ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
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TRENDS IN NEONATAL MORTALITY AND ASSESSMENT OF ASSOCIATED RISK FACTORS IN BUTAJIRA DISTRICT,SOUTH CENTERAL ETHIOPIA,(1987-2008)

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A THESIS TO BE SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, ADDIS ABABA UNIVERSITY AS PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN EPIDEMIOLOGY

JUNE 2012
ADDIS ABABA

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Acknowledgement

First and for most I am grateful to the almighty God for giving me health and strength to accomplish my masters program.

My sincere and deepest gratitude goes to my advisor Dr.Mitike Molla for her unreserved assistance,timely guidance, and comments from the title selection until completion of this thesis.My appreciation and gratefulness also goes to my advisor Dr.Wubegzier Mekonnen for his uncountable assistance rendered me from proposal development to the completion of this work.

I would like to appreciate the techinical management commite of BRHP, for allowing me to use the BRHP database for this thesis work. I would like to appricate and thank the BRHP researchers for establishing and sustaining it for so long. I would like to express my appreciation to Meskan Woreda Health Office.

My special thanks go to Dr. Alemayehu Worku and Dr.Samson G/Medhin for offering valuable materials and consistently sharing their valuable personal information over the study period.

I would like to acknowledge the School of Public Health, Addis Ababa University for giving me this opportunity and funding my thesis.

I would like to extend gratitude to all staff of the School of Public Health; particularly librarians,and administrative staffs for facilitatation and cooperation on various aspects.

I also acknowledge study participants for both the qualitative and quantitative study. I also would like to express my gratitude to all who have supported me technically, and psychologically.

Finally, I would like to express my deepest gratitude to my family for their continuous encouragement, motivation and support.

Dedication

This thesis work is dedicated to W/ro Etetu Hailu who has been the source of inspiration,engine of courage, and secret for all of my achievements through all aspect of my life.

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Abbreviations

ANC	Anti Natal Care
BRHP	Butajira Rural Health Programme
DSS	Demographic Surveillance System
EDHS	Ethiopian Demographic and Health survey
ENMR	Early Neonatal Mortality Rate
HIV/AIDS	Human Immunodeficiency Virus /Acquired Immune Deficiency Syndrome
ICD	International Classification of Disease
LMIC	Low and Middle Income Countries
LNMR	Late Neonatal Mortality Rate
MaNHEP	Maternal and Neonatal Health in Ethiopia Partnership
MDGs-	Millennium Development Goals
NMR-	Neonatal Mortality Rate
PI-	Principal Investigator
SNNPR-	Southern Nations, Nationalities and Peoples Region
UNICEF-	United Nations Children's Fund
WHO -	World Health Organization

Abstract

Introduction: Child mortality is an important indicator of a country's developmental status. Neonatal mortality and stillbirth shared a higher percentage of child mortality. However, in developing countries where most deliveries occur at home and there is no civil registration, it is difficult to measure the magnitude of neonatal mortality. In such set-ups, the use of data from continous demographic survillance systems provided a valid result. Therefore, this study was conducted in rural Butajira using a 22 years dataset with the aim of assessing trends of neonatal mortality and assessment of associated risk factors.

Methods: The Butajira Rural Health Programme was launched in 1987 with an objective of developing and evaluating a system for a continuous registration of vital events. The surveillance system operates an open cohort system. An event history analysis was carried out to calculate the yearly neonatal mortality and magnitude of death along different covariates. Poisson regression model was used to elicit neonatal mortality risk factors.

Results: The trends of neonatal mortality did not show a change over the study period (P-value=0.099). There was a high burden of early neonatal mortality with the highest risk of death on the first day of life (incidence rate ratios 4.84 [4.5 5.2] and 18 [16.6 19.4] respectively). Significant risk factors for all-cause neonatal mortality were being male 1.65(1.4-1.9), distance to hospital 1.5(1.11- 2.0), born to follower of Islam 1.2[1.01 1.50], born to mothers with no oxen 1.16(1.01- 1.34) and neonates were born to mothers living in thatched house 2.9(2.4-3.5).

Conculussion:- Despite there is an urgent need of reducing neonatal mortality at national level , no significant change observed in neonatal mortality in Butajira. The death was significantly associated with sex of the child, socio economic variables, and physical access to hospital. Therefore, comprehensive prevention strategies directed at reducing neonatal death should address community, household and individual level factors, which significantly influence neonatal mortality in Butajira.

1. Introduction

1.1 Background

The neonatal period begins with birth and ends 28 completed days after birth (1)**.** Neonatal deaths may be subdivided into early neonatal deaths that is occurring during the first seven days of life (0-6 days), and late neonatal deaths occurs after the seventh day but before the 28th day of life (2).

The grief of a neonatal death is unlike any other form of grief: the months of excitement and expectation, planning, eager questions, and drama of labour all magnifying the devastating incomprehension of giving birth to a baby no longer live (3)

Although being newborn is not a disease, the large number of children may die soon after birth: many of them in the first four weeks of life (neonatal deaths), and most of those during the first week (early neonatal deaths). Furthermore for every baby who dies in the first week after birth, another is born dead (fetal deaths or stillbirths) (4).

Among 130 million babies born every year, about 4 million die in the first 4 weeks of life where three-quarters of all neonatal deaths happen in the first week of life and the highest risk of death is on the first day of life. Almost all (99%) neonatal deaths arise in low and middle-income countries, yet most epidemiological and other research focuses on 1% of deaths which occur in rich countries (5).

The highest numbers of neonatal deaths are in south-central Asian countries and the highest rates are generally in sub-Saharan Africa. Over the pool 20 years (1990-2009) 31 million neonatal death happened in Southeast Asian low and middle income countries , and 21 million in African low and middle income countries and one million in higher income countries (6).

In addition to this, the proportion of child deaths that occurs in the neonatal period globally increased from 37% in 1990, 38% in 2000 and to 41% in 2009(6-8). ın order to achieve the world Millennium Development Goals of lowering the under-5 mortality rate of 1990 by two-thirds by 2015, it is critical to reduce neonatal mortality rates (9-13).

Ethiopia has high child mortality rate, with large proportion of deaths occurring in the first month of life. Over the preceding 15 years infant and under-five mortality had undergone considerable improvement with a reduction in the rate of approximately 48 and 45 percent respectively. However, neonatal mortality declined only by few points (14).

Globally, the main direct causes of neonatal death include preterm birth (28%), sepsis (26%), and asphyxia (23%). Neonatal tetanus accounts for a smaller proportion of deaths (7%), but is easily preventable. Low birth weight is an important indirect cause of death. Maternal complications in labour carry a high risk of neonatal death, and poverty is strongly associated with an increased risk (7, 8).

Neonatal mortality emerges as an increasingly prominent component of overall under-five mortality and is thus receiving additional attention. Consequently, information on per natal and neonatal mortality at international level is in great demand and reducing neonatal deaths is, therefore, an essential step towards reducing infant mortality (4).

1.2 Rationale

Neonatal mortality has not been widely studied in developing countries including Ethiopia where mortality rates are extremely high, and information to improve services is scarce. This is mainly due to the lack of civil registration where the commonly available data source is hospital- based, which is highly prone to under reporting due to low health service utilization in such set-ups. Neonatal mortality reduction is the focus of the world community at large, by setting a Millennium Developmental Goals (MDGs) 4, which calls for a two-thirds reduction in mortality risks of children under 5 years of age at the end of 2015. It is also a focus area under Ethiopian government strategy. Under this strategy, the government set the target to reduce neonatal mortality to 18 per 1000 live births by the year 2015, considering the low rate of skilled care during pregnancy and delivery as major contributing factor. To accomplish this target, the government planned to intensify the Health Extension Programme in response to recognition that the health extension workers can able to provide skilled pregnancy and delivery care at grass root level(15).

Longitudinal data from demographic surveillance systems (DSS) could be useful in areas where civil registration is lacking and continious updating mechanism is abscent . Using DSS data which is based on continuous surveillance system provide a reliable estimate of mortality and offers the possibility of using a robust statistical analysis.So this study was conducted to exibit and understand the trends in neonatal death and its associated risk factors in the former Meskan and Marako districts of, Gurage Zone using the Butajira Health Demographic Surveillance Site. The outcome of this study can be an input both for local and national planning.

2.Litrature review

2.1 Magnitude of neonatal mortality

Of all deaths in children under the age of five years, nearly 40% occur during the first four weeks of life. Every hour, around 450 babies die before the age of four weeks (the neonatal period), mainly from preventable cause; globally three-quarters of neonatal deaths occur in the first week of life, with the highest risk of death on the first day of life (16).

A systemic review of neonatal mortality on 193 countries, in 2009 indicates that the 20 year from 1990 to 2009, an estimated 79 million babies died in the first 4 weeks of life. Of these, the vast majority (98%) died in low and middle-income countries. All regions of the world have seen reductions in NMR, but there are major regional variations in the estimated rate of reduction. Globally, the average NMR has fallen by more than a quarter over 20 year, from 33.2 to 23.9 per 1,000 live births, or an average of 1.7% per year which is by far less than from average yearly reduction to meet MDG 4, which requires a reduction of 4.4% per annum (6).

The smallest percentage reductions in neonatal mortality rate have seen in African Low and Middle Income Countries (LMIS) (35.9). Moreover, Africa Region categorize between the only two regions with average annual reductions in NMR of less than 2%, with a total reduction of only 17.6% (1.0% per year) between 1990 and 2009 (6).

Sub- Saharan Africa has the highest rates while, south-central Asia has the highest absolute number of neonatal deaths. Two-thirds of deaths occur in 10 countries (Afghanistan, Bangladesh, China, Democratic Republic of Congo, Ethiopia, India, Nigeria, Pakistan, Indonesia, and the United Republic of Tanzania) (16).

Study done across 106 national DHS surveys in developing countries, indicated that the NMR varies from 10 to 62 per 1000 live births, with a median value of 33 (17). By region, the median value is highest in Central and Western Africa which is 41, followed by Eastern and Southern Africa which is 36 and Middle East-North Africa of 33, and lowest in Latin America and the Caribbean of 24. Early Neonatal mortality Rate (ENMR) averages 24 per 1000 live births, (17).

According to study conducted in Bangladesh, between 2004 and 2007 child mortality has fallen from 88 per 1,000 live births to 65 per 1,000 live births. However, despite this encouraging trend, neonatal mortality in Bangladesh is still high, accounting for more than half of all under-five deaths and more than two thirds of infant deaths (18). An estimated 120,000 newborns die every year in Bangladesh. The share of neonatal deaths to infant mortality has increased over the period (18).

A study done in the state of Rio Grade d soul,Brazil showed that although the infant mortality has been decreasing ,post neonatal mortality showed the largest decrease, with the concentration of early neonatal mortality(19).

According to a study done in Ghana Navorongo, the majority (62.7%) deaths occurred in the early neonatal period (20). The study showed the overall NMR declined at an average of 2.5 per 1000 live births per year, down by nearly 50% from 40.9 (95% C.I. 34.1–46.8) in 1995 to 20.5 (95% C.I. 17.3–22.7) in 2002 (20). (86.1%) of deaths occurred at home, with only 141(13.2%) occurring at the health facility. In addition, there were significantly more male than female deaths.

2.2 Neonatal mortality in Ethiopia

Ethiopia has high infant mortality rate (55 deaths per 1,000 live births), of which half of the deaths occurring in the first month of life. Infant and under-five mortality rates obtained for the five years preceding the two surveys confirm a declining trend in mortality with under-five mortality, declined from 166 deaths per 1,000 live births in the 2000 survey to 123 for the 2005 survey and 88 in the 2011 survey. The infant mortality declined from 97 deaths per 1,000 live births in the 2000 survey to 77 for the 2005 survey and 59 in the 2011 survey. However, the neonatal and post neonatal mortality declined only by few points, i.e. 49, 39 and 37 in 2000, 2005 and 2011 EDHS respectively. Moreover, only 9.7% of births are attended by a skilled professional, while nearly 85% are attended by untrained traditional birth attendant or relative (14, 21, 22).

According to demographic survey study of developing countries in 2006 by taking EDHS 2000, among list of 108 surveys by region and country, Ethiopia records estimated neonatal mortality rate of 48 per 1000 live births; with 35 per 1000 live births and 13 per 1000 live births for early neonatal mortality and late neonatal mortality respectively (17).

A community based study in Butajira district in 1987-1996 showed that the overall neonatal mortality rate was 27/1000 live births. The rates in the early and late neonatal periods were 20 and 8 per1000 live births, respectively. The mortality incidence rates show that, every day, three of every 1000 newborns die in their 1st week of life (23). In addition, neonatal mortality accounted for 43% of infant mortality (23).

Hospital based study from Gondar Teaching Hospital indicated that, the neonatal mortality unacceptably high, 41.4% (24).

2.3 Risk factors of neonatal mortality

Neonatal deaths and stillbirths stem from poor maternal health, inadequate care during pregnancy, in appropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, and lack of newborn care (4, 25).

Several factors such as women's status in society, their nutritional status at the time of conception, early childbearing, too many closely spaced pregnancies are affecting neonatal mortality. Moreover, harmful practices, such as inadequate cord care, letting the baby stay wet and cold, discarding colostrum and feeding other food, are deeply rooted in the cultural fabric of societies and interact in ways with neonatal mortality that are not always clearly understood (4).

In most countries the neonatal mortality rates vary by socio economic status (26). Disaggregation by urban-rural residence type neonatal mortality rate was high in rural areas, which is linked with high number of home delivery, mainly assisted by unskilled family members and bad access to medical care (25, 26). High mortality rates of neonate are underpinned by the fact that 85 per cent of women gave birth at home, most with unskilled attendants or relatives assisting. The low status of women, poor quality and low uptake of services are some of the reasons for this situation. Low awareness about the need for additional nutritious food during pregnancy, and disempowerment of women played a great role for increment of mortality (27, 28).

Universal access to basic health services before, during and after childbirth as being protective against the occurrence of perinatal deaths in study done in rural community(29). Against this, the rate of prenatal diagnosis decreases with increasing distance between parental residence and referral center. However, these factors had no significant effects on neonatal mortality (30). Similarly other findings shows no evidence to suggest that living further from hospitals, in terms of road travel time, increased the risk of infant death or stillbirth (31, 32).

A study done in the state of Rio Grande d soul, Brazil showed adequate basic environmental sanitation, mother education, and the dependency ratio as determinants of infant mortality. In the same line this study suggest that an increase in family health programme coverage, controlling for other variables ,reduced the infant mortality rate(19).

Males have higher mortality than females at every age in most countries. However, the magnitude of the male disadvantage varies depending on environmental, social, and economic conditions(33). Males disadvantage in mortality is highly vissble in early neonatal mortality (34).The cause for underpinned mortality at this time assocciated with both infectious disease and perinatal conditions, but the male disadvantage is greater for perinatal and biological conditions (33).

Birth weight, and prematurity are major risk factors for neonatal mortality (35). Study showed an inverse relationship between birth weight and neonatal death; while the same study indicated cesarean births had a protective effect, especially for preterm newborns. Early elective delivery with adequate indication for a cesarean section may reduce the risk of death for preterm newborns at risk (28).

According to community based study done in Butajira district living in a rural, twin births and male gender hypothesized as contributing risk factor for neonatal mortality (15).

According to study done in Ghana Navorongo, Prematurity (38%) and birth injuries (19%) were the major causes of early neonatal deaths, while infectious causes (66%) were the major contributors to late neonatal deaths (20).Overall, the four leading causes of neonatal deaths were infections (39.2%), prematurity (26.0%), birth injuries (14.4%) and neonatal infanticides. High levels of home delivery (78%), unskilled attendants at delivery, (62%) and low-birth weight (30%) characterized the history of the cases of neonatal deaths over the review period (20).

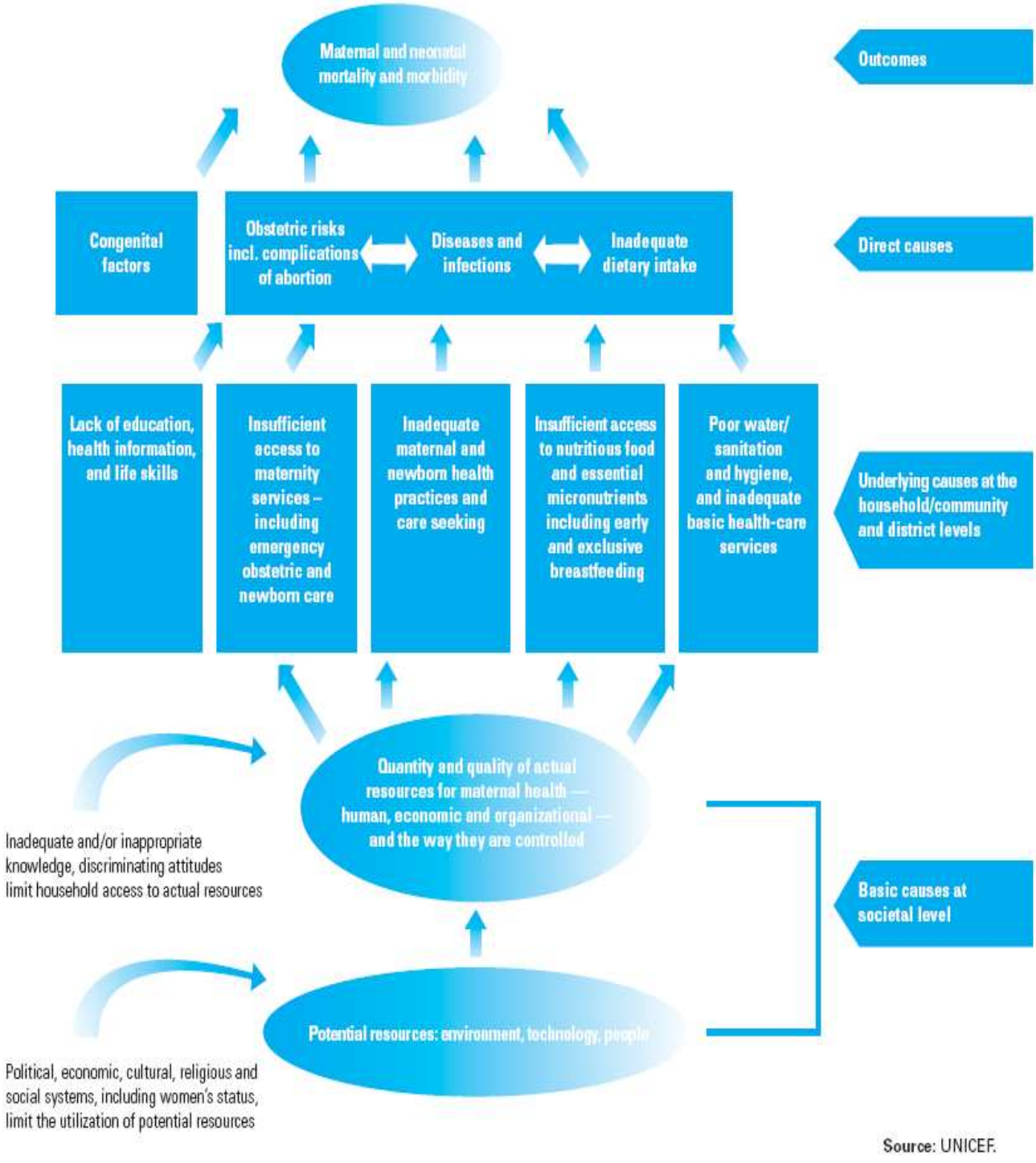

Figure 1 Conceptual framework indicating factors influencing maternal and neonatal mortality and morbidity

This conceptual framework on the causes of maternal and newborn deaths illustrates that health outcomes are determined by interrelated factors, encompassing nutrition, water, sanitation and hygiene, health-care services and healthy behaviors, and disease control, among others. These factors are defined as proximate (individual), underlying (household, community and district) and basic (societal). Factors at one level influence other levels. The framework is devised to be useful in assessing and analyzing the causes of maternal and newborn mortality and morbidity, and in planning effective actions to enhance maternal and neonatal health. Generally from above figure one can understand that the risk of neonatal mortality is multiple and complex. The cleaned Butajira DSS dataset only comprises the socio-demographic and economic factors, such as: age, sex, residential area, religion, oxen ownership, house ownership, water source, roof type and distance to hospital.

3. Objective

3.1 General objective

To assess the trends and assocciated risk factors of neonatal mortality in a rural district of Butajira

3.2 Specific objective

1.To assess the magnitude and trends of neonatal mortality between 1987 and 2008

2.To identify risk factors of neonatal mortality

4.Method and materials

4.1 Study area and nature of the BRHP surveillance system

The study was carried out in the south central Ethiopia in the former Meskan and Marako district, Gurage Zone. The district is located 135 Km south of Addis Ababa. Butajira is the capital of the district and located in the midland area. The district is bounded by Siliti district to the south, the Adamitulu district to the east, the Sabat –Bet Gurage to the West and the Sodo District to the north. The vast majority (2/3) of the district population follows the Islamic religion. The District's population is currently estimated at 175,682, corresponding to a density of around 325 per km2 (36). The DSS area covers a sample within the District, following ten communities initially sampled from the entire District using a probability proportional to size technique. The DSS population is currently estimated 70,000. Nine of the ten sites are rural and one urban kebeles located in Butajira town**.** The predominant language is Guragigna. The population gets health services from one Zonal Hospital, Health Centers, Clinics (private and public), Pharmacies, drug venders, Health posts and so on. The backbone of the economy in the district is the agricultural sector. Pepper, khat and teff are mainly produced crops in the district(37, 38).

We extracted the data from the Butajira Rural Health Programme (BRHP) data set 1987-2008.
The BRHP was launched in 1987 with an objective of developing and evaluating a system for continuous registration of vital events, such as birth, death, migration, marriage, internal movement and household characteristics.

In this arrangement, the first census was conducted in April 1986. Data were collected initially monthly, later quarterly by visiting each household; village-based enumerators conduct the household interviews; each household is identified by unique number within its village, and each individual within their household.

The surveillance system operates on an open cohort system and is dynamic. The Butajira DSS has been a major attraction to epidemiologists and other researchers wishing to conduct community-based study (37).

4.2 Study design

For this study, analysis was carried out using the BRHP open cohort.The BRHP follows an open prospective cohort after an intital cencess in 1986. In this cohort people enter the cohort by birth and in migration and exit the cohort by death and outmigration. The surveillance system tracks this change using quarterly update of occurrance of events in each household. This study used a 22 years extracted data set for the period of 1987-2008.

4.3 Source and Study population

4.3.1 Source population

Source populations were all live births in the former district of Meskan and Marako.

4.3.2 Study population

Neonates registered in the demographic surveillance area that was born, residing, or entered into the HDSS between 1987 and 2008.

4.4 Inclusion and exclusion Criteria

Inclusion criteria-

Children in the age range 0-28 days and tracked by the database from 1987-2008 was included in the study.

4.5 Sample size of the study

All under one month live births in surveillance site, from 1987-2008 were included in this study.

4.6 Data collection tools and techniques

This data were collected using structured standard questionnaires. Data is collected using structured questionnaire for each event. A household characteristic is collected during census and when a new house is constructed or a marked change in the structure is occurring. Otherwise, the other events are recorded quarterly by village based data collectors who had completed high school, speak the local language and obtained trainings when joining the base and a periodic training is given as required. Field supervisors followed all field data collection activities (23).Besides re-census and annual reconciliations were conducted to update individual and household characteristics.

4.7 Data quality management

Quality control is ensured by several checking mechanisms that are put in place at different stages of the surveillance. The most critical of this is the field supervision. Field supervisors (6 persons) each were assigned to 1-2 villages and project coordinators over see the data collection procedure on a daily basis. Research assistants perform the next level of supervision. The researchers covered the other tasks. Supervisors need to re-interview at least 5% of registered events. They have to rectify inconsistencies in each completed format. Besides, they are responsible to record GPS data. Research assistants extracted a sample of recorded events from the database and check their content and coverage validity at the field. The quality of data has been checked at the office level. Special software designed on DBASE platform was used to capture and manage the longitudinal surveillance with an internal consistency system (15).

4.8 Measurement of study variables

To ease data analysis, the orginal 22 –year data was extracted from the database and prepared in longitudinal format with start and end of exposure. Then these two inependent episodes were appended to have a single merged data -set. After this the data quality was checked by cross tabulating events by following event to see the chronological order of events. A censoring variable was created to see whether an event occurs with in the Demographic Surveillance Area (DSA). Primary events in the surveillance are birth, in-migration, internal move, outmigration and death. Entry could be due to birth, inmigration and move in to the household. While exit could be due to outmigration,death and moving out of the household. The primary outcome was neonatal death, which was the death of a live born infant in the first month of life (before 28 day). In the descriptive analyses, the neonatal mortality rate, defined as the number of neonatal deaths per 1000 person-days, was used. In these analyses, the outcome was neonatal deaths recoded as a binary variable. The explanatory variables included in this study were generated from the dataset: Age, sex, residential area, religion, oxen ownership, house ownership, water source, roof type and distance to hospital. There were nine community level (contextual) variables of which four represented the demographic characteristics of a cluster (Age, sex, residential area and religion); three were socioeconomic status variables (Oxen ownership, house ownership and roof type); and one were indicator of community access to pregnancy and delivery care services (distance to hospital)

4.9 Data processing and analysis

An Event History Analysis (EHA) was carried out using the Butajira HDSS 22 year data set (1987 and 2008). All 10 villages and all deaths of children under the age of 28 days that occurred between 1987 and 2008 were included in the analysis. Data analysis was conducted using STATA version 11 software. Mortality rates estimation was done using the number of deaths and person-days lived by the children for each year. These were computed from the date of entrance into the HDSS, and the date children exited the population. However, STATA software has a programming limitation which did not capture the exposure of children who were born and died on the same date. We thus have to add one day on date of start (dsart+1=dbeg) to correct such kind of problem. Neonatal incidence rates trends with their 95% confidence interval were computed. Furthermore, adjusted and unadjusted neonatal mortality Incidence Rate Ratio (IRR) along with 95% CI were computed using the Poisson regression. Moreover, comparison of variables and risk factors of mortality were calculated by using Poisson regression model. The approach used robust standard error in order to manage the deviance and correlation created from longitudinal data nature. Overall time trends in mortality were analyzed with STATA software and test of significance was checked by looking the 95% Confidence Interval (CI); if the CI crossover each other it declared to be statistically not significant and otherwise it declared as significant. Final mortality trend curve was prepared by running mean smoother (with 4-year moving averages) in order to smooth random fluctuations in the material. The temporal trend graphs were done using Microsoft Excel 2007.

4.10 Variables

Dependent variables- neonatal mortality

Independent variables –

- Age
- Sex
- Residential area
- Religion
- Oxen ownership
- House ownership
- Water source
- Roof type
- Distance to hospital

4.11 Ethical Considerations

Ethical clearances were obtained from research ethics committee of School of Public Health. Permission to use the database was obtained from BRHP management committee after thoroughly discussing the ultimate purpose, method of the study and need of confidentiality of data.

4.12 Dissemination of the result

The output of this study will be disseminated to School of Public Health College of Health Sciences as partial fulfillment of master's degree in public health. It will also be disseminated to BRHP committee and other concerned governmental and non-governmental organizations. Publication in peer reviewed journal and presentations in scientific conferences are other ways that we consider for dissemination.

5. Results

5.1 Early, late and overall neonatal mortality rate.

During the period 1987 through 2008,a total of 1055 deaths of children aged 0-27 days were identified and contributed 803370 person-days. Of these, 768 [73%] were early neonatal deaths(0-6 days) and 287[27%] were late neonatal deaths(7-27 days). Of the total number of neonatal mortality 573[54%] occured in the first 24 hours of life.

The incidence of dying in the first 24 hours after birth was 18 per 1000 person-days (95%CI: 16.6, 19.4). Early neonatal mortality incidence rate (ENMIR) of 4.84 early neonatal deaths per 1000 person-days (95% CI: 4.5, 5.2), late neonatal mortality incidence rate(LNMIR) of 0.44 late neonatal deaths per 1000 person-days (95%CI: 0.40 0.50) and an overall neonatal mortality incidence rate (NMIR) of 1.3 neonatal deaths per 1000 person-days (95% CI: 1.20, 1.40) was identified **(Table 1).** In addition, neonatal mortality constitutes 31% of the infant mortality at study period.

Table 1: Distribution of the neonatal incidence mortality rate by selected differentials, Butajira district 1987-2008

Variable	**Dead 0-6**	**Dead 7-27**	**Pearson-days, early Neonatal**	**Pearson-days, late neonatal**	**Early NMIR**	**Late NMIR**	**NMIR**
Overall	768	287	158471	644899	4.8(4.5, 5.2)	0.4(0.4, 0.5)	1.3(1.2, 1.4)
Sex							
Male	467	166	80428	326581	5.8(5.3, 6.3)	0.5(0.4, 0.6)	1.5(1.4, 1.7)
Female	301	121	78043	318318	3.8(3.4, 4.3)	0.3(0.3, 0.4)	1.0(1.0, 1.2)
Area							
Low land	360	142	62668	255120	5.74(5.2, 6.4)	0.6(0.5, 0.6)	1.6(1.4, 1.7)
High land	324	119	68080	276470	4.76(4.2, 5.3)	0.4(0.3, 0.5)	1.3(1.2, 1.4)
Urban	84	26	27723	113309	3.0(2.4, 3.75)	0.2(0.1, 0.3)	0.8(0.6, 0.9)
Religion							
Muslim	386	133	101714	412817	3.8(3.4, 4.2)	0.3(0.3, 0.4)	1.0(0.9, 1.0)
Christian	86	41	29867	122065	2.9(2.3, 3.5)	0.3(0.2, 0.4)	0.8(0.7,1.0)
House own							
Own	682	268	141928	576599	4.8(4.4, 5.2)	0.5(0.4, 0.5)	1.3(1.2, 1.4)
Rented	39	7	11104	45806	3.5(2.5, 4.8)	0.1(0.1, 0.3)	0.8(0.6, 1.0)
Others	47	12	5439	22494	8.6(6.5, 11.5)	0.5(0.3, 0.9)	2.1(1.6, 2.7)
Distance to hospital							
<5km	125	41	37420	152817	3.3(2.8, 4.0)	0.3(0.2, 0.4)	0.9(0.7,1.0)
5-9 km	302	118	59010	239741	5.1(4.6, 5.7)	0.5(0.4, 0.6)	1.4(1.3, 1.5)
>=10 km	341	128	62041	252341	5.5(4.9, 6.1)	0.5(0.4, 0.6)	1.5(1.4, 1.6)
Roof							
Iron sheet	82	28	31790	129961	2.6(2.0, 3.2)	0.2(0.2, 0.3)	0.68(0.6,0.8)
Thatched	686	259	126681	514938	5.4(5.0, 5.8)	0.5(0.4,0.6)	1.5(1.4, 1.6)

Uneven variations in neonatal mortality rates were observed across neonatal period. A higher level of early neonatal mortality rate compared to late neonatal mortality rate was observed. There is a significant decline in mortality after neonates survive the first week of life in the observation period. The death of children on the level, first day comprises the larger proportion from early neonatal mortality. (Fig 2)

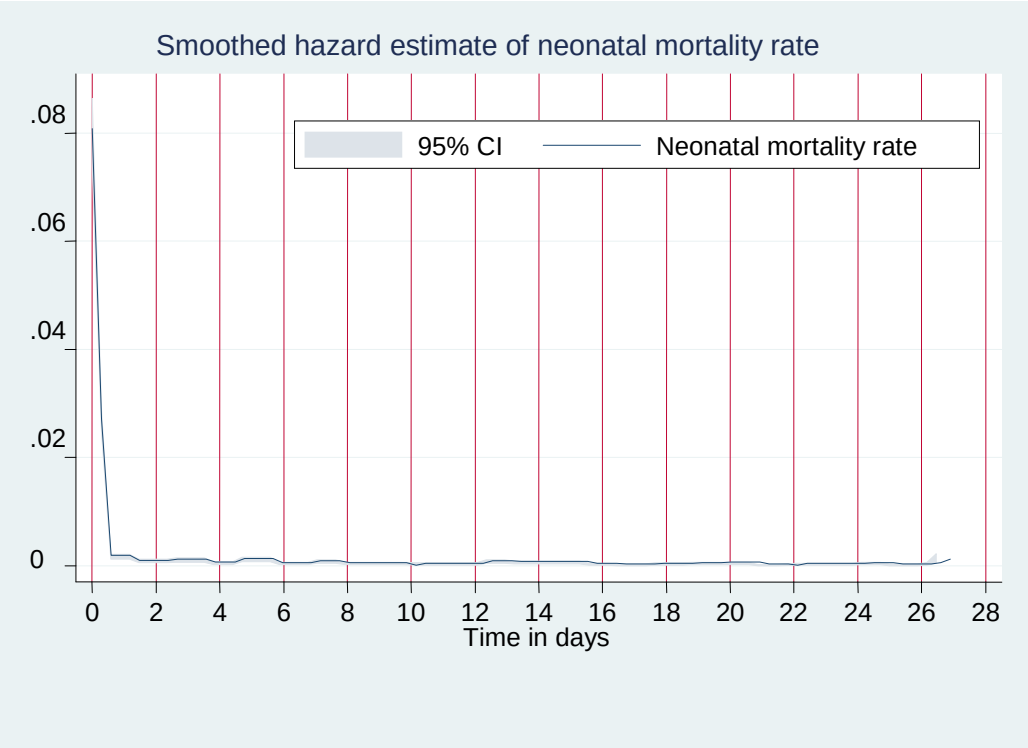

Figure 2 Level of death observed during neonatal period in Butajira district 1987-2008

5.2 Early, late and neonatal mortality rate by selected covariates

5.2.1 Early neonatal mortality incidence rate by sex

Males comprised 633[60%] of all neonates who died during the observation period, while Females shared 422[40%] of neonatal deaths. Early sex specific mortality incidence rate of 5.8 early neonatal deaths per 1000 person-days(95%CI:5.3, 6.3) and 3.85 early neonatal deaths per 1000 person-days (95%CI:3.4, 4.3),were identified for male and female respectively.

5.2.2 Late neonatal mortality incidence rate by sex

Late sex specific mortality incidence rate of 0.5 late neonatal deaths per 1000 person-days(95%CI:0.4, 0.6) and 0.38 late neonatal deaths per 1000 person-days (95%CI:0.3, 0.4) were identified for male and female respectively.

5.2.3 Neonatal mortality incidence rate by sex

Neonatal mortality incidence rate of 1.55 neonatal deaths per 1000 person-days (95%CI: 1.40, 1.70) and 1.0 neonatal deaths per 1000 person-days (95%CI: 0.97, 1.20) were identified for male and female respectively. **(Table 1)**

The male excess in neonatal mortality rate was most prominent during the first week of life (0-6) and it was the approximate peak of the male disadvantage. After passing the first week of life mortality rate was at the same level for both sex. (Fig 3)

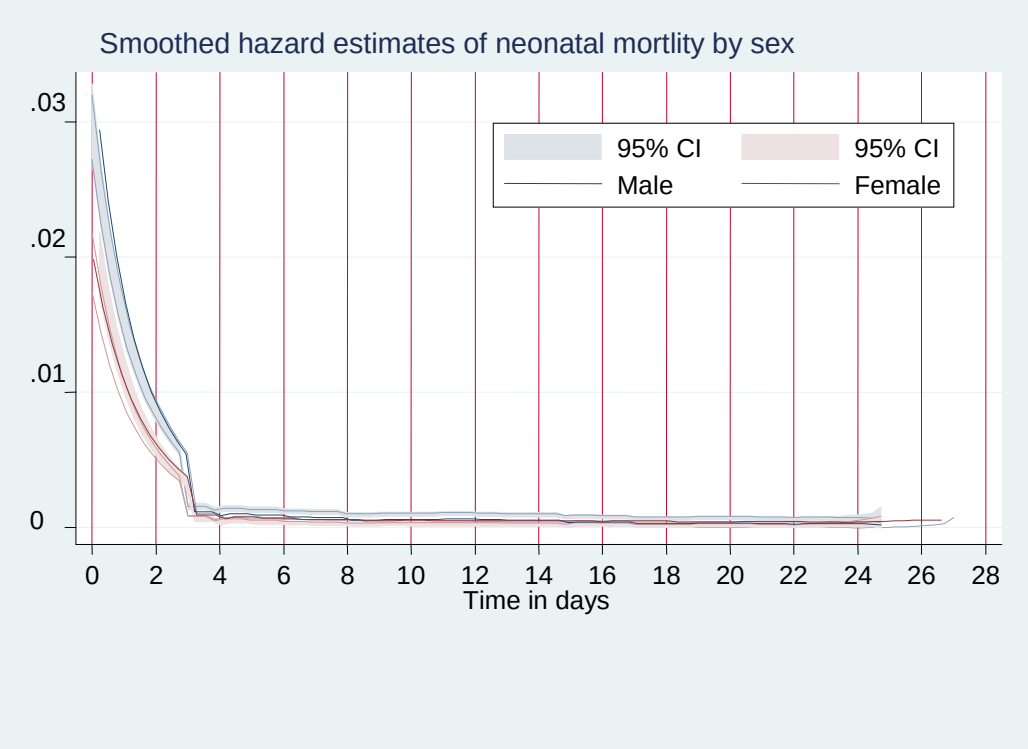

Figure 3 Magnitude of death observed during neonatal period by sex in Butajira district 1987-2008

5.2.4 Neonatal mortality incidence rate by residential area

Neonates who were born to mothers living in the low lands had higher mortality incidence rates (1.58 neonatal deaths per 1000 Person Days) than those living in the rural highlands(1.28 neonatal deaths per 1000 Person Days) and in urban areas (0.78 neonatal deaths per 1000 Person Days).**(Table 1)**

Excess mortality was seen in rural highland and lowland mostly at early neonatal period compared to urban dwellers. The diffrence become very narrow when neonates passed the first week of life.(Fig 4)

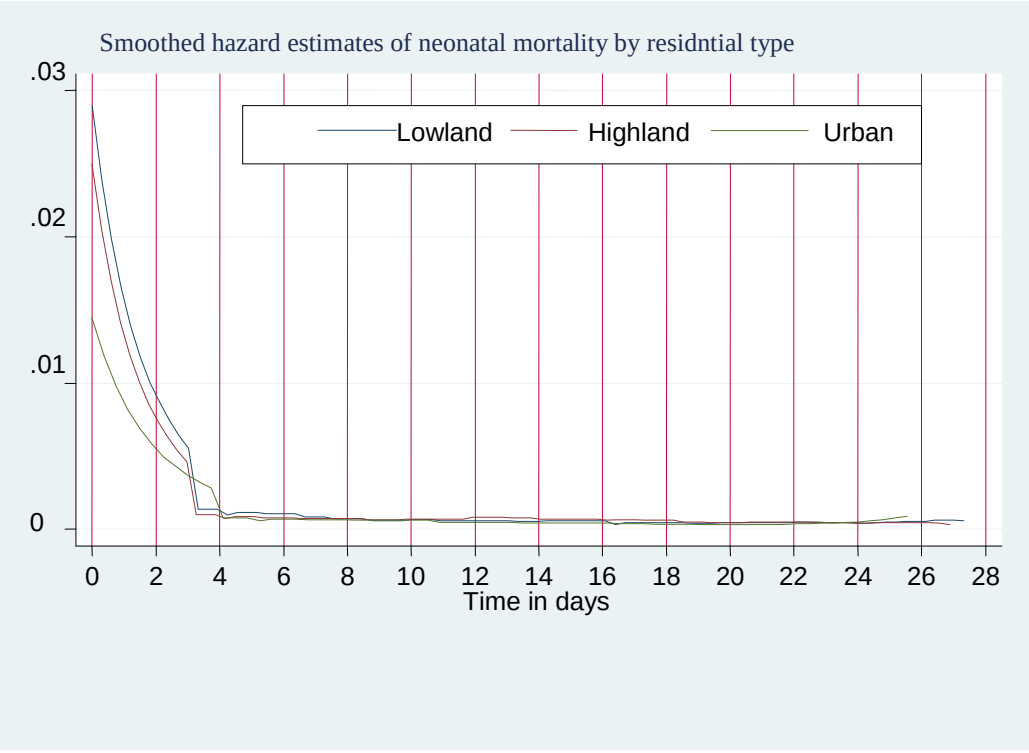

Figure 4 Magnitude of mortality observed during neonatal period by residential area in Butajira district 1987-2008

5.2.5 Early neonatal mortality incidence rate by distance to Hospital

The neonatal mortality rate was calculated based on distance to hospital from the residence house of mothers. Neonates who were born to mothers living closer (<5km) Hospital had 3.34 early neonatal deaths per 1000 person-days(95%CI:2.8, 4.0), neonates who were born to mothers living between 5-9 km had 5.1 early neonatal deaths per 1000 person-days (95% CI: 4.5, 5.7), and neonates who were born to mothers living farther than 10 km had 5.5 early neonatal deaths per 1000 person-days (95%CI: 4.9, 6.0).

5.2.6 Late neonatal mortality incidence rate by distance to Hospital

Late neonatal mortalty rate of 0.27 late neonatal deaths per 1000 person days (95%CI: 0.20, 0.36), 0.49 late neonatal deaths per 1000 person days(95%CI: 0.41, 0.60), and 0.5 late neonatal deaths per 1000 person-days (95%CI: 0.4, 0.6) for distance <5km, 9-10km and >10 km respectively.

5.2.7 Neonatal mortality incidence rate by distance to Hospital

Neonatal mortality rates of 0.87 neonatal deaths per 1000 person days (95% CI: 0.75, 1.00), 1.4 neonatal deaths per 1000 person days(95%CI: 1.3, 1.5) and 1.49 neonatal deaths per 1000 person-days (95%CI: 1.36, 1.6) for distance <5km, 9-10km and >10 km respectively.

5.2.8 Neonatal mortality incidence rate by religion

Neonates who were born to musilim mothers had higher mortality rate [neonatl mortality rates of 1 neonatal deaths per 1000 person-days] than those who were born from christian mothers [neonatl mortality rates of 0.83 neonatal deaths per 1000 person-days].

5.2.9 Neonatal mortality incidence rate by Oxen ownership

Neonates who were born to a family who had oxen have lower mortality incidence rates (1 per 1000 PD) than those who born to family had no oxen (1.47 per 1000 PD). (**Table 1)**

5.2 Temporal trend of neonatal mortality in Butajir district (1987-2008)

The trends of neonatal mortality rate in the Butajira HDSS area for the period from 1987 to 2008 are shown in Table 3 below. Variations in Neonatal mortality rates were observed across years. Of these 22 years of analysis, 1987-1999 appeared to show a tendency of increment for neonatal mortality trend; while the year 2000 onwards the trend have shown a declining pattern. Nevertheless, both the increment and decline were not statically significant, since the confidence interval cross over each other.

Table 2: Neonatal mortality rates per year in Butajira HDSS, (1987-2008)

Year	**No.of death**	**Person days**	**Rate**	**95% CI**
1987	26	40222	0.65	(0.44, 0.95)
1988	34	36998	0.90	(0.65, 1.30)
1989	44	32699	1.30	(1.00 , 1.80)
1990	70	38512	1.80	(1.40, 2.30)
1991	58	35909	1.60	(1.25, 2.00)
1992	30	34009	0.90	(0.60, 1.26)
1993	52	36062	1.44	(1.10, 1.90)
1994	27	37922	0.70	(0.50, 1.03)
1995	20	35411	0.60	(0.36, 0.90)
1996	48	40901	1.20	(0.90, 1.50)
1997	55	41602	1.30	(1.01, 1.70)
1998	80	42512	1.90	(1.50, 2.30)
1999	66	33161	2.00	(1.50, 2.50)
2000	57	37208	1.50	(1.20, 2.00)
2001	46	40014	1.10	(0.86, 1.53)
2002	46	35529	1.30	(0.97, 1.70)
2003	59	31938	1.85	(1.40, 2.40)
2004	66	37746	1.70	(1.37, 2.20)
2005	49	38587	1.20	(0.96, 1.68)
2006	42	33721	1.20	(0.90, 1.70)
2007	41	32780	1.25	(0.90, 1.70)
2008	39	29927	1.30	(0.95, 1.80)

Uneven increasing pattern on neonatal mortality was seen between the period of 1987 and 1990, 1995 and 1998 and 2001 and 2003. Neonatal mortality had shown uneven declining pattern between the year 1991 and 1995, 1999 and 2001 and 2003 and 2005. In the last years of study period neonatal mortality, become stable at the same level of year 2005. Nevertheless, both the increment and decline were not statically significant, since the these the community based neonatal mortality curve show a series of unstable Rates—the confidence intervals around each rate are wide and overlap(cross-over) each other and the pattern over time is quite jagged (Fig 5).

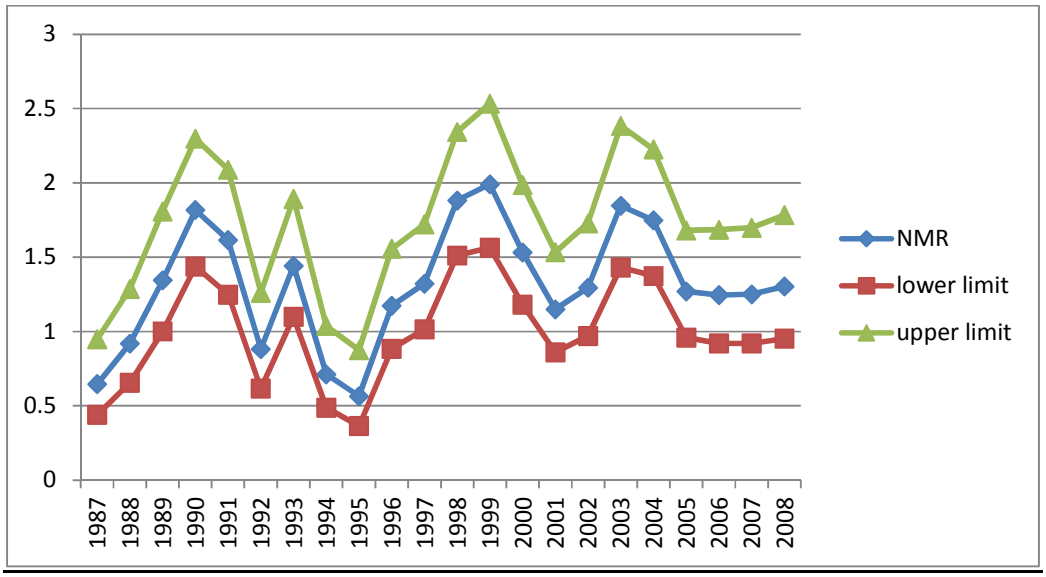

Figure 5 *Observed rates by year in Butajira district 1987-2008*

Using the four year moving averages to gain stability and smoothness, variations in neonatal mortality rates were observed across years, the average year of 1997-2000 appeared as a 'peak year'. No linear trend (significant changes) were observed for neonatal deaths over the year using linear trend analysis (P-value=0.099). Despite the fact that, the result was not statically significant, there is tendency of increment at 1.2% per year on average in neonatal mortality in the observation period; a result much more consistent with what is seen in the plots (Fig 6).

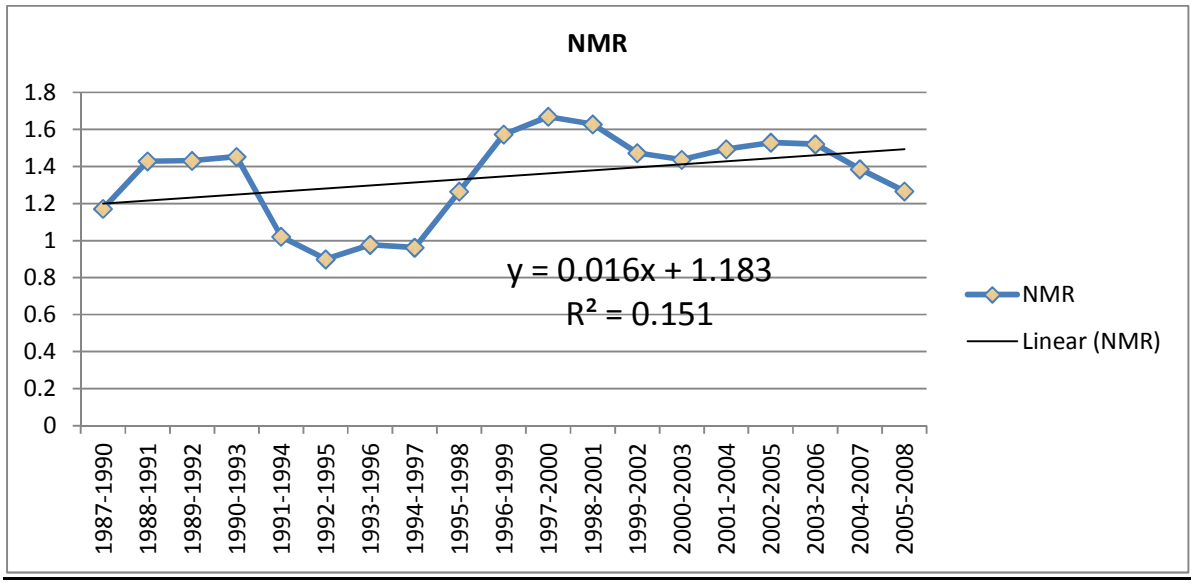

Figure 6 *A 22-year neonatal mortality trends with 4-year moving averages of the observed rates Butajira district.*

5.3 Risk factors of neonatal mortality in the Butajira district (1987-2008)

A poisson regeration model, taking into account sex, residential area, source of water,,houseownership,religion,type of roof and distance to hospital showed that male neonates had siginificantly higher risk of death(adjusted incidence rate ratios [with 95%CI] 1.65[1.4-1.9] than females. Mortality rates were significantly higher among Muslim compared to all Christian religions (adjusted incidence rate ratios [with 95%CI] 1.2[1.01-1.50]].

With regard to residential area, neonates living in the rural lowlands and highlands had higher probablity of death in the bivariate analysis but the diffrence was not stastically siginificant in multivariate anlysis.Those neonates were born to mothers who have no oxen were siginificantly asocciated with mortality rate 1.67(1.3- 2.2). At the same time there was also significance assocciation with roof type, those who were born to mothers living in thatched roof have highest probablity of neonatal mortality 2.9(2.4-3.5). Distance to hospital(5-9km) had significantly higher mortality rate compared to <5km.However,distance farther than 10 km from Hospital,houseownership and water source were not appreciably assocciated with neonatal mortality. (Table 2).

Table 3: Poisson regeration model result depiciting mortality rate ratios adjusted for diffrent risk factors among neonates in Butajira district for the period (1987-2008).

(Ref =reference category,RR=1)

Variable	Deaths	Person days	Unadjusted IRR (95%CI)	Adjusted IRR (95%CI)
Sex				
Male	633	407009	1.60(1.40-1.80)	**1.65(1.40-1.90)*** **
Female	422	396361	Ref.	Ref.
Area				
Low land	502	317788	2.85(2.30-3.50)	1.00(0.66 -1.76)
High land	443	344550	2.00 (1.65-2.50)	0.84(0.52 -1.34)
Urban	110	141032	Ref.	Ref.
Religion				
Muslim	519	514531	1.29 (1.00-1.56)	**1.20(1.01 -1.50)*** **
Christian	127	151932	Ref.	Ref.
House own				
Own	950	718527	2.05(1.53-2.74)	0.93(0.64-1.35)
Rented	46	56910	Ref.	Ref.
Water source				
Protected	296	277510	0.76 (0.66-0.86)	1.10(0.90-1.30)
Unprotected	759	525860	Ref.	Ref.
Distance to hospital				
<5km	166	190237	Ref.	Ref.
5-9 km	420	298751	2.00(1.70-2.50)	**1.50(1.11- 2.00)*** **
>=10 km	469	314382	2.20(1.80-2.60)	1.30(0.96- 1.80)
Oxen				
No	787	534824	1.43 (1.20-1.60)	**1.16(1.01- 1.34)** **
Yes	268	268546	Ref.	Ref.
Roof				
Thatched	945	641619	2.65(1.80 -3.90)	**2.90(2.40-3.50)*** **
Iron sheet	110	161751	Ref.	Ref.

6. Discussion

Our data suggested that no significant decline was observed in neonatal mortality trend in the study period. High mortality was associated with male sex, distances to hospital, born to mothers have no oxen and neonates were born to mothers living in thatched house.

Mortality rate estimation was done using person days generated from the surveillance as denominator resulted that the risk of dying in the early neonatal mortality was four times greater than in the late neonatal period. Moreover, consistent with other several studies stated majority of neonatal mortality happen at early neonatal period (4, 16). These could be because majority of neonatal death is associated with events surrounding delivery, pregnancy, and neonatal care following birth.

Since the yearly trends of neonatal mortality show a serious of unstable rates, the confidence intervals around each rate are very wide and cross over each other, and the pattern over time is quite jagged, it is very difficult meaningfully interpret the yearly mortality rate. Therefore, to overcome the problems other techniques like moving averages have been applied and further analysis and interpretation made based on four years moving average. Therefore, the increment in mortality rates in this population was seen in the early study period and the year between 1994 and 1999 and the rapid decline in mortality rates particularly marked in 1990-1996. The reason for rapid decline in these years could be explained by weaker data supervision, preceding the first re-census in 1995 (39). The increase was particularly seen in 1998 and 1999, and can be largely attributed to the humanitarian crisis with the Butajira population during 1998-1999, which reflect epidemics of malaria and diarrheal disease and it resulted excess mortality rate in this period (40). However, the overall mortality trends did not show a change; this result is consistent with EDHS this state's no considerable declining in neonatal mortality observed.

Butajira HDSS data suggest absence of change in mortality trend during the period under consideration (1987-2008). High mortality was associated on male sex, Muslim, those who have no oxen, and those who living further to the hospital.

The sex of the neonates significantly influenced the rate ratio of dying, and consistent with other reports, we found females had a lower risk of mortality than males during the first month of life (14, 35, 41). This increased risk may be also due to the large proportions of neonatal deaths occurring in the first week, which is the time when gender differences in neonatal mortality are more pronounced(34). The biological factors that have been implicated with this increased risks of neonatal deaths in male infants include respiratory syndrome related to late maturity(42) immunodeficiency(43) increasing the risks of infectious diseases in males, late maturity (34)resulting in a high prevalence of respiratory diseases in males, and congenital malformations of the urogenital system.

Most previous study revealed that distribution of neonatal mortality rates vary in rural-urban residence. I.e. neonatal mortality is high in rural areas (14, 25, 26). In this study, it was clear that there were an evidence of change in mortality between urban and rural at bivariate analysis. However, the multivariate regression model used suggests that there was no a persisting disparities between the residential area. This is consistent with EDHS 2011, which states urban areas have lower mortality than in rural areas [41 per 1000 live births and 43 per 1000 live births respectively](14). However, the difference is quite small and is not statically significant. This could be explained by progress of Ethiopian government successful polices on developing the rural areas through provision of health and provide skilled pregnancy and delivery care at grass root level.

In most countries, the mortality rates vary by socio economic status (14, 26, 44). We have incorporated some proxy indicators for socio economic status such as type of roof, oxen and house ownership. Since the variables that show socio economic status is very low, we could not compute wealth index or principal component analysis. The results showed direct associations between neonates were born to mothers had no oxen and their house type is thatched (low socioeconomic status) and a high neonatal mortality rate during the study period.

On the other way, though, there was no significant association between house ownership and neonatal mortality this study showed larger neonatal mortality among those who live in their own house than those who live in rent house. This largely attributed to most people in the rural area live in own house in the “Tikul”. Therefore, these may depict low quality of houses and poverty level of the community.

Religion emerged as the predictor of neonatal mortality. Those neonates were born to Muslim significantly influenced the rate ratio of neonatal dying. This increased risk could be largely explained by large fixed religion effect on study area.

Relying on straight- line distance from home to the hospital as an indicator of geographical accessibility to hospital facilities utilizing GIS to estimate distance to hospital; potentially a more accurate assessment of geographical accessibility was assessed. There was evidence to suggest that living further to hospital increased the risk of neonatal mortality in Butajira district. However, distance farther than 10 km had no significant effect on neonatal mortality. Larger numbers of episodes in this segment of population make the denominator to be big and the rate to become small could explain this. Therefore, there was increasing risk of neonatal death with larger travel time to hospital. Our findings are consistent with those of previous studies that identified universal access to basic health services before, during and after childbirth as being protective against the occurrence of perinatal deaths(29). Controversy to this study, other findings found that longer the distance between maternal residences had no significant effects on neonatal mortality (30-32). They suggest that factors other than geographic access may be key to understanding the risks associated with health care utilization. These could include quality of care, level of available care (primary versus secondary), cost and social barriers. Therefore, this suggests problems of service quality rather than geographic access, and highlights the need to assess and improve the capacity of health facility.

A limitation of the study is the potential to miss neonatal deaths, particularly early neonatal deaths, which would underestimate the overall neonatal mortality burden. Neonates that are born and then die during the same day may not be reported, particularly if the mother migrated out of the household. However, any missed deaths have always been incorporated in to the database retrospectively when discovered. Some important determinants of neonatal mortality were not explored because of missed data and lack of information; this also can be seen as limitation of this study. These things make it probable that neonatal mortality is underestimated and making difficult to have more determinant factors.

7. Conclusion

The 1987–2008 Butajira HDSS data examined in this analysis demonstrated that no significant change observed in neonatal mortality trend. The study showed that socio economic and demographic variables had significantly affected neonatal mortality in Butajira district. The most important determinant of neonatal mortality is male sex, born to mothers have no oxen, neonates were born to mothers living in thatched house, and low access to hospital. There was no difference in neonatal mortality levels between urban and rural areas.

8. Recommendation

These findings point to the need for comprehensive prevention strategies to further reduce neonatal mortality in Butajira district. Income generating activities would be created in the rural area and consequently they can inhance thier socioeconomic status. At the community level, particularly in area where the rate ratio of neonatal death is significantly higher, the availability of health infrastructure near to the community will have significant impact in reducing neonatal mortality. At the household and individual levels, health promotion strategies to increase awareness of the importance of institutional delivery and postnatal care service utilization are needed given their protective effect on early neonatal mortality. The surveillance system should also incorporate pregnancy follow up in the routine data collection activities in order to get complete information related to pregnancy outcomes and associated factors. We also strongly recommend operational community-based studies using population framework of Butajira HDSS aimed at further identifying different determinant factors of neonatal mortality that are amenable to intervention.

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Annex:

Annex I: BRHP data collection forms

Birth registration form

Butajira Rural Health Project

0. Reason for filling out this form ⌊_⌋ 1. Surveillance 2. Reconciliation

		DD MM YYYY
1.	Date of interview	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋
2.	Name of interviewer / /	code⌊_⌋⌊_⌋
3.	House number (where the mother gives birth)	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋
4.	Name of the head of family / /	
5.	Name and ID of child / /	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋
6.	Sex of the child ⌊_⌋ 1. Male 2. Female	
7.	Mother's name / /	
8.	Mother's house number ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	ID ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋
9.	Father's name / /	
10.	Father's house number ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋	ID ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋
11	Mother's relation to the family head ⌊_⌋⌊_⌋	

01. Head	02. 1st spouse	03. 2nd spouse
04. 3rd spouse	05. 4th spouse & above	12. Child of head and 1st spouse
13. Child of head and 2nd spouse	14. Child of head and 3rd spouse	15. Child of head and 4th spouse
21. Child of head only	22. Child of 1st spouse only	23. Child of 2nd spouse only
24. Child of 3rd spouse only	25. Child of 4th spouse only	31. Parent of head
32. Parent of 1st spouse	33. Parent of 2nd spouse	34. Parent of 3rd spouse
35. Parent of 4th spouse	41. Other relative of head	42. Other relative of 1st spouse
43. Other relative of 2nd spouse	44. Other relative of 3rd spouse	45. Other relative of 4th spouse
46. Other relatives	47. Adopted child	48. None relative

12. Relation of the child to the family head ⌊_⌋⌊_⌋ (refer codes from ques. 12)

		DD MM YYYY
13.	Date of birth	⌊_⌋⌊_⌋ ⌊_⌋⌊_⌋ ⌊_⌋⌊_⌋⌊_⌋⌊_⌋
14.	Status of the baby at birth? ⌊_⌋	1. Live birth 2. Still birth
15.	Was the birth single? ⌊_⌋	1. Single 2. Twin 3. Triple & more
16.	Was the new born child physically normal ⌊_⌋	1. Normal 2. Physically abnormal

17. Place of delivery? ⌊_⌋⌊_⌋

01. Parents' home 02. Own home 03. Neighbour's house 04. Health post
05.Clinic/Health station 06. Health center 07. Hospital 08. Private clinic
91. others (specify) _____

18. Who assisted the delivery? ⌊⌋
1. TBA 2. Relative 3. Neighbour 4. Health professional (doctor, nurse) 5. TTBA
6. No assistant 7. Community health worker (CHA) 8. other (specify) _____

19. Did the mother seek health care for complications of delivery like retained placenta and post partum hemmoriage? ⌊⌋ 1. Yes 2. No

20. If yes to question 20, where did she seek care? ⌊⌋
1.Health post 2. Clinic/health station 3. Health center 4. Hospital 5. Private clinic 6. Others (specify) ____ 7. None

21. Total number of pregnancy (including this birth) ⌊⌋⌊⌋

22. Total number of deliveries (including this birth and any still births)⌊⌋⌊⌋

23. Total number of Live births (inclding this birth) ⌊⌋⌊⌋

24. Total number of Live children at present? ⌊⌋⌊⌋

25. Is your next to last child alive? ⌊⌋ 1. Yes 2. No 3. First child_____

26. What is the religion of the child ? ⌊⌋
1.Orthodox Christians 2. Muslim 3. Catholic. 4. Protestant 5. No religion 6. 0thers (specify) _____

27. What is the ethnicity of the child? ⌊⌋ 0. Welene 1. Sodo 2. Dobi 3. Meskan 4. Mareko 5. Silti 6. Amhara 7. Oromo 8. Other (specify) _____

Death form

Butajira Rural Health Project

0. Reason for filling out this form? ⌊_⌋ 1. Surveillance 2. Reconciliation

1. Date of interview DD MM YYYY ⌊_⌋⌊_⌋⌊_⌋⌊_⌋

2. Name of interviewer code⌊_⌋

3. House number ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

4. Name of the deceased person ID ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋ / /

5. Date of death DD MM YYYY ⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋

6. Sex ⌊_⌋ 1. Male 2. Female

7. If female, was she pregnant at the time of death? ⌊_⌋ 1. Yes 2. No 3. Under age/child (Skip to # 9)

8. If female, when was her last delivery ? ⌊_⌋ 1. Less than 6 weeks 2. 6 weeks to 3 months 3.4-11 months ago 4.1-4 years ago 5.five years or more 8.Unknown 9. Name of family head / /

10. Relation of deceased person to the head. ⌊_⌋⌊_⌋

01. head	02. 1st spouse	03.2nd spouse
04. 3rd spouse	05. 4th spouse & above	12. child of head and 1st spouse
13. Child of head and 2nd spouse	14. child of head and 3rd spouse	15. child of head and 4th spouse
21. child of head only	22. child of 1st spouse only	23. child of 2nd spouse only
24. child of 3rd spouse only	25. child of 4th spouse only	31. parent of head
32. parent of 1st spouse	33. parent of 2nd spouse	34. parent of 3rd spouse
35. parent of 4th spouse	41. other relative of head	42. other relative of 1st spouse
43. other relative of 3rd spouse	44. other relative of 3rd spouse	45. other relative of 4th spouse
46. other relatives	47. adopted child	48. non-relative

11. Cause of death (reported) ⌊_⌋⌊_⌋

01. Still birth	09. Malnutrition	18. Suicide
02. Premature birth	11. Meningits	19. AIDS
04 .Malaria	12. Tubreculosis	20. Inv Abortion
05. Phneumonia	14. Sudden death	21. Ind. Abortion
06. Measles	15. Tetanus	22. Glandular TBC
07. Whooping cough	16. Hepatits	81. Accident (describe)
08. Diarrhea/vomiting	17. Pregnancy/ delivery related	91. Other describe

12. Place of death ⌊_⌋⌊_⌋

01. Parents house	02. Own residence	03. Neighbour
04. Health post	05. Clinic	06. Health center
07. Hospital	91. Other (specify) _____	

13. Where did the deceased mainly seek health care for the illness that lead him to death? ⌊_⌋⌊_⌋

01. Governmental health center	04. Traditional health care	07. Health station
02. CHA/HP	05. Did self-treatment	08. Did nothing
03. Pharmacy	06. Private clinic	
09. Other (specify)_____		
10. Hospital		

BRHP House Registration Form

1. Reason for filling out this form ⎕ 1. Surveillance 2. Reconciliation

2. Date of interview **DD MM YYYY** ⎕⎕ ⎕⎕ ⎕⎕⎕⎕

3. Name of interviewer and code ⎕⎕

/ /

4. Is it a newly built house? ⎕

1. Yes, new 2. No 3. Yes, modified 4. Yes, demolished & rebuilt 5. No, demolished

5. If new, the nearest house number ⎕⎕⎕⎕‖⎕⎕⎕⎕

6. House number ⎕⎕⎕⎕‖⎕⎕⎕⎕

7. Name and ID of head ⎕⎕⎕⎕‖⎕⎕⎕⎕‖⎕⎕

/ /

8. Who is the owner of the house? ⎕

1. Own 2. Governmental / Kebele 3. Rented from Individuals/Private 4. Cohabitant (Un-rentablel)

5. Other (specify) _____ 6. Cohabitant (Paying)

9. Type of roof ⎕

1. Thatched 2. Corrugated iron sheet 3. Other (specify) _____

10. Characteristics of the wall of the house? ⎕

1. Wood and mud 2. Wood and stalk/ grass 3. Stone and cement 4. Hollow blocks

5. Bricks 6. Corrugated iron sheets 7. Other (specify) _____

11. Does the house have a separate kitchen? ⎕

1. Yes 2. No 3. Yes, shared

12. How many rooms does the house have (excluding kitchen)? ⎕⎕

13. Does the house have windows? ⎕

1. Yes, a small opening 2. Yes, openable and closeable 3. No

14. Does the house have its own source of water within the compound? |__|

1. Yes, well 2. Yes, Pipe 3. No

15. What type of toilet facility does the house have? |__|

1.None 2. Pit latrine (functional) 3. Pit latrine (non-functional) 4. Flush toilet (functional)

5. Flush toilet (non functional)

6. Other (specify _____

16. Does the house have electricity? |__|

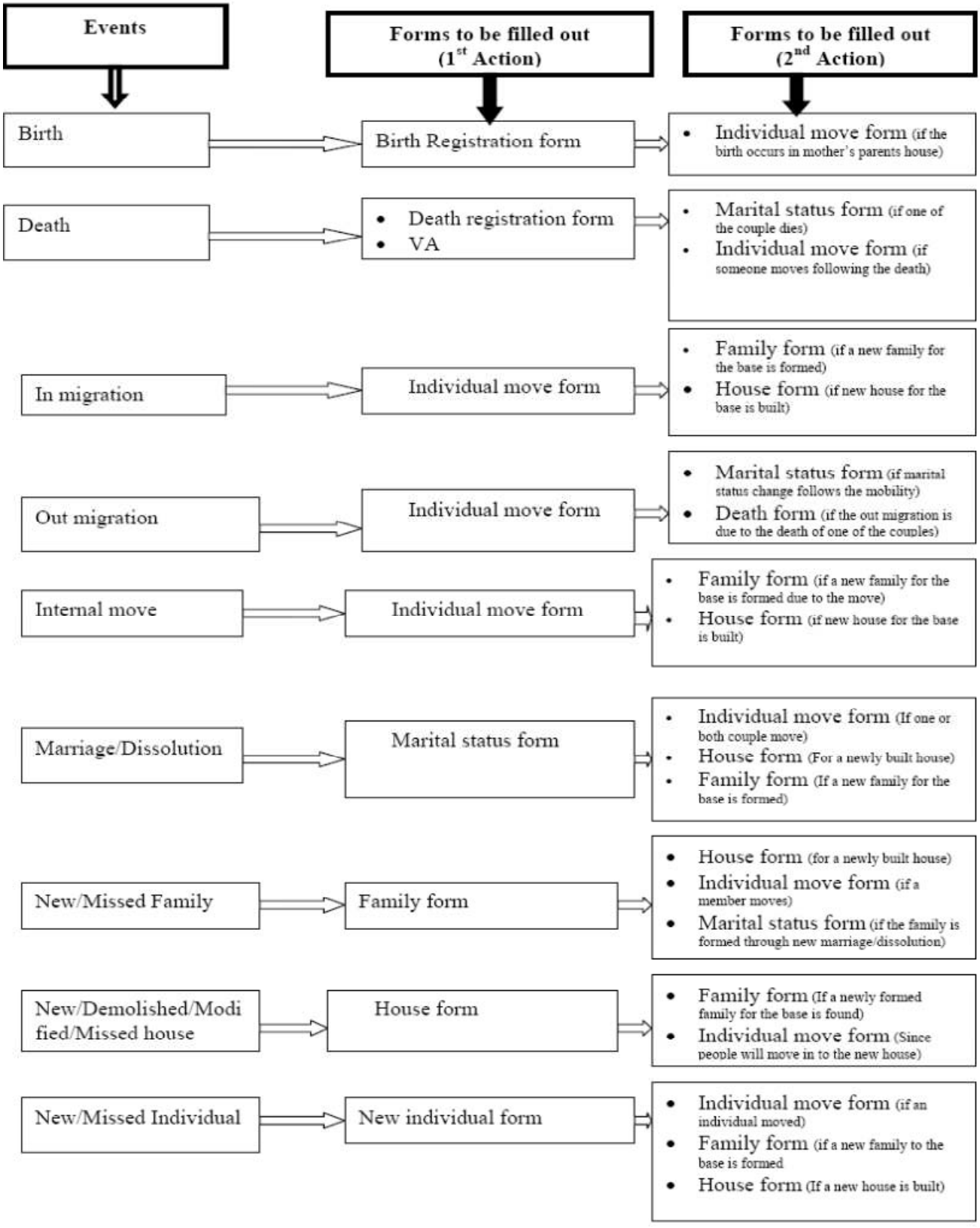
1. Yes 2. No

17. Geographical position: North |__|__|.|__|__|__|__| East 038^{o} |__|__|__|__|

18. Housing dimension (Tukuls) Axis |__|__|__|__| Radius |__|__|__|__| Wall height |__|__|__|__| (Cms)

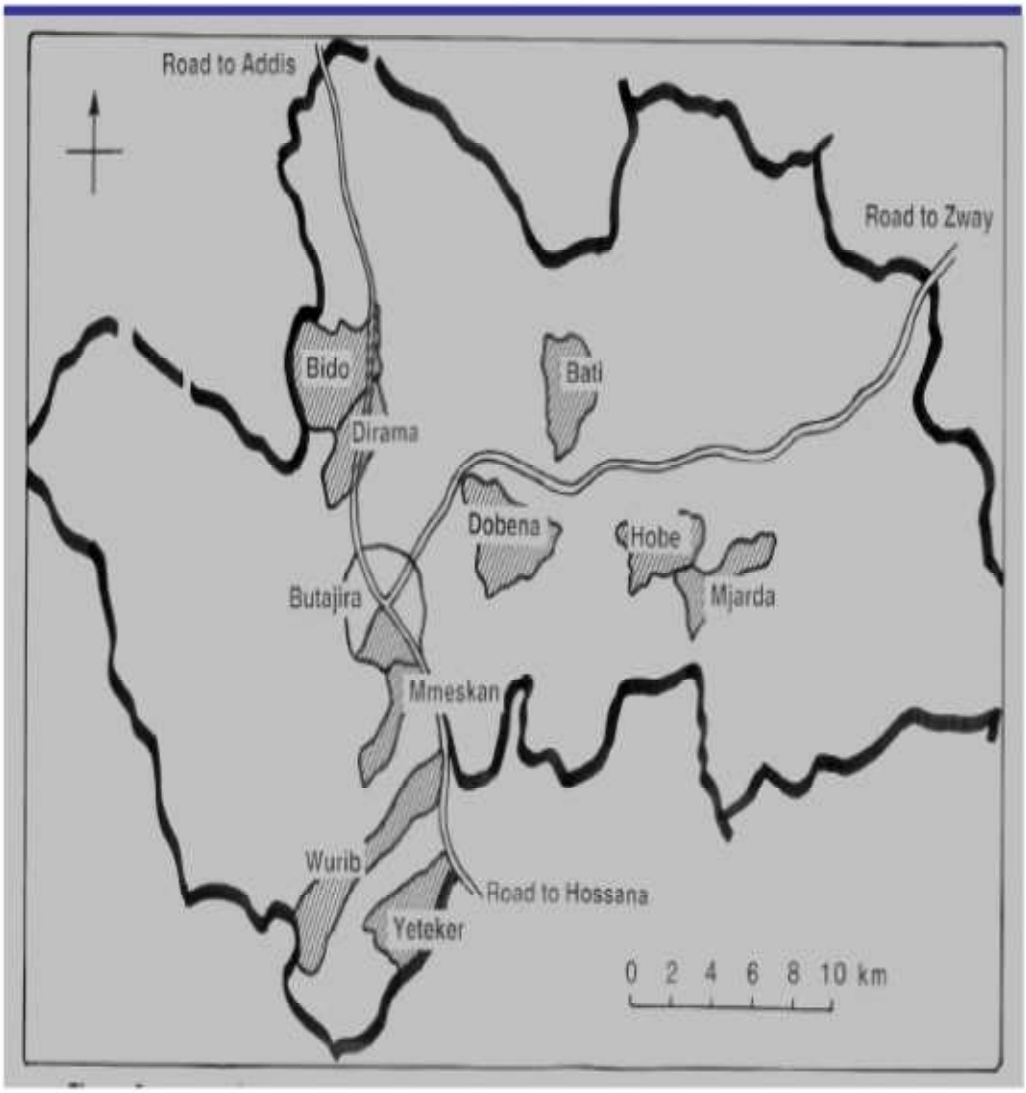
BRHP: House registration form Version: II Print Date: June 2, 2004 Serial #: _____

Flow chart showing the activities of a BRHP data collector

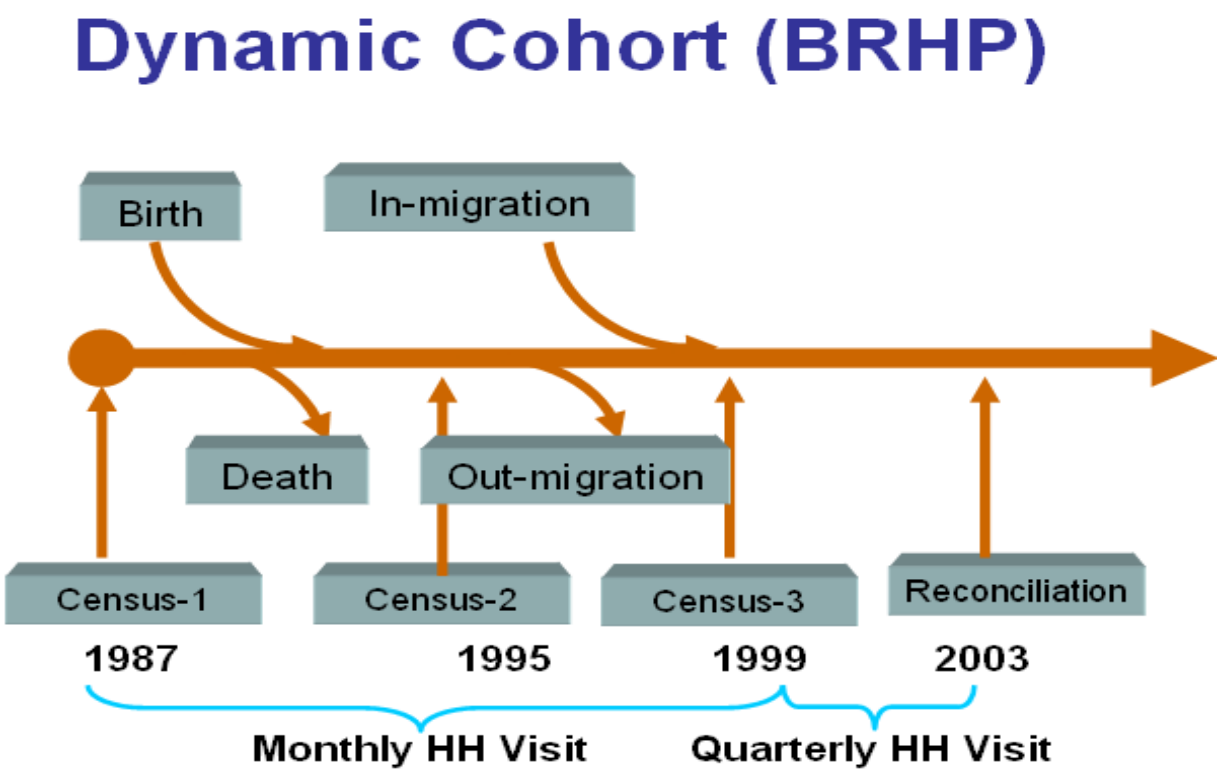


Annex II Geographical map of Butajira district

Annex III Geographical map of sampled kebeles



Annex IV Dynamic cohort of BRHP



DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in this or another university and all the sources of materials used for the thesis have been fully acknowledged.

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Signature: _____

Date _____

This thesis work has been submitted for the examination with my approval as a university advisor

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