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Improving neonatal survival in East Africa

Analysis of maternal service utilization, effectiveness of care and risk factors for neonatal mortality in Kenya, Uganda, and Tanzania

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SOCIAL MEDICINE AND GLOBAL HEALTH | FACULTY OF MEDICINE | LUND UNIVERSITY





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Improving neonatal survival in East Africa

Analysis of maternal service utilization,
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in Kenya, Uganda, and Tanzania.

Malachi Ochieng Arunda



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DOCTORAL DISSERTATION

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Title: Improving neonatal survival in East Africa: analysis of maternal service utilization, effectiveness of care and risk factors for neonatal mortality in Kenya, Uganda, and Tanzania.		
Abstract <p>Despite profound progress made in reducing neonatal mortality, it remains one of the major global health challenges. In 2019, the World Health Organization estimated that 2.4 million neonatal deaths occurred, accounting for over 45 percent of under-5 deaths worldwide. Most of these neonatal mortalities occur in low- and middle-income (LMIC) with East African countries of Kenya, Uganda and Tanzania among countries reporting persistent slow decline in neonatal death rates. The major causes of neonatal deaths include prematurity, infections and birth complications, most of which are preventable. Very limited population-based research has been conducted to examine determinants of continued care utilization from pregnancy to postnatal period, effectiveness of care as well as the impact of leading risk factors for neonatal deaths in Kenya, Uganda and Tanzania. Thus, the aim of this thesis was to examine the determinants of maternal care utilization, effectiveness of care and risk factors for neonatal mortality in Kenya, Tanzania, and Uganda. The findings, of which are contributing to further research around the world and could have significant implications for policy development, prioritization and resource allocations in public health and care systems in the three most populated East African Community countries. We used nationally representative cross-sectional data from the demographic and health surveys in the respective countries. In Study I we found that lack of antenatal (ANC) attendance, unskilled ANC provision and lack of check-ups for pregnancy complications were among the leading indirect risk factors for preventable neonatal mortality in Kenya. Study II concluded that low birthweight contributes a substantial proportion of neonatal deaths in Uganda. Study III reported that the disproportionate access to caesarean delivery has widened along socioeconomic lines in Tanzania and Kenya. Higher risk of caesarean-related deaths exists. Out of the findings of Study IV, we suggested the need for a comprehensive review to develop a toolkit using care utilization information to enable classification of maternal care-seeking behaviour and adopt new strategies to close the care-seeking gaps. Study V found much higher neonatal deaths among married adolescents with unintended pregnancies adolescent-born neonates from unintended pregnancies and proposed strengthening of existing strategies and use of new approaches to reduce adolescent pregnancies and provide focused obstetric care for adolescents. The thesis suggests an array of evidence-based interventions to improve neonatal survival ranging from education and contraceptive use to improved ANC and postnatal care attendance.</p>		
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Improving neonatal survival in East Africa

Analysis of maternal service utilization,
effectiveness of care and risk factors for neonatal mortality
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MADE IN SWEDEN 

To my dearest family.

*The fruit of the spirit is love, joy, peace, patience, kindness,
generosity, faithfulness, gentleness, and self-control.
Against such things there is no law.
Galatians 5: 22-23*

Abbreviations

ANC	Antenatal care
CD	Cesarean delivery
PNC	Postnatal care
DHS	Demographic and Health Survey
LBW	Low birthweight
TT	Tetanus toxoid
LBW	Low birthweight
LMIC	Low - and Middle - income countries
SSA	Sub-Saharan Africa
HIC	High income countries
WHO	World Health Organization
UN	United Nations
UNICEF	United Nations Children's Fund
UNFPA	United Nations Populations Fund
PMNCH	Partnership for Maternal, Newborn and Child Health

List of publications

This thesis project is based on the following studies:

- I. Arunda M, Emmelin A, Asamoah BO. Effectiveness of antenatal care services in reducing neonatal mortality in Kenya: analysis of national survey data. *Glob Health Action*. 2017;10(1):1328796.
- II. Arunda MO, Agardh A, Asamoah BO. Survival of low birthweight neonates in Uganda: analysis of progress between 1995 and 2011. *BMC Pregnancy Childbirth*. 2018 May 30;18(1):189.
- III. Ochieng Arunda M, Agardh A, Asamoah BO. Cesarean delivery and associated socioeconomic factors and neonatal survival outcome in Kenya and Tanzania: analysis of national survey data. *Glob Health Action*. 2020 Dec 31;13(1):1748403.
- IV. Arunda MO, Agardh A, Asamoah BO. Determinants of continued maternal care-seeking during pregnancy, birth and postnatal period and associated neonatal survival outcomes in Kenya and Uganda: analysis of demographic and survey data. *Accepted for publication*.
- V. Arunda MO, Agardh A, Asamoah BO. Survival of adolescent-born neonates and the effect of pregnancy intentions and marital status on survival patterns: analysis of cross-sectional surveys in Kenya, Uganda, and Tanzania, 2014–2016. *Manuscript*

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Introduction

Reducing neonatal mortality (newborn death within 28 days after birth) has been a persistent major global challenge and although profound progress has been made (1), it still accounts for about 45 percent of under-5 deaths worldwide(2). In 2019, over 2.4 million neonates died, over 80 percent of whom occurred in sub-Saharan Africa (SSA), and in southern and central Asia (2). The recent United Nations Inter-agency Group for Child Mortality Estimation reported that there was no decline in neonatal mortality rates in 21 out of 48 countries in SSA in about three decades, between 1990 and 2019 (2). The wider disparities in neonatal mortality rates (NMR) across and within regions and countries is a major indication that most of the neonatal deaths are preventable. For instance when comparing sub-Saharan Africa with highest NMR (27 deaths per 1000 live births) and Europe with the lowest NMR (3 deaths per 1000 live births) (2).

Sustainable development Goal (SDG) 3

The SDG 3 that aims to “ensure healthy lives and promote well-being for all at all ages”, has its specific target 3.2, “to reduce neonatal deaths to at least as low as 12 deaths per 1000 live births by 2030” (3). A recent study in *The Lancet* projected that about 60 countries need to expedite their progress in order to meet the SDG 3.2 target (1). To achieve this, target 3.8, that aims “to achieve universal health coverage” (UHC) was also adopted. The UHC intends to achieve universal access to essential health services including maternal and child health care services for at least 1 billion more people every five-years since 2015 leading to 2030. Acknowledging that poverty is a major risk factor for mortality, one of the main focus of UHC is to eliminate out-of-pocket health expenditure that impoverishes many households, particularly in low-and middle-income countries (4, 5). Although the progress of attaining UHC has been hampered by the Covid-19 pandemic since 2020, WHO together with UNICEF, World Bank, Ministries of Health and other global partners continue to work to support attainment of the UHC target (4, 6, 7).

Another strategy that was previously adopted and contributes to the realization of target 3.2 was the *Global strategy for women’s, children’s and adolescents’ health*. This strategy takes a life-course approach and aims among others to end preventable newborn deaths as well as prevent maternal and adolescents’ deaths and stillbirths

by 2030 (8). The Global strategy emphasizes human rights, equity and universality in its approach and aims to meet the needs of all, including the most vulnerable and marginalized. It highlights the immense returns countries would realize (both in health and economic growth) from investing in women's, children's and adolescents' health in their course of life from birth through childhood to adolescence and adulthood (8).

Global inequalities in maternal and newborn health service utilization

Whereas removal of barriers to maternal care utilization has been a major global priority over the years (9), socioeconomic inequalities that limit access to maternal and newborn health services are still widespread in most low-and middle-income countries (LMIC). A recent systematic review by Ogundele et al. found that the socioeconomic inequalities in reproductive care utilization in sub-Saharan Africa was highest for skilled childbirth but varies in different countries. Nonetheless, progress has also been observed in certain countries. An analysis of trends in usage of ANC and skilled birth attendance among young mothers in Ghana by Asamoah and Agardh, indicated that inequalities related to place of residence and education levels declined overtime between 2003 and 2014 (10). However, wealth-related inequalities in ANC and childbirth service utilization are persistently high in many countries (10-12). The consequences of these inequality are costly to individuals and societies. Estimates from UNFPA indicate that universal access to modern contraceptives, maternal and newborn services would save millions of maternal and neonatal lives and gain billions of monetary benefits to countries (13).

Continuum of care

In 2005, WHO shifted its strategy from addressing maternal and newborn health care separately to advocating for continuum of maternal care approach through achieving universal health coverage (14). The continuum of care would enable equitable and high coverage of maternal and child health care from pregnancy through childbirth to first few weeks after childbirth (14, 15). Given that most neonatal deaths occur within the first 7 days after birth, continuum of care would enable linking of maternal and newborn interventions from pregnancy to postnatal period thus building a strategic interaction to improve access and utilization of health care (16).

Antenatal care attendance

Antenatal care (ANC), referred to as routine care given to pregnant women between conception and onset of labour (17), is one of the leading strategies that is universally recommended to prevent neonatal and maternal morbidities and deaths (18-20). In high income countries (HIC) such as in Sweden, in 2019, almost all (98%) pregnant women attended about 8–12 ANC bookings with skilled midwives (21, 22). In comparison, a 2018 study in low-and middle-income countries (LMIC), indicated that 90% of pregnant women attended at least 1 ANC visit and in about 55 countries with known statistics, only 44% had 4 or more ANC visits (23). In 2013, early ANC visits (visit during first trimester) was about 48% in LMIC compared to 85% in high income countries (17). These disparities in ANC attendance between HIC and LMIC perhaps explain much of the mortality differences between the regions. Further, many countries with high coverage in sub-Saharan Africa and Southern Asia have poor and low quality of health care(23). Evidence-based findings by WHO show that at population level, the higher the ANC visits, the lower the neonatal mortality rates (18, 19). As such, in 2016 WHO increased the recommended ANC visits in LMIC to at least 8 from previous 4 visits (18).

Health facility birth (skilled birth attendance)

Health facility birth, largely conducted by skilled birth attendants is recommended by WHO for favorable neonatal outcomes (24, 25). WHO defines skilled birth attendance as “care provided to a woman and her newborn during pregnancy, childbirth and immediately after birth by an accredited and competent health care provider who has the necessary equipment and support of a functioning health system, including transport and referral facilities for emergency obstetric care” (24). Utilization of institutional childbirth services range from over 99 % in many high-and upper-middle-income countries to less than 50% in several low-income countries (26, 27). Factors that hinder facility childbirth service utilization in LMIC include socioeconomic factors, women’s lack autonomy in health decision making, longer distance to health facilities, lack of hospital supplies and poor attitudes of health providers among others (28-30)

Whereas a number of population-based studies in LMIC associate facility delivery to positive neonatal outcomes (31), others only agree in part. Instead, the studies indicate that facility births are associated with neonatal protective effects only when mothers experienced obstetric complications (32, 33). Nonetheless, neonatal mortality in LMIC is a complex phenomenon involving several other factors at individual, community and health facility levels associated with delays to seek or

receive care (34), which in-turn are a result of socioeconomic inequalities (35) and longer distance to health facilities among other factors (36). Further, inadequate training and lack of emergency facilities in many health institutions as well as poor quality of care and referral systems are also indirect risk factors for neonatal deaths (37-39).

Postnatal care

Postnatal care (PNC) is another key strategy that profoundly contribute to neonatal survival but that is severely underutilized particularly in many LMIC (40). A multi-country study in 36 sub-Saharan Africa countries indicated that PNC utilization between 2008 and 2018 was 52.5%, with Eastern Africa having the lowest PNC attendance of 31.7% (41). More than two-thirds of all neonatal mortalities occur during postnatal, first week after birth (41-43). WHO recommends that for institutional births, mother and newborn(s) be given PNC for at least 24 hours after birth and for home births, the first PNC contact should be within 24 hours (40). Given that about one-third of all newborn deaths occur within a day(2), this recommendation, if adhered to could prevent many newborn deaths. Follow up PNC visits should be after 3 days, implying that most (75%) of the preventable neonatal deaths could be avoided by comprehensive PNC. Other visits are recommended within 7-14 days and 6 weeks after birth (40).

Causes of neonatal mortality

The leading direct (clinical) causes of neonatal deaths are infections such as *sepsis*, *pneumonia*, *meningitis*, *tetanus* and *diarrhoea*, preterm and intrapartum-related complications such as *birth asphyxia* (43-45). Low birthweight is a major underlying (intermediate) obstetric risk factor for neonatal deaths associated with most of the direct causes of newborn mortality (46). Other non-causal risk factors for neonatal mortality include sociodemographic, maternal and newborn factors that are hypothesized to either hinder care-seeking and/or are indirectly associated with neonatal death or risk factors for neonatal deaths. These include living in rural areas (47), inadequate care utilization (48), low maternal or paternal education(49, 50), poverty (51), single motherhood (52), young maternal age(50), lack of knowledge about neonatal complications (53), and male sex of newborn (50) among others.

Kenya, Uganda, and Tanzania

Kenya, Uganda, and Tanzania have relatively similar demographics. With an estimated total population of over 130 million in 2014-2019 and sex ratio roughly 1.1 (54-56), they constitute the most populated countries among all 6 East Africa Community member states. Fertility rates range from 3.9 in Kenya (57) to 5.4 in Uganda (55). About 23–43 percent of women have their first child before 19 years of age (55, 57, 58). Modern contraceptive use among married women of reproductive age, 15-49 years in 2014-2016 ranged from 32% in Tanzania, 35% in Uganda to 53 % in Kenya (59-61).

Policies and health system challenges in Kenya, Uganda, and Tanzania.

The three countries are in comparable state of maternal and neonatal health situation and are in the pathway towards achieving universal health coverage. Being signatory of the SDGs, Kenya, Uganda, and Tanzania have strengthened their commitment to reduce preventable neonatal and maternal deaths. This is evidenced by the national roadmaps and strategic plans aimed to improve maternal and child care in Uganda (62), Tanzania (63) and Kenya (64, 65). Policy frameworks of the National Health Sector Development Plan, 2015-2020 in Uganda (66), the Kenya Community Health Strategy, 2020-2025 (65) and the Strategic plan to improve maternal, newborn, child and adolescent health in Tanzania, 2016-2020 (63) have all adopted the right based approach to expedite progress towards universal health coverage (UHC) and minimize inequalities and discriminatory practices in access to quality health care including maternity care. Nonetheless, despite the efforts, the health care systems in the three countries are insufficiently funded and have workforce shortages thus affecting access and quality of services. The health expenditures as a percentage of national gross domestic product (GDP) for each of the three east African countries in 2015/2016 and currently is about half (7%) of the Abuja declaration target of 15% (67-71). Free and subsidized maternity and child health care do exist at first level health facilities in Kenya, Uganda, and Tanzania (72-76).

Neonatal mortality in Kenya, Uganda, and Tanzania

The WHO progress report of 2020 indicate that Kenya, Uganda and Tanzania are among 20 countries with the highest neonatal deaths globally (77). The neonatal mortality rates in these three countries ranged from 20–22 deaths per 1000 live births in 2016 (78). The causes of which are similar to those reported globally (79).

Conceptual framework: Determinants of neonatal mortality in Kenya, Uganda, and Tanzania

The conceptual framework of this thesis is adapted from Mosley and Chen's proximate determinants framework, WHO and UNICEF frameworks for child survival and social determinants of health in low-and middle-income countries. According to Mosley and Chen, given optimal settings, over 97 percent of live-born neonates can be expected to survive (80). The proximal determinants such as maternal age or antenatal care attendance that directly influence the risk of neonatal deaths are based on the premise that (neonatal) survival in any society is dependent on socioeconomic, biological and environmental forces (80). The WHO's social determinants of health framework for action highlights how social factors at individual or societal levels substantially shape inequitable access to health leading to poor neonatal survival outcomes (81). The UNICEF model links the interrelated underlying risk factors showing how factors at one level impacts other levels leading to the direct causes of neonatal (and maternal) death (82).

The detailed framework can be seen in Figure 1.

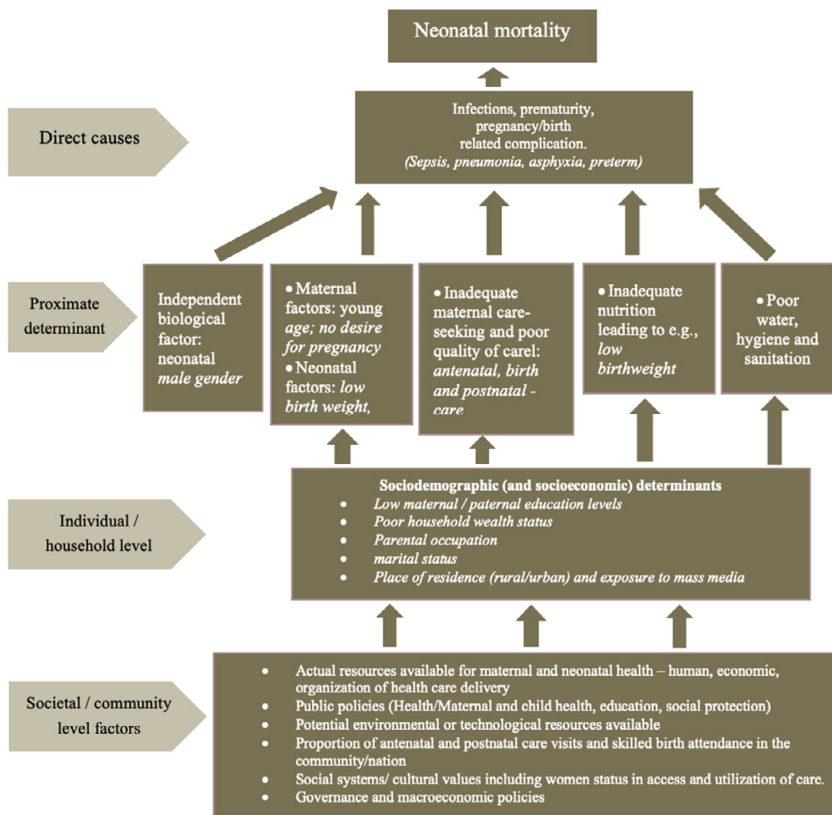


Figure 1: Conceptual framework for direct and indirect risk factors associated with neonatal mortality in Kenya, Uganda, and Tanzania, adapted from Mosley and Chen, WHO, and UNICEF frameworks for child survival and social determinants of health in Low-and middle-income countries.

Analytical model

The analytical model in Figure 2 shows a summary of how individual studies of this thesis project contribute to the whole. It reflects how direct risk factors for neonatal death such as birth-related complications, prematurity and infections are linked to the intermediate and indirect risk factors that form the variable basis for this thesis from pre-pregnancy through childbirth to postnatal period. Study I focus on factors surrounding pregnancy period and neonatal survival outcomes. Study II focuses on a major underlying risk factors associated with postnatal morbidity and mortality. Study III examines factors associated with access to emergency or advance obstetric procedure. Study IV complements all the first three studies by investigating a combination of all the major maternity and newborn care intervention while study V examines a major proximate factor associated with biological and physiological risk factor to neonatal survival.

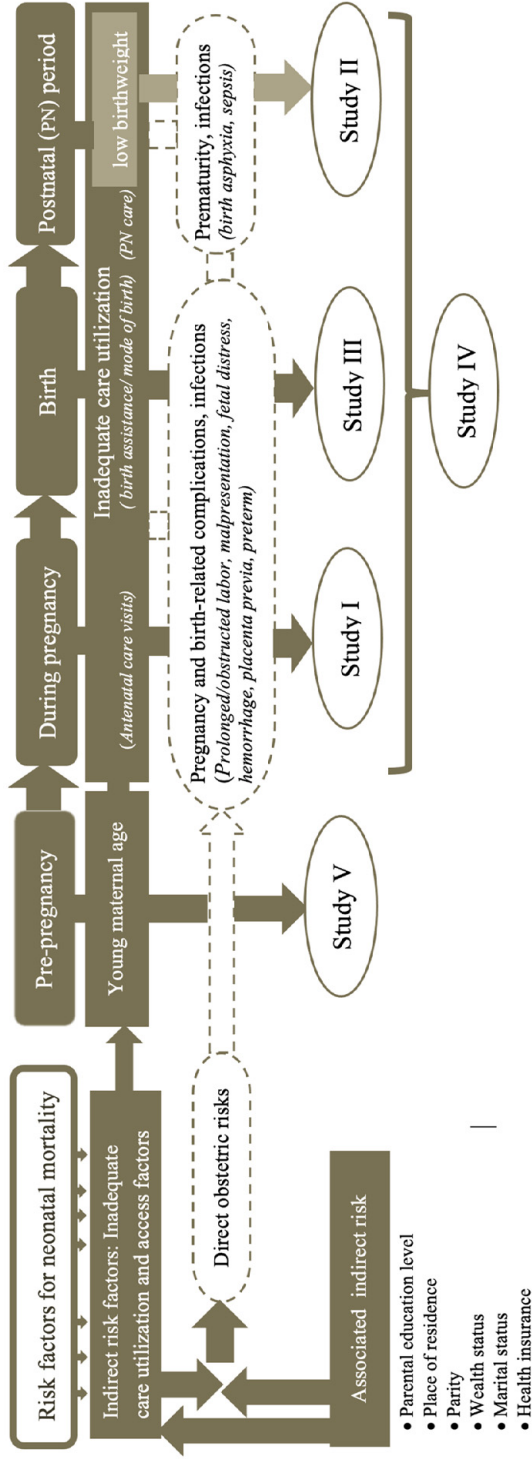


Figure 2: Analytical model showing specific pathways of risk factors for neonatal mortality and care interventions investigated by studies 1-V.

AIM

General aim

To examine determinants of maternal service utilization, effectiveness of care and risk factors for neonatal mortality in Kenya, Tanzania, and Uganda.

Specific aims

To examine the effectiveness of antenatal care services in reducing neonatal mortality in Kenya.

To determine the association between low birthweight and neonatal mortality in Uganda and to estimate the national trends of LBW-attributable neonatal mortality between 1995 and 2011.

To examine the socioeconomic factors associated with cesarean delivery in Kenya and Tanzania and to assess the impact of cesarean delivery on neonatal survival in both countries.

To investigate determinants of continued maternal care-seeking during pregnancy, birth and postnatal and associated neonatal survival outcomes in Kenya and Uganda: analysis of cross-sectional, demographic and health survey data.

To assess survival patterns of neonates born to adolescent mothers and the effect of pregnancy intentions and marital status on newborn survival in Kenya, Uganda, and Tanzania, 2014–2016.

Materials and Methods

Study setting

The five studies in this thesis were conducted in East Africa region, in Kenya, Tanzania, and Uganda. The three countries neighbour each other and have a total population of about 130 million in 2016. Their population growth rates are relatively high. Majority live in rural areas with agriculture as their main source of livelihood. Table 1 provides summary of the specific settings, aim and study populations for each of the five studies.

Data source and study design

All the studies I–V in this thesis obtained data from the Demographic Health Surveys (DHS) program in Kenya, Uganda, and Tanzania. Both household and woman questionnaires were employed to conduct survey interviews across the entire nation in each of the three countries. The surveys were conducted by the respective bureaus of statistics in each country, i.e., Uganda Bureau of Statistics (UBOS), Kenya National Bureau of Statistics (KNBS) and the National Bureau of Statistics (NBS) in Tanzania in collaboration with ministries of health and other partners in each country. In each of the countries, the sampling strategy ensured representative sampling nationally, in rural and urban areas and first administrative unit (and/or geographical areas) such as regions or counties using a two-stage cluster design. In the first part, clusters were selected as primary sampling units from the national census registrations and in the second part samples of households were drawn from each selected sampling unit. In Kenya DHS 2014, 1612 clusters (enumeration areas (EAs)) were selected, and 40,300 households were sample. In TDHS 2015-16, 608 clusters were selected and 13, 376 households sampled. In UDHS 2015-16, 697 EAs and 20, 880 households selected. For Uganda 2011, 2006, 2000-2001 and 1995 surveys, 10,086, 9,864, 8,792, 8,093 households were selected respectively. The response rate based on sampled households was over 95 percent for all the surveys. Eligible women of reproductive ages 15-49 years old were interviewed to obtain information about the background characteristics and a range of maternal health service utilization and childhood (neonatal) mortality. Measurements such as height and weight were also taken.

The Institutional Review Boards for the DHS program and the host countries approved the data collection and the distribution of datasets for public health research upon formal request. We obtained access to the datasets for this thesis project after sending a formal request to DHS secretariat. Further details of DHS methodology and manuals can be obtained from <https://dhsprogram.com/methodology/survey-types/DHS-Methodology.cfm> .

Table 1 also provides a summary of the inclusion criteria and statistical methods used in this thesis.

Table 1. Summary of the thesis: Aim, study settings and study population, inclusion criteria, study design and statistical methods

Study	Study setting	aim	Study population	Inclusion criteria	Statistical analysis
Study I	Kenya	Examine the effectiveness of ANC services in reducing neonatal mortality in Kenya	Most recent live-born children, dead or alive whose mothers (aged 15–49 years) were eligible for interviews in 2014.	All singleton children born 3-5 years prior to the 2014 survey. Neonatal mortality defined as death of a single liveborn baby within 28 days after birth.	Descriptive statistics, bivariate and binary logistic regression. Population attributable fractions (PAF) were estimated.
Study II	Uganda	Investigate the association between low birthweight and neonatal mortality and to determine the trends of neonatal deaths attributable to low birthweight in Uganda between 1995 and 2011.	Most recent live-born children, dead or alive whose mothers (aged 15–49 years) were eligible for interviews in 1995, 2000-2001, 2006, 2011.	All singleton neonates born 3-5 years prior to the 1995, 2000-2001, 2006, 2011 surveys and had birthweight less or equal to 4000 grams ($\leq 4000g$).	Descriptive statistics, bivariate and binary logistic regression. PAF.
Study III	Tanzania and Kenya	Examine caesarean delivery and its associated socioeconomic patterns and neonatal survival outcomes in Kenya and Tanzania.	Most recent live-born children, dead or alive whose mothers (aged 15–49 years) were eligible for interviews in Kenya in 2014 and Tanzania in 2015-2016.	All singleton neonates born 1-59 months prior to the Kenya 2014 and Tanzania 2015-2016 surveys and were born in health institutions (skilled attendance).	Descriptive statistics, bivariate and binary logistic regression.
Study IV	Uganda and Kenya	To examine how maternal and sociodemographic factors determine continued maternal care-seeking behaviour from pregnancy to postnatal period in Kenya and Uganda and to estimate associated neonatal survival outcomes.	Most recent live-born children, dead or alive whose mothers (aged 15–49 years) were eligible for interviews in Kenya 2014 and Uganda 2015-2016 surveys.	All neonates born 1-59 months prior to the Kenya 2014 and Uganda 2015-2016 surveys.	Descriptive statistics, bivariate and multinomial and binary logistic regression. PAF
Study V	Uganda, Kenya and Tanzania	To assess survival patterns among neonates born to adolescents and the effect of pregnancy intentions and marital status on survival in Kenya, Uganda, and Tanzania.	Most recent live-born children, dead or alive whose mothers (aged 15–49 years) were eligible for interviews in Kenya 2014 and in Uganda and Tanzania 2015-2016 surveys.	All neonates born 1-59 months prior to the Kenya 2014 and Tanzania/Uganda 2015-2016 surveys whose mothers were aged 15–19 years and comparison group, 20–49 years old.	Descriptive statistics, bivariate and survival analysis. PAF

Study variables

Outcome variables

The main dependent variable was neonatal survival outcome which was dichotomized into dead or alive and was examined in all studies I–V. Neonatal death or mortality as the outcome of interest was defined as death of a baby within the first 28 days of life after birth. Other primary outcome variables included low birthweight (Study II), mode of delivery/childbirth (cesarean or caesarean section) (Study III), care-seeking continuum (antenatal care (ANC) attendance and ANC services, facility birth, postnatal care (PNC) attendance (Studies I and IV). Certain outcome variables were also included as independent variables and as secondary objectives in different studies.

Independent variables

The main independent factors constituted sociodemographic, maternal, neonatal, and care-seeking variables that are known or theorized to be associated with neonatal survival or mortality. The categorizations of these variables were guided by previous studies, theories or the DHS methods based on science or common understanding. Different studies classified or regrouped the variables to suit the objectives of the studies. For instance, maternal age was originally grouped as 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49 years old but in this thesis, it was generally reclassified as 15-24, 25-34, and 35-49 years (83, 84) except in study V. Socioeconomic factors such as educational level was reclassified as no education, primary education and secondary or higher (85), wealth status was generally regrouped as poor, middle and rich (85), place of residence was dichotomized into rural and urban (86). Parity (87). Other variables included newborn gender and multiple gestations (88, 89).

Statistical analysis

All the analysis were conducted using Statistical software packages IBM SPSS version 22.0 and 24.0 (IBM, Armonk, New York, USA), Microsoft excel (2017-2021) and Stata versions 12 and 16 (College Station, Texas: Stata Press), at 5% level of significance. To maintain the representativeness of the data during analysis and to adjust for non-response, data sampling weights were applied and adjustment for complex sample design done in all the studies I–V and in all datasets except, Uganda DHS, 1995 data which was not subjected to weighting.

Study I

We used Pearson's chi square test to examine the distribution of sociodemographic and maternal variables by antenatal care interventions (primary predictor variables), classified as 'yes' if a given service was received and 'no' if not attended/received. The distribution of variables was also examined by neonatal survival outcomes among singleton births and was the dependent variable, dichotomized into died or alive. Both crude and adjusted odds ratios were determined using binary logistic regression analysis to estimate the associations between the inadequate antenatal care services and neonatal death in Kenya, 2014. Crude odds ratios were generated in model 1. Potential confounders were adjusted for using stepwise modelling in models 2, 3 and 4. In model 2, sociodemographic variables such as place of residence, wealth status and maternal factors such as age, parity were adjusted for. Model 3 adjusted for all factors in model 2 plus childbirth related variables while model 4 controlled for all variables in models 2 and 3 in addition to birth weight.

Study II

Descriptive statistics were generated using cross-tabulations. Kaplan-Meier estimator was used to generate survival curves for different birthweight categories in Uganda between 1995 and 2011. Binary logistic regression was used to examine the associations between low birthweight and neonatal death with adjustment for confounders that included sociodemographic and maternal factors, check-up for complications and cesarean delivery.

Study III

The distribution of study variables by mode of delivery and stratified by place of residence (rural and urban) were examined using cross-tabulations. Excel was used to generate graphical display of cesarean delivery rates across various socioeconomic classes in Kenya, 2014 and Tanzania, 2015-2016. Similarly, distribution of study variables by neonatal mortality in Kenya and Tanzania was also assessed. Binomial logistic regression was used to determine the association between socioeconomic variables and cesarean delivery while controlling for other explanatory factors that are potential confounders such as birthweight, multiple gestations, parity, and maternal age. The regression analysis was also used to determine associations between cesarean delivery and neonatal death at 95% confidence interval in Kenya and Tanzania.

Study IV

Microsoft Excel was used to assess the correlations between antenatal care visits and the proportions of health facility births and postnatal care visits in Kenya 2014 and Uganda 2015-2016. Cross-tabulations were used to examine the distribution of sociodemographic, maternal, and paternal variables by 15 different classes (categories) of care-seeking continuum from those mothers who attended all recommended care (*highest* care-seekers) i.e., 4 or more antenatal care, health facility (skilled) childbirth and at least one postnatal attendance within 4 weeks after birth to *lowest* care-seekers i.e., those who received no skilled maternity care. Multinomial logistic regression was used to examine associations between sociodemographic, maternal factors and continuum of care-seeking behaviour in Kenya and Uganda. Further, binary logistic regression was used to determine the associations between selected levels of care-seeking continuum and neonatal mortality in Kenya and Uganda.

Study V

Distribution of variables between adolescent mothers, 15–19 years and mothers 20–29 years old were examined using Pearson's chi square test at significance level, $\alpha=0.05$. Kaplan-Meier's estimator was used to visualize neonatal survival during 28 days after birth among adolescent, 15-19 years old and mother 20-29 years old in Uganda, Tanzania, and Kenya. The equality of survival curves was assessed using Log-rank method. We employed cox hazard regression models to examine the hazard of death among neonates born to adolescents as compared to those born to women 20-29 years old while controlling for potential confounding variables. Crude and adjusted hazard ratios were determined. Models were used to adjust for various risk factors at different levels. Our analysis was further stratified by marital status and pregnancy intentions both separately and when combined. Furthermore, analysis was stratified by parity. Both the global Schoenfeld test and log-log transformation to the overall function were used to assess the proportional hazard assumptions.

Results

Study I and IV

Study I

Figure 3 below shows that about 95 percent of mothers to singleton neonates in Kenya had at least 1 ANC visit with skilled attendance in 2014 but only about 20% visited within the first 3 months of pregnancy (1st trimester). First ANC visit for majority (67%) of the mothers was between 4 and 6 months of pregnancy (2nd trimester).

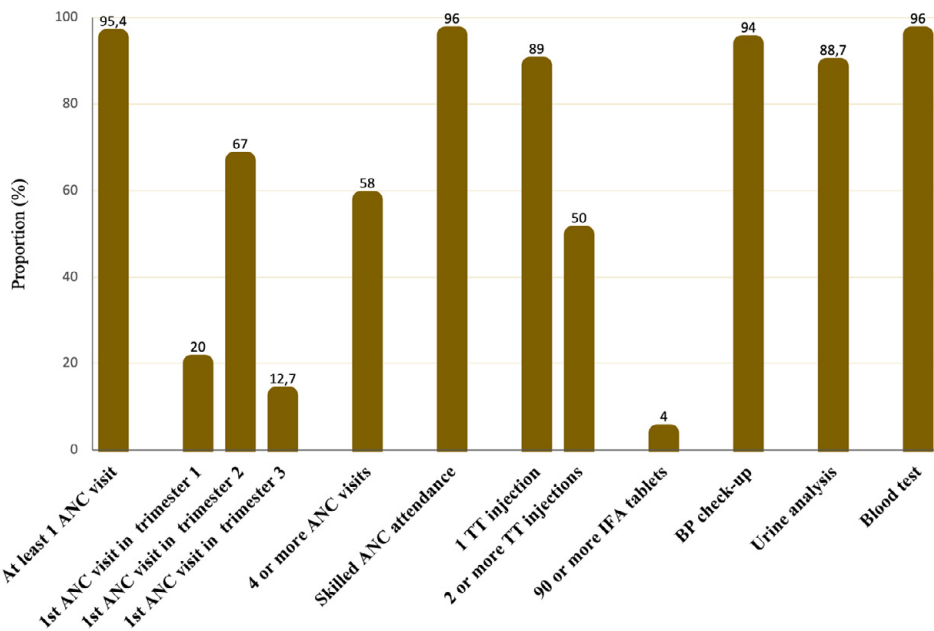


Figure 3. Proportion of antenatal care (ANC) visits and service utilization by pregnant mothers in Kenya using demographic and health survey 2014.

Study IV

Figure 4 below shows that over 95 percent of the mothers had at least 1 ANC visit and 56.7% had 4 or more ANC visits in 2014-2016, with Uganda having slightly more mothers attending recommended number of visits at that time than Kenya. 6 % and 2% had no ANC visits in Kenya and Uganda respectively.

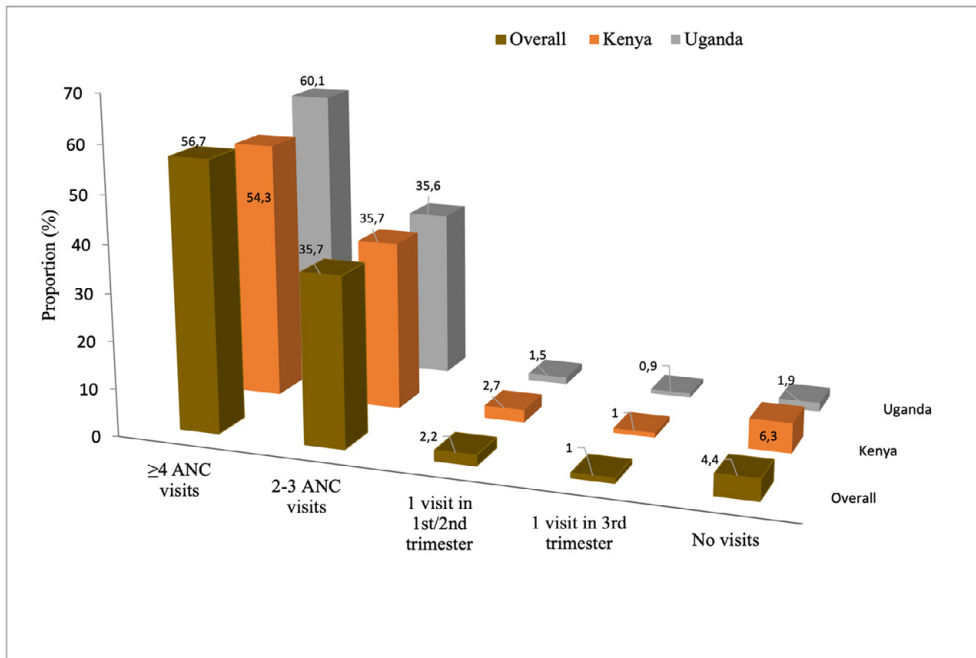


Figure 4. Proportions of antenatal care visits by number of ANC contacts in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Figure 5 below shows a direct linear correlation between the number of ANC visits and proportions of health facility births and postnatal care visits.

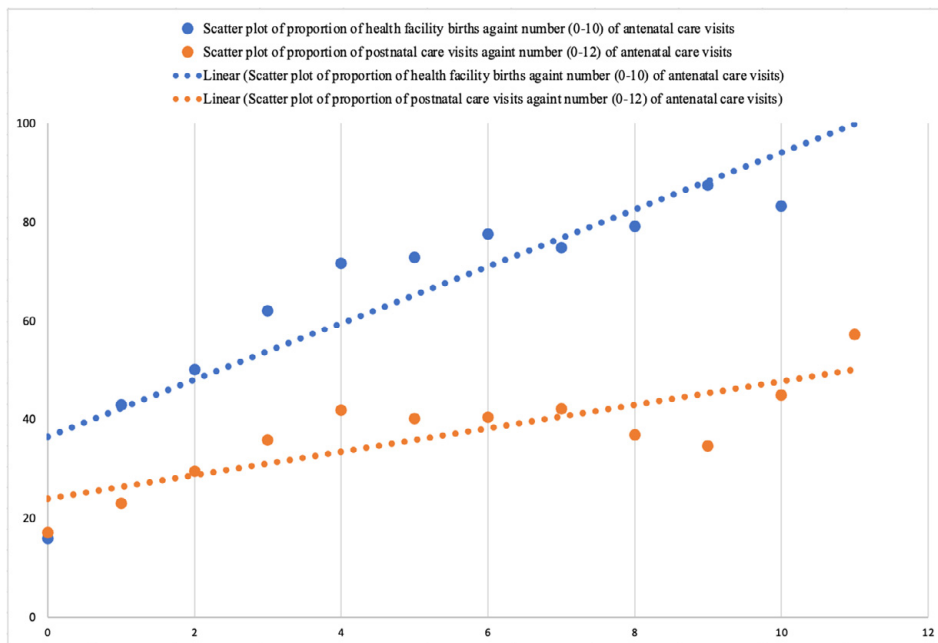


Figure 5. A scatter plot showing correlation between number of antenatal care (ANC) visits and proportions of facility births and postnatal care visits in Kenya and Uganda, using demographic and health survey 2014-2016 data.

Figure 6 is a forest plot showing multinomial regressions for the associations between maternal and socio-demographic factors and different classes of care-seeking continuum during pregnancy, birth and postnatal care in Kenya and Uganda 2014-2016. The figure shows that higher maternal and paternal education versus no formal education, were largely associated with higher care-seeking, except among those who had 1 ANC visit/facility birth or lower. Detailed numbers (not include in the figure) show that the tendency for care-seeking, relative risk ratios RRRs ranged from 2.1– 8.0, (95% confidence intervals [95% CI] 1.1–16.3) for primary or higher parental education compared to no formal education. The higher the education level, the higher the care-seeking tendency. Similarly, exposure to mass media (television/radio) versus no exposure was also largely associated with more continued care-seeking, RRRs ranged from 1.8– 3.2 (95% CI 1.2–5.4). Being told about pregnancy complications generally enhanced care-seeking in Kenya, data for Uganda was not available.

On the contrary, problem with distance to the health facility was generally associated with low care-seeking during pregnancy to postnatal period, RRRs ranged from 0.6 – 0.7 (95% CI 0.5–0.9). Only in a few care-seeking classes was the

problem with distance not statistically significant. Similarly, living in rural areas versus urban was also generally associated with lower care-seeking tendencies. Another factor that noticeably hindered care-seeking was when the husband/partner rather than the woman herself made major decisions for maternity care-seeking, this was true in most (9) care-seeking categories, RRRs ranged from 0.5 – 0.7 (95% CI 0.3–0.9).

Other factors such as older maternal age versus young indicated lower associations with care-seeking in all the classes, however the results were not statistically significant, RRRs ranged from 0.4 – 0.9 (95% CI 0.3–1.7). Similarly, having a desire to have a child generally indicated no associations with care-seeking behavior. Being in middle wealth class compared to being poor showed higher care-seeking behavior, but these were only statistically significant in less than half of the care-seeking classes. While among the rich, there was no significant association with care-seeking when compared to the poor, except in one class.

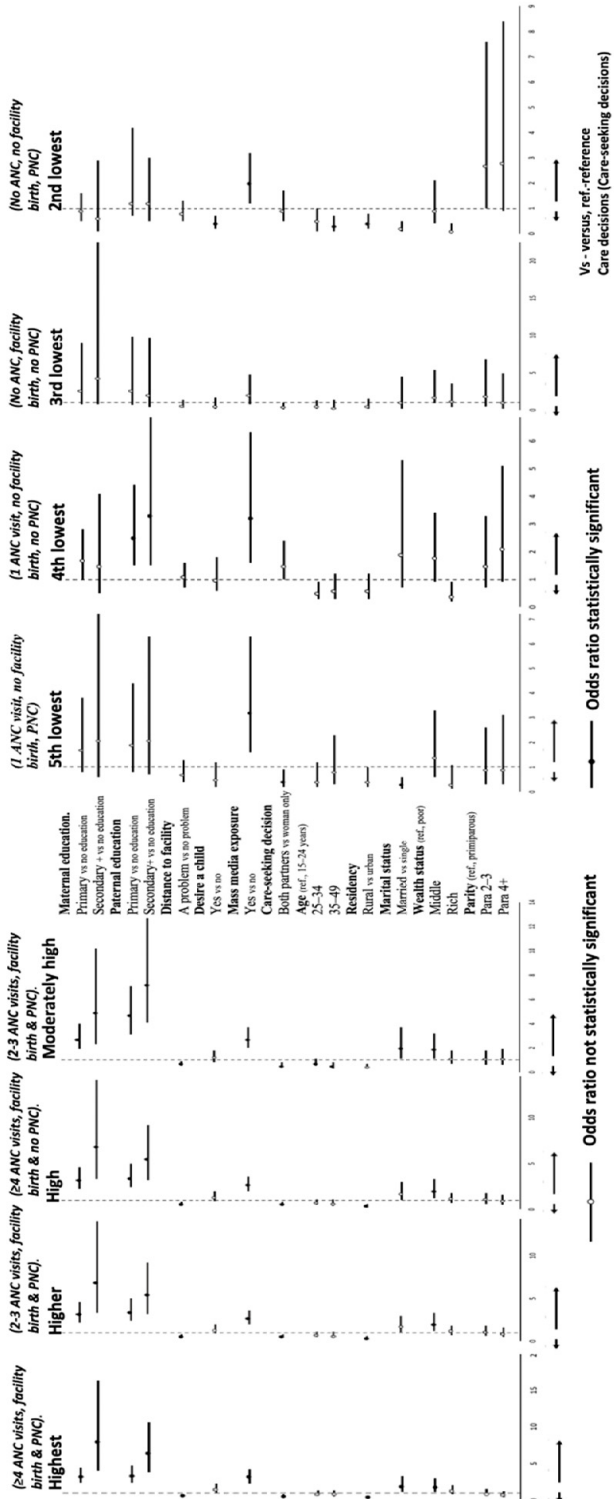


Figure 6: A forest plot showing relative risk ratios (RRR) for the associations between maternal and socio-demographic factors and maternal continuum of care-seeking behaviour in Kenya and Uganda, using demographic and health survey 2014-2016 data

Summary findings for studies I and IV

Figure 7 is also a forest plot showing adjusted odds ratios obtain from findings in study I and study IV.

Study I was conducted in Kenya, 2014. The Figure reveals the associations between lack of or inadequate utilization of antenatal care (ANC) services and neonatal mortality in Kenya. After adjusting for socio-demographic factors, maternal, birth-related factors, and birthweight, the findings showed that no ANC visits (aOR 4.0, 95% CI 1.7 – 9.1) or inadequate (1-3 ANC) visits, (aOR 1.8, 95% CI 1.1–3.0) versus 4 or more ANC visits were associated with neonatal mortality. Similarly, unskilled ANC attendance (aOR 3.0, 95% CI 1.4 – 6.1) versus skilled and no check-up for pregnancy complications compared to check-up, (aOR 2.4, 95% CI 1.4 – 4.0) were all associated with neonatal death. Further, Unskilled (home) birth compared to skilled (health facility) birth was not associated with neonatal death (aOR 0.7, 95% CI 0.6 – 1.5). Having no tetanus toxoid (TT) injection (aOR 2.4, 95% CI 1.1–5.6) compared to having one TT injection was also associated with neonatal mortality. No ANC visit accounted for an estimated 9.1% of neonatal deaths in Kenya. neonatal death,

Study IV was conducted in Kenya, 2014 and Uganda, 2015-2016. In Figure 7 and Table 3, care-seeking continuum of *no ANC visits–no facility births–no PNC (lowest category)* and *No ANC–facility birth–no PNC* were significantly associated with neonatal mortality, (aOR 4.2, 95% CI 1.6–10.9 and aOR 4.2, 95% CI 2.3–7.8 respectively) when compared a continuum of 4 or more ANC–facility birth–1 PNC visit within 28 days after birth. For the *lowest* category of care continuum with no care utilization in both countries, the odds of neonatal deaths were higher in Kenya (aOR 6.0, 95% CI 2.6–13.6) compared to that in Uganda (aOR 2.5, 95% CI 1.0–6.5).

Figure 7 shows the summary of findings above for studies I and IV.

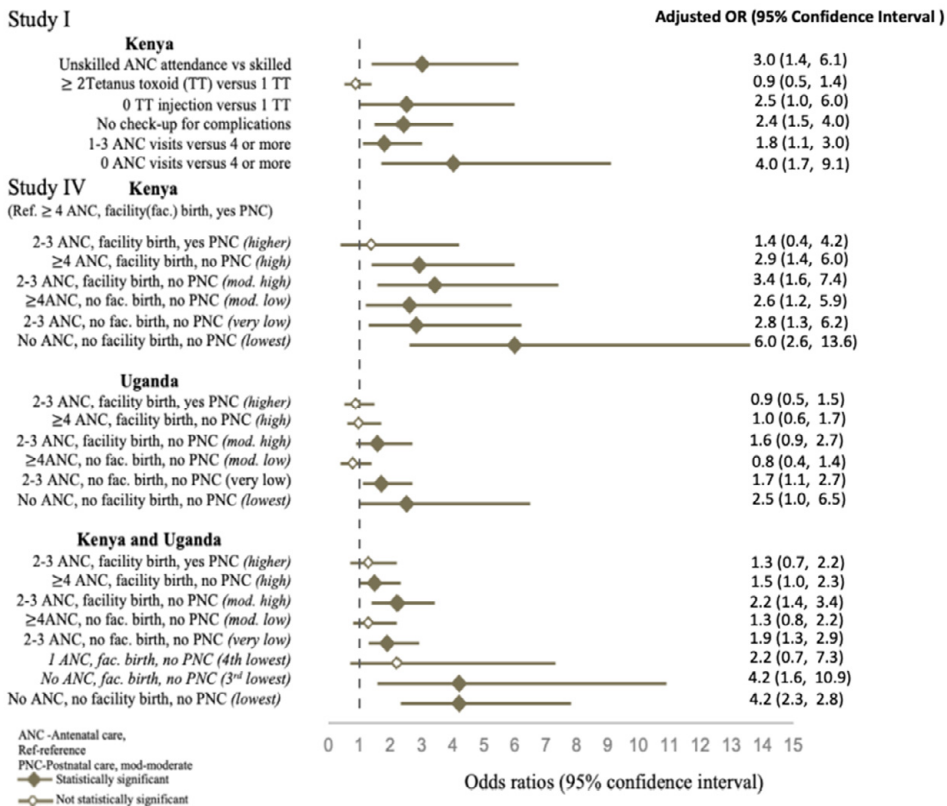


Figure 7. A forest plot summarizing findings from study I and study IV showing associations between the lacking care interventions and neonatal mortality in Kenya 2014 and Uganda 2015-2016.

Table 3 (Study IV): Crude and adjusted odds ratios for the association between classes of care-seeking behavior in continuum of care and neonatal mortality in Kenya and Uganda, using demographic and health survey 2014–2016 data.

Classes of care-seeking behaviour	Overall Crude odds ratio (95% CI) n=22538	Overall aOR* (95% CI)	Popn. Attr. neonatal mortality risk fraction (%)	Proportion of the total in Kenya (%) n=12579	Kenya only aOR* (95% CI)	Popn. Attr. neonatal mortality risk fraction	Uganda only aOR* (95% CI)	Popn. Attr. neonatal mortality risk fraction
	Ref.	Ref.	Ref.	(13.4)	Ref.	Ref.	Ref.	Ref.
Highest (≥4 ANC visits, health facility birth, yes PNC).	1.5 (1.0-2.4)	1.3 (0.7-2.2)	–	(6.1)	1.4 (0.4-4.2)	–	0.9 (0.5-1.5)	–
Higher (2-3 ANC visits, Health facility birth, yes PNC). Mis=47	1.5 (1.0-2.2)	1.5 (1.0-2.3)	–	(29.8)	2.9 (1.4-6.0)	19.9%	1.0 (0.6-1.7)	–
High (≥4 ANC visits, Health facility birth, no PNC). Mis=72	2.4 (1.6-3.7)	2.2 (1.4-3.4)	9%	(16.0)	3.4 (1.6-7.4)	14.6%	1.6 (0.9-2.7)	–
Moderately high (2-3 ANC visits, health facility birth and no PNC). Mis=33	1.3 (0.8-2.1)	1.3 (0.8-2.2)	–	(14.5)	2.6 (1.2-5.9)	8.6%	0.8 (0.4-1.4)	–
Moderately low (≥4 ANC visits, no facility birth, no PNC). Mis=44	1.9 (1.3-2.8)	1.9 (1.3-2.9)	7%	(14.7)	2.8 (1.3-6.2)	9.3%	1.7 (1.1-2.7)	6.7%
Very low (2-3 ANC visits, no facility birth, no PNC). Mis=48	2.2 (0.7-6.7)	2.2 (0.7-7.3)	–	(2.1)	–	–	–	–
4th lowest (1 ANC visit, no health facility births, no PNC) Mis=2	7.8 (3.5-17.5)	4.2 (1.6-10.9)	1.9	(0.5)	–	–	–	–
3rd lowest (No ANC, health facility births and no PNC). Mis=2	4.5 (2.5-7.8)	4.2 (2.3-7.8)	5%	(5.6)	6.0 (2.6-13.6)	10%	2.5 (1.0-6.5)	–
Lowest (No ANC, no facility births and no PNC.). Mis=17								

*adjusted/restricted to birthweight ≥2500 g and singleton births. Mis – Missing: Due to non-response, proportionally (relatively random) distributed across all strata. Popn. Attr. Population attributable, Ref-Reference

Figure 8 summarizes findings from studies I and IV. The Figure indicates that lack of or inadequate ANC visits (<4 ANC) accounted for about 28 % of neonatal deaths in Kenya (Study 1). Similarly, neonatal deaths due to lack of PNC visits exceeded 20 % of the total mortalities in Kenya. Overall, from study IV (Figure 8 and Table 3), at least 63% of neonatal deaths in Kenya could be avoided by providing full minimal care of 4 ANC visits, hospital birth and at least 1 PNC. In Uganda, more than 7% of neonatal deaths were associated with 2-3 ANC, no facility birth, and no PNC. For both countries inadequate maternal care utilization is attributable to at least 23 % of neonatal deaths.

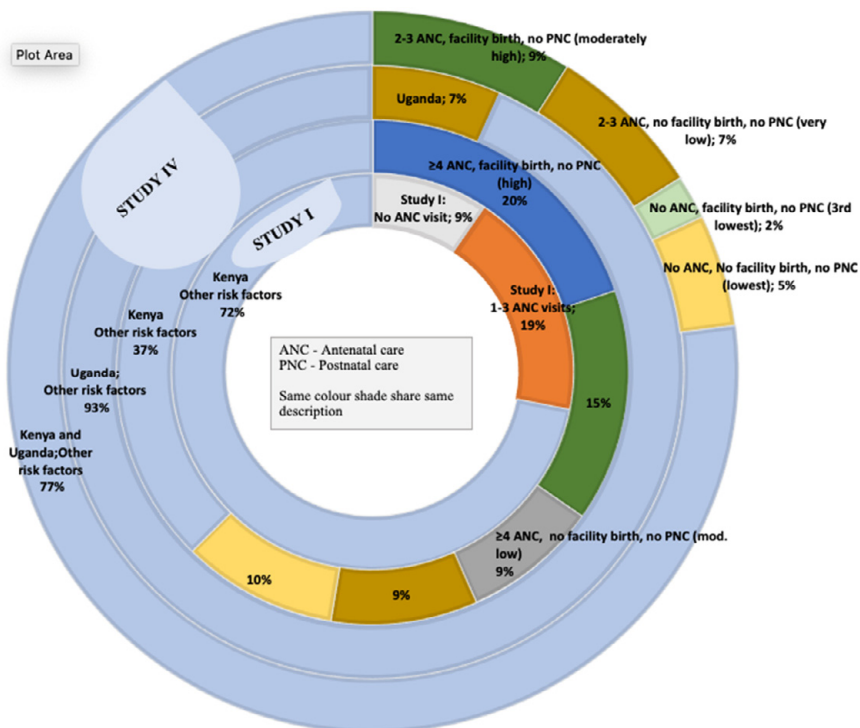


Figure 8: Population attributable neonatal mortality risk fraction for lack of or inadequate interventions in the continuum of care in Kenya and Uganda, 2014-2016.

Study II

Generally, young mothers below 20 years of age were overrepresented among mothers with low birthweight neonates. In Table 4 below, low birthweight (LBW) was associated with neonatal death in all the surveys, 1995-2011 in Uganda. The odds of deaths among low birthweight neonates (versus normal birthweight) declined gradually overtime from 6.2 in 1995 to 3.8 in 2011, although with

overlapping confidence intervals. There was a 10% decline in the proportion of neonatal mortalities among low birthweight newborns from 1995 to 2011. In 2011, over 70 percent of neonatal deaths among low birthweight newborns in Uganda could be accounted for their LBW status. However, in the general population, neonatal deaths from LBW declined by half from 1995 to 15.3 % in 2011.

Table 4: Adjusted odds ratios for the association between low birthweight and neonatal mortality in Uganda between 1995–2011 and associated attributable risk fractions.

Adjusted odds ratios (95% Confidence Interval)				
Variable	1995 N=1995	2000-2001 N=1100	2006 N=1519	2011 N=2223
Birthweight				
Low birthweight (<2500 g) (Compared to normal birthweight ≥ 2500g – 4000g)	6.2 (2.3-17.0) ^b	5.3 (1.7–16.1) ^b	4.3 (1.3–14.2) ^a	3.8 (1.3–11.2) ^a
Associated Attributable risk proportion	83.9%	81.1%	76.7%	73.7%
Population attributable mortality risk proportion	33.6%	27.0%	24.0%	15.3%

^aAdjusted for sociodemographic factors (maternal age, education, parity, marital status, wealth index and place of residence), maternal, pregnancy and birth-related factors
^bAdjusted for all socio-demographic factors in (^a) above (except wealth status), maternal, pregnancy and birth-related factors in Table 1. Birth complications were not adjusted for in 1995 findings

Study III

Study III was conducted in Tanzania and Kenya. Findings in Figure 9 indicate that cesarean delivery (CD) was generally higher among mothers in high socioeconomic status, living in urban, than those in low socioeconomic status or in rural areas. CD rates ranged from 5% among the poorer in rural Tanzania to 19% among the richest in Urban Kenya. From 6.8% among mothers with no formal education in rural Kenya to 35% among post-secondary educated mothers in urban Tanzania. From 6.9% among rural domestic workers to 37.5% among urban mothers in managerial positions, in Tanzania. And from 7.5% among mothers without health insurance to 29% among health-insured mothers in Tanzania.

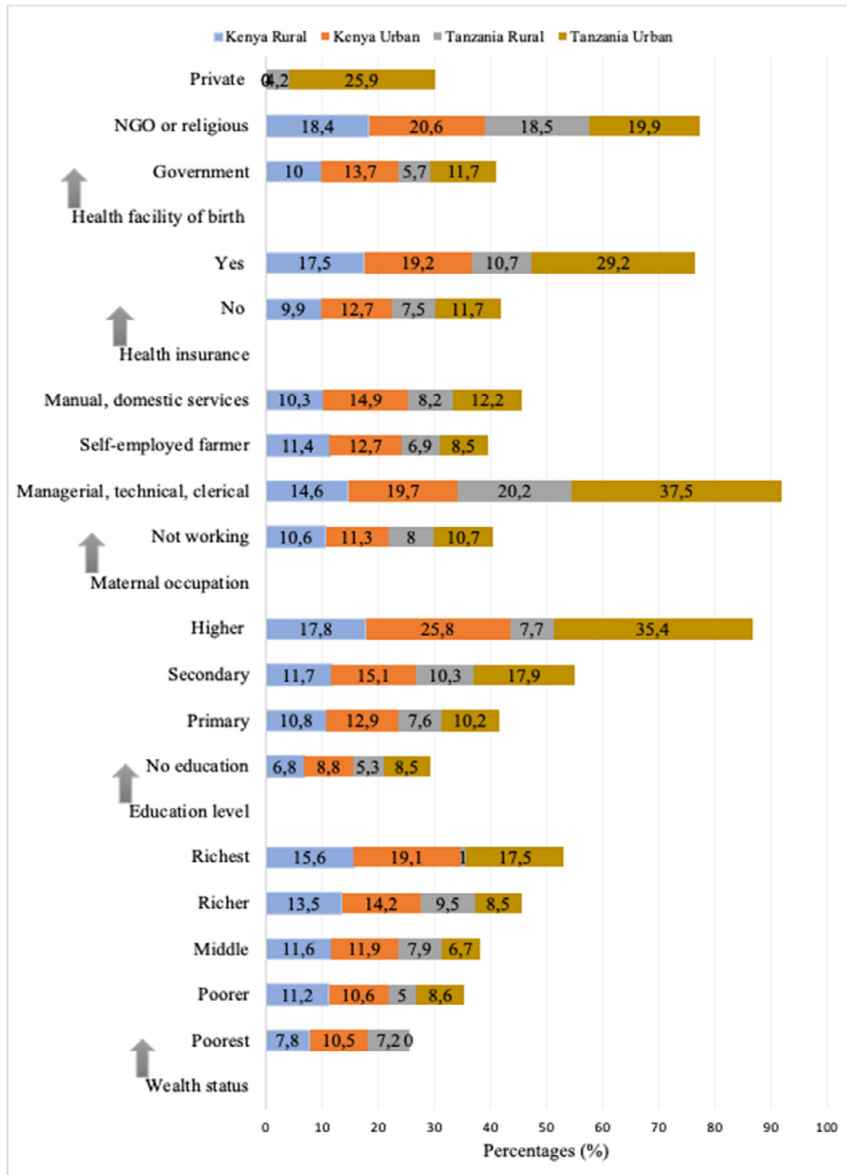


Figure 9. A sample graphical presentation showing cesarean delivery rates by sociodemographic variables and place of residence in 2014-2016, Kenya and Tanzania.

Table 5 presents the odds ratios for the associations between socioeconomic status and CD in Kenya and Uganda. Overall, the richest (aOR 1.4, 95% CI 1.2–1.8), postsecondary educated women (aOR 1.6, 95% CI 1.2–2.0), women managers (aOR 1.7, 95% CI 1.3–2.3) and those health insured (aOR 1.6, 95% CI 1.3–1.9) indicated higher odds of undergoing cesarean birth as compared to middle class, primary

educated, unemployed, and uninsured respectively. Country-specific results show that Tanzania generally had higher and significant odds of CD among all the four socioeconomic categories while in Kenya, only mothers with health insurance versus uninsured had statistically significant odds of CD.

With regards to health facility of birth, in comparison to government owned facilities, mission (aOR 2.7, 95% CI 2.1–3.4) and private (aOR 2.2, 95% CI 1.3–3.5) facilities in Tanzania indicated highest odds of cesarean delivery. Similarly, mission facilities in Kenya showed higher odds (aOR 1.5, 95% CI 1.2–1.8) of cesarean birth.

Table 5. Logistic regression analysis showing associations between socioeconomic status and cesarean delivery in Kenya 2014 and Tanzania, 2015-2016.

Variables	Adjusted odds ratios (95% confidence interval)		
	Overall	Kenya	Tanzania
Wealth index	<i>Reference category – Middle status of wealth</i>		
Poorest	0.9(0.7–1.2)	0.9 (0.6–1.2)	0.9(0.6–1.4)
Poor	0.9(0.7–1.2)	0.9(0.7–1.2)	0.6(0.4–1.0)
Rich	1.1(0.9–1.4)	1.1(0.8–1.4)	1.1(0.7–1.4)
Richest	1.4 (1.2–1.8)	1.2 (0.9–1.6)	1.6 (1.2–2.2)
Education level	<i>Reference category – Primary education</i>		
No education	0.8(0.6–1.0)	0.9(0.6–1.4)	0.8(0.5–1.1)
Secondary education	1.2(1.0–1.4)	1.1(0.8–1.2)	1.4(1.1–1.8)
Higher/post-secondary	1.6 (1.2–2.0)	1.4 (1.0–1.8)	1.6 (1.2–2.0)
Maternal occupation	<i>Reference category – Not working</i>		
Managerial, technical, clerical	1.7 (1.3–2.2)	1.3 (0.9–1.7)	2.9 (1.9–4.3)
Self-employed farmer	0.9 (0.7–1.1)	1.0 (0.8–1.3)	0.9 (0.7–1.3)
Manual, domestic services	1.0 (0.8–1.2)	1.0(0.8–1.3)	1.1(0.8–1.5)
Health insurance	<i>Reference category – No insurance</i>		
Have insurance	1.6(1.3–1.9)	1.4(1.2–1.8)	1.8(1.4–2.4)
Place of residence	<i>Reference category – Rural</i>		
Urban	1.3(1.2–1.5)	1.2(1.0–1.4)	1.5(1.2–1.8)
Health facility of birth	<i>Reference category – Government facility</i>		
Mission health facility	1.9(1.6–2.2)	1.5(1.2–1.8)	2.7(2.1–3.4)
Private facility	N/A	N/A	2.2(1.3–3.5)

Each socioeconomic factor independently adjusted for maternal age, birthweight, parity, and multiple births.

In Table 6, cesarean delivery showed significant overall association with neonatal mortality in Kenya and Tanzania after adjusting sociodemographic factors and maternal body mass index (BMI), (aOR 1.7, 95% CI 1.2–2.7). However, further adjusting for birthweight, multiple births in model 2 and additional adjustment for antenatal care visits in model 3, resulted in high but not statistically significant associations aOR 1.6, 95% CI 1.0–2.7 and aOR 1.7, 95% CI 0.9–3.4 respectively.

Table 6. Binomial logistic regression analysis (model 1–3) for the associations between cesarean delivery and neonatal death, adjusted odds ratio (aOR) in Kenya 2014 and Tanzania, 2015–2016.

	Model 1 aOR (95% CI)			Model 2 aOR (95% CI)			Model 3 aOR (95% CI)		
	Overall, N=12,898	Kenya	Tanzania	Overall,	Kenya	Tanzania	Overall,	Kenya	Tanzania
Cesarean section									
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	1.7 (1.2-2.7)	1.6 (0.8-3.4)	1.8 (1.0-3.2)	1.6 (1.0-2.7)	1.5 (0.7-3.5)	1.7 (0.9-3.4)	1.6 (0.9-2.6)	1.4 (0.6-3.2)	1.7 (0.6-3.4)

Model 1: Adjusted for maternal factors (maternal age, parity, education level and Base mass index), Model 2: adjusted for Model 1 factors and fetal risk factors (multiple births and birthweight), Model 3: adjusted for Models 1 and 2 factors and number of antenatal care visits.

Study V

Study V examined neonatal survival patterns among adolescent mothers and the effect of pregnancy intentions and marital status on mortality in Kenya, Uganda, and Tanzania. Figure 10 below is Kaplan-Meier survival curve showing statistically significant difference (log rank test, $P < 0.05$) in neonatal survival between babies born to adolescent mothers and those born to mothers 20-29 years of age.

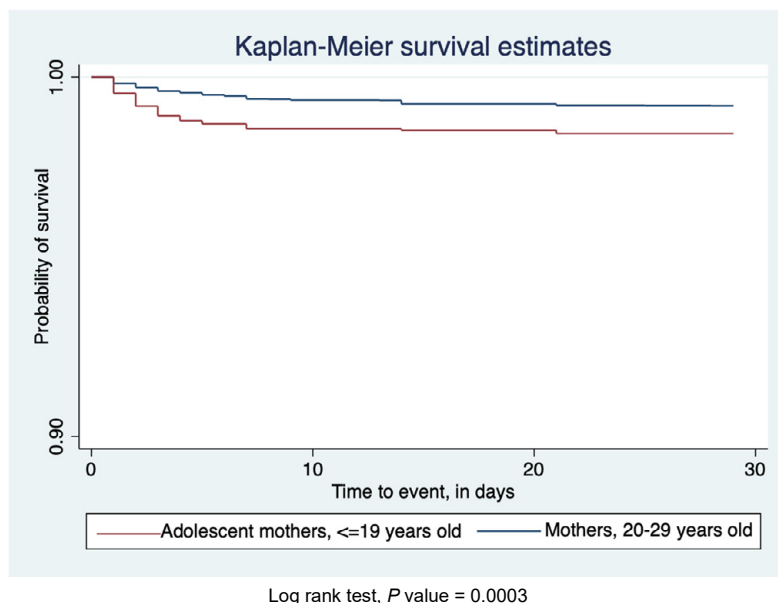
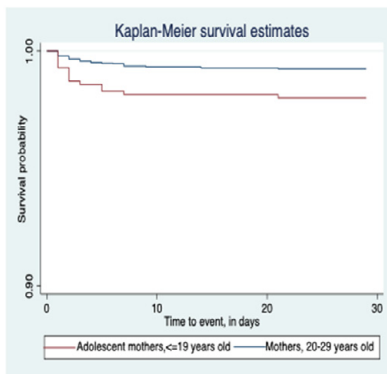
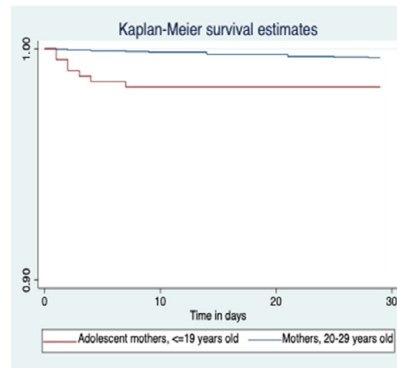


Figure 10. Kaplan-Meier survival functions for neonates born to adolescent mothers (15-19 years old) and those born to mothers aged 20-29 years in Kenya, Uganda, and Tanzania, 2014-2016.

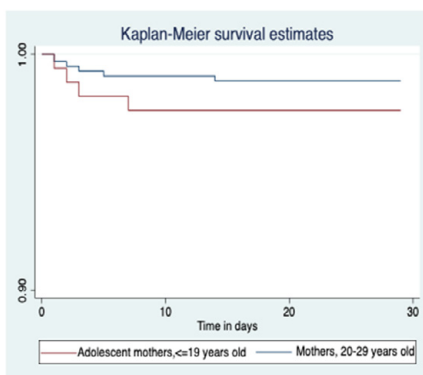
Figure 11 graphically indicates shorter survival time to neonatal deaths among mothers born to adolescents as compared to older mothers, (20-29 years old) among married mothers (a-b) and those unmarried with pregnancy intentions (c) in Kenya, Uganda, and Tanzania, 2014-2016.). There is no observed difference in survival time by maternal age-group among unmarried mothers with no pregnancy intentions (d).



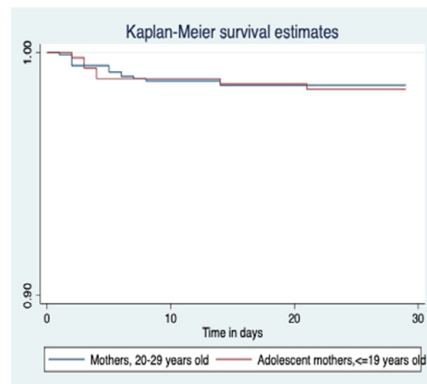
(a) Among married and pregnancy intended



(b) Among married and pregnancy unintended



(c) Among unmarried and pregnancy intended



(d) Among unmarried and pregnancy unintended

Figure 11 a-d. Kaplan-Meier survival curves for neonates born to adolescent mothers, (15-19 years old) versus neonates born to older mothers, (20-29 years old), stratified by marital status and pregnancy intentions in Kenya, Uganda, and Tanzania, 2014-2016.

Adjusted models in Table 7 generally shows that the hazard of neonatal death is about twice higher among neonates born to adolescent mothers than older mothers even after adjusting for other major risk factors.

Table 7: Distribution of study variables by neonatal survival status and cox proportion hazards regression models showing hazard of death for neonates born to adolescents compared to those born to mothers, 20-29 years old in Kenya, Uganda, and Tanzania, 2014-2016.

Variables	Censored		Died	Unadjusted HR	Model 1*(95%CI)		Model 2 (95%CI)		Model 3 (95%CI)	
	n	(%)			aHR*	aHR**	aHR**	aHR**		
Maternal age										
^a Adolescents, ≤19 years	2160	(12.2)	59(23.8)	1.98(1.36-2.87)	1.80(1.22-2.63)	1.78(1.20-2.64)	1.86(1.06-3.29)	1.00	1.00	1.00
^b 20-29 years	15616	(87.8)	189(76.2)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Marital Status										
Single(unmarried)	3443	(19.6)	60(24.7)	1.57(1.11-2.22)	1.41 (0.98-2.01)	1.41(0.98-2.02)	—	—	—	—
Married	14159	(80.4)	183(75.3)	1.00	1.00	1.00	—	—	—	—
Newborn pregnancy intentions										
Intended	8173	(61.0)	126(64.3)	0.85(0.65-1.11)	0.75(0.52-1.10)	0.72(0.49-1.05)	—	—	—	—
Unintended	5231	(39.0)	70(35.7)	1.00	1.00	1.00	—	—	—	—
Place of residence										
Rural	12504	(70.3)	175(70.6)	0.94(0.67-1.32)	1.01(0.70-1.46)	1.01(0.70-1.46)	0.74(0.29-1.85)	1.00	1.00	1.00
Urban	5272	(29.7)	73(29.4)	1.00	1.00	1.00	—	—	—	—
Education level										
No or primary education	12485	(70.2)	181(73.0)	1.32(1.00-1.72)	1.15(0.79-1.66)	1.10(0.76-1.60)	0.70(0.42-1.16)	1.00	1.00	1.00
Secondary or higher	5291	(29.8)	67(27.0)	1.00	1.00	1.00	—	—	—	—
^a Neonatal mortality rate (NMR)=26.6 per 1000 live births										
^b Neonatal mortality rate (NMR)=12.0 per 1000 live births										
Model 1. Adjusted for sociodemographic factors, pregnancy intentions and sex of child										
Model 2. Adjusted for all model 1 covariates and ANC, PNC, and Place of delivery										
Model 3. Adjusted for all covariates in model 1 and model 2 (except marital status and pregnancy intentions) and low birthweight										
*Marital status was used to determine HR in all models 1 and 2 in the absence of "Newborn pregnancy intended" variable and newborn pregnancy intended was added to the model in the absence of variable "Marital status" due to collinearity. Bolded results are statistically significant (95 % confidence interval (CI)). LBW – low birthweight, NBW										

LBW – Low birthweight
NBW –Normal birthweight. CI-Confidence interval

Model 1. Adjusted for sociodemographic factors, pregnancy intentions and sex of child
Model 2. Adjusted for all model 1 covariates and ANC, PNC, and Place of delivery
Model 3. Adjusted for all covariates in model 1 and model 2 (except marital status and pregnancy intentions) and low birthweight

*Marital status was used to determine HR in all models 1 and 2 in the absence of "Newborn pregnancy intended" variable and newborn pregnancy intended was added to the model in the absence of variable "Marital status" due to collinearity. **Bolded** results are statistically significant (95 % confidence interval (CI)). LBW – low birthweight, NBW

Wealth status						
Poor	8287(46.6)	112(45.2)	0.97(0.70-1.34)	0.75(0.53-1.07)	0.70(0.49-1.00)	0.75(0.43-1.30)
Middle	3236(18.2)	60(24.2)	1.00	1.00	1.00	1.00
Rich	6253(35.2)	76(30.7)				
Sex of newborn						
Male	9084(51.1)	150(60.5)	0.69(0.49-0.92)	0.67(0.49-0.93)	0.66(0.48-0.91)	0.58(0.34-0.95)
Female	8692(48.9)	98(39.5)	1.00	1.00	1.00	1.00
ANC visits						
<4	7770 (43.9)	138(55.7)	1.45(1.06-1.97)		1.40(1.02-1.93)	1.73(1.08-2.77)
≥4	9945(56.1)	110(44.4)	1.00		1.00	1.00
Place of delivery						
Home	5512(31.0)	69(28.0)	0.94(0.67-1.32)		1.01(0.70-1.46)	0.74(0.29-1.85)
Health facility	12251(69.0)	177(72.0)	1.00		1.00	1.00
PNC visit within 28 days after birth						
Yes	4424(26.0)	29(11.7)	1.76(1.16-2.66)		1.69(1.11-2.56)	2.78(1.49-5.20)
No	12595(74.0)	219(88.3)	1.00		1.00	1.00
Low birthweight						
Yes	1989(12.7)	62 (29.7)	3.57(2.49-5.14)			4.43(2.76-7.11)
No	13685(87.3)	147(70.3)	1.00			
Parity						
Primiparous	11273 (63.5)	92(37.3)				
Multiparous	6495(36.6)	155 (62.7)				
^a Neonatal mortality rate (NMR)=26.6 per 1000 live births						
^b Neonatal mortality rate (NMR)=12.0 per 1000 live births						
			LBW – Low birthweight		CI-Confidence interval	
			NBW –Normal birthweight.			
Model 1. Adjusted for sociodemographic factors, pregnancy intentions and sex of child						
Model 2. Adjusted for all model 1 covariates and ANC, PNC, and Place of delivery						
Model 3. Adjusted for all covariates in model 1 and model 2 (except marital status and pregnancy intentions) and low birthweight						
*Marital status was used to determine HR in all models 1 and 2 in the absence of "Newborn pregnancy intended" variable and newborn pregnancy intended was added to the model in the absence of variable "Marital status" due to collinearity						
Bolded results are statistically significant (95 % confidence interval (CI)). LBW – low birthweight. NBW						

In Table 8, we observe that when stratified by marital status and pregnancy intentions, the hazard of neonatal death among married adolescent mothers (15-19 years old) compared to married older mothers, 20-29 years old increases about 3 times among those with pregnancy intentions and 4 times among those with unintended pregnancies. Further, when considering only first-time mothers, the hazard of neonatal death among married adolescent mothers increased 4-6 times higher compared to their older counterparts, with unintended pregnancies registering highest hazard of neonatal death. There were no reliable mortality numbers for viable analysis in certain strata among the unmarried and multiparous mothers.

Table 8. Adjusted hazard ratios (aHR)* for neonatal mortality among adolescent mothers compared to mothers, 20-29 years old in Kenya, Uganda, and Tanzania, 2014-2016, stratified by marital status and †pregnancy intentions, both overall and among primi-and multi-parous mothers.

Overall				
Variable	Model 1, AHR	Model 2, AHR	Model 3, AHR**	Model 4, AHR**
Adolescent mothers, 15-19 years	2.86 (1.55-5.26)	4.08 (1.62-10.31)	1.89 (0.59-6.08)	1.13 (0.46-2.80)
Mothers, 20-29 years old	1.00	1.00	1.00	1.00
Among primiparous only (First time mothers)				
Adolescent mothers, 15-19 years	4.32 (1.41-13.27)	6.48 (1.37-30.71)	–	1.56 (0.39-6.09)
Mothers, 20-29 years old	1.00	1.00	–	1.00
Among multiparous only (Given birth to at least once previously)				
Adolescent mothers, ≤ 19 years	1.84 (0.89-3.80)	2.43 (0.75-7.98)	–	0.63 (0.19-2.11)
Mothers, 20-29 years old	1.00	1.00	–	1.00
Model 1- Among married mothers and newborn from intended pregnancy				
Model 2- Among married mothers and newborn from unintended pregnancy				
Model 3- Among unmarried mothers and newborn from intended pregnancy				
Model 4- Among unmarried mothers and newborn was unintended pregnancy				
*Adjusted for sociodemographic factors and maternal care variables (antenatal and postnatal attendance and place of delivery)				
†Whether or not the neonate pregnancy was intended. Birth weight was not adjusted for due to insufficient data in the various strata.				
** Insufficient mortality data among unmarried (single) mothers with intended pregnancies hindered plausible analysis				

Discussion

The general objective of this thesis was to examine determinants of maternal service utilization, effectiveness of care and risk factors for neonatal mortality in Kenya, Tanzania, and Uganda. Overall results indicate that inadequate utilization of care, low birthweight, and young maternal age (adolescents) are leading indirect or intermediate risk factors that contribute substantial proportion of neonatal deaths in Kenya, Uganda, and Tanzania. Various sociodemographic and maternal factors play significant role in determining utilization of care services during pregnancy, childbirth, and postnatal period, indicating unequal access to care. Further, there exists disproportionate utilization of emergency or planned cesarean delivery (CD) along socioeconomic divide and type of health facility. However, despite more access to emergency obstetric procedure such as CD among higher socioeconomic class, there was no clear indication of improved neonatal survival outcomes at population level among these mothers.

Dominant among the factors that determine maternal care utilization is parental education, the higher the level of education of one or both parents the greater the tendency to utilize obstetric services in almost all care-seeking classes. Several studies agree with these findings (90, 91). Also, consistent with other findings (92-94), access to mass media (radio/television) and being told about maternity-related complications also play a significant positive role towards maternal care-seeking tendency. On the contrary, maternal care-seeking was relatively hindered when a husband/partner was a major decision maker for maternity care-seeking versus when a woman makes that decision herself. Similar findings have also been reported by other studies (95, 96). Perhaps future research could investigate the mean time (in days) between asking for husband/partners support for care-seeking and the actual going to the health facility to seek care compared to when a woman makes decisions herself. This could reveal specific details to the general household delays highlighted by Waiswa et al. in East Africa (97). Similarly, problems with (longer) distances to the health facilities and associated rural residency were also found to be deterring factors to utilization of care.

Despite introduction of free or subsidized maternal and child health care policies in Kenya, Uganda and Tanzania that aim to eliminate all or part of catastrophic out-of-pocket expenditure (63, 98, 99), wide disparities in utilization of care across socioeconomic groupings still exist. From our results, these disparities seem to emanate from a complex interaction of factors ranging from individual, household,

and societal level factors highlighted by the conceptual framework in this thesis, derived from Mosley and Chen, WHO and UNICEF frameworks (80-82). For instance, at individual level, lack of knowledge about the need to seek maternity care impeded care utilization among mothers with low education and lack of access to mass media or have not been told about maternity complications. From societal perspective, majority of women in these countries live in rural areas as also reflected by our studies and are largely self-employed, subsistence farmers or are in agricultural labour employment (57, 58, 100, 101). Thus, most of the women have lower financial income to meet their maternity needs such as transportation to the health facilities and other minor hospital charges thus less likely to afford to freely seek care. The situation is aggravated by gender inequalities that disfavour a spectrum of socioeconomic aspects among women such as land ownership in rural areas. In this thesis, about 80 percent of women were married, implying most of them can obtain financial support from their spouses. At household level, this financial dependency can also hinder prompt care-seeking as previously discussed. On the contrary, those unmarried or without recognizable partners have financial constraints to seek care leading to poor care utilization and this is reflected in our results (Paper IV).

Studies in LMIC agree that improving household socioeconomic status will improve care utilization (102-104). Societal factors related to gender inequities and inequalities that are unsupportive of women to freely determine when to seek care still exist, for instance unpaid daily roles of 'stay-home' mothers who take care of their families and are regarded as playing a less important role due to no financial gains as compared to a formally employed husband/partner. This financial dependency on the husband/partner to seek care can to some extent be deterring factor (100, 104), although other factors such as education have a more profound impact.

Although this thesis could not examine the quality of maternal or newborn care, care-seeking at minimal levels (modified recommendations prior to 2016) of 4 or more ANC, skilled (facility) birth and at least one PNC with 28 days postpartum can be highly effective in reducing neonatal deaths in Kenya, Uganda, and Tanzania. This is particularly evident in this thesis with ANC and PNC utilization and findings from other studies concur (19, 20, 105, 106). Sufficient data from Kenya DHS enabled plausible analysis in Study IV that revealed that about 63 % of neonatal deaths would be avoided if mothers attend full (recommended) continuum of care from ANC to at least one PNC. Findings from *The Lancet series* and UN agencies also showed comparable estimate of 67 % of neonatal deaths in sub-Saharan Africa that could be prevented with high continuum of care coverage (14, 107). Further, Darmstadt et al. also estimated, that low to moderate PNC utilization would avert 17– 29 % of neonatal deaths in 75 countries across the world of which more than 50% were from Africa. This figure is also comparable to 20 % estimate obtained from lack of at least 1 PNC visit within 28 days in Kenya.

Furthermore, study I that examined neonatal survival outcomes between facility and home birth did not find any statistically significant differences in survival or mortality. However, in Study IV it was evident that ANC is positively correlated with facility births and PNC, implying that facility births could still enhance utilization of PNC services. A cluster-randomized controlled trial in *The Lancet* also found no survival benefits of facility births as compared to home births. However, the study recommended facility births only when emergency obstetric or newborn services are available in a facility (33). However, contrary to our study I findings on facility births, a systematic review by Tura et al. indicated greater neonatal survival outcomes among facility births compared to home births (31).

Adolescent maternal age is a well-known risk factor for neonatal (and maternal) mortality (108, 109) and this thesis (Study V) findings confirmed that in East Africa. However, we further considered how marital status and pregnancy intentions affect neonatal survival in the age-group, 15-19 years. The results indicate 3-4 times higher hazard of neonatal death among married adolescent mothers compared to their corresponding older counterparts aged 20-29 years old. Findings from Singh et al. are consistent with these results (110). Lack of sufficient data hindered further analysis among the unmarried women. However, studies suggest that abortions are common in East Africa among unmarried adolescents and young women and that could have affected reporting and data availability (111, 112). Future studies could explore more.

The hazard of death was much higher (4-6 times) among primiparous (nulliparous) married adolescent mothers versus their corresponding older counterparts aged 20-29 years. Generally, neonates born to adolescent mothers with unintended pregnancies had much higher death hazard when compared with those of similar mothers of older age 20-29, than when adolescent with intended pregnancies were compared with corresponding older mothers. However, the findings were not statistically significant among multiparous married women irrespective of pregnancy intentions. Similar findings were recently reported by Zhang et al. (87, 113). Another study by Klerman made parity comparisons between adolescent mothers and found worse neonatal outcomes among multiparous adolescent mothers compared to primiparous adolescents (114). However, when he compared first and second births of the same adolescent mothers, the first birth had worse neonatal outcomes (114). Nonetheless, the difference in neonatal mortality by parity among adolescents could be further investigated to understand the mechanisms leading to these differences. Again, lack of sufficient data in mortality strata could not allow for more reasonable analysis among multiparous unmarried adolescents in our study.

Methodological consideration

General

The nationally representative data of the DHS for Kenya, Uganda, and Tanzania allowed for valid statistical investigations with several stratifications and the findings are generalizable across similar settings. The data collection also captured neonatal births and deaths that may have not been recorded in health facility birth or death registries. Nevertheless, further stratifications would have been desirable to unearth more findings, for instance, in study V where analysis were limited to mainly married adolescents and mothers 20-29 years old. Similarly, certain country specific stratification was not possible for Uganda and Tanzania due to relatively lower numbers compared to Kenya.

Because of the retrospective nature of the cross-sectional data collection, we cannot ascertain that all recall bias were eliminated, particularly when more detailed information such as birthweight were asked during verbal interviews and when perhaps the mother had no birth information card to remember. This could have affected mothers that gave birth much earlier prior to the data collection period and consequently could have lowered the accuracy of our findings. Further, a study by Biks et al. reported that home births and neonatal deaths had less likelihood of being weighed at birth (115). We however, minimized the recall bias through using data of most recent births and neonatal death occurrences from most recent pregnancies, all of which are significant events not easily forgotten by mothers or carers. A recent randomized study by Akuze et al. compared two DHS questionnaire modules across different surveillance sites including Uganda, found no difference in reporting of neonatal deaths (116), indicating minimal recall bias, no interviewer and social desirability biases.

It was not possible to determine the quality of maternity care that was rendered to the mothers or neonates or lack of hospital supplies. However, proxy indicators such as skilled ANC attendance could be regarded to render the required standard of care. Moreover, the studies could not capture other internal facility factors hypothesized by other studies to deter maternal care-seeking such as mistreatment and abuse of mothers during childbirth by health personnel (117-119) and absence of facility staff (120).

Non-response led to few missing data across variables in all the three countries. In Uganda in particular, data collection in older surveys such as 1995 were affected by civil and military conflict in northern Uganda that led to compensation by data being sampled/collected in other areas instead. Also, the 1995 data was not weighted and that could have rendered it less representative. However, an investigation of the missingness of data in all most recent year surveys in all the three countries indicated

random distribution between rural and urban and across key variables in all the studies in this thesis.

General implications for public health policy and future research

Policies intended to improve maternal care utilization could consider routine group maternal education for mothers seeking ANC to enlighten them about pregnancy, birth and perinatal complications and highlight neonatal death statistics and importance of completing the care-continuum including PNC. For the long term, social and educational policies could include focus geared towards improving knowledge about safe maternity care and rights from lower primary education for both boys and girls to adult education, this could easily be integrated in biology or health science curricula. Additionally, over 4 years after WHO updated its ANC recommendations to 8 visits in 2016, over 90 percent of countries in SSA are still non-adherent (121). Public health campaigns could promote this and ANC guidelines in Kenya, Uganda and Tanzania ought to not only be updated but also implemented in health facilities countrywide. This could bring a significant improvement in neonatal survival outcomes.

Our findings indicated wider socioeconomic disparities in utilization of care implying that the current free or subsidized maternity policies have not achieved their intended goals. Advocating for “absolutely” free maternal and newborn care could be considered in Kenya, Uganda, and Tanzania. In turn this will also lead to promotion of intervention to prevent unwanted pregnancies through use of contraceptives and eliminating child marriages to alleviate health systems from unnecessary financial burdens resulting from providing free maternal health care for the many unintended adolescent pregnancies.

Beyond the current social and educational policies aimed at preventing adolescent pregnancies, there could be continuous evaluation research of the impact of such policies to improve their effectiveness. Additionally, given the high population of young people in these countries, there could be a sustained national crisis-level intervention to prevent adolescent pregnancies. Implying that even in vulnerable situations such as covid-19 pandemic lockdowns, keeping adolescents free from pregnancies could be among the highest national priorities. For the long term, access to quality education for all and tertiary skills could be improved beyond the current state, and this could be legally binding for parents with primary level children in East Africa. Return on investments that spotlights earnings that can be realized through prevention of adolescent pregnancies for instance the “Girls not bride” campaigns (122) across SSA could be highlighted to give impetus to political support and policy implementations.

Conclusion and recommendations

Inadequate care utilization, low birthweight, and adolescent maternal age are major risk factors to neonatal deaths in Kenya, Uganda, and Tanzania. Further research to understand the broader spectrum of factors influencing maternal care-seeking behaviour is necessary. Understanding which maternal and newborn care policies have been fully implemented in East African countries and which ones exist only in print, including the 8 ANC visit recommendations (121) is vital to closing the implementation gaps.

The many strategies aimed at reducing adolescent pregnancies have not achieved any improvements in Kenya, Uganda, and Tanzania. For instance, the 2020 revised guidelines for prevention and management of teenage pregnancy in school settings in Uganda outlines previous 9 separate policy frameworks since 1995 aimed at preventing adolescent pregnancies (123). The report acknowledges that teenage pregnancy rates has persistently remained high and continue to contribute to both low birthweight and neonatal (and maternal) deaths in East Africa. Given our finds that maternal education plays a key role in prevention strategy, perhaps new strategies such as integrating reproductive education in primary and secondary school curricula would be a result-oriented strategy to eliminate adolescent pregnancies. Harnessing political support through highlighting research findings to parliamentarians such as the very high neonatal deaths among unintended adolescent pregnancies in this study, could help to mobilize resources needed to propel tangible preventive strategies such contraceptive awareness and education. These strategies have proved efficacies in contributing to efforts in HIC to reduce adolescent pregnancies and consequent neonatal deaths (124).

Achieving SDG 3.2 target for neonatal survival in Kenya, Uganda and Tanzania will necessitate adopting new and innovative strategies to improve care utilization. One such approach would be to adopt an evidence-based brief set of standard questions with an overall score scale, that can be used during the first ANC visit to determine care-seeking tendencies of a mother and use that information to close the care-seeking gaps where most needed. Using existing structures such as community health workers or village health teams and perhaps mobile health (mHealth) strategy to send reminder messages to pregnant mothers to seek care ought to be explored.

Given our findings of 63% avoidable neonatal deaths in Kenya, it can be noted that even with the current state of quality of maternal health care in Kenya, and perhaps

in Uganda and Tanzania too, improving and sustaining care-seeking among expectant mothers in East Africa to a minimum of at least 4 ANC, facility birth and at least 1 PNC could help to achieve SDG 3.2 that aims to reduce neonatal deaths to as low as 12 deaths per 1000 live births much earlier before 2030.

Sammanfattning på svenska

I denna avhandling, med titeln “*Förbättring av neonatal överlevnad i Östafrika: analys av mödravårdsanvändning, värdeeffektivitet och riskfaktorer för neonatal dödlighet i Kenya, Uganda och Tanzania*”, undersöker vi ledande riskfaktorer och interventioner som påverkar neonatal överlevnad i de tre mest befolkade länderna i East Africa Community (EAC). Kenya, Uganda och Tanzania är tre afrikanska länderna söder om Sahara som har registrerat en mycket långsam nedgång av neonatal dödlighet. Detta beror delvis på brist på forskning för att informera evidensbaserad policyformulering och implementering, samt resursfördelning. Detta forskningsprojekt bidrar delvis redan till att fylla luckorna i evidensbasen för att möjliggöra förverkligandet av Sustainable Development Goals (SDG) 3, mål 3.2 som syftar till att avsevärt minska neonatal dödlighet till 12 dödsfall per 1000 levande födda innan slutet av 2030.

FN noterar att vissa länder i Afrika söder om Sahara fortfarande använder föråldrade riktlinjer som hindrar tillhandahållande av livräddande hälso-och sjukvård. Under 2019 dog över 2,4 miljoner nyfödda (neonatala) barn, vilket motsvarar nästan hälften av alla dödsfall under 5 år. Över 80 procent av dödligheten inträffar i låg- och medelinkomstländer. Vissa låg inkomstländer, som Rwanda och Malawi, uppnådde millennieutvecklingsmål (MDG) 4 2015, medan Kenya, Uganda och Tanzania fortfarande är bland de länder som bidrar mest flest neonatala dödsfall i Afrika trots att de har relativt bättre ekonomi. MDG 4 syftade till att minska barns dödsfall med två tredjedelar mellan 1990 och 2015.

De största (direkta) riskfaktorerna för neonatala dödsfall är infektioner, förlossningskomplikationer och för tidig födsel. De flesta av riskfaktorerna kan förebyggas med insatser utanför intensivvården. Födslar utanför vårdinrättningar (hemma) är vanliga i många länder i Afrika söder om Sahara vilket gör att ett antal sjukhusbaserade studier är mindre representativa för befolkningen. Vidare gör bristen på födelse-och dödsdata för nyfödda det svårt att bedriva forskning för att informera evidensbaserad policy. Likt många andra afrikanska länder söder om Sahara finns det mycket begränsade befolkningsbaserade studier i Östafrika. Detta projekt använder nationellt representativa data från *Demographic and Health Survey* (DHS) för att ge en djupare förståelse av faktorer som påverkar neonatal överlevnad i Östafrika. Projektet genererar också rekommendationer för att stödja beslutsfattare i att vägleda mödra-och barnhälsointerventioner för ökad överlevnad hos nyfödda.

Projektet består av 5 individuella studier som kompletterar varandra: Studie I, II, III, IV och V. Data från DHS användes i alla studier. Fördelarna med att använda denna typ av data är att det är nationellt representativt, det vill säga, att data samlades in över hela landet. Insamlade data fångade även de många neonatala födselar och dödsfall som inte registrerades officiellt, eftersom de inträffade utanför vårdinrättningarna. Dataanalysen omfattade binomial och multinomial logistikregression samt överlevnadsanalysmetoder.

I studie I, med titeln, ”*Effektivitet av mödravård för att förbygga neonatal dödlighet i Kenya: analys av nationella enkätdata*”, undersökte vi hur besök hos barnmorskor, olika vårdinsatser, och kontroll för graviditetskomplikationer bidrar till neonatal överlevnad i Kenya. Resultaten indikerar att brist på, eller färre besök hos, barnmorskor bidrog till ungefär 28 % av neonatala dödsfall i Kenya 2014, och att mödravård med okvalificerad personal indirekt orsakade 9% av neonatala dödsfall.

Syftet med studie II, med titeln ”*Överlevnad hos nyfödda med låg födelsevikt i Uganda: analys av framsteg mellan 1995 och 2011*”, var att undersöka sambandet mellan låg födelsevikt (LFV) (bebisar som väger mindre än 2500 gram vid födseln) och neonatal dödlighet, och att fastställa trenderna för neonatala dödsfall på grund av låg födelsevikt i Uganda mellan 1995 och 2011. Resultaten visade att låg födelsevikt är en stor underliggande riskfaktor för neonatala dödsfall. Jämfört med normal födelsevikt (2500–4000 gram) var risken (oddsen) för neonatal dödlighet i Uganda 6 gånger högre för barn med LFV 1995, och denna risk minskade gradvis till cirka 4 gånger högre år 2011. Över 70% av LFB nyfödda dog i Uganda i 2011, en minskning med ungefär hälften sedan 1995.

Studie III, med titeln ”*Kejsarsnittsförlossningar och associerade socioekonomiska faktorer och neonatala överlevnadsutfall i Kenya och Tanzania: analys av nationella enkätdata*”, undersökte hur kejsarsnitt och associerade socioekonomiska faktorer påverkar överlevnad bland nyfödda barn i Kenya och Tanzania. Resultaten tyder på att användandet av kejsarsnitt var mycket högre bland mödrar från rikare hushåll, med mer utbildning, samt bland mödrar i högre anställningsspositioner. Dessutom var kejsarsnittsförlossningarna högre bland de som födde barn på missionärbaserade sjukhus jämfört med statliga sjukhus i Kenya och Tanzania. Vi fann också betydande samband mellan kejsarsnitt och neonatala dödsfall. Ytterligare forskning behövs för att stärka dessa resultat.

Syftet med studie IV, med titeln ”*Bestämningsfaktorer för fortsatt mödravårdsanvändande under graviditet, födsel och postnatalt och associerad neonatala överlevnadsutfall i Kenya och Uganda: analys av demografisk-och undersökningsdata*”, var att undersöka hur socioekonomiska faktorer påverkar mödrars vårdökande från graviditet till födsel och till den postnatala perioden, och dess samband med neonatal överlevnad i Kenya och Uganda. Detta är ett område som tidigare sällan studerats i låginkomstländer. Resultaten av studien visar att Kenya kunde 63 % av all neonatala dödsfall ha förhindrats om alla gravida mödrar

hade besökt kvalificerad personal minst 4 gånger, hade sin förlossning på sjukhuset, och besökte postnatalvården minst en gång tidigt efter förlossning. Resultaten visar också att både i Kenya och i Uganda så var det bara ungefär hälften (56%) av gravida som besökte mödravården 4 eller fler gånger, och mycket färre hade 1 postnatalvårdsbesök. Tendensen att söka vård ökar som mest bland mödrar där någon av föräldrarna hade högre utbildning. Tillgången till media, så som radio och TV, ökade också mödrars vårdsökande. Längre avstånd till vårdinrättningar minskade vårdsökandet. Vidare så visade resultaten att mödrar som var mer beroende av sin man i beslutstagande kring när de bör söka mödravård var mindre benägna att söka vård, än de som bestämde själva.

Studie V, med titeln ”*Överlevnad bland nyfödda med tonårsmödrar och effekterna av graviditetsintention och civilstatus på nyföddas överlevnad: analys av en tvärsnittundersökning i Kenya, Uganda och Tanzania, 2014 – 2016*” undersökte effekterna av graviditetsintention och civilstatus på överlevnadsmönstret bland nyfödda med mödrar i tonåren i Kenya, Uganda och Tanzania. Överlevnadstiden hos nyfödda med mödrar i tonåren var ungefär två gånger så kort i jämförelse med äldre mödrar, i åldrarna 20–29. Bland gifta tonåringar med oplanerad graviditet så var risken för neonatala dödsfall inom en kort period efter födsel 3–4 gånger högre. Bland förstagångsmödrar i tonåren med oplanerad graviditet så var risken för neonatala dödsfall 6 gånger högre.

Resultaten visar att brist på, eller otillräckligt mödravårdsanvändande, låg födelsevikt och ung ålder är bland de främsta riskfaktorerna och bidrar till en hög andel av neonatala dödsfall i Kenya, Uganda och Tanzania. Implementering av, och förstärkning till, existerande rekommendationer så som den nya 8 ANC rekommendationen från WHO kan bidra till ökad neonatal överlevnad. Nya strategier för att främja vårdsökande bland mödrar i Kenya, Uganda och Tanzania måste undersökas för att nå drastiska förändringar som i sin tur kan bidra till att nå Sustainable Development Goal 3.2 som syftar till att avsevärt minska neonatal dödlighet till 12 dödsfall per 1000 levande födda innan slutet.

Summary in Swahili

Katika mradi huu kwa kichwa, *"Uporeshaji wa maisha ya watoto wachanga Afrika Mashariki: utafiti kuhusu utumiaji wa huduma za akina mama, ufanisi wa huduma za afya na sababu hatari zinazotelea vifo vya watoto wachanga nchini Kenya, Uganda na Tanzania."* Tunachunguza vitu vinavyoongoza kuhatarisha maisha ya watoto wachanga (chini ya umri wa siku 28), na suluhisho za kipekee zinazotelea watoto hao wachanga kunusurika katika nchi tatu zenye watu wengi sana katika jumuiya ya Afrika Mashariki (EAC). Kenya, Uganda na Tanzania ni miongoni mwa nchi zilizoko Kusini mwa Jangwa la Sahara ambazo zimepungua polepole sana viwango vya vifo vya watoto wachanga ndani ya siku 28 baada ya kuzaliwa. Hii kwa kiasi fulani ni kwa sababu ya ukosefu wa utafiti wa kufahamisha uundaji na utekelezaji wa sera unaozingatia ushahidi na ugawaji wa rasilimali. Mradi huu wa utafiti, kwa kiasi, tayari unachangia kujaza mapengo yanayohitaji ushahidi mathubuti kuwezesha utimilifu wa Lengo la Maendeleo Endelevu (SDG) 3, lengo 3.2 ambalo linalenga kupunguza kwa kiasi kikubwa viwango vya vifo vya watoto wachanga (chini ya umri wa mwezi mmoja) hadi vifo 12 kwa watoto 1000 wanaozaliwa wakiwa hai ifikapo mwaka 2030.

Umoja wa mataifa ulibainisha kua baadhi ya nchi za Africa kusini mwa Jangwa la Sahara bado zinatimia sera ambazo hazina uwezo na ambazo mwongozo wao ni wa kitambo sana unaozuia utoaji wa huduma bora zinazookoa maisha. Mnamo mwaka 2019, zaidi ya watoto milioni 2.4 chini ya umri wa mwezi mmoja walikufa, ambayo ni takribani asilimia 47 ya vifo vya watoto chini ya miaka 5. Zaidi ya asilimia 80 ya vifo vya watoto hawa hutokea kwenye nchi zenye mapato ya chini na ya katikati. Hata hivyo, baadhi ya nchi zenye pato la chini kama Rwanda na Malawi zilikia Malengo ya Maendeleo Milenia (MDG) 4 mnamo mwaka 2015 huku Kenya, Uganda na Tanzania zikabaki kati ya nchi zinazochangia vifo vingi sana vya watoto wachanga Afrika licha ya kuwa na uchumi mzuri kiasi kuliko Rwanda na Malawi.

Sababu kuu za hatari zinayosababisha vifo vya watoto wachanga hujumuisha; kuzaliwa kwa watoto mapema kabla ya wakati, maambukizi, na matatizo ya kujifungua, ambayo mengi yanazuilika kwa uingiliaji wa huduma zisizo za wagongjwa mahututi. Wamama kujifungua wakiwa nyumbani pasipo kutembelea vituo vya afya vinaenea kwa wingi katika nchi nyingi za Afrika kusini mwa Jangwa la Sahara. Wao huchukua sehemu kubwa ya mafunzo ya kiafya kuwakilisha idadi ya watu. Zaidi ya hayo, upungufu wa rekodi za usajili hospitalini pamoja na upungufu wa ukaguzi wa kitaifa kuonyesha miezi kabla na baada ya kuzaliwa kwa

mtoto, na tena rekodi ya vifo vya watoto wachanga hufanya vigumu sana kufanya utafiti na kuzua sera halisi. Ukizingatia nchi nyingi za Afrika Kusini mwa Jangwa la Sahara, utafiti kuhusu idadi ya watu, hupatikana kwa nadra sana katika Afrika Mashariki. Mradi huu kwa sasa hutumia hesabu za kitaifa za idadi ya watu na utafiti wa kiafya (DHS) kutoa ufahamu wa kindani kuhusu sababu zinazoamua hatima ya watoto wachanga Afrika Mashariki. Mradi huu pia huzalisha mapendekezo ya kusaidia juhudi za watunga sera kuongoza afya ya mama na mtoto kwa matokeo bora ya watoto wachanga.

Mradi huu wa utafiti hunajumuisha tafiti tano za kibinafsi ambayo yanapongezana: Masomo I, II, III, IV na V. Tulitumia data ya uchunguzi kutoka kwa tafiti za idadi ya watu na afya (DHS). Kutumia aina hii ya data kulikuwa na faida kwa kuwa ilikuwa uwakilishi wa kitaifa. kwa mfano, habari inakusanywa kutoka sehemu yote ya nchi. Data iliyokusanywa ilinasa hata vifo vingi vya watoto wachanga na vifo ambavyo havijasajiliwa katika sajili za kuzaliwa au vifo kwa sababu vilitokea nje ya vituo vya afya.

Kwa uchanganuzi wa data, tulitumia njia ya uchambuzi wa data inayoitwa "logistic regression", "multinomial logistic regression" na pia "survival analysis" kwa lugha ya kingereza.

Katika utafiti wa I, kwa kichwa: "*Ufanisi wa huduma za utunzaji katika ujauzito katika kupunguza vifo vya watoto wachanga nchini Kenya: uchambuzi wa data ya uchunguzi wa kitaifa*". Tunachunguza mama wajawazito akienda kuhudumiwa katika kituo cha afya (yani, antenatal care), na huduma mbalimbali kama, utunzaji wa ujauzito wenye ujuzi, kupata sindano ya Pepopunda, na kuangalia matatizo ya mimba ili kusaidia kupunguza vifo vya watoto wachanga. Matokeo yanaonyesha kuwa, mama mjamzito anapokosa kutembelea vituo vya huduma za afya, au bila kabisa kupata huduma za kutosha inaletea vifo vya watoto wachanga asilimia 28 nchini Kenya katika mwaka wa 2014 na kwa kutopata ujuzi kutokana na huduma za kiafya, imeletea vifo vya watoto wachanga asilimia 9.

Katika utafiti wa II, kwa kichwa: "*Maisha ya watoto wanaozaliwa wakiwa na kipimo cha uzito mdogo nchini Uganda: Utafiti wa maendeleo haya ulifanyika kati ya mwaka wa 1995 na 2011*". Lengo hasa lilikuwa kutathmini uhusiano kati ya watoto waliozaliwa na uzito ulio chini ya gramu 2500, na vifo vya watoto wachanga, na kuamua ni mwenendo au kiwango gani kilichotelea vifo vya watoto hao waliozaliwa na uzito wa chini miaka hiyo (1995-2011).

Matokea yalionyesha kuwa uzito wa kiwango cha chini kwa watoto wanaozaliwa ni sababu kuu ya hatari inayotelea vifo vya watoto wachanga. Tukilinganisha na watoto wa kawaida wanaopima kati ya gramu 2500 na 4000 baada ya kuzaliwa, uwezekano wa vifo vya watoto wanaokufa wakiwa wachanga nchini Uganda ni mara 6 zaidi ya wale watoto wachanga waliopima uzito wa chini mnamo mwaka wa 1995. Hii hatari iliendelea kupungua taratibu hadi mara 4 zaidi ilipofikia mwaka wa 2011.

Zaidi ya asilimia 70 ya watoto wanaozaliwa wakipima uzito wa chini walikufa nchini Uganda mnamo mwaka wa 2011. Katika nchi nzima ya Uganda, hii iliweza kuchangia takribani asilimia 15 ya watoto waliokufa wakiwa wachanga katika mwaka wa 2011 wachache kwa takribani nusu tangu mwaka wa 1995.

Katika somo la III, lenye kichwa: *“Kujifungua kwa upasuaji na sababu zinazohusiana za kijamii na kiuchumi na matokeo ya maisha ya watoto wachanga nchini Kenya na Tanzania: uchambuzi wa data ya uchunguzi wa kitaifa”*. Lengo Lake ni kuchunguza sababu za kijamii na za kiuchumi zinazosababisha kujifungua kwa njia ya oparesheni nchini Kenya na Tanzania ili kutathmini athari za Maisha baada ya kuzaliwa kwa mtoto. Matokeo yanayoonyesha kuwa utumiaji wa huduma ya upasuaji ulikua wa juu zaidi miongoni kwa wamama wajawazito kutoka familia tajiri, wenye elimu ya juu na wale walio na vyeo vya juu kazini. Pia waliojifungua kwa upasuaji walikuwa juu zaidi kati ya wale waliojifungulia katika hospitali ya misheni ikilinganishwa na hospitali za serikali nchini Kenya na Tanzania. Pia tulipata uhusiano mkubwa kati ya kujifungua kwa upasuaji na vifo vya watoto wachanga. Hata hivyo utafiti zaidi unahitajika ili kutoa ushahidi zaidi.

Katika utafiti wa IV, kwa kichwa; *“Viamuzi vya kuendelea kutafuta huduma ya uzazi wakati wa ujauzito, kujifungua na baada ya kuzaa na matokeo yanayohusiana na maisha ya watoto wachanga: uchambuzi wa data ya uchunguzi wa kitaifa”*. Hii ni sehemu ambayo ilikuwa na masomo machache sana ya hapo awali katika nchi za kipato cha chini na kati. Utafiti huo ulilenga kuchunguza sababu zinazoathiri wamama kuendelea kutafuta huduma kutoka kwa ujauzito hadi kuzaliwa kwa mtoto nchini Kenya na Uganda. Tuligundua kwamba nchini Kenya hasa watu asilimia 62 wanaotokana na vifo vya watoto wachanga (neonates) wanaweza kingwa iwapo wanawake wajawazito afadhali hutembelea vituo vya huduma za afya mara nne kabla ya kujifungua, hujifungulia hospitalini na kwa uchache sana hutembelea vituo vya huduma za afya mara moja baada ya kujifungua.

Matokeo yanaonyesha kuwa Kenya na Uganda nusu pekee (asilimia 56) ya wanawake wajawazito walitembelea mara nne au zaidi vituo vya huduma za afya, na wachache sana walivitembelea vituo hivyo kupokea huduma. Mazoea ya kutembelea vituo vya huduma za afya iliongezeka kwa wazazi walioelimika sana. Pia kufikia vyombo vya habari vikiwemo redio na runinga, huongeza hamu na haja ya wanawake wajawazito kutembelea vituo vya afya kupokea huduma. Hali kadhalika, baadhi ya wanawake ambao walitegemea waume zao kufanya maamuzi ya lini watatafuta huduma ya uzazi walikuwa na mwelekeo mdogo wa kutafuta matunzo ikilinganishwa na wale ambao wangeweza kuamua wao wenyewe.

Masomo ya (V) kwa kichwa, *“Kua hai kwa watoto wachanga chini ya mwezi mmoja wanaozaliwa na wanawake vijana na athari za nia la kupata mimba pamoja na viwango vya hali ya maisha ya ndoa nchini Kenya, Uganda na Tanzania”*. Kua hai kwa watoto wachanga wanaozaliwa kimakusudi na wamama vijana ulikuwa mara dufu kwa ufupi ukilinganisha na wamama wakomavu wa umri kati ya miaka 20-29.

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