-sites stayed in permanent houses (188 (14.1%), and 135 (11.5%) respectively). Data is missing concerning the economical status of 20 interviewees (0.8%).

In all study-sites, more than 75% of the interviewees were married or living together with their partner. In general, statistically, the sites did not differ significantly regarding the family status. Hardly any difference between intervention-sites and control-sites was found regarding married percentages in the interviewed population (1,072 (79.9%), and 960 (81.8%) respectively); data is missing regarding the family status of 11 women (0.4%).

The mean number of carried pregnancies per woman was 3.75 in intervention-sites and 3.33 in control-sites.

About half of all interviewees delivered their first child between 19 and 22 years of age. About 30% gave birth for the first time below 18 years. Teenage pregnancy was more frequent in Eburru (141 (37.6%)) and lowest in Nyakio (124 (25.5%)). In all regions, between 1.0% and 1.6% of interviewees delivered their first child below the age of 15 years, except Karati region where this happened less often (0.2%). Less than 1% delivered the first child above 30 years; in Karati 1.5%. Data of 26 women (1.0%) were missing concerning the age of the interviewee at first delivery.

In Eburru and Koinange people had to overcome the greatest distance to reach the next place where health care was available. The mode distance in these two regions was 60 to 90 minutes while it was 30 to 60 minutes by foot in the rest of the study-sites. 105 (7.8%) interviewees of intervention-sites had to walk for more than two hours to reach the next health facility while 149 (12.7%) interviewees of control-sites had to walk this far. 920 (68.7%) interviewees of intervention-sites and 651 (55.5%) of control-sites could reach the next health facility in less than one hour of walking. Information from 15 women (0.6%) was missing regarding the distance.

3.2. Primary objective: Impact of the NCH-project

The impact of the NCH-project can be mainly seen from two different perspectives:

- the increase of knowledge about safe pregnancy and delivery in the population
- the increase in facility deliveries in the communities

3.2.1. Increase of perinatal-related knowledge

3.2.1.1. Correlation between participation status and total knowledge score (Hypothesis 1)

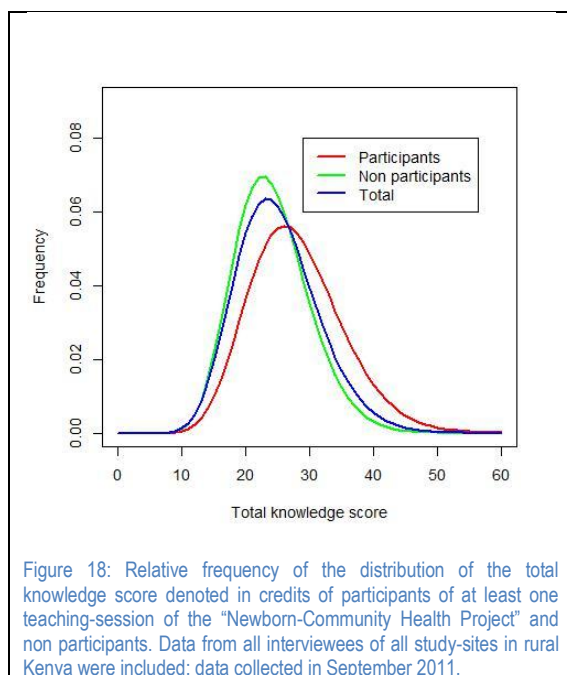
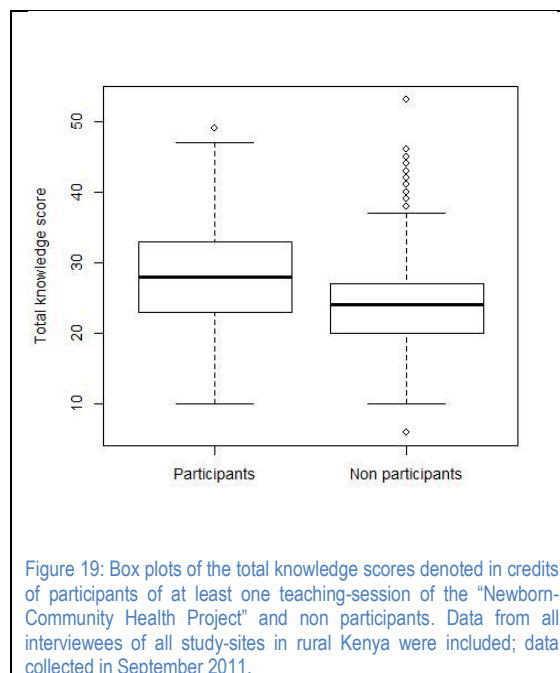


Figure 18 shows the distribution of the total knowledge score with further differentiation between participants and non participants. In total, data from 2,106 women were included, with 470 participants (red curve) and 1,636 non participants (green curve). Data from 420 (16.6%) women were missing due to unavailable information about either the total knowledge score of the interviewee or the information about her participation status. For the Chi-square test of independence, categories were determined (0-19 credits, 20-29 credits, 30-39 credits, ≥ 40 credits). The result of the Chi-square test of independence shows a

statistical significant correlation ($p < 0.001$) between the total knowledge score and the participation status.

The mean total knowledge score of participants was 28.3 credits – 4.2 credits higher than the mean score of non participants who achieved on average 24.1 credits (Figure 19). The Welch two sample tests, two and one sided, were also statistically significant ($p < 0.001$).

Figure 20 shows the distribution and box plots of the total knowledge score of interviewees of each intervention-site. For the Chi-square test of independence and the Welch-two-sample test, two sides tested, categories were determined (0-24 credits, 25-29 credits, ≥ 30 credits). In Eburru and Nyakio, the difference was statistically significant (Eburru: Chi-square $p = 0.009$, Welch-two-sample $p < 0.001$; Nyakio: Chi-square $p < 0.001$, Welch-two-sample $p < 0.001$), while there was no statistically



significant deviation seen in Kinale (Kinale: Chi-square $p=0.779$, Welch-two-sample $p=0.072$).

Figure 21 shows the distribution and the box plots of the total knowledge score of the interviewees of each control-site.

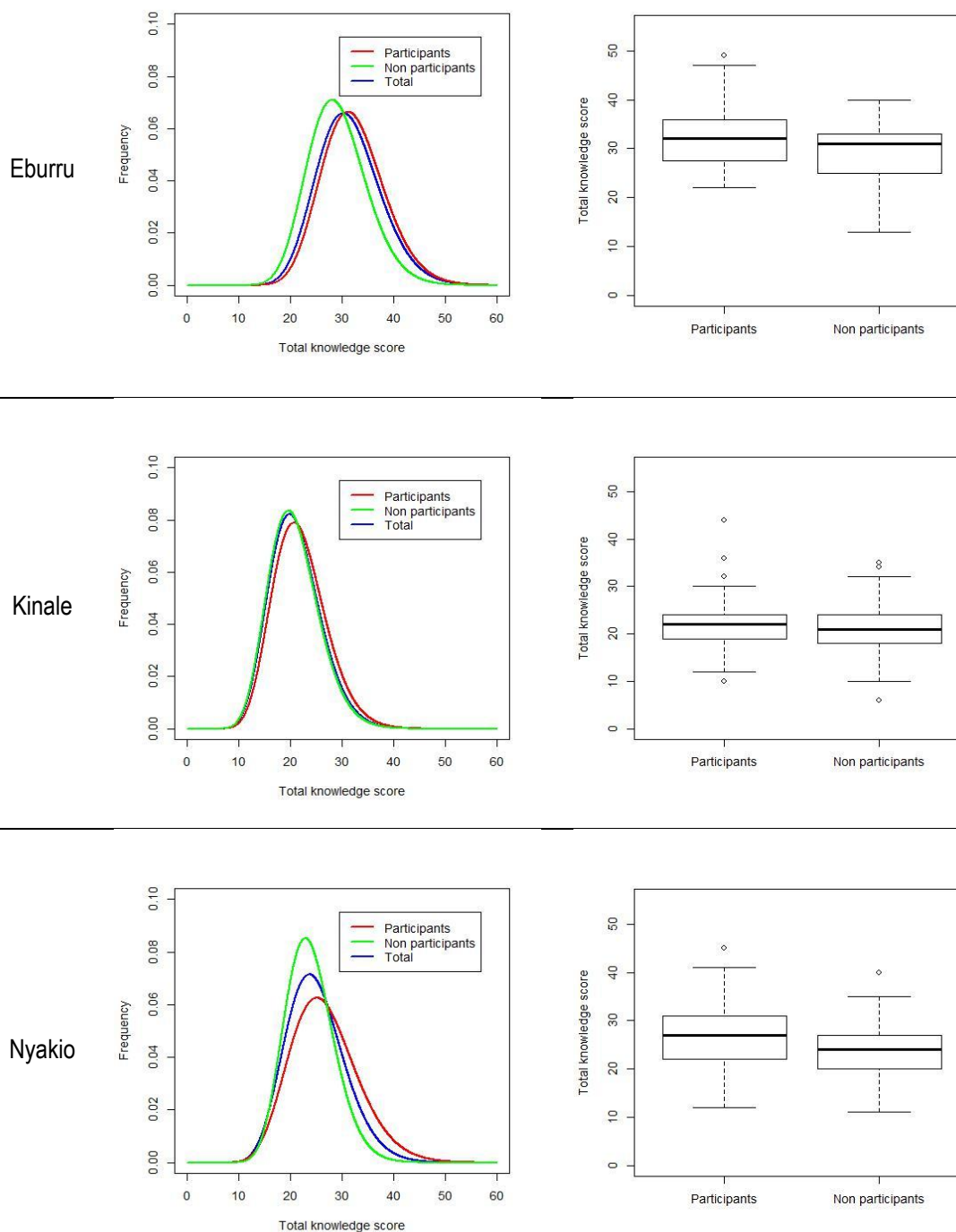
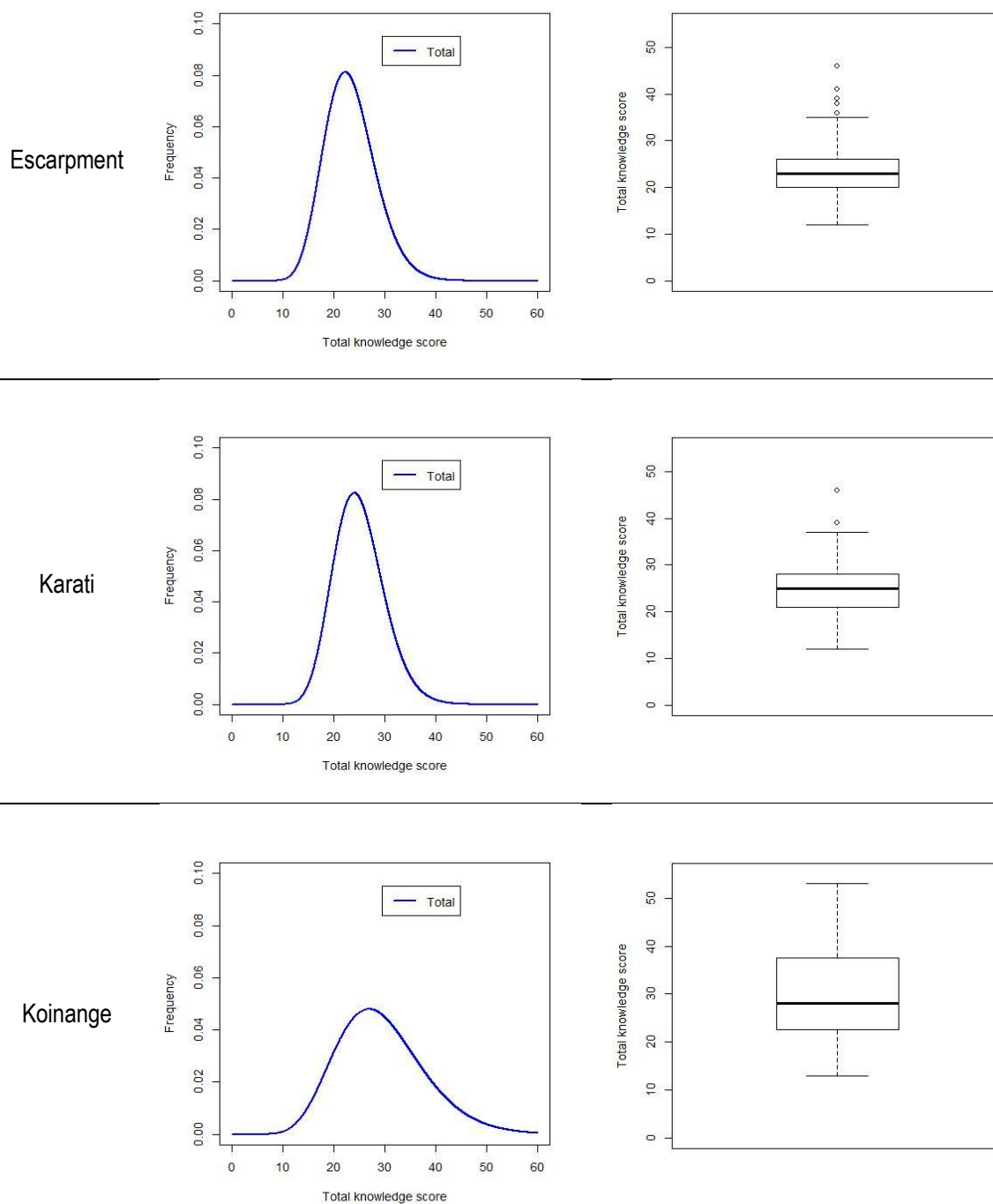


Figure 20: Distribution (on the left) and box plots (on the right) of the total knowledge score denoted in credits of participants of at least one teaching-session of the "Newborn-Community Health Project" and non participants. Data from all interviewees of each intervention-site in rural Kenya were included; data collected in September 2011.



3.2.1.2. Correlation between the total knowledge score of a mother and the place of birth of her last-born (Hypothesis 2)

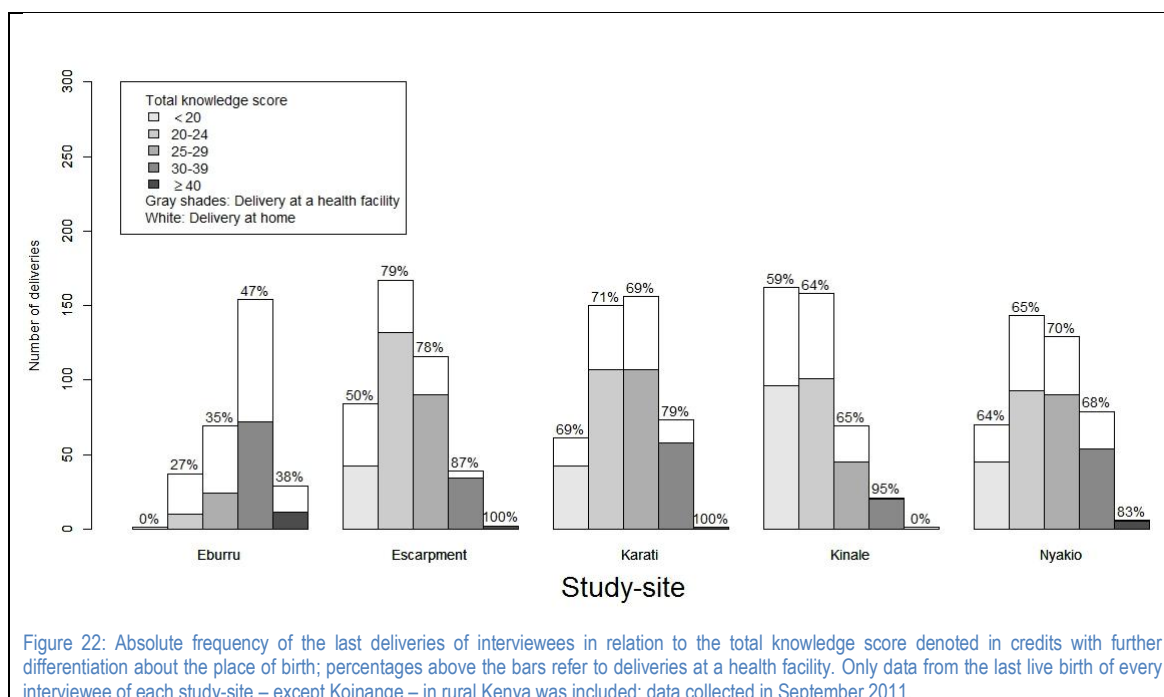


Figure 22 shows bar plots with absolute frequencies of deliveries of the last-born regarding the total knowledge score of the interviewees of each study-site and the place of birth of their children.

Because the total knowledge score of a mother might have changed over the years, only information about the last-born of every interviewee was included here. It was assumed that the knowledge about perinatal health issues of a mother was the same at her last delivery as in September 2011, when data was collected. In this survey, last deliveries ranged from children born in 1981 to 2011. The median of last deliveries was found in the year of 2008. 91.4% of all last deliveries happened between the years 2000 and 2011.

In this study, 8,085 live births were recorded with 4,887 deliveries at a health facility and 3,081 home deliveries; data was missing for 117 (1.4%) children regarding the place of birth. Of the 3,081 home deliveries, 23 children were reported to be born on the road when the mother was on her way to a health facility. These deliveries on the road are included in the numbers of home deliveries in the further course of the text.

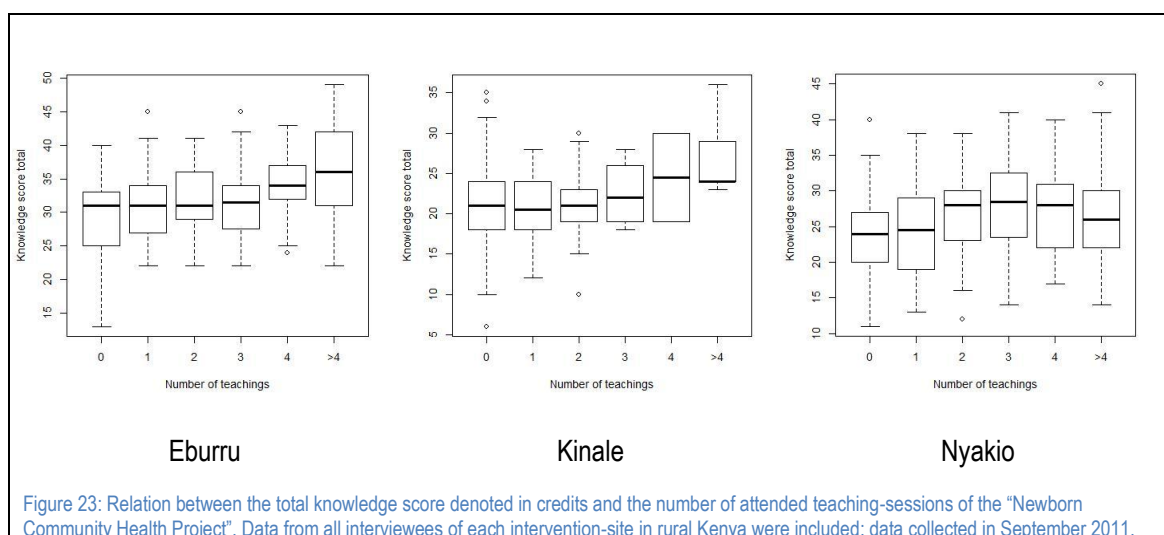
In the bar plot (Figure 22), data from 1,877 mothers were included. Information from 450 (19.3%) interviewees was missing due to missing data regarding the total knowledge score or the place where the mother delivered her last child.

The correlation between the total knowledge score and the place of delivery of the last-born was statistically significant ($p=0.006$). This difference was tested with the Chi-square test of independence, and categories were determined as in Figure 22.

The correlation was furthermore tested for each study-site independently. Due to small sample sizes, categories were determined differently (0-24 credits, 25-29 credits, ≥ 30 credits). In Eburru ($p=0.070$), Escarpment ($p=0.025$) and Kinale ($p=0.037$) a statistically significant difference could be shown, while in Nyakio ($p=0.450$) and Karati ($p=0.402$) no statistical correlation was found.

3.2.1.3. Correlation between the number of attended teachings of the NCH-project and the total knowledge score (Hypothesis 4)

Figure 23 shows box plots of the total knowledge score regarding the number of attended teaching-sessions. Included were only interviewees from intervention-sites, regardless of their participation status in the NCH-project.



For each intervention-site, the Chi-square test of independence was done separately in order to test the correlation between the number of attended teachings and the total knowledge score. Only those intervention-site mothers who participated in at least one teaching of the NCH-project were included in this test. The total knowledge score was split into categories (0-24 credits; 25-29 credits; ≥ 30 credits); the number of teachings was also categorized (1-2 teachings, 3-4 teachings, >4 teachings).

In Eburru, data from 178 participants were included (101 non participants, missing data of 96 mothers (25.6%)). In Eburru, the Chi-square test of independence did not show any statistical significance ($p=0.409$).

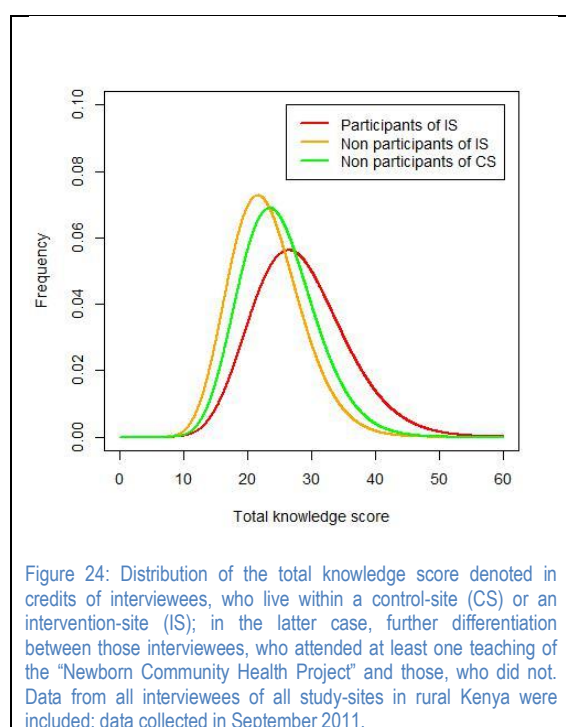
In Kinale, data from 80 participants were included (379 non participants; missing data of 29 interviewees (5.9%)). In Kinale, a significant correlation between the number of attended teachings and the knowledge score was found ($p=0.022$).

In Nyakio, 162 participants were included in the analysis (295 non participants; missing data of 30 mothers (6.2%)). Like in Eburru, the Chi-square test of independence was not statistically significant ($p=0.593$).

Table 18: Mean total knowledge scores denoted in credits of interviewees of each intervention-site in rural Kenya, who attended only one and four or more teaching-sessions of the NCH-project; data collected in September 2011.
NCH-project: "Newborn Community Health Project"

		Mean total knowledge score of participants of only one teaching-session of the NCH-project	Mean total knowledge score of participants of four or more teaching-sessions of the NCH-project	Welch-two-sample test two side accomplished
Intervention-site	Eburru	31.1 credits	35.4 credits	$p=0.001$
	Kinale	20.2 credits	26.4 credits	$p=0.007$
	Nyakio	24.8 credits	26.8 credits	$p=0.183$

The mean total knowledge score of participants of only one teaching was, in all intervention-sites, lower than the mean total knowledge score of those who attended four or more teachings (Table 18). With the Welch-two-sample test, two side accomplished, a statistical correlation between the total knowledge score of one or four or more teachings was demonstrated, in Eburru ($p=0.001$) and in Kinale ($p=0.007$). In Nyakio, no significant correlation was found ($p=0.183$).



3.2.1.4. Differences between the total knowledge scores of non participants of intervention-sites and control-sites (Hypothesis 5)

Figure 24 shows the distribution of the total knowledge score of interviewees of all study-sites regarding whether the interviewee lives within an intervention-site or a control-site (green curve). If the interviewee lives within an intervention-site, it was further distinguished between participants (red curve) and non participants (orange curve) of the NCH-project. In total, data from 2,106 interviewees have been included in this diagram with 470 participants of intervention-sites, 655 no -

participants of intervention-sites, and 981 non participants of control-sites. Data from 420 (16.6%) interviewees were not included in this diagram due to missing information regarding either the total knowledge score or the participation status.

The distribution of the total knowledge scores of intervention-sites and control-sites was tested with the Chi-square test of independence. Categories were determined (0-19 credits, 20-29 credits, 30-39 credits, ≥ 40 credits). A statistically significant difference of the two groups was found ($p < 0.001$). The Welch-two-sample test accomplished two-sided showed, however, no statistically significant deviation ($p = 0.247$), leading to the result that the means of the two groups did not differ significantly.

The median total knowledge score of interviewees of both intervention-sites and control-sites was 24 credits. The mean total knowledge score of mothers from intervention-sites was 25.2 credits, and 24.9 credits from mothers of control-sites.

3.2.1.5. Correlation between the educational level and the total knowledge score (Hypothesis 6), and estimated probability between the educational level and the participation status

In Figure 25, the years of school-attendance were categorized and plotted in relation to the achieved total knowledge score of interviewees. Categories were determined due to the following rule: no category had less data than five values.

In total, data from 2,098 interviewees were included in this figure. Data from 428 (16.9%) mothers were missing due to lack of information about either the total knowledge score or the numbers of years of school-attendance.

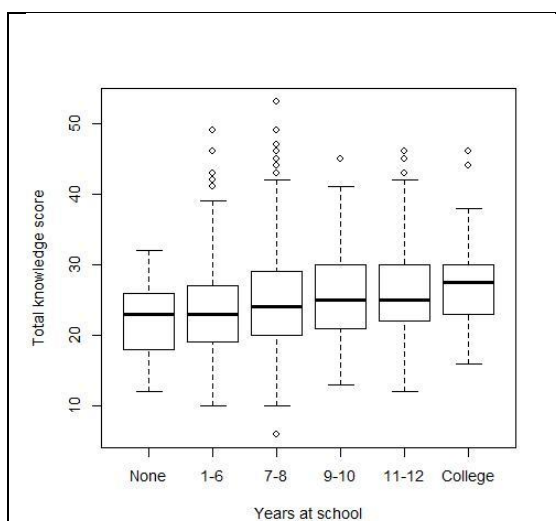


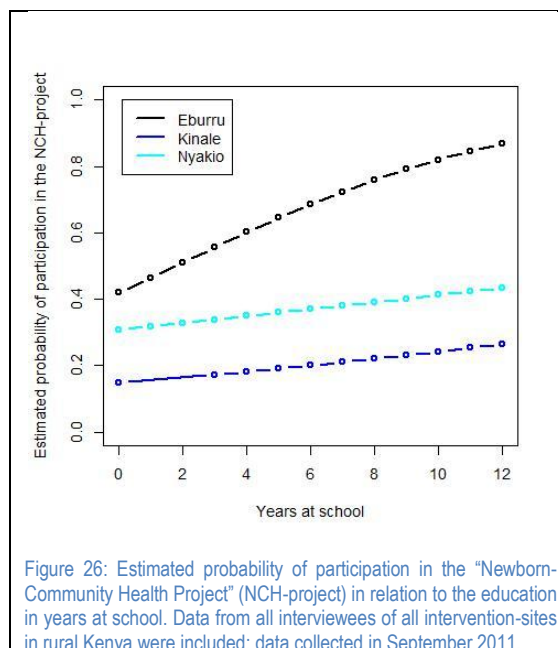
Figure 25: Box-plots of the years of school-attendance in relation to the total knowledge score denoted in credits. Data from all interviewees of all study-sites in rural Kenya were included; data collected in September 2011.

For the Chi-square test of independence categories were determined as follows: 0 years at school, 1-6 years at school, 7-8 years at school, 9-10 years at school, 11 years at school or more (including college). There was statistically a very high significant correlation between the number of years of school-attendance and the total knowledge score ($p < 0.001$).

The correlation was tested for each study-site independently. Because of the very small sample size of those mothers who did not go to school at all, categories were determined as follows: 0-6 years at school, 7-8 years at school, 9-10 years at school, 11 years at school or more (including college).

A statistical significant correlation was found in Eburru ($p=0.015$), Escarpment ($p=0.003$), Karati ($p=0.027$), Kinale ($p=0.007$), and Nyakio ($p<0.001$); only in Koinange, no statistical significance was demonstrated ($p=0.965$).

In Figure 26 the estimated probability of participation in the NCH-project in relation to the level of education was illustrated. This figure was drawn for illustration purpose only.



3.2.2. Increase of facility deliveries

3.2.2.1. Trends in facility deliveries in the study-sites from 2006 to 2011

Table 19 and Figure 27 show in which places (facility versus home delivery) deliveries took place in each study-site from 2006 until 2011. Data from 2011 are based only on the first nine months of the year. For analyzing the effect of the NCH-project, further differentiation between participants of the NCH-project and non participants was necessary. Unfortunately it was not known when and in which year the interviewee attended, but information was only available as to whether she participated at any time in at least one teaching-session.

Table 19: Total numbers of live births in each study-site in rural Kenya per year with further differentiation about the place of birth of the deliveries. In the intervention-sites (Eburru, Kinale, Nyakio), the years of the beginning of the intervention of the "Newborn Community Health Project" is highlighted in light blue, the following year is highlighted in medium blue and the third year of intervention in dark blue. Data collected in September 2011.

		2006		2007		2008		2009		2010		2011	
		Facility delivery	Home delivery	Facility delivery	Home delivery	Facility delivery	Home delivery	Facility delivery	Home delivery	Facility delivery	Home delivery	Facility delivery	Home delivery
Study-site	Eburru	27	52	27	45	28	41	46	45	39	42	36	49
	Escarpment	52	22	59	17	47	15	57	14	57	12	57	5
	Karati	51	34	57	28	50	33	56	24	88	22	93	20
	Kinale	55	40	61	26	70	28	63	28	82	29	95	28
	Nyakio	50	23	51	25	64	23	49	14	72	12	89	24

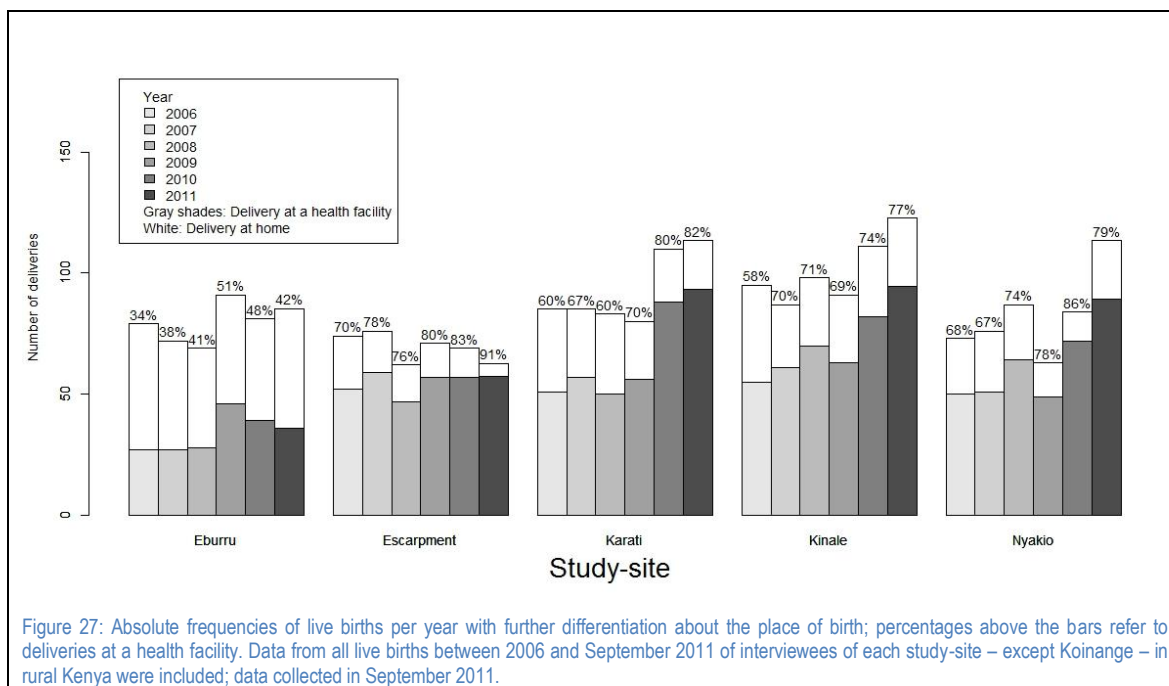
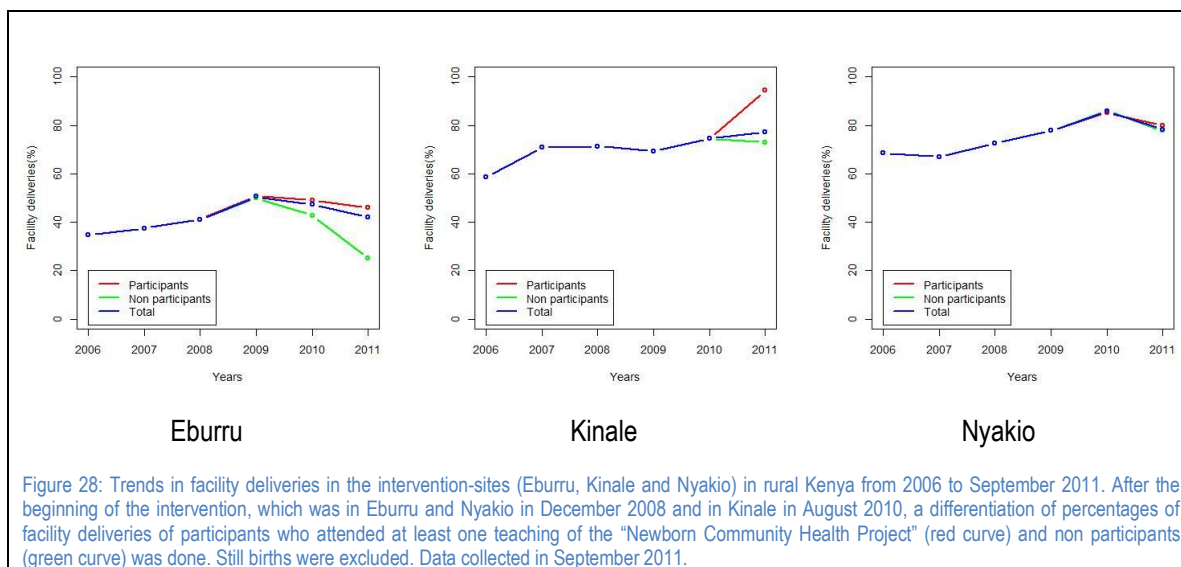


Figure 28 and Figure 29 show the change in percentages of facility deliveries in each study-site from 2006 to September 2011. Figure 28 contains the intervention-sites and Figure 29 the control-sites.



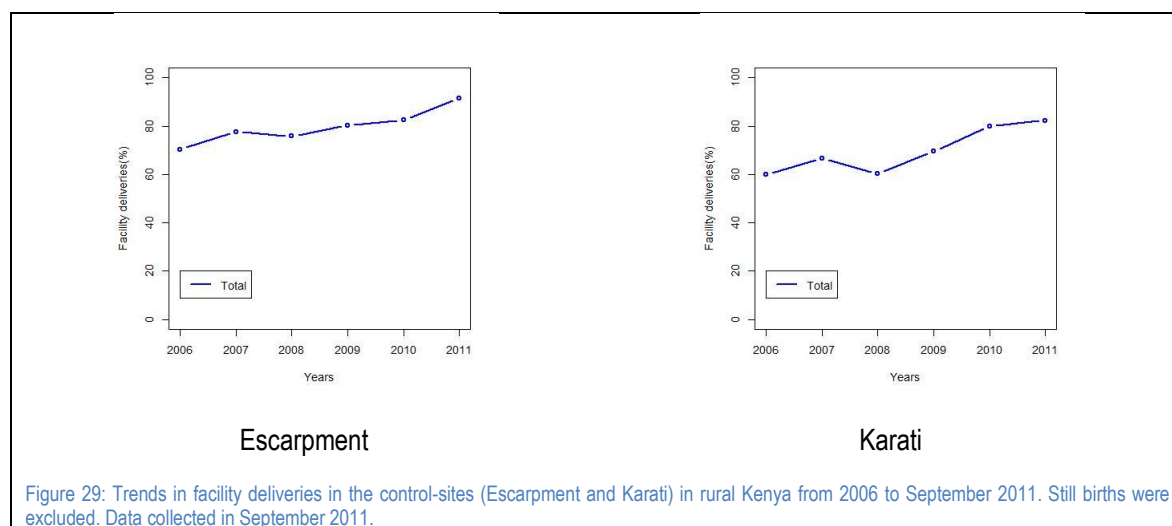
To Figure 28:

In Eburru, information from 480 deliveries between 2006 and 2011 were available (260 home deliveries, 193 facility deliveries, missing data of 27 deliveries (5.6%) which did not include

information about either the year of birth, the place of birth, or both). Only facility deliveries ($n = 193$) were included in the graph.

In Kinale, data from 402 deliveries were included in the graph (169 home deliveries, 402 facility deliveries, missing data of 26 deliveries (4.4%) for all years together).

In Nyakio, data from 348 deliveries were included in the graph (115 home deliveries, 348 facility deliveries, missing data of 5 deliveries (1.1%) for all years together).



To Figure 29:

In Escarpment region, data from 312 deliveries were included in the graph (111 home deliveries, 312 facility deliveries, missing data of 11 deliveries (2.5%) for all years together).

In Karati, data from 369 deliveries were included in the graph (156 home deliveries, 369 facility deliveries, missing data of 8 deliveries (1.5%) for all years together).

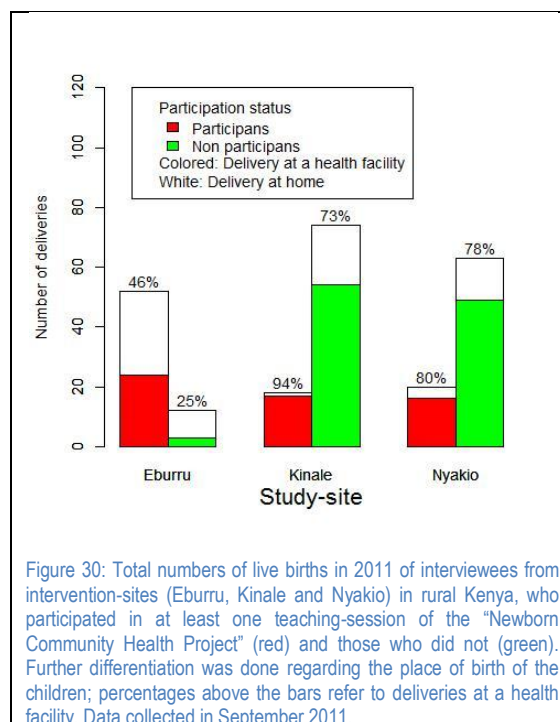
Due to small numbers in each group, tests regarding the place of birth, the participation status and the year of delivery were not run for each region independently.

3.2.2.2. Dependence between participation status and facility delivery (Hypothesis 3)

Figure 30 shows bar plots with the total numbers of deliveries of participants (red) and non participants (green) of intervention-sites with further differentiation about the place of birth of their children. Only children born in 2011 were included in Figure 30, because the participation status of an interviewee was most probably the same in 2011 when she gave birth as it was in September 2011 when data collection took place.

Information from 239 deliveries was included in this figure; missing data was 13 (5.2%).

In all intervention-sites, percentages of facility deliveries were higher in mothers who attended at least one teaching-session compared to non participants: Eburru 46.2% versus 25.0%, Kinale 94.4% versus 73.0%, Nyakio 80.0% versus 77.8%. There was no statistically significant correlation with the exact Fisher test between the participation status of a mother and the location where she gave birth in 2011 (Eburru: $p=0.213$; Kinale: $p=0.062$; Nyakio: $p=1.000$)



3.2.2.3. Intention where to deliver in the future, correlation between intention and previous experiences, and correlation between intention and participation status

63.3% (1,599) of all interviewees expressed a desire to deliver their next baby at a health facility, while 3.4% (85) of the interviewees wanted to deliver their next child at home. 30.6% (773) of all interviewees did not want to have any further children, and 69 interviewees (2.7%) mentioned something else. There was no missing data regarding the intention concerning where to deliver in the future.

Of those 85 interviewees who wanted to deliver their next child at home, 31 (36.5%) have had good experiences at a health facility, or have heard something nice about it, but still do not want to deliver there in the future.

In intervention-sites, the correlation between the intention regarding where to deliver in the future and the participation status of the interviewee was checked: In total, 564 women participated in at least one teaching-session and out of those, 21 women (3.7%) preferred to deliver their next child at home. A slightly higher percentage (4.6%) was found in those women (36 out of 775) who never participated in a teaching. There was missing information about the participation status of 11 women (0.8%). The Fisher test shows no significant correlation between the participation status and the intention of where to deliver in the future ($p=0.413$).

3.3. Secondary objectives

3.3.1. Treatment-seeking behavior

In order to evaluate the treatment-seeking behavior of the interviewees, ANC-coverage and immunization-rates were analyzed. Due to respect and psychological reasons, information about ANC-visits and the immunization status of the children were only collected from children who were still alive ($n=7,806$ children) when data was collected in September 2011.

PNC-coverage was supposed to be analyzed, but unfortunately the meaning of the word “Post-natal-care” was interpreted differently in the study-sites. PNC was meant to be the clinical examination of the post-natal mother at a health facility, but, mainly in Eburru, interviewees thought that PNC is the child-clinic where newborns get weighed and vaccinated. Due to this misunderstanding, it was not possible to analyze the PNC-coverage.

3.3.1.1. Correlation between ANC-coverage and delivery under skilled attendance (Hypothesis 8)

Table 20: Total number of pregnancies in relation to the number of attended ANC-visits during pregnancy. Data from all pregnancies of children who were still alive at the time of point of data collection, of all interviewees of each study-site – except Koinange – in rural Kenya were included; data collected in September 2011.

ANC-visit: Antenatal Care visit

		Study-site					Total
		Eburru	Escarment	Karati	Kinale	Nyakio	
Number of ANC-visits	0	26 (1.9%)	86 (5.7%)	58 (4.3%)	112 (6.8%)	60 (4.3%)	342 (4.7%)
	1-3	578 (42.9%)	409 (27.0%)	660 (48.7%)	944 (57.5%)	657 (47.1%)	3248 (44.8%)
	≥4	744 (55.2%)	1020 (67.3%)	638 (47.1%)	585 (35.7%)	677 (48.6%)	3664 (50.5%)

During pregnancy, the mother presented for the recommended four ANC-visits or more in 50.5% (3,664 children: 744 in Eburru (55.2%), 1,020 in Escarpment (67.3%), 638 in Karati (47.01%), 585 in Kinale (35.7%), 677 in Nyakio (48.6%)). Of them, 67.4% (2,468 children) were delivered under skilled attendance (missing data of 69 children (1.9%)).

Only very rarely (4.7%, 342 children) the mother did not go to any single ANC-clinic before delivery (26 in Eburru (1.9%), 86 in Escarpment (5.7%), 58 in Karati (4.3%), 112 in Kinale (6.8%), 60 in Nyakio (4.3%)). Of them, 21.1% (72 children) were delivered under skilled attendance (missing data of 3 children (0.9%)).

Data from 552 children (7.1%) were missing regarding the information about the number of ANC-visits.

With the Fisher's exact test, a statistically significant correlation ($p < 0.001$) between the attendance of at least four ANC-visits during pregnancy and delivery under skilled attendance was demonstrated in all study-sites.

3.3.1.2. Immunization-rates

In this study, 7,335 children (94.0%) were fully immunized as required for their age, according to the information given by their mothers (1,274 in Eburru (90.5%), 1,530 in Escarpment (95.6%), 1,440 in Karati (96.5%), 1,637 in Kinale (93.2%), and 1,454 in Nyakio (93.9%)).

Only 80 children (1.0%) did not receive any single vaccine (15 (1.1%) children in Eburru (belonging to 7 different mothers), 20 (1.3%) children in Escarpment (belonging to 9 women), 2 (0.1%) children in Karati (belonging to 2 women), 26 (1.5%) in Kinale (belonging to 10 mothers), and 17 (1.1%) children in Nyakio (belonging to 10 women)).

Information from 194 children (2.5%) was missing regarding their immunization status. For the rest (197 children), other options were mentioned, e.g. being partly immunized.

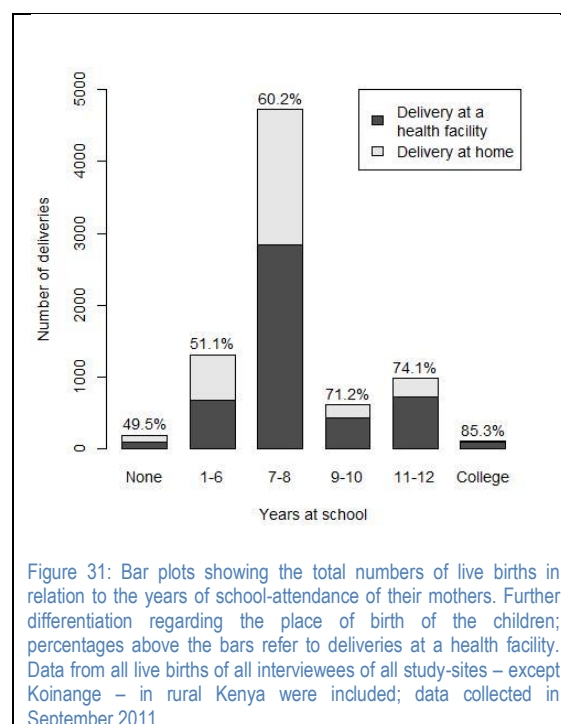
3.3.2. Factors influencing the place of birth

The statistical correlation between the place of birth, the level of education, the economical background, the distance to the next health facility, the birth order, and the family status of a mother were separately analyzed.

3.3.2.1. Number of years of school-attendance of the mother and the place of birth of her children (Hypothesis 7)

As soon as a mother dropped out of school because of being pregnant, she most probably did not return to school after giving birth. For this reason it was decided to include all pregnancies of a mother in the analysis of the correlation between the number of years of school-attendance and the place of birth.

Figure 31 shows bar plots for different categories of school-attendance. The total number of deliveries is



plotted in the diagram with further distinction in regard to where the children were born. In total, data from 7,906 live births (2,298 mothers) were included in the graph. Data from 29 (1.2%) mothers were missing.

The statistical correlation between the number of years of school-attendance and the place of delivery was tested with the Chi-square test of independence. A strong statistically significant correlation ($p < 0.001$) was demonstrated; the same result was demonstrated after testing the correlation in each study-site independently.

Table 21: Total numbers of facility and home deliveries regarding the number of years of school-attendance of their mothers. Data from all live births of all interviewees of all study-sites (except Koinange) in rural Kenya were included; data collected in September 2011.

		Number of years of school-attendance						Total
		Non	1-6 years	7-8 years	9-10 years	11-12 years	College	
Place of delivery	Facility delivery	91 (49.5%)	668 (51.1%)	2845 (60.2%)	435 (71.2%)	724 (74.1%)	87 (85.3%)	4850 (61.3%)
	Home delivery	93 (50.5%)	640 (48.9%)	1879 (39.8%)	176 (28.8%)	253 (25.9%)	15 (14.7%)	3056 (38.7%)

As shown in Table 21, the more years a mother went to school, the higher the percentage of facility deliveries. According to data of this survey, only 49.5% (91 out of 184) of all deliveries of those women who never went to school, took place at a health facility compared to 85.3% (87 out of 102) of those who went to college.

The influence of education on the decision on birth location was furthermore evaluated by checking the location of delivery of the firstborn of each interviewee of those who finished primary school compared to those who did not. It was decided to focus on the firstborns of each interviewee in this analysis, because the woman was not influenced by previous bad or good experiences of earlier deliveries. Findings are summarized in Table 22. Information from 92 women was missing regarding the place of birth of the firstborn or the level of education of the mother.

Table 22: Total numbers of facility and home deliveries of the firstborns in relation to the level of education of their mothers. Data from every firstborn of all interviewees of all study-sites – except Koinange – in rural Kenya were included; only live births were included. Data collected in September 2011.

	Place of delivery		Total
	Facility delivery	Home delivery	
Finished primary school	1224 (82.6%)	258 (17.4%)	1482
Did not finish primary school	544 (72.2%)	209 (25.8%)	753

The strength of the association between finished primary school education and the location of birth of the firstborn was calculated: women who finished primary school were 1.14 times more likely to

deliver their firstborn at a health facility compared to their counterparts who did not finish primary school (OR 1.82 (95% CI: 1.47-2.26)); a statistically significant correlation was found in Escarpment ($p = 0.004$), Karati ($p = 0.921$), Kinale ($p = 0.018$), and Nyakio ($p = 0.008$); no statistical correlation in Eburru ($p = 1.118$).

3.3.2.2. Economic status of a mother and the place of birth of her last-born (Hypothesis 9)

Figure 32 shows the economical status (as determined by the house in which a woman lives together with her family, and the number of interviewees of all study-sites who live in these circumstances. A further differentiation of absolute frequency concerning the place of delivery can be seen.

Data from 2,186 women were included. Data from 141 (6.1%) mothers was missing due to current pregnancy, missing information about the economical status of a mother, or the place where she gave birth to her last-born.

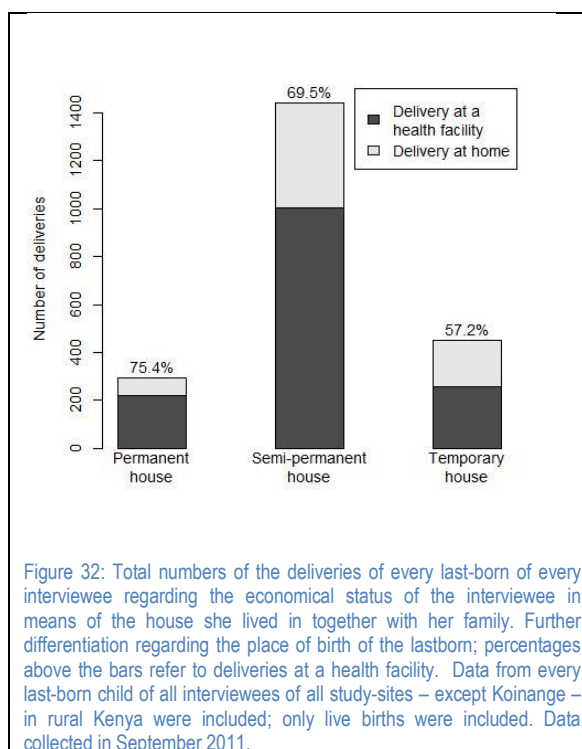
Because the woman most probably would have stayed under the same economical

circumstances at the time of the interview and at her last delivery, while she might have moved from one house to another in any previous pregnancy, only the last delivery was included in this analysis.

57.2% (258) women who stay in a temporary house delivered at a health facility compared to 75.4% (221) of facility deliveries among those who live in a permanent house.

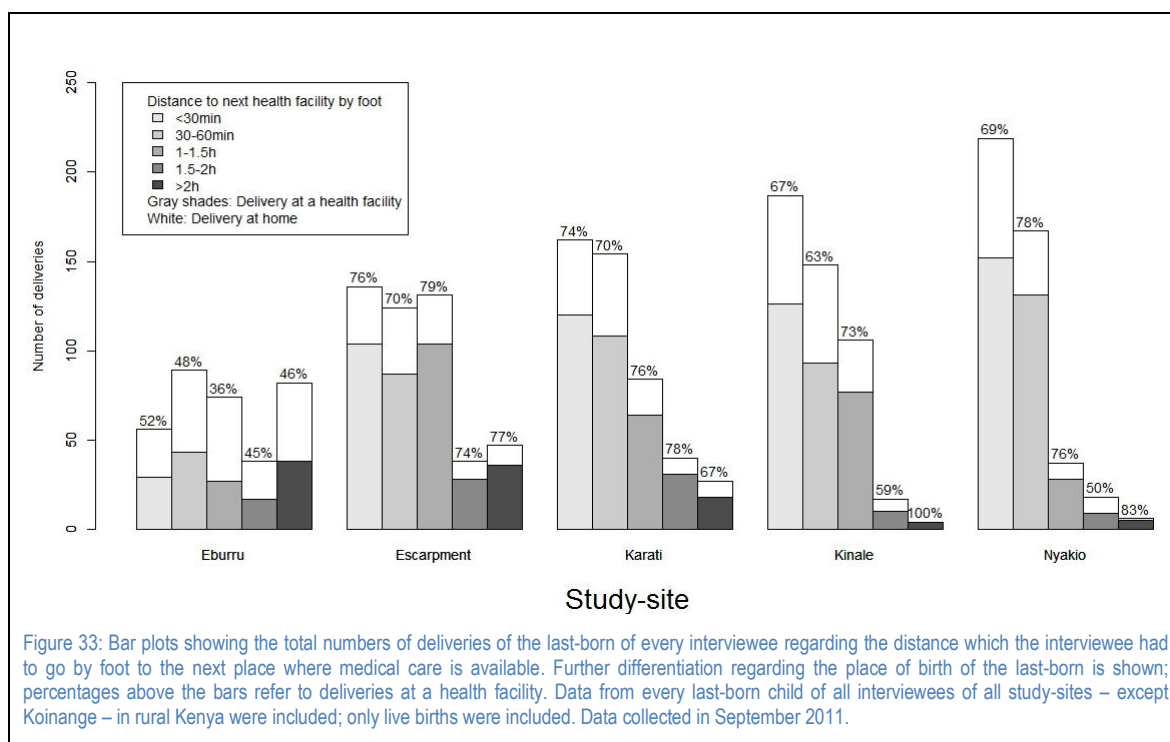
The Chi-square test of independence showed a statistically significant correlation between the economic status of the mother and the place of delivery of her last-born ($p < 0.001$).

The statistical correlation was furthermore tested for each study-site independently: a significant correlation was found only in Kinale ($p = 0.028$); in all other regions, no statistical correlation between the economical status and the place of birth was found (Eburru $p = 0.615$, Escarpment $p = 0.514$, Karati $p = 0.593$, and Nyakio $p = 0.153$).



3.3.2.3. Correlation between the distance to the next health facility and the probability of delivery at a health facility (Hypothesis 10)

Figure 33 shows total numbers of deliveries in relation to the distance a mother has to walk to go to the closest place where deliveries are performed and medical care is available. Furthermore, the place of birth of the last-born was analyzed.



It is possible that during child-bearing age, the interviewee had moved to another place which is closer or farther to the next health facility, and so it was decided to include only deliveries of the last-born of every interviewee in this analysis in order to increase reliability of the results.

In total, data from 2,191 women were included in Figure 33. Data from 136 (5.8%) mothers was missing, due to lack of information about the distance to the next facility or place where they gave birth to their last-born, if they were currently pregnant, or if the interviewee mentioned a different birth location.

With the Chi-square test of independence, the statistical correlation between the distance and the place of delivery was tested. There was no statistically significant correlation found either by testing all regions together or independently ($p=0.281$).

3.3.2.4. The place of birth of the firstborns (Hypothesis 11)

With the exact binomial test, the assumption that at least 75% of all women deliver their first child at a health facility was tested [$H_1: p > 0.75$; $H_0: p = < 0.75$]. The null hypothesis could have been rejected ($p < 0.001$; CI 99%: 0.771-1.0; CI 95%: 0.777-1.0).

Data from the firstborns of 2,253 interviewees from all study-sites were included in this test. Missing data was 74 (3.2%), due to lack of information about the place of birth of the firstborn of a mother.

According to the findings of this survey, 79.2% (1,784 out of 2,253 women) delivered their first child at a health facility.

Data of all study-sites showed that about a quarter of all women who delivered a child at a facility (independent of the birth order), did not deliver their immediate next child at a health facility again. In other words, one woman out of four who came to a health facility for delivery, did not come back for the immediate next delivery.

These results varied in different study-sites, and were greatest in Eburru, where about 45% of women did not deliver the next child at a facility, and smallest in Escarpment, where only 15% decided not to deliver the next child at a facility.

Of all mothers who delivered their child at home, a quarter did deliver the immediate next child at a facility. This trend was smallest in Eburru, where only about 15% of women who delivered their previous child at home went to deliver at a facility, while in Escarpment, 35% of women decided to do so.

3.3.2.5. Correlation between the birth order and the place of birth (Hypothesis 12)

Table 23: Absolute frequencies of facility and home deliveries (with percentages in brackets) regarding the birth order of the child. Data from all live births of all interviewees of all study-sites – except Koinange – in rural Kenya were included; data collected in September 2011.

	Birth order													
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th
Facility delivery	1784 (79.2)	1159 (62.0)	788 (56.5)	501 (52.6)	276 (45.6)	148 (40.5)	103 (45.6)	62 (46.6)	30 (41.7)	15 (38.5)	9 (34.6)	5 (27.8)	7 (58.3)	0 (0.0)
Home delivery	469 (20.8)	711 (38.0)	607 (43.5)	451 (47.4)	329 (54.4)	217 (59.5)	123 (54.4)	71 (53.4)	42 (58.3)	24 (61.5)	17 (56.4)	13 (72.2)	5 (41.7)	2 (100.0)

Figure 34 and Table 23 show the total number of all live births of interviewees from all study-sites according to the birth order with further differentiation about the place of birth.

Data from 2,316 mothers who gave birth to a total of 7,968 children were included for analysis. Information on the location of delivery was missing from 11 (0.5%) mothers.

The correlation between the birth order and the birth place was tested with the Chi-square test of independence. Therefore, every birth order was listed separately, except for those above 12, which, due to small numbers, were summarized in the 13-and-above category.

A statistically significant correlation between the birth order and the place of delivery was found in all regions together, and in each study-site tested independently ($p < 0.001$). In the latter case, all birth orders above eight children were summarized in one category.

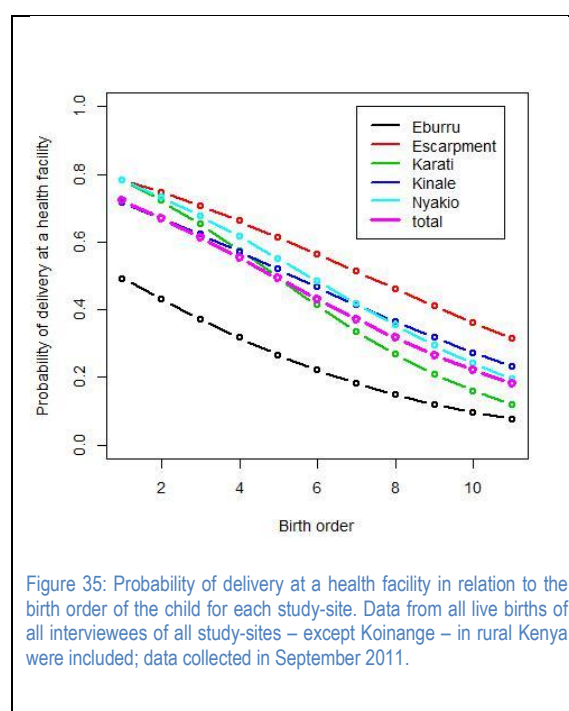
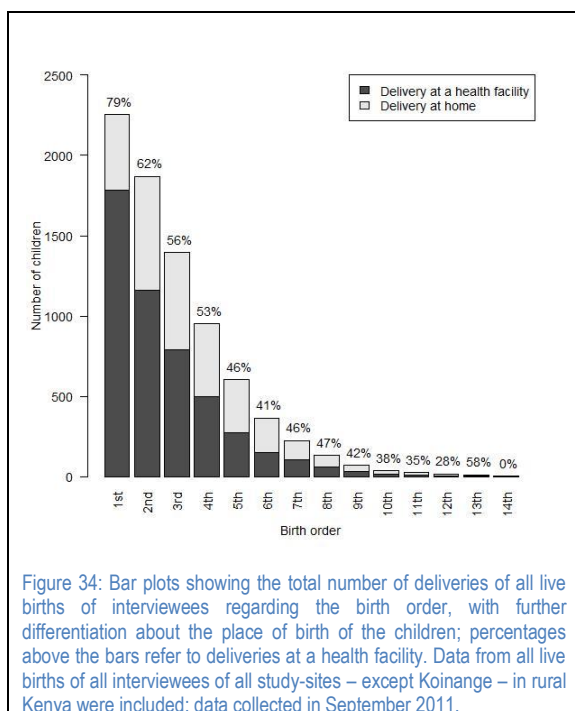


Figure 35 illustrates, for all study-sites separately, that the higher the birth order, the less likely the mother will deliver at a health facility.

3.3.2.6. Correlation between the family status, the total number of carried pregnancies, and the place of birth of the last-born (Hypothesis 13)

The statistical dependence between the family status and the number of total pregnancies was analyzed. Interviewees of all study-sites were grouped according to their family status. Box-plots were drawn for each category, related to the total number of carried pregnancies per woman (Figure 36). Data from 2,315 women were included; data from 12 (0.5%) interviewees were missing.

The correlation between the family status of a mother and the place where she gave birth to her child was tested with the Chi-square test of independence:

Including all deliveries of a mother, and comparing

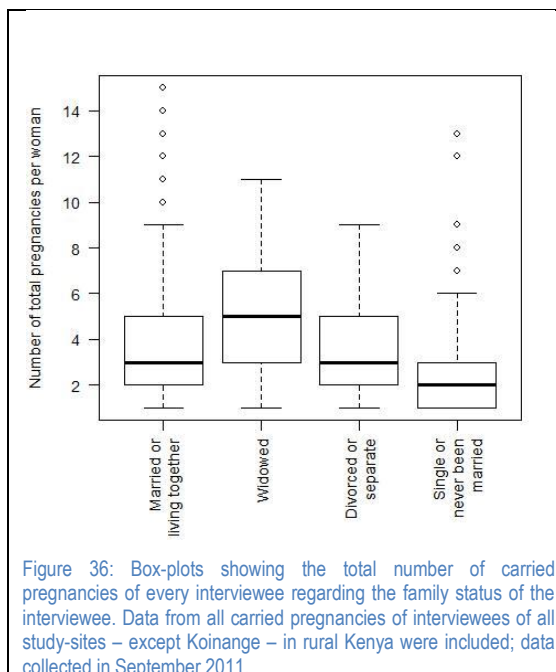
married women and singles, or women who have never been married, no statistically significant difference was found ($p=0.329$).

Including only the last delivery of each interviewee, a statistically significant correlation between all four family statuses and place of delivery was found ($p=0.013$).

According to the findings of this study, there is a statistical correlation between the birth order and the place of birth. Since most widowed mothers had plenty of children, it was decided to do another test and to exclude all widowed mothers: no statistical correlation between the three remaining family statuses and the place of delivery was found ($p=0.690$); there was even no statistical dependence found when tested for each study-site independently, except for Nyakio, where a significant correlation was found ($p=0.005$).

When only the last delivery of every interviewee was included, and only those women were analyzed who delivered three or four children in total, no statistically significant dependence was seen between the family statuses and the place of birth of the children ($p=0.234$).

These results show that the family status does not seem to influence the location of birth.



3.3.2.7. Attitude towards the closest health facilities

The attitude of interviewees regarding both the closest health center and the closest hospital was investigated. For descriptive purposes, only the most frequent answers to this open-ended question, with multiple answers possible, are listed in Table 24.

Of those interviewees who reported having had bad experiences in a health center or in a hospital, 96.9% and 94.6% respectively, reported an intention to deliver their next child at a health facility. 96.6% of interviewees, who mentioned good experiences in health centers or hospitals, reported a desire to deliver their next child at a health facility.

Table 24: Attitude of interviewees towards the closest health facilities. The total number of women who mentioned each of the comments regarding the facility is given. Data collected in all study-sites in rural Kenya in September 2011.

		Attitude towards ...	
		... the closest health center	... the closest hospital
Negative comments of interviewees	I would never go there.	32	23
	I have had bad experiences in the facility.	247	127
	People told me bad stories about the facility.	32	36
	It is too far away, so I can't get there.	14	27
	I don't have enough money to go there.	12	19
	The service is very expensive.	9	33
	Delay or slow service provided.	50	23
	No medicine or lack of drugs in the facility.	55	5
	Lack of medical equipment in the facility or lack of facilities in general.	29	9
	No staff, medical doctor or nurse in the facility.	11	1
	Abusive, disrespectful or rude staff in the facility.	40	22
	I don't know, or I have never been there.	36	45
	God takes care of me, so it is sin to go there.	0	11
Positive comments of interviewees	I have had nice experiences in the facility.	2104	2117
	People told me nice stories about the facility.	95	165
	Good, fair, or excellent service was provided there.	31	39
	The service has improved.	3	1

3.3.3. Deaths and mortality rates

3.3.3.1 Correlation between time of death after birth and the place of delivery

In this survey, information about 8,370 pregnancies among 2,325 mothers (total fertility rate is 3.6 children per mother) was gathered. From 2 mothers, information about their pregnancies and deliveries was missing. Of the remaining 8,370 pregnancies, 8,085 (96.6%) children were delivered alive. At the point of time of data collection, 459 children had already passed, with 180 (2.2%) intra-uterine deaths and 279 (3.3%) post-natal deaths. 43 current pregnancies were recorded. Information on 62 children (0.7%) was incomplete or missing. See also Table 25.

180 pregnancies were interrupted before delivery. The exact gestational age of 93 of these intrauterine deaths was not known. Due to this the exact rate of stillbirths, defined as death above 22 weeks of gestational age, could not be calculated and so perinatal mortality rates were not computed.

Table 25: Available data from pregnancies and deliveries of interviewees of all study-sites – except Koinange – in rural Kenya; data collected in September 2011.

NMR: Neonatal Mortality Rate; IMR: Infant Mortality Rate; U5MR: Under-five Mortality Rate

		Number		Percentage
Available data of pregnancies*		8370		100.0%
Current pregnancies		43		0.5%
Intrauterine deaths		180		2.2%
	1st trimester		43	
	2nd trimester		31	
	3rd trimester		13	
	Gestation age of intrauterine deaths unknown		93	
Missing data		62		0.7%
Live births		8085		96.6%
	Children still alive at time of data collection		7806	
	Post-delivery deaths		279	
	Time of death unknown		12	
	Total childhood deaths with known time of death		267	
	Neonatal period (death within the 1st month of life)		132 (47.3%)	NMR: 16.3/1000 live births
	Infant period (death from birth until the end of the 1st year of life)		211 (75.6%)	IMR: 26.1/1000 live births
	Under-five child deaths (death from birth until the end of the 5th year of life)		241 (86.4%)	U5MR: 29.8/1000 live births
	Death above five years of age		26	

* Here, twins are recorded as two independent pregnancies, triplets are recorded as three independent pregnancies, ...

Figure 37 shows the number of post-delivery deaths in relation to the time of death after delivery, with further differentiation about the place of birth of the child. Data from 267 children were included. There is missing data for 12 (4.3%) children due to lack of information about the time of death after delivery.

Of those 267 children, 132 (49.4%) children died within the neonatal period (within the first month of life), 211 (79.0%) in the infant period (from birth until the end of the first year of life), 241 (90.3%) under five years of age, and 26 (9.7%) after 5 years.

Even though time intervals get larger from the neonatal age, to infancy and childhood under five,

the mortality rate decreases: almost half (47.3%) of all childhood deaths in this study occurred in the first month of life (neonatal period) and 80% up to the end of the first year of life.

The pie charts in Figure 38 and Figure 39 show the deaths of those children who were delivered at home on the left (Figure 38), and those who were delivered at a health facility on the right (Figure 39). In both charts, the time span after delivery was measured and compared.

Data of 52 children who died after delivery were not included in those pie charts, due to missing information about the place of birth.

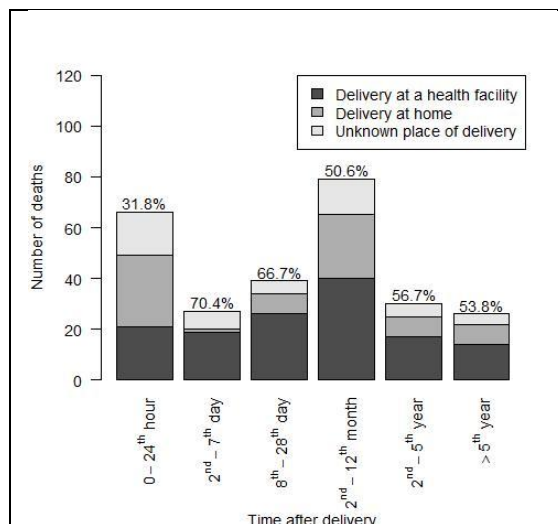


Figure 37: Total number of post-delivery deaths of children in relation to the time of death after delivery. Further differentiation regarding the place of birth of the child; percentages above the bars refer to deliveries at a health facility. All post-delivery deaths of children belonging to interviewees of all study-sites – except Koinange – in rural Kenya were included; data collected in September 2011.

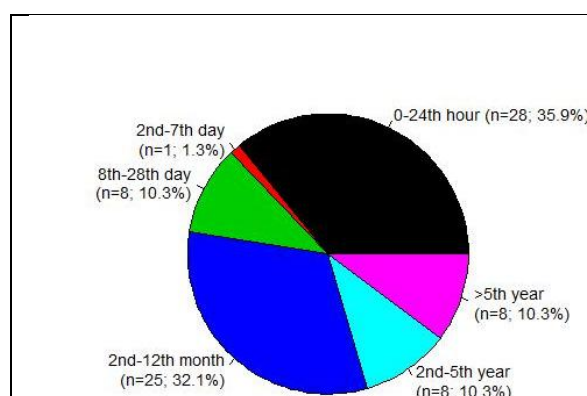


Figure 38: Post-delivery deaths of children, who were delivered at home, in relation to the time of death after delivery. Data from all post-delivery deaths after home deliveries belonging to interviewees of all study-sites – except Koinange – in rural Kenya were included; data collected in September 2011.

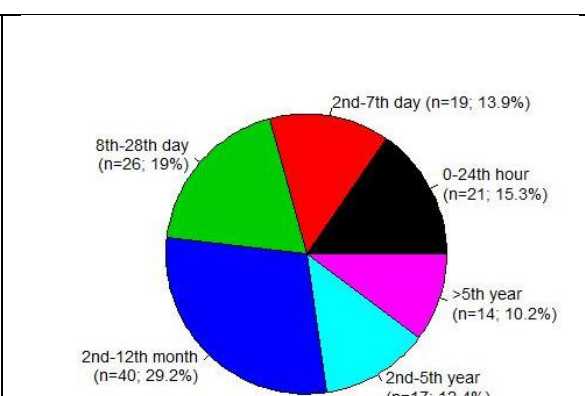


Figure 39: Post-delivery deaths of children, who were delivered at a health facility, in relation to the time of death after delivery. Data from all post-delivery deaths after deliveries at a health facility belonging to interviewees of all study-sites – except Koinange – in rural Kenya were included; data collected in September 2011.

To Figure 38:

Data from 78 children were included in the pie chart. Of them, 28 children died within the first day of life (0-24 hours), and only 1 child died in the first week of life (second to seventh day).

In total, 37 neonates died (47.4% of all post-home-delivery deaths), 25 infants (32.1% of all post-home-delivery deaths), 8 children (10.3% of all post-home-delivery deaths), and 8 people above five years of age (10.2% of all post-home-delivery deaths).

In this study, a total of 3,081 children were born at home. 78 children (2.5%) of all home deliveries died.

To Figure 39:

Data from 137 children were included in this pie chart. Of them, 21 children died within the first day of life (0-24 hours) and 19 children died within the first week of life (second to seventh day).

66 neonates (48.2% of all post-facility-delivery deaths), 40 infants (29.2% of all post-facility-delivery deaths), 17 children (12.4% of all post-facility-delivery deaths), and 14 people above the age of five (10.2% of all post-facility-delivery deaths) died.

In this study, 4,885 children were born at a health facility. 137 (2.8%) of them died.

3.3.3.2. Neonatal, infant and under-five mortality rates

A change of neonatal, infant, under-five, and perinatal mortality could not be shown in this study. The number of deliveries in the observed populations and the described time period were too small to calculate reliable mortality rates for each year and study-site. Nevertheless, Table 26 shows mortality rates, which were calculated with a 95% confidence level based on cumulative data of all study-sites together for all years and for the years 2006 until September 2011.

Table 26: Neonatal, infant, and under-five mortality rates expressed per 1,000 live births with a confidence level of 0.95 based on data collected in all study-sites in rural Kenya – except Koinange – in September 2011. Mortality rates of Kenya based on data from UNICEF ⁷³.
CI: Confidence Interval; UNICEF: United Nations Children Fund

	Mortality rate in this study		Mortality rate of Kenya (data of 2011)
	For all years together (1971-2011)	From 2006-2011	
Neonatal mortality rate	16.33 (95% CI: 13.68-19.33)	16.29 (95% CI: 11.66 – 22.11)	27 ⁷³
Infant mortality rate	26.10 (95% CI: 22.73-29.81)	25.65 (95% CI: 19.77-23.70)	48 ⁷³
Under-five mortality rate	29.81 (95% CI: 26.21-33.75)	28.91 (95% CI: 22.65-36.33)	73 ⁷³

4. Discussion

4.1. Primary objectives: Impact of the NCH-project

The primary objectives of the NCH-project were to increase the knowledge about safe pregnancy, delivery and neonatal care in the community and to promote facility deliveries.

4.1.1. Increase of knowledge about perinatal health

It was assumed that mothers from intervention-sites who participated in at least one teaching-session, would achieve higher knowledge scores than those who did not participate in any session. In two intervention-sites (Eburru and Nyakio), the total knowledge score of participants was significantly higher statistically, compared to non participants. In the third intervention-site (Kinale), no statistically significant difference between these two groups could be shown. However, this is probably due to the fact that the NCH-project had been implemented in Kinale in 2010, just one year before the survey, while in other areas, teaching interventions had already started in 2008.

The distribution of the total knowledge score in all study-sites showed clearly that participants of at least one teaching had the highest scores, followed by interviewees who came from control-sites and who had never had the chance to attend a teaching-session. It is interesting that mothers from intervention-sites who did not attend a teaching, received in general the lowest total knowledge scores. It was assumed that women of interventions-sites would in general achieve higher knowledge scores, due to NCHFs and participants of NCH-teachings spreading the messages within the entire intervention-site. Therefore, findings of this study show that unless a certain density of NCHFs per household is reached, it is not enough to just live within an intervention-site, but one has to attend the teaching in order to increase one's knowledge about safe motherhood and neonatal care.

Also the number of attended teaching-sessions matters: In two of the three intervention-sites (Kinale and Eburru), participants of four or more teachings had learned significantly more, statistically, about safe pregnancy, delivery and neonatal care than those who attended only one teaching; in Nyakio, no statistical correlation between perinatal knowledge and the number of teaching-sessions could be demonstrated.

Not only does the NCH-project add to the perinatal-related knowledge of mothers, but also the mother's educational background: In five of six study-sites, a statistically significant correlation

between the number of years of school attendance and the knowledge of a mother was demonstrated. The longer a mother attended school, the more knowledge about safe motherhood and care of the newborn she had, even though there is no subject at Kenyan schools teaching pupils about perinatal health in particular. A woman who went to school for some years has a broader general education, which gives her the opportunity to quickly understand relations. A good educational background adds to the openness and preparedness of women to study on their own, and to critically search for information and solutions about topics which she may encounter in her life.

4.1.2. Increase of facility deliveries

4.1.2.1. Participation-status of the NCH-project and facility delivery

Although there was no statistically significant correlation between the participation status of a mother and the place where she delivered her child in intervention-sites, the number of women delivering under skilled attendance was higher among mothers who reported receiving at least one health message, compared to those who did not. In the intervention-sites, the percentage of facility deliveries of participants versus non participants was 46.2% versus 25.0%, 94.4% versus 73.0%, and 80.0% versus 77.8%.

These results are similar to the findings of a hospital-based cross-sectional study carried out in Kenya, which postulates that women with correct information and knowledge about safe delivery practices were more likely to deliver with a skilled birth attendant than those with incorrect information ⁷⁸.

In the first two pilot regions Eburru and Nyakio, it took at least two years to determine a noticeable difference between the percentages of facility deliveries of mothers who participated in at least one teaching of the NCH-project, and of those who did not participate. In Kinale, this effect was already found one year after the intervention started. Experiences from the first two regions may have assisted the NCH-team to implement the project faster in the third intervention-site.

A significant change in the women's knowledge level was not yet detectable, despite an increase in the number of facility based deliveries already occurring after one year of teaching in Kinale. The most important aspect of the NCH-project, which is the widespread promotion of facility deliveries, got implemented in Kinale very quickly, but the increase of knowledge took longer. It remains unclear, whether the rising numbers of facility deliveries is secondary to the effect of the teaching, or due to other improvements in the health infrastructure (e.g. better staffing, opening hours) that were

initiated secondary to the start of the project in the region and reports given to district health officers and other regional leaders.

4.1.2.2. Perinatal knowledge and facility delivery

The higher the perinatal-related knowledge of interviewees, the higher the rates of facility deliveries of the last-born child; hence a statistically significant correlation between knowledge and place of birth was found only in two study-sites (Escarpment and Kinale).

In Nyakio, 5% less participants delivered at a health facility compared to non participants, despite higher perinatal knowledge scores of the participants. Even two years after the NCH-project was implemented in this area, no major change between participants and non participants regarding the place of birth was noticed. This result might be due to the fact, that in Nyakio, improvements of the health care system and its infrastructure took longer; only the knowledge of the inhabitants of this region has increased so far. Furthermore the density of the NCHFs per household was much lower in Nyakio compared to Eburru.

This assumption is reinforced by findings of a national health facility survey carried out in Uganda, which concludes, that improving availability and quality of care can increase skilled attendance at delivery: sufficiently equipped health facilities (e.g. running water, electricity, offering basic or comprehensive emergency obstetric care) were associated with increased facility deliveries in this study.⁴⁵

To sum up, it can be said that knowledge alone is not sufficient to sustainably reduce rates of home deliveries. It has to go in parallel with more health facilities, better equipment and qualified staffing to reach that goal. These findings go in line with results published in the Every Newborn Series of the Lancet, where experts discussed achievements and evidence-based strategies in order to globally reduce neonatal mortality. They demonstrate the essential need for increasing workforce, better equipment, and training health care providers in both basic and high-level emergency care practices. Closing the quality gap and scaling-up the quality of health facilities especially in low-income countries has the potential to decrease neonatal deaths by almost 80%.^{8 19 43}

4.1.2.3. Various programs which promote facility deliveries

In all study-sites, numbers of deliveries under skilled attendance at health facilities increased, and numbers of home deliveries decreased over the years. This achievement is probably the result of a mix of activities related to perinatal health.

Besides the teaching of the NCH-project in intervention-sites, there were also campaigns from government health services (e.g. training CHWs and promoting the use of NHIF cards), interventions of non-governmental organizations (e.g. introduction of a delivery voucher system in some neighboring regions), and local activities promoting safe motherhood (e.g. medical campaigns, which tried to change wrong attitudes and beliefs about HIV/AIDS and which also emphasized the necessity for ANC-visits). According to the Kenya Service Provision Assessment Survey in 2010, emergency support (e.g. availability of Ambu bags, external heat source, nasogastric tubes) and useful, evidence-based routine newborn care practices (e.g. drying the newborn and wrapping it in clothes instead of a full immersion bath, Kangaroo mother care) have become more common all over the country from 2004 to 2010 ⁴⁸.

Over the last few years, access to health care was improved in all study-sites to a different extent. As a result of biannual reports of the NCH-team to health authorities, in some intervention-sites more health facilities were built; in others regions, health facilities were better staffed and equipped to improve the quality of care and achieve longer opening hours.

Escarpment, one of the control-sites, where very high delivery rates at health facilities were recorded, is an example for various influences:

Subsidized delivery vouchers (as described above) were introduced in areas east of “AIC Kijabe Hospital” from 2006 to 2009 (see Chapter 1.2.3.3. p.14). Escarpment was the only study-site that was eligible to receive such vouchers. Subsidized delivery vouchers can increase the utilization of health facility deliveries, deliveries under skilled attendance, and the utilization of PNC-services; in addition, they improve the utilization and the quality of health centers through competition ⁵³.

Furthermore, the main health center for the region (“Lari Health Center”) is open seven days a week for 24 hours and accepts National Health Insurance (NHIF) cards to ease the payment of the bill for uncomplicated deliveries. This was not the case in any other study-site. Only some of the employed workers have a NHIF-card, although women from all study-sites are eligible to enroll in the NHIF system. For the majority of subsistence farmers, who do not have bank accounts, travelling to an NHIF office for payments of small monthly amounts was not feasible and was time consuming. Some people had bad experiences, not willing to entrust their money to NHIF money collectors. Furthermore, it is difficult to convince people to invest into the NHIF, if their local health center does not yet accept NHIF cards, because it is not yet accredited.

The high delivery rates at health facilities in Escarpment demonstrate that access to health facilities can be significantly improved through subsidized vouchers, better access to health insurance

schemes, and functioning health services for 24 hours. Although such systems may create a positive competition between health care providers and enable women to choose good quality care it still remains unclear how to sustain such sometimes heavy subsidized programs.

Another attempt to explain the high rates of facility deliveries in Escarpment is based on the fact, that there was a statistically significant correlation between the knowledge score and the place of birth demonstrated in this study-site. This fact leads to the assumption that perinatal knowledge, plus NHIF, plus possibly also the voucher system, plus functioning health services for 24 hours would significantly increase the number of skilled deliveries at facilities up to over 90%.

4.1.3. Dissemination, Sustainability and Effect of the NCH-project

4.1.3.1. Dissemination of the NCH-project into the community

One core aim mentioned in the Every Newborn Series in the Lancet is to optimize service delivery by dynamic leaderships including community empowerment and innovation. The NCH-project accomplishes this demand for community-based strategies including community engagement, since the empowerment of communities still account for 20% of neonatal deaths prevented ^{8 19}.

The exact influence of different independent activities of the multicomponent NCH-project, which aim to improve access to health care, cannot be measured separately. The different components aim at behavior change at the community level and address several components at the same time in order to create an “enabling environment” (see Chapter 1.2.1.2. p.4). It can be concluded from the data, that the dissemination of knowledge into the community, including those not attending NCH-teachings, is a long process and a certain density of trained NCHFs is necessary and still to be defined.

The NCH-team implemented the project in those areas, where conditions and knowledge about safe motherhood and newborn care were worse. In addition it is a key program challenge to reach those mothers and newborns in the greatest need. As Figure 26 shows, the NCH-project so far reached more educated than uneducated women. Approaches still have to be found to attract, to reach and to train more uneducated women in the future.

Furthermore, the dissemination of knowledge into the community is also influenced by the density of trained CHWs and NCHFs. No intervention-site has yet reached high density of trained NCHFs, and the ratio of trained NCHFs remained substantially below Kenya’s goal of one CHW per 20 households (average household size of five people). Perhaps more substantial program coverage would have been helpful to further improve perinatal-related knowledge, deliveries under skilled

attendance, and treatment seeking behavior within the community even more.

But the ability to demonstrate improvements in proximal indicators, such as knowledge, does provide reassurance that processes are on track to achieve desired objectives when upgrades in interventions are available.

4.1.3.2. Retention rates and sustainability of the NCH-project

Sustainability is crucial and a critical indicator for success in any community health project.

After three years of the intervention, the NCH-project has trained 42 NCHFs in Eburru, who later were integrated into the government community health strategy. A short time after data collection for this survey in 2011, the NCH-project slowly withdrew from this region. To date, volunteers continue to function with a high level of responsibility and promote maternal and newborn health messages within their community: 31 of 42 trained NCHFs remain active (2 died, 3 relocated and 6 had increased family obligations). This means that 2.5 years after graduation from the NCH-training and 1.5 years after the NCH-team completely withdrew from Eburru region, retention was more than 80% (31 of 37 NCHFs). These retention rates are higher than those reported in other Kenyan studies, where drop-out rates of 33 to 40% of trained CHWs were noted ^{30 54}.

Similar evidence of sustained impact is present in Nyakio, where graduated NCHFs remain active two years after withdrawal of the support given by the NCH-project.

Sustainability is an important advantage for a community-based process, and sustaining behavior change messages in a community is essential to increase the dosage of message delivery. Behavior is rarely changed after initial exposure to new information. Rather, as the community begins to develop new norms that result in new patterns of behavior, the process is more likely sustainable within the community and therefore increases the likelihood of healthier mothers and newborns.

In the Newborn Action Plan, the need for the change of social norms is mentioned through the promotion of zero tolerance for preventable mortality and advocate for optimal behaviors through multi-media communication campaigns and community programmes ^{43 79}. Support from the media or the community can increase both, acceptance and sustainability of the NCH-project by reinforcing the types of changes they are promoting at level one thru national advertising medic campaigns. The NCH-project for example discovered that time and resources needed to train a group of volunteers could be reduced by 50% when there is more support from the community and as national norms

and community norms help promote these behavior changes the time required for acceptance of changes may be reduced.

4.1.3.3. Impact of non professional volunteers in the NCH-project and Effectiveness trial

The NCH-project meets the demand of the Newborn Action Plan ⁷⁹ to use community strategies to bridge gaps between families and the health sector by working with non professional volunteers who improve the need of health services including birth preparedness and essential newborn care practices, do home visits, and engage in participatory women's groups.

This study demonstrates the importance of community passed participatory processes. Community volunteers, such as small-scale farmers, can effectively increase the knowledge of maternal and newborn health in their communities, and can promote delivery under skilled attendance. The innovations made to the spacing and interval of training delivery was a process that required community input driven by their needs, not input from professional educators. The slower pace of training, in adaptation to the agrarian lifestyle, contributed substantially to the retention of volunteers. When working with adult learners, especially those with low literacy, skill practice under supervision can prove an effective motivational tool, building on the strength of their oral and relational capacity.

This study is an effectiveness trial. Effectiveness trials are of special interest since they prove up to what extent theoretical constructs and theories can work in real settings under actual conditions. In resource constrained areas, as in the study-sites of this survey, only those interventions are feasible, which are sustainable, affordable, culturally accepted and suitable in the specific setting. Effectiveness trials using quasi-experimental designs do not address as many potential threats to validity as do randomized trials, but this is clearly a case where the good should not be an enemy of the best.

4.2. Secondary objectives

The secondary objectives of this study were to evaluate the change of treatment seeking behavior in the communities and to analyze factors which influence the place of birth. The analysis of child deaths and mortality rates were also defined to be secondary objectives.

4.2.1. Treatment seeking behavior

Rates of ANC-visits and immunization rates were investigated, while rates of early onset of exclusive breastfeeding were not investigated.

4.2.1.1. Antenatal Care visits

According to the latest data from UNICEF, 92% of Kenyan mothers attend ANC-clinics at least once during their pregnancies, but only 47% go to ANC-clinic at least four times, as recommended ⁶⁷. These numbers are similar to the findings of this survey: in half (50.5%) of all pregnancies, mothers did undergo at least four ANC-visits. Of them, 67.4% finally delivered under skilled attendance (compare: in this study, 61.3% of all deliveries took place under skilled attendance at a health facility). In only 4.7% of the pregnancies, the mother did not attend any ANC-clinic, and of them only 21.1% delivered under skilled attendance. A statistically significant correlation between at least four ANC-visits before delivery and delivery under skilled attendance was found in all study-sites. Attending an ANC-clinic for at least four times, therefore, seems to go along with higher numbers in deliveries under skilled attendance.

A Canadian study reviewed the relation between ANC and subsequent delivery under skilled attendance, by correcting for endogeneity problems in four sub-Saharan countries including Kenya. By using structural equation models, a largely underestimated direct effect of ANC on skilled birth attendance was detected in all four countries. In Kenya, women who attended an ANC-clinic at least four times, were 20% more likely to deliver under skilled attendance, compared to women who attended less than four visits. This effect was, by the way, mediated by the quality of services provided during an ANC-visit in Kenya. ²

Both the results of the Canadian study and the findings of this survey, suggest that more emphasis should be put on the role of ANC-visits in order to increase skilled birth attendance. Medical staff involved in ANC-visits need to be trained to use these opportunities for teaching and as entry points to reach out to the pregnant women in the community.

4.2.1.2. Immunization rates

According to UNICEF, Kenya has made significant progress in its vaccination efforts since Kenya's Ministry of Health reported that 83% of children in the country are fully immunized by their first birthday ⁶⁵. According to the information given by interviewees, 94.0% of children were fully immunized in this survey with cross-checking vaccination cards where available. It is unclear

whether the rates in the area are really that high, or if there is over-reporting due to socially desirable reporting.

4.2.2. Factors influencing the place of birth

As shown in other studies, socio-economic factors, such as low education, large distance to the next health facility, living under poor conditions, and bad previous experiences at a health facility significantly influence the decision of a mother as to where to deliver her child.

4.2.2.1. Education

In this study, a strong statistical correlation between the level of education and the likeliness of a woman to deliver at a health facility was found. The percentage of women who had delivered their babies at a health facility varied between 49.5% (no education) and 85.3% (tertiary education).

These findings are in line with data from the Kenya Demographic and Health Survey 2008-2009: 19.2% of women with no education delivered their babies under skilled attendance compared to 72.5% with secondary or higher education ²⁶. Similar results were arrived by studies in other countries: In rural Tanzania, primary and higher education was positively correlated with facility deliveries (RR 1.30, 95% CI 1.23-1.38) ⁴⁷; a study in Mumbai/India used an adjusted multivariable regression model, finding that the odds ratio of home delivery rose with low literacy ¹⁸; an Afghan study postulated that literacy in mothers was associated with deliveries under skilled attendance in contrast to illiterate women (OR 2.5 (95% CI: 2.0-3.1)) ⁴⁴.

Data of this study also shows that especially the last two years of primary school (Form 7 and 8) influence the decision of a mother as to where to give birth, even though there is no specific course about safe motherhood or newborn care in these two years of primary school. Women who finished primary school, were 1.14 times more likely to deliver their first child at a facility compared to those, who did not finish primary school (OR 1.82 (95% CI: 1.47-2.26)).

4.2.2.2. Distance to the next health facility

In rural areas, the distance a mother has to walk to the next health facility was assumed to be one of the most important factors influencing a mothers' decision on where to deliver.

In Asia, a case referent study showed that the distance to the next place where medical help is available was negatively correlated with neonatal mortality ⁴¹; in a cross-sectional study in Afghanistan, increased distance from the household to the health facility was associated with lower use of a skilled birth attendant ⁴⁴.

In contrast, findings of this cross-sectional study in Kenya did not demonstrate a statistically significant dependence between distance and place of delivery. It is only after 1.5 hours distance to a health center that the percentage of women delivering at health facilities decreases from around 70% to 60%. It seems that if a mother is convinced that facility delivery is the better option compared to delivering the child at home, she will most probably not change her mind despite the long distance to the next health facility. A similar result was described in a Tanzanian study, where women chose to skip close health facilities and to go to the health facility with better quality and care despite longer distances; nevertheless, the influence of distance was always present and just expanded or contracted depending on severity of illness and necessity of health care ³⁷.

The influence of the distance to the next health facility in this study was probably also diminished, because it was part of the NCH-teaching to educate women about making a birth plan, which includes timely addressing the means of transport to the health facility. In a study carried out in slums in Mumbai/India, more than half of all pregnant women planned to deliver at a facility, but named lack of time to reach the next facility because of rapidly progressing labour, and missing transport, as the most common reasons why they finally delivered at home ¹⁸. It is very possible that the NCH-project decreased the influence of distance to the next health facility through its educational program. Furthermore occasional teachings also for men, who often control the limited financial and transport resources, may have had additional positive effects.

4.2.2.3. Economical status

Access to health services is not only determined by the distance to the next health center, but also is dependent on the economic status of mothers, local transport systems, staffing and opening hours of health facilities, and in some regions also cultural barriers.

Studies in Tanzania ⁴⁷, Afghanistan ⁴⁴, and in slums of India ¹⁸ all describe the same: increasing numbers of home deliveries in poor families.

In this study, a similar result was seen comparing the poorer with the richer households, since 57.2% of women living under poor conditions delivered their children at a facility compared to 75.4% of women living under better conditions. A statistically significant correlation between the economical status of a mother and the place of birth of her child could only be demonstrated in one study-site (Kinale).

In several sub-Saharan countries, medical care around pregnancy and delivery is nowadays free of charge in order to decrease financial barriers to medical aid. In Ghana, for example, time-series

methods, which assess the impact of free delivery care and free national health insurance for pregnant women, reveal that the increase in facility deliveries was greatest in the poorest, leading to a decline of socio-economical differences ²⁰. In India, financial barriers to health facilities were diminished through a conditional cash transfer scheme which should incentivize women to give birth in a health facility; it had an impressive effect on increasing the number of facility deliveries, but was only associated with modest reduction in perinatal mortality, possibly because the quality of facility care provided was low ³⁸.

Unfortunately, in Kenya, women still have to pay for deliveries at a health facility and prices for a delivery range between KSh 500 to 1,500 (5 to 10 €) in government health facilities and from KSh 2,500 to 5,000 in private facilities. Costs for a cesarean-section are usually up to tenfold higher, depending on the length of the hospital stay. In addition, women have to find money for the transport to the health facility and their absence from home has to be compensated by other family members.

In the Every Newborn Series, decreasing financial barriers e.g. by expansion of health insurances, voucher systems, and conditional cash transfer is crucial for a substantial reduction of neonatal deaths. Furthermore the money government spending on health per head has to dramatically increase in low- and middle-income countries in order to diminish high out-of pocket spending on health. ¹⁹ According to the World Bank, the health expenditure per capita was USD 45 in Kenya in 2012 (in Germany it was USD 4,683 in 2012) ⁶².

4.2.2.4. Birth order

In each study-site, there is a significant decline (5 to 10% with each pregnancy) of willingness to deliver at health facilities between a primigravida (79.2%) and women with two (62.0%), three (56.5%) or more deliveries (40 to 50%). All in all, in this study, birth order seemed to be the most predicting factor for the place of delivery.

The Kenya Demographic and Health Survey 2008-2009 demonstrates the same trend of willingness to deliver with a skilled attendant of primigravida (62.2%), women with two or three deliveries (46.5%), women with four or five deliveries (34.2%), and women with six or more deliveries (26.5%) ²⁶. Similar results are postulated with differences on the magnitude of parity: A case-control study carried out in Kathmandu/Nepal found out that multiparity increases rates of home deliveries by 3.1 times (compared to primigravida) ¹²; a prospective study in Mumbai/India revealed a similar finding using a logistic regression model with multivariable analysis (OR 1.56 (95% CI: 1.40-1.74)) ¹⁸.

Higher rates of home deliveries in multiparity might be on one side due to increased self confidence after each pregnancy, and on the other side due to bad experiences with delivery at health facilities. The more healthy babies a mother delivered, the less she will judge the need to deliver at a facility due to her growing experiences. In contrast the study cannot tell if mothers are more likely to deliver their next child at a health center if they encountered difficulties during their previous pregnancy.

In all study-sites grandmothers support the idea that giving birth is an easy and natural practice which neither needs neither high tech medicine nor the influence of foreigners. These elderly ladies need to be integrated into health teachings, as they are held in high esteem and are opinion leaders of communities.

4.2.2.5. Previous experiences and attitudes towards health facilities

Findings of this survey show that almost 80% of women reported to have delivered their firstborn at a health facility, but about a quarter of them did not deliver their next child at a health facility.

This result is in a very large proportion due to the birth order as discussed above. But also experiences during the first and second delivery influence women as to where to deliver their following children. During the interview, about 10% of women reported having had bad experiences, such as lack of drugs, sufficient equipment, and medical personnel at the facility. In general, interviewees reported that the service provided at hospitals is better, but more expensive, compared to health centers. Health centers, on the other hand, are easier to reach, but often there is a delay in treatment; lack of medicine, medical equipment or personnel; and the medical staff is rude and disrespectful to elderly.

Group discussions with women in different provinces all over Kenya were carried out in the Kenya Service Provision Assessment Survey in 2010. This survey mentions three main reasons why women avoid giving birth at a health facility in Kenya: women do not want to make an HIV-test (30%), medical personnel in maternities abuse and sometimes even beat women in labour (26%), and women do not want to get examined by a male health professional (16%).⁴⁸

A descriptive study carried out in Malawi shows that the attitude of women regarding health care providers and institutions were significant barriers for facility delivery²⁹.

In contrast, this study was not able to show any difference between women who had good experiences at a health facility and those who had bad experiences, since in both groups, more than 95% reported that they intended to deliver their next child at a health facility.

As in this survey, 61.3% of all deliveries took place at health facilities, but more than 95% of women reported intending to deliver their next child at a facility, possibly socially desirable answers distorted the analysis of this variable. Furthermore this demonstrates that there are numerous factors that influence a mother's intention where to deliver.

4.2.2.6. Family status

Findings of this study demonstrate that the family status of the mother seems to not influence the decision as to where to deliver the child.

A study carried out in Finland revealed that marriage protects pregnancy, since unmarried women were much more likely to have particular risk factors such as unemployment or smoking. Small-for-gestation age, preterm birth (below 37 completed weeks), and low birth weight (under 2,500g) were 20% more common in unmarried women compared to married mothers.⁵⁵

Similar results were found in a review and meta-analysis published in Canada comparing findings of 21 studies: low birth weight, preterm birth, and small-for-gestation age were increased among unmarried, single, and cohabitating mothers compared to married women.⁶⁰

No study was found which compared family status and the place of birth specifically. In addition, not much is known about this aspect in developing countries. In many sub-Saharan African countries, for example, the social fabric in general plays a more prominent role compared to developed countries: especially in rural areas, children often get raised more by the community than by their birth parents, and single mothers or orphans receive strong support and protection from other community members. In Eastern Africa, after the death of a father, the community chooses another paterfamilias, who from then on has to care for the family of the widow; it is very common, that the newly chosen paterfamilias will also maintain legal guardianship, which is officially registered and accepted at the national level. As a consequence, the impact of single-motherhood might be completely different in developing countries compared to developed countries.

Based on the findings of this study, it might be that in the Kenyan setting the family status itself does not influence the decision of a mother as to where to give birth, but rather that the socioeconomic circumstances are worse, risk factors more, and barriers are higher for unmarried, single or widowed mothers compared to married women. More research is needed to evaluate the importance of the family status regarding the place of birth in sub-Saharan Africa in particular.

4.2.3. Mortality rates and deaths

4.2.3.1. Mortality rates

Due to small numbers of deaths, exact mortality rates could not be calculated for each study-site and year independently. However, mortality rates have been calculated as accurately as possible for all study-sites together. Although, in the interview of 2,325 mothers, 8,370 pregnancies and the outcomes of 8,085 live births were captured, the mortality rates given are still lower than the “true” neonatal, infant and under-five mortality rates for Kenya. In this study, between 2006 and 2011, NMR is 16.3, infant mortality rate 25.7, and under-five mortality rate 28.9 per 1,000 live births. Rates published by UNICEF in 2011 were higher with a NMR in Kenya of 27, an infant mortality rate of 48 and an under-five mortality rate of 73 ⁷³.

Country health information systems draw on a broad range of data sources, including mainly censuses, household surveys, health facility reporting systems and assessments, and vital registration systems. The quality of such data is often insufficient. Mortality rates published, for example, in the annual reports titled “State of the World’s Children” by UNICEF are statistical projections from databases of the Interagency Group for Child mortality estimation (this group includes UNICEF, WHO, the United Nations Population Division and the World Bank). Every year the estimated mortality rates are updated according to recent data which includes only statistically sound and nationally representative data from household surveys and other sources. Quite often the mortality rates are adjustments of the previously reported rates. The Interagency Group for Child mortality estimations cautions to use these data for the analysis of mortality trends over time. ⁷³

In addition, low birth registration rates make it difficult to follow up delivery outcomes and to calculate valid mortality rates. In 2008 and 2009, only 60% of children were registered right after birth in Kenya. However, compared to other sub-Saharan countries, the percentage of birth registration rate in Kenya is quite good (Zambia 14%, Tanzania 16%, Liberia 4%, Congo 28%, Chad 16%). ⁶⁴

The question should be asked how health authorities and other organizations worldwide can improve registration rates right after birth. In the recently published Newborn Action Plan by the WHO, more accurate perinatal mortality data collection is crucial; improved facility-based data systems, and an inclusion of more neonatal and still-birth-relevant metrics can create an understanding of delays and failures in newborn care and are priority for design of context-specific community strategies. ^{31 43 79}

The lower mortality rates of this study compared to the Kenyan average might be based on the proximity of all study-sites to Nairobi. Data published by UNICEF contain mortality rates for all

districts in Kenya, including also extremely remote areas in the north of Kenya bordering Somalia and Ethiopia, where there is often poor coverage of health facilities. It is possible that mortality rates in the study-sites of this survey are in fact lower than the national rates because of better infrastructure and density of health facilities in the more populated districts around Nairobi. According to the last census in Kenya from 2009, the total fertility rate is on average 4.6 children per woman, but it varies between urban (2.9) and rural (5.2) regions ²⁶. The average total fertility rate from this survey of only 3.6 may again be influenced by the proximity of the regions to Nairobi, but true figures may be also slightly higher as some pregnancy outcomes of interviewed mothers may have not been captured due to various reasons and a few women may have had further pregnancies after the survey.

When mothers were interviewed about the outcome of all their pregnancies in this cross-sectional survey, some of their children had not yet reached their fifth birthday, so their survival up to that point is unclear. Furthermore, the deaths of 12 children were not included in the mortality rates, because of the unknown time of death.

Data of this survey was only collected from women who are still alive. Information about pregnancies, live births and child deaths of mothers who died, were not investigated. This is crucial, because children who lost their mother face many more risks in childhood compared to their counterparts who receive care by their mothers. A study carried out in Bangladesh showed that children up to age ten are three to ten times more likely to die within two years after the death of their mother, compared to those children whose mothers are still alive ⁶¹. According to UNICEF, the adjusted maternal mortality ratio was 360 per 100,000 live births in Kenya in 2010 ⁷³. This means that the database of this survey, with 8,370 reported births, would have been enriched with data from 30 women who died in the perinatal period and who therefore were not included in the study. It is suggested that the information from these 30 women who died very likely contained more neonatal deaths compared to 30 women who were living at the time of this study.

In this study, the proportion of under-five deaths that occur in the neonatal period is 56% compared to 37% in Kenya according to UNICEF ⁷³. Worldwide attention to newborn health increased due to widespread campaigns, actions, and research in the last several years. However the financial investments of donors remain disproportionate. 44% of deaths in children under-five occur in the newborn period, yet only about 4% of child health investments go to newborn health ¹⁷. While provision of obstetric care is crucial and substantial progress has been made, progress on maternal outcomes will not automatically tickle down perinatal outcomes. The average annual rate of

reduction in NMR is 2.8% and the rate of reduction is slower than that of other age groups highlights the need for specific attention and funding on programs that focus on the first 28 days of life.

4.2.3.2. Deaths

In this survey, 2.8% of facility deliveries died compared to 2.5% of home deliveries. Comparing the pie charts in Figure 38 and Figure 39, one can see that infant death, under-five death, and death above the age of five is represented in similar proportions regardless of whether the children were born at home or at a health facility; but there is a great difference in the neonatal period in the two groups. While more children born at home die during the first 24 hours of life, those children born at a health facility are more likely to die beyond the first day of life. However, the percentages equalize towards the end of the first month of life. In this study, a verbal autopsy to find out the reasons for the deaths of the children was not done as it was often difficult for mothers to remember and to describe causes of death.

According to the data of this survey, it seems that babies born at home in the village die faster, compared to those who are born at a health facility. But interestingly, even children at risk born at a health facility do not survive much longer (only beyond the first day of life).

The majority of neonatal deaths occur secondary to infection, prematurity and birth asphyxia ¹¹. Premature and asphyxiated children can only get the recommended, immediate, and life saving treatment at a health facility. This fact might explain the high numbers of deaths immediately after delivery at home, since life saving treatment cannot be provided in domestic surroundings.

The high percentages of deaths in children who were born at a facility, but who died between day one to seven, are perhaps caused by the circumstance of early discharge of mothers and their newborns after delivery and lack of sufficient follow up through regular post natal home visits.

Child deaths at a health facility occur in the first day of life less often when both mother and newborn are under the close observation and supervision of medical personnel (largely reducing complications due to prematurity and asphyxia). It might be that the mother does not receive enough instruction and teaching while still admitted at the facility (e.g. instruction about prevention of infection of the newborn and danger signs in newborns,...). Studies conducted in India ^{5 28}, Bangladesh ⁶, and Pakistan ⁹ demonstrate that postnatal home visits done by a health worker can reduce deaths of newborns in high mortality-settings and developing countries by 30 to 61%. These early home visits improved significantly newborn care, rates of early exclusive breastfeeding, rates of

correct cord care, hygienic care by hand washing with soap and water, and recognition of danger signs in both the newborn and the mother.

A retrospective cohort study carried out in Canada, and including more than 4 million pregnant women, shows that teenage pregnancy (ages of 10 to 19 years) increases the risk for both neonatal and post-neonatal mortality. The higher numbers of neonatal mortality is mainly due to increased risk for prematurity, but the post-neonatal mortality is independent of both gestation age at birth and weight gain during pregnancy.¹³

Therefore, teenage pregnancy itself is a great risk factor for newborns. Approximately 30% of interviewees in this study gave birth to their firstborn before the age of 18 and teenage pregnancy ranged between 25.5% (in Nyakio) and 37.6% (in Eburru). These high numbers call for action and underline the need to address safe motherhood issues in primary school before the onset of sexual activity.

In this survey, the age and educational background of mothers was investigated, because of the well known dependence between low education and early pregnancy, resulting in higher maternal and neonatal mortality rates^{71 76}.

A good educational background is, according to findings of this study, a potential protective factor for newborns, assuming that facility deliveries significantly lower the risk for neonatal mortality compared to home deliveries^{33 76}: Women who finished primary school were 1.14 more likely to deliver their first child at a health facility compared to those who did not finish primary school (OR 1.82 (95% CI: 1.47-2.26)).

4.3. Strengths and weakness of this study

4.3.1. Quality of data

The low numbers of missing data (only two lost questionnaires) and the high willingness of women to participate (only nine refusals, and 15 who dropped out of the interview early) demonstrate the high quality of the assessed data and the acceptance of the study and their interviewers in the study-sites. This was only achieved through repeated training prior to the start of the interviews. Furthermore, close collaboration with local (health) authorities and recruiting interviewers familiar with their study region were essential.

The design of the questionnaire and the composition and order of the questions minimized bias and

prejudice in the interviewers. The participation status, for example, was asked as the very last question at the end of the interview so that the interviewers were not influenced by the knowledge of their participation status. Variation of types of questioning kept the interest and motivation of the interviewee high through the interview resulting in high concentration and low numbers of withdrawals.

Data entry was done carefully and diligently. A randomized proportion of about 14% of surveys were double entered in the database to ensure accuracy. Due to intense training and re-checks of entered data, the error rate remained very low and was estimated to be less than 1%.

4.3.2. Limitations of this study

This study has some limitations, which will be discussed below.

4.3.2.1. Demographic differences

Some demographic variables (especially the economic status of the interviewee and the distance to the next health facility) varied statistically significantly between each study-site.

Intervention-sites generally were socioeconomically better off than the control-sites. This result gives a distorted picture because of the quite good economical status of Kinale and Nyakio – two intervention-sites. But without doubt, the economic status was not equal and varied largely between the particular study-sites. Therefore a separate analysis of the dependence between the economical status and the place of birth of the child was done for each study-site independently. Only in Kinale, did the socio-economic background of the interviewees seem to significantly influence a woman's decision as to where to deliver. As a logical consequence, it is hard to measure the influence of the NCH-project independently of this variable, on the aspect of facility deliveries versus home deliveries for Kinale.

In contrast, the distance to a delivery center seems to be less important, and so the magnitude of this bias was smaller. As above, interviewees of control-sites were in a disadvantage regarding the distance to the next place of medical help: 12.7% had to walk for more than two hours to reach the next health facility, while this was the case with only 7.8% of interviewees of intervention-sites. The differences of the distance might reflect some changes which occurred within intervention-sites: to use the words of Adegoke, the NCH-project created an “enabling environment” ¹ (see Chapter 1.2.1.2. p.4). In intervention-sites, new facilities opened, health centers were better staffed and equipped, and working hours were optimized so that pregnant women had to overcome fewer barriers to get to the next place where medical help was available.

Despite the attempts to find suitable and comparable control-sites, regions differed. Koinange is an area which is similar to Eburru, with the exception that mothers from Koinange have in general a better economical status and a better educational background. Escarpment and Karati are comparable to Kinale and Nyakio, but women from Escarpment and Karati have in general a better educational background, but a worse economic status and a longer distance to the next health facility. By testing statistical dependencies and correlations for each study-site independently, an attempt was made to minimize the bias of different demographic backgrounds of the sites.

4.3.2.2. Imparity in the number of participants and non participants

564 participants and 1,944 non participants were included in this study. The different numbers of these two groups might have had an influence whenever the participation status was put in correlation with another factor or variable. The confidence interval of the group of participants was much larger than the one of non participants. Sometimes no statistical significance could be demonstrated, not only due to small numbers of events, but also due to small numbers in the group of participants.

4.3.2.3. Weaknesses of data collection and study design

The NCH-project was adapted for rural agrarian populations and the results may not be generalizable to both pastoralist and urban populations.

Self-report was utilized in the questionnaire. Self-report, especially where it requires increased length of time for recall, is subject to bias. However, the birth and death of children are significant events, and place of delivery is likely to be retained in memory.

The dosage of messages delivered to those who reported exposure to the NCH-project was measured, but the date of receiving the health messages was not reported.

The study design does not control for alternative explanations that could have been reasons for improvements. The multicomponent design of the NCH-project addressed several regional problems and barriers to health access in various ways. However, since part of the intervention was to assist communities in advocating for their health care needs, any increase in health services could be considered part of the intervention.

This study demonstrates an innovative low cost design to gain a longitudinal perspective by combining a cross sectional approach with a retrospective birth history of all the children each woman had. Longitudinal time series evaluations can be very labor intensive and expensive. This

type of design has important limits. However, it does provide a low cost option to examine the effectiveness of adaptations to evidence based interventions.

4.4. Conclusion

This study documents that a group of community volunteers, who are small-scale farmers in Kenya, can effectively increase knowledge of maternal and newborn health in their communities and successfully promote delivery under skilled attendance. Women exposed to the NCH-project had more knowledge of maternal and newborn health issues, and deliveries at health facilities increased by 2% to 12% in three geographically separate areas in rural Kenya. The NCH-project demonstrates that community based participatory processes are useful in developing appropriate contextual adaptations of evidence based interventions.

The magnitude of the impact of the intervention seems to be influenced also by other contextual factors. In general, the level of education, the economic status, the birth order and the number of attended ANC-visits have a larger influence on women's decisions as to where to deliver, than the distance to the next health facility or her family status. Whereas more than 75% of all women delivered their firstborn at a health facility, with every consecutive pregnancy, the percentage of home deliveries increased by 5 to 10%. In areas where greater educational opportunities or greater economic resources were available, more women were choosing a facility-based delivery even before any health related intervention started. However, even in more advantaged areas (e.g. Nyakio), the positive trend of an exposure to the intervention increasing the probability of a woman choosing a skilled delivery, continued.

The intervention showed evidence of maintenance of sustainable impact since 1.5 years after the NCH-team withdrew, more than 80% of volunteers continue to deliver health messages.

Within the first 24 hours of life, almost 21% less deaths occur in children born at a health facility compared to home deliveries, but this gain is not maintained beyond the end of the first week of life, probably most likely due to insufficient follow up and early discharge of postnatal mothers. 48% of all deaths in children happen within the neonatal period; special attention must be given to the first month of life in order to substantial reduce child mortality.

5. Summary

Worldwide progress to reduce under-five mortality and maternal mortality is unequal and the highest mortality-rates can still be found in sub-Saharan Africa where one in 11 children dies before the age of five and one in 200 mothers does not survive pregnancy or delivery. The risk of dying for a child is 15 times higher in the first month of life compared to any subsequent month of infancy. In Kenya, 37% of all deaths in children under-five occur within the first month of life and Kenya's newborn mortality rate is high with 27 deaths per 1,000 live births.

The "Newborn Community Health (NCH) Project" is a multicomponent intervention in Kenya that aims to reduce neonatal and maternal morbidity and mortality by empowering rural communities with accurate information on safe motherhood and newborn care and to increase deliveries under skilled attendance. It is an evidence based intervention contextually adapted to train non-medical volunteers ("Newborn Community Health Facilitators" (NCHFs)) in basic knowledge on newborn care and safe motherhood, and to support them in spreading health messages.

This study examined the impact of the NCH-project. The primary aim of the study was to test the effectiveness of using NCHFs to improve the local communities' knowledge of maternal and newborn care and to examine the effectiveness of this strategy in promoting delivery with a skilled birth attendant. Secondary objectives were to evaluate treatment-seeking behavior, to identify factors influencing the place of birth, to analyze post-partum deaths, and to calculate mortality rates.

This study utilized a quasi-experimental nonequivalent design that examined demographic items and knowledge about maternal and newborn health, combined with a comprehensive retrospective birth history of women's children, using oral interviews of women who were exposed to health messages delivered by NCHFs (participants) and those who were not exposed (non participants). The project trained NCHFs in three geographically distinct areas in rural Kenya; data was also collected from three adjacent control-sites. Systematic random sampling was used. In three intervention-sites (n = 1,398) and three control-sites (n=1,200) interviews were conducted in Kikuyu or Kiswahili and data recorded in English using EXCEL with analysis in SPSS and R. Ethics approval was obtained through Kijabe Hospital Ethics Committee in Kenya and from the University of Ulm Ethics Committee in Germany. Letters of collaboration were received from District Health Teams and local chiefs.

The mean perinatal-related knowledge scores were significantly higher in participants, compared to non participants (28.3 credits versus 24.1 credits). Within the three intervention-sites, the mean

perinatal-related knowledge score was higher among women who reported receiving one or more health messages, compared to those who did not. Knowledge scores were also higher for women who reported four or more exposures to health messages, as compared to just one exposure (Eburru: 35.4 versus 31.1 credits; Kinale: 26.4 versus 20.2 credits; Nyakio: 26.8 versus 24.8 credits). Findings furthermore show that it was not enough to live within an intervention-site, but one had to attend the teaching in order to improve one's perinatal-related knowledge.

In each intervention-site, percentages of facility deliveries were higher in participants compared to non participants (Eburru: 46.2% versus 25.0%; Kinale: 94.4% versus 73.0%; Nyakio: 80.0% versus 77.8%), even though no statistically significant correlation between the participation status and the place of birth of her child was demonstrated.

Increasing percentages of deliveries under skilled attendance were associated with attending Antenatal Care-clinic for at least four times, a good educational and economic background, and being a primipara. Factors like the distance to the next health facility or the family status of a mother did not play important roles in the decision of where to deliver. The influence of the distance was probably diminished since barriers to health access caused by long distances were addressed in the NCH-curriculum; the family status, on the other hand, may play a minor role due to cultural reasons and the prominent role of the social fabric in rural Kenya.

Within the first 24 hours of life, almost 21% less deaths occur in children born at a health facility compared to home deliveries, but this gain is not maintained beyond the end of the first week of life, most likely due to early discharge of postnatal mothers with insufficient information and due to lack of follow up through postnatal home visits. In this study, 48% of all deaths in children happened within the neonatal period; special attention must be given to the first month of life in order to sustainably reduce child mortality as outlined in the recently published "Newborn action plan" by the World Health Organization. Between 2006 and 2011, neonatal mortality rate was 16.3, infant mortality 25.7, and under-five mortality 28.9 per 1,000 live births in this study. These rates are below those published by national authorities, probably because of the proximity of the study-sites to Nairobi.

The NCH-project demonstrates that community based participatory processes are useful in developing appropriate contextual adaptations of evidenced based interventions, and that volunteers from the community can effectively share health messages that increase knowledge of maternal and newborn care and encourage deliveries under skilled attendance, resulting in increases of 2% to 21% in three separate regions in rural Kenya. The intervention showed sustainability, since 1.5 years after the NCH-team withdrew, more than 80% of volunteers continued to deliver health messages.

6. Literature review

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Annex

Annex 1: Questionnaire

Personal ID: _____

QUESTIONNAIRE Location: _____ Date: _____

Informed consent and inclusion criteria

We're a group of health care workers from Kijabe Hospital carrying out a survey on newborn health in Eburru, Nyakio, Escarpment, Karati, and Kinale Forrest. To improve the health of mothers and newborns, we started to assist the community with seminars about maternal and newborn health issues some time ago. The following questionnaire will assist us to know more about the needs of the community and the knowledge about these issues these days. Confidentiality is guaranteed. No monetary or other rewards will be given. All participants have the right to refuse to take part and withdraw without any penalty at any point during the process. The participant is also free to neglect answering any question she does not want to answer without further explanation. Will you give your permission to participate?

Interviewer to record those who decline to participate and proceed to next household per protocol.

Does the interviewee agree to participate in this study?

Yes	No

Name of interviewer _____; Village interviewee comes from _____

Does the interviewee meet the **Inclusion criteria**?

*Age 15-49 years	Yes	No
*At least 1 delivery while living in the study area		
*Voluntary consent is obtained		

Does the interviewee NOT meet the **Exclusion criteria**?

*Immediate immigrants	Yes/Correct	No
*Relatives and friends of the interviewers		

Questionnaire

1. How old are you?

15-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60

2. For how many years have you attended class at school?

non	1	2	3	4	5	6	7	8	Form 1	Form 2	Form 3	Form 4	>12 years (college/university)

3. Please tell me your family status.

Married	Widowed	Divorced	Single

4. How many wives does your husband have?

1	2	3	4	5	6 or more

5. In which house do you and your family live?

Permanent house (walls: stones/bricks; roof: iron sheet)		Semi-permanent house (walls: wood/iron sheet; roof: iron)		Temporary house (walls: mud/grass; roof: grass/iron)	
Renting	Owning	Renting	Owning	Renting	Owning

6. At what age did you deliver your first child?

<15	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	>38

Please fill now the questionnaire concerning the children of the woman!

Personal ID:

[illegible]

Comments: _____

Please continue now with the questionnaire!

Personal ID: _____

7. Where are you going to deliver in the future?
(the interviewer marks the answers given by the woman, without telling her the single options)
- At AIC health center/hospital.
 - At a government health center.
 - At a private health center.
 - Would give birth at home.
 - I am not planning to deliver any further children.
 - Others (specify): _____
8. How long do you need to go by foot to the next place where medical care is available?
(the interviewer marks the answer given by the woman, without telling her the single options)
- < 15 minutes
 - 15 – 30 minutes
 - 30 minutes – 1 hour
 - 1 hour – 1,5 hours
 - 1,5 hours – 2 hours
 - 2-3 hours
 - > 3 hours
9. If you need to go to a hospital to which hospital would you go to?
(the interviewer marks the answers given by the woman, without telling her the single options)
- Naivasha Government District Hospital
 - Kijabe Hospital
 - Gilgil Hospital
 - Tigoni Hospital
 - Kiambu Hospital
 - KNH
 - Nakuru PGH (provincial general hospital)
 - North Kinagop Hospital
 - Others (specify): _____
10. What is your attitude towards the closest health care facility (health center, dispensary) in your area?
(multiple answers are possible; the interviewer marks the answers given by the woman, without telling her the single options)
- I would never go there.
 - I had some bad experiences in a health care facility.
 - I had some nice experiences in a health care facility.
 - Friends told me bad things about this institution.
 - Friends told me nice things about this institution.
 - I do not have enough money to go to a health center.
 - I cannot get to a health center because of the long distance.
 - Others (specify): _____
11. What is your attitude towards the hospital in your area?
(multiple answers are possible; the interviewer marks the answers given by the woman, without telling her the single options)
- I would never go there.
 - I had some bad experiences in this hospital.
 - I had some nice experiences in this hospital.
 - Friends told me bad things about this institution.
 - Friends told me nice things about this institution.
 - I do not have enough money to go to a hospital.
 - I cannot get to a hospital because of the long distance.
 - I do not need to go because God will take care of me
 - Others (specify): _____

Personal ID: _____

12. How do you pay your hospital bill?

(the Interviewer marks the answers given by the woman, without telling her the single options)

- a. By cash.
- b. By insurance (NHIF or others).
- c. By fund raising.
- d. By voucher.
- e. Others (specify): _____

Measuring the knowledge13. Do you know what a **birth plan** is? What should such a plan contain?*(the Interviewer marks the answers given by the woman, without telling her the single options)*

- a. The date when to deliver.
- b. Equipment needed for delivery.
- c. Amount of money the mother needs for transport and payment of the hospital bill.
- d. The place where to deliver / Choose a clinic for delivery.
- e. How to reach the hospital.
- f. A birth partner whom she had informed about her pregnancy long before.
- g. A skilled attendance to help with delivery.
- h. Others (specify): _____
- i. No idea what a birth plan is about.

14. Why does one go to **Antenatal clinic**?*(the Interviewer marks the answers given by the woman, without telling her the single options)*

- a. They make sure the mother and her baby are healthy.
- b. They prepare an individual birth plan.
- c. They tell the mother about danger signs in pregnancy and delivery.
- d. They give medicine to pregnant women.
- e. They do counseling and testing of HIV/AIDS.
- f. They procure abortion.
- g. They tell mothers about nutrition during pregnancy.
- h. They do tell mothers about family planning after delivery.
- i. Going to clinic is not necessary as it does not help you.
- j. Others (specify): _____

15. What investigation and exams (laboratory or blood tests) are carried out in **Antenatal clinic**?*(the Interviewer marks the answers given by the woman, without telling her the single options)*

- a) Level of blood (Hb) in the body.
- b) Urine for presence of any germs.
- c) Testing for blood group type.
- d) Testing for HIV.
- e) Checking vital signs, temperature, blood pressure, pulse rate, respiration rate and weight.
- f) General examination.
- g) Testing for syphilis.
- h) Others (specify): _____

16. What signs in pregnancy would be **signs of danger** to you?*(the Interviewer marks the answers given by the woman, without telling her the single options)*

- a) Bleeding from birth canal.
- b) Premature breaking of the water.
- c) Labour before baby is 37 weeks old.
- d) Decrease or cessation of fetal movement.
- e) Pregnant woman develops fever.
- f) Swelling of the face, lower back and limbs.
- g) Convulsion and fits.
- h) Abdominal tenderness.
- i) Anything the mother may not be comfortable which should be addressed by health centre professionals.

Personal ID: _____

- j) High blood pressure.
 k) Loss of a previous child in a previous pregnancy or around delivery.
 l) Others (specify): _____

17. What are **danger signs in newborns**?*(the interviewer marks the answers given by the woman, without telling her the single options)*

- a) Poor breastfeeding.
 b) Lethargy or unconsciousness.
 c) Bulging or sunken fontanel.
 d) Change in breathing pattern.
 e) Umbilical redness.
 f) Diarrhea, vomiting or blood in stool.
 g) Fever.
 h) Cold extremities.
 i) Jaundice.
 j) Convulsion.
 k) Others (specify): _____

18. and 19.	< 1 week	1 - 2 weeks	2 - 4 weeks	1 - 2 months	2 - 4 months	4 - 6 months	6 months	6 - 8 months	> 8 months
18) For how long should a mother be only breastfeeding and give nothing else than breastmilk to her child?									
19) At what age does a child need additional nutrition ?									

Comments: _____

20. **General questions** (Answers yes ("Y"), no ("N"), or I don't know ("IDN"))*(the interviewer reads the statements to the woman and marks the answers given by her)*

- Y / N / IDN Newborns who have not been breastfed cannot fight infections as good as babies who have been exclusively breastfed for six months.
- Y / N / IDN The umbilical cord falls off usually 3 days after birth.
- Y / N / IDN It is not dangerous if the first urine of a newborn is colored dark orange.
- Y / N / IDN I can see if the baby feels cold it starts to shiver.
- Y / N / IDN The umbilical cord should be covered with wet, clean diapers in order to keep it clean and to protect it from any germs.
- Y / N / IDN An HIV-positive mother gives birth to a child which is automatically HIV-positive, too.
- Y / N / IDN An HIV-positive mother should not breastfeed her child in order to keep the risk of transmission of the virus to the minimum.
- Y / N / IDN Mixed feeding before 4-6 months may trigger allergies.
- Y / N / IDN Recommended treatment of a child who is coughing is to buy cough syrup from a chemist.
- Y / N / IDN For the umbilicus to dry and fall off one needs to apply clean water daily.
- Y / N / IDN When the child has diarrhea, the mother cannot recognize danger signs in her baby easily.
- Y / N / IDN Premature babies should be wrapped with many clothes on the way to hospital.
- Y / N / IDN The mother should wipe the white substance that covers the baby during birth since it is dirt.

Personal ID: _____

21. What has to be done with the baby **after delivery in the first hour**?*(the interviewer marks the answers given by the woman, without telling her the single options; multiple answers possible)*

- a) Dry the baby.
- b) Wash it.
- c) Wrap it in clothes.
- d) Place it on the mothers' chest.
- e) Breastfeed it.
- f) Others (specify): _____

22. Why would you **take a postnatal mother to a health care facility after delivery**?*(the interviewer marks the answers given by the woman, without telling her the single options; multiple answers possible)*

- a) When she has fever.
- b) When she is still bleeding.
- c) When there is discharge from the vagina.
- d) When the discharge is smelling badly.
- e) When she feels abdominal pain.
- f) When she collapses.
- g) Others (specify): _____

23. What is the **price for delivery in a health care facility**?*(the interviewer should ask the mother about the price first and then ask her about which health facility she is talking since the prices differ a lot; after these two answers the interviewer has to mark the options below)*

- a) Asked person has a clear idea about the prices in the health facility.
- b) Asked person has no idea.

24. **How would you get to the health care facility** in case of emergency?*(the interviewer should let the woman explain her answer and then mark the options below concerning how clear the idea and the plan of the woman is)*

- a) Asked person has clear ideas and plans where to deliver
- b) Asked person has a rough idea, but no clear plans where to deliver
- c) Asked person has no idea where to deliver in an emergency or would go to an unsafe place (TBA)

25. Did you attend a **teaching of the "Kijabe Newborn Community Health project"**?

Yes			No, because...					
How many teachings?	With how many people have you shared your knowledge?	Did you see any benefit the teaching brought to you?	... I have not yet heard about it.	... I am not interested in that.	... I did not have time/the possibility to attend teachings.	... a teaching has not been offered in my region.	... my husband did not allow me.	Others (specify)
		yes no						

Comments: _____

Other free comments from the interviewer regarding this interview:

Annex 2: P-values comparing each demographic variable of every study-site with each other

Education level (number of years of school-attendance)

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	1,33 x 10 ⁻⁹	1,20 x 10 ⁻⁹	0,00476313	5,26 x 10 ⁻⁶	0,0016451
Escarpment	1,33 x 10 ⁻⁹	1	0,02465646	0,00148041	0,24663231	0,10180943
Karati	1,20 x 10 ⁻⁹	0,02465646	1	0,00075427	0,02080159	0,17753575
Kinale	0,00476313	0,00148041	0,00075427	1	0,15387211	0,58100718
Nyakio	5,26 x 10 ⁻⁶	0,24663231	0,02080159	0,15387211	1	0,55389398
Koinange	0,0016451	0,10180943	0,17753575	0,58100718	0,55389398	1

Economic status (type of house)

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	1,19 x 10 ⁻³²	2,24 x 10 ⁻²⁶	1,53 x 10 ⁻⁸⁰	8,84 x 10 ⁻⁶⁷	1,75 x 10 ⁻⁹
Escarpment	1,19 x 10 ⁻³²	1	8,08 x 10 ⁻¹¹	1,48 x 10 ⁻¹⁹	3,24 x 10 ⁻²⁰	7,23 x 10 ⁻⁵³
Karati	2,24 x 10 ⁻²⁶	8,08 x 10 ⁻¹¹	1	6,53 x 10 ⁻³³	4,36 x 10 ⁻¹⁵	7,10 x 10 ⁻⁴⁰
Kinale	1,53 x 10 ⁻⁸⁰	1,48 x 10 ⁻¹⁹	6,53 x 10 ⁻³³	1	1,94 x 10 ⁻¹²	5,17 x 10 ⁻¹⁰⁷
Nyakio	8,84 x 10 ⁻⁶⁷	3,24 x 10 ⁻²⁰	4,36 x 10 ⁻¹⁵	1,94 x 10 ⁻¹²	1	4,76 x 10 ⁻⁸⁵
Koinange	1,75 x 10 ⁻⁹	7,23 x 10 ⁻⁵³	7,10 x 10 ⁻⁴⁰	5,17 x 10 ⁻¹⁰⁷	4,76 x 10 ⁻⁸⁵	1

Family status

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	0,01360326	0,05200304	0,30326452	0,3995661	0,14213848
Escarpment	0,01360326	1	0,79177999	0,00163798	0,00203204	0,00752611
Karati	0,05200304	0,79177999	1	0,01275911	0,01498043	0,04149979
Kinale	0,30326452	0,00163798	0,01275911	1	0,9783659	0,68865066
Nyakio	0,3995661	0,00203204	0,01498043	0,9783659	1	0,59784602
Koinange	0,14213848	0,00752611	0,04149979	0,68865066	0,59784602	1

Number of pregnancies

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	0,0019839	0,00010588	0,28762403	0,00266144	N/A*
Escarpment	0,0019839	1	0,5550667	0,0237278	0,99406457	N/A*
Karati	0,00010588	0,5550667	1	0,00469566	0,55400068	N/A*
Kinale	0,28762403	0,0237278	0,00469566	1	0,03202277	N/A*
Nyakio	0,00266144	0,99406457	0,55400068	0,03202277	1	N/A*
Koinange	N/A*	N/A*	N/A*	N/A*	N/A*	N/A*

* N/A: data not applicable

Age of the mother during first delivery

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	0,00363446	$1,74 \times 10^{-5}$	0,0595159	$4,21 \times 10^{-6}$	0,09753106
Escarpment	0,00363446	1	0,31229019	0,56228401	0,17571597	0,09865378
Karati	$1,74 \times 10^{-5}$	0,31229019	1	0,03584306	0,94417834	0,00946139
Kinale	0,0595159	0,56228401	0,03584306	1	0,01427111	0,21165697
Nyakio	$4,21 \times 10^{-6}$	0,17571597	0,94417834	0,01427111	1	0,00461029
Koinange	0,09753106	0,09865378	0,00946139	0,21165697	0,00461029	1

Distance to next health facility by foot in time

	Eburru	Escarpment	Karati	Kinale	Nyakio	Koinange
Eburru	1	$1,10 \times 10^{-8}$	$1,99 \times 10^{-18}$	$3,95 \times 10^{-31}$	$3,23 \times 10^{-43}$	0,00217932
Escarpment	$1,10 \times 10^{-8}$	1	$3,89 \times 10^{-5}$	$1,84 \times 10^{-12}$	$2,97 \times 10^{-26}$	$1,41 \times 10^{-17}$
Karati	$1,99 \times 10^{-18}$	$3,89 \times 10^{-5}$	1	0,00021209	$2,86 \times 10^{-10}$	$3,75 \times 10^{-29}$
Kinale	$3,95 \times 10^{-31}$	$1,84 \times 10^{-12}$	0,00021209	1	$4,79 \times 10^{-7}$	$4,57 \times 10^{-45}$
Nyakio	$3,23 \times 10^{-43}$	$2,97 \times 10^{-26}$	$2,86 \times 10^{-10}$	$4,79 \times 10^{-7}$	1	$3,26 \times 10^{-54}$
Koinange	0,00217932	$1,41 \times 10^{-17}$	$3,75 \times 10^{-29}$	$4,57 \times 10^{-45}$	$3,26 \times 10^{-54}$	1

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For data protection reasons the Acknowledgements have been removed.

Curriculum vitae: Maria Dillmann

For data protection reasons the Curriculum vitae has been removed.