**ADDIS ABABA UNIVERSITY**

**COLLEGE OF HEALTH SCIENCES**

**SCHOOL OF PUBLIC HEALTH**

# Assessment of Effect of Access to Free Health Care on Early Childhood Mortality, Controlled Quasi Experimental Study of Butajira Birth Cohorts from 2002-2008, South Central Ethiopia.

Principal Investigator: Mebrahtu Abay (BSc.)

**Advisors**: Prof. Ahmed Ali, PhD

Dr. Wubegzier Mekonnen, PhD

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A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters in Public Health.

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By: Mebrahtu Abay, Bsc.

**Approved by Examining Board**

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| | |
|---|---|
| **AHR** | Adjusted Hazard Ratio |
| **AOR** | Adjusted Odds Ratio |
| **BRHP** | Butajira Rural Health Program |
| **CHR** | Crude Hazard Ratio |
| **CI** | Confidence Interval |
| **C-MaMiE** | Child outcomes in relation to Maternal Mental health in Ethiopia |
| **DSA** | Demographic Surveillance Area |
| **DSS** | Demographic Surveillance System |
| **EDHS** | Ethiopian Demographic and Health Survey |
| **FMoH** | Federal Ministry of Health of Ethiopia |
| **HR** | Hazard Ratio |
| **ID** | Identification Number |
| **IMR** | Infant Mortality Rate |
| **MDG** | Millennium Development Goal |
| **NMR** | Neonatal Mortality Rate |
| **PHC** | Primary Health Care |
| **PYO** | Person Years Observation |
| **SNNPR** | Southern Nations Nationalities and Peoples Regional state |
| **SSA** | Sub Saharan Africa |
| **TTBA** | Trained Traditional Birth Attendants |
| **U5MR** | Under-five Mortality Rate |
| **UNICEF** | United Nations International Children's Emergency Fund |

# ABSTRACT

**Background**: Mortality in African children is unacceptably high. Providing free health care to young children has been hypothesized to improve access to health care and lead to better health outcomes. However, there have been only few methodologically robust studies testing this hypothesis. This study examined the impact of free healthcare provided to a birth cohort of children born from March, 2005 to June, 2006 in Butajira DSA (Demographic Surveillance Area) through the C-MaMiE project (Child outcomes in relation to Maternal Mental health in Ethiopia), in comparison to three cohorts of user fee children (children born within 2.5 years before and after the intervention and parallel with the intervention).

**Objective**: The aim of this study was to assess the impact of making health care services free at the point of use upon under-fives mortality.

**Methods**: This controlled quasi-experimental study compared intervention cohort, children born in Butajira from March, 2005 to June, 2006 and received free health care provided by the C-MaMiE project, from pre-birth (pregnancy) to 12 months, and from 24 to 60 months, and three comparison cohorts of children born in the same geographical area (2.5 years before, during and after the intervention). The crude and adjusted under-five mortality in the intervention cohort versus the comparison cohorts was evaluated using Cox regression model.

**Result**: Incidence of under-five mortality was 15.7 (12.3-20.0), 98.7 (88.3-110.3), 41.2 (35.2-48.2) and 39.3 (33.5-46.1) per 1000 person-years of observation children provided free, user fee before intervention, user fee during intervention and user fee after intervention health care services, respectively. The risk of under-five mortality among user fee children (before, during and after the intervention) were 5.87 (4.47-7.72), 2.45 (1.84-3.28), and 2.72 (2.03-3.66) times higher than those provided freely, respectively. Maternal death (AHR=2.10; 95% CI; 1.36-3.23), rural residence (AHR=0.56; 95% CI; 0.44-0.72) and death of elder child (AHR=1.28; 95% CI; 1.01-1.61) were also found to be independent predictors of under-five mortality.

**Conclusion and recommendation:** There was a slow decrement of early childhood mortality in the study area and was relatively high among user fee children, even compared to the after arm comparison cohort whereby lower mortality is expected, and health policy makers should give more emphasis on abolition of user fee health care services as it is one of the methods which significantly reduce under five mortality.

# 1. INTRODUCTION

## 1.1. Background

Mortality in African children is unacceptably high; every year approximately 10 million children under 5 years of age die throughout the world, mostly from developing countries [1-2]. Out of 1000 children born in sub-Saharan Africa, approximately 170 die, compared with less than 10 of those who are born in developed countries [2]. To achieve reduction in child mortality, it is vital to establish good levels of access to essential health care for young children [3].

Considerable efforts have been made to identify barriers to accessing health care like perceived quality of service, socio-cultural factors, availability of health services, travel cost and cost of services [4]. In many developing countries, people are expected to contribute to the cost of health care from their own pockets [3]. As a result, the affordability of health care has become a critical policy issue in developing countries [5], and a particularly urgent issue where households face combined user fee burdens from various essential service sectors such as health, education and water [6-8]. Children in the poorest countries are falling ill and dying since health services are unaffordable, physically inaccessible or low quality [9].

Universal access to healthcare is not an unaffordable pipe dream. Some of the poorest countries in the world have made dramatic strides towards ensuring that every child, regardless of where they live, and their family's level of income, can get the prevention, care and treatment needed to lead healthy lives [10]. However, many more countries continue to fund healthcare from fees charged at the point of use, which often forces children either to forgo essential care or drives their families into poverty [10]. Many low and middle-income countries have exempted patients from user fees in certain categories of population or of services. These exemptions are very effective in lifting part of the financial barrier to access services [11], but they have been organized within unstable health systems, where there are sometimes numerous dysfunctions [12]. Progress of under-five mortality is slow especially in Africa [10].

## 1.2. Statement of the Problem and Significance of the Study

One of the Millennium Development Goals to achieve by the year 2015 is the Millennium Development Goal 4 (MDG-4) which underscores reduction in child mortality by two third. If we have to reduce the level of child mortality, a concerted effort is needed to improve the coverage of health services [13]. International donors and agencies have called for removal of healthcare user fees for vulnerable populations in developing countries, including children and mothers [14-15]. However, for governments to consider committing to removal of user fees there needs to be strong evidence of the effectiveness of this approach in terms of improved health outcomes within the population. Furthermore, removal of user fees may limit income-generating opportunities for health facilities and result in difficulties with service quality or medication supply, which in turn may impact on uptake of health care. Currently this evidence is lacking [16].

There has been considerable controversy about role of removal of user fees, with advocates putting the case for user fees based on the need for additional resources, investment in quality services and reduction of frivolous demand [17-18]. The area of health financing is very dynamic, with many countries introducing reforms to user fees in recent years. The aims of these reforms have typically been to reduce the overall burden of direct payments for users, and/or to target benefits to priority user groups and services. In many cases, with an eye to slow progress towards the Millennium Development Goals, the focus has been on pregnant women and young children [19]. User fee reduction or removal is one such approach. Many of these policies are still in their early stages and a body of evidence based on thorough evaluations has not yet emerged [17].

One of the five pillars of the Consensus for Maternal, Newborn and Child Health, agreed in 2009, includes: ‘Removing barriers to access, with services for women and children being free at the point of use where countries choose [5]. Recent UN and other international initiatives have also highlighted the importance of addressing the financial barriers to accessing health care, including user fees, which represent one of main barriers for poor people [5].

In recent years several countries have introduced reforms to user fees; a growing number of countries are also introducing basic health care free at the point of use. In many cases, the focus has been on making health care more accessible for priority groups, particularly pregnant women and young children. However, despite the high interest in user fee removal, there are many information gaps on the current status of user fees in low-income countries, particularly for those interested in carrying out international comparisons [17].

Since episodes of illness are often difficult to anticipate and can involve large one-off costs which poor households are least able to meet, user charges can have a life and death impact [10]. Children are often the first and worst affected, since they account for a large proportion of healthcare needs [10]. Expecting families to pay for healthcare at the point they need it is bad for child health. Healthcare for children will only be accessible if it is free at the point in which it is used [10, 20].

Many previous studies evaluating the impact of removing user fees have relied on before-after comparisons which do not account for secular trends. They have also been limited by reliance on health service use as an indicator of success, without examining the impact of removing user fees on actual health outcomes [14-15, 17, 21]. Which countries charge user fees for health care? What level of fees do they charge? What sort of exemptions do they offer? Are these exemptions effective? How do the official fees interact with informal payments by users? These are all questions of great practical importance as development partners and researchers work to support health financing reforms in these health systems. There is no easy source of answers at present [17, 22].

In Ethiopia, it is clear that the population in the lowest wealth quintile has significantly poorer access to basic health care [50]. A study on the perceptions of user fees for health services showed that fees presented a considerable psychological burden to a family, especially when dealing with unexpected major illnesses. Families usually did not save and were often forced to sell assets in these situations [51].

A more recent study on vulnerable children showed that the cost of illness was a significant factor in tipping families from poverty into extreme vulnerability and exposure to several risks

[50-51]. The fees charged are often not standard and the indirect costs of health care such as transport costs and lodging for the family and food were as much of a burden as the fees themselves. Similarly, the recent National Health Account (NHA) survey round IV found that 4 out of 10 people who had been sick within the 4 weeks preceding the survey did not seek care and by far the most common reason given was affordability. This survey also estimated the national out of-pocket per capita health expenditure to be US $4.15 for outpatients, US $0.46 for inpatients, and US $0.94 for non health expenditures (transport, accommodation, and food etc.). The indirect costs were higher for rural residents than urban. Half of clients walk almost 10 km to get to facilities [51].

The implementation manual for health care financing reforms of the Federal Ministry 2005 [51] states that prenatal, delivery, postnatal, and family planning services provided by primary healthcare units (health centers and health posts) should be exempt from payment for all people (regardless of ability to pay), along with tuberculosis treatment, immunization, voluntary counseling and testing (VCT) for HIV, prevention of mother-to-child transmission of HIV (PMTCT), leprosy, and epidemic related services. However, as stated above, the cost of these services is not reimbursed to health centers and must be covered by other revenues. Exemptions do not apply at hospital level [50-51]. This database study allows comparison between birth cohorts of children who did or did not receive free healthcare during their childhood period, and this is linked to the outcome of early childhood mortality.

# 2. LITERATURE REVIEW

## 2.1. Levels and Determinants of Early Childhood Mortality

### 2.1.1. Levels of Early Childhood Mortality

Infant and child mortality has long been used as indicator of the level of socio-economic development of a nation [11]. In 2002, as part of the Millennium Development Goals (MDGs) for health, nations pledged to ensure a two third reduction in child mortality by 2015, from the base year of 1990 [23]. The level of infant mortality improved until the 1970s. The progress of infant mortality for the period 1975-85 was a lost decade as it stagnated at 150 per 1,000. Only in 1985-90, infant mortality started to decline and again today Ethiopia has, wish values around 110 deaths per 1000 live births in the first year of life. In the 1990s, U5MR was estimated above 180 per 1000, implying that not even one out of six new born is reaching its $5^{th}$ birthday [3]. According to existing literatures on famine in Ethiopia, it is estimated that the U5MR for refugee population with 316 births 1000 for males and 276 for females [23].

Ethiopia, in the last decade, has made great strides to improve child survival. However, the National Infant and Under-five Mortality Rates are still high, about 97/1000 and 140/1000 respectively [3]. Though there is a continuously declining trend of child mortality, still about 472,000 Ethiopian children die each year before their fifth birthday [24-25], which places Ethiopia sixth among the countries of the world in terms of the absolute number of child deaths. A Child Survival Strategy was developed in order to lower the child mortality rate to 67/1000 by 2015 [3].

According to the Countdown analysis, only seven of the 60 countries with the highest burden of under-five mortality in 2004 are on track to achieve MDG 4; Ethiopia was not included in this reduction. Across Sub Saharan Africa a 10-fold increase is required in the annual rate of reduction of under-five mortality [26].

Among 1,445 birth cohorts included in a particular study at Butajira DSA, 2006, 215 (14.9%) child deaths were experienced for the last five years of exposure. These study subjects had contributed 5,957 person-years with 26 incidence cases, and the overall under five mortality rate in the study was found to be 117.7 deaths per 1000 live births [23]. Neonatal, infant and under five mortality rates from the EDHS reports, were 49, 97 and 166 in the year 2000, 39, 77 and 123 in the year 2005, and 37, 59 and 88 in the year 2011, respectively [27].

Another study at Butajira, Ethiopia in 2012 also revealed that the trend of neonatal mortality did not show a change over the study period and there was a highest risk of death on the first day of life (incidence rate ratio of 18(16.6-19.4) [28].

### 2.1.2. Determinants of Early Childhood Mortality

The causes of most of childhood deaths are pneumonia, diarrhea and malaria, and complications and infections during and immediately after birth [30]. These diseases rarely lead to early mortality among children in rich countries [29-30]. Children are continuing to die in huge numbers in the poorest countries not because the solutions are unknown, but because the known solutions are not reaching them. Ninety nine per cent of children's deaths are in developing countries, half of them in SSA [31].

In sub-Saharan Africa, studies have shown that premature birth, low birth weight and infant illnesses are main proximate causes of child death, with under nutrition underlying 50% of the mortality associated with these conditions [32-33]. About 90% of mortality in under-fives is caused by pneumonia, neonatal causes (prematurity, asphyxia and neonatal sepsis), malaria, diarrhea and measles [1, 24, 34]. The levels of mortality are exacerbated by poverty and being unable to pay for health care services [4, 6, 35].

A study in Butajira, Ethiopia indicated that the level of malnutrition is high and socioeconomic factor and women's education were important in explaining the variation in long-term nutritional status of children [23]. The same study revealed that child survival was not associated with educational status, marital status, religion, working status, age of mother and ethnicity of the mother.

An event history analysis from EDHS also stated that maternal education, twin births, births to teenage mothers and being male sex, can generally be regarded as high risk of under-five mortality [36]. Another study from south west Ethiopia revealed not attending antenatal care follow-up [AOR=2.04, 95% CI:(1.04,4.02)], not using soap for hand washing before feeding child, negative perceived benefits of mother to modern treatment and prevention, small birth size and high birth order with short birth interval were found to be independent determinants of child mortality [24].

An event history analysis of neonatal death in Butajira showed that being male, distance to hospital, born to follower of Muslim, born to mothers with no oxen and living in thatched house were significant risk factors of neonatal mortality [28, 37]

## 2.2. Medical Care Cost and Under-five Mortality

The concern of many governments is whether to secure additional finance through non-budgetary sources such as payroll taxes, voluntary insurance, and increased private finance through patient cost-sharing or to remove user fees [7, 38]. However, before such reforms can be considered, information is needed on the extent to which increased or removed charges may affect access to health services, especially amongst the poor [38]. Whether governments should charge patients fees to use public health services has become one of the most contentious social policy issues worldwide. Sadly for policy makers, in recent years, the quality of debate in this area has often been poor [39].

In the 1980s, after two decades of free but poor quality health services, nearly all African countries introduced user fees for public health care services. This decision, taken by governments with the support of the World Bank, was nevertheless contested by many in civil society and the scientific community [6].

For many years, pregnant women, breastfeeding mothers and children have suffered and died because they simply could not pay fees for consultations, drugs and other services [40]. Health

services in Ethiopia are financed by four main sources: 1) government (both federal and regional), 2) bilateral and multilateral donors (both grants and loans), 3) non-governmental organizations, and 4) private contributions, both from out of pocket payments and through private sector investment in health services [41].

Scaling up some cost-effective health-care interventions would improve the health status of people in the developing world [34]. However, this improvement can happen only when people actively use the services delivered. To have services nominally available is not enough; services need to be used. In many low-income countries, the rate of utilization is very low. For example, in the Democratic Republic of Congo, people visit a health facility only once every 6.7 years [13].

A study from Ghana stated that providing free health care had a modest, but significant, impact on health care utilization. Children were taken to primary care facilities significantly more frequently in the intervention than in the control arm with relative risk of 1.12 ($p=0.001$) [4].
A study from Gambia suggested that 20% of care givers of ill children did not attend health centers because of health service cost. Furthermore, a case–control study in the same country found no difference in the odds of child death between children whose parents paid to get to the health center and those whose parents did not [42]. A study from Hungary found that there is statistically significant association between amenable mortality and deprivation status in both genders ($p<0.05$) [1]. Another study from Tanzania revealed that under-five mortality was associated with socio-economic status and the poorest were 2.4 times more likely to die compared to the most rich [43].

A study from Kenya revealed that the rate of sick-child visits for infants, increased by 191% (95% CI 75–384) in intervention villages (free medical care) more than in comparison villages, but did not increase significantly more in older children [14]. Later on, an increase was particularly notable among children 5–9 years old, who previously would have been excluded from the government-sponsored free care program [14, 44].
An African systematic review with three stage analysis used statistical modeling to show that abolition of fees could prevent approximately 233,000 deaths (estimate range 153,000-305,000)

annually in 20 African countries [35]. It reflects the application of the Ugandan experience, where poor people are assumed to be the main beneficiaries of such a policy. Abolition of user fees can have an immediate and important impact on reducing child deaths. Evidence on the positive relation between out of pocket and catastrophic health expenditures suggests that it may also help to stabilize household incomes, although only if fees make up a substantial proportion of the costs of ill health [45]. The mortality concentration index for under-five children is indicated to be considerable health inequality between poor and non-poor [43].

Despite its advantages, free access to health care has disruptions like immediate and significant increases in service utilization, perceived heavier workloads for health workers, lack of information about free services provided and their reimbursement, and unpredictable and insufficient fundings [12].

A study from Mali showed that for children less than 5 years, the health care utilization rate increased progressively from 0.34 in 2004 to 0.45 in 2005 and 0.70 in 2006. In 2007, with free care, it increased to 2.86, corresponding to four times more children being treated compared with the first phase of the project and was sustained to 2008 [45]. A similar study from Gambia states that parents who were unable to cut spending for health care of their children (OR: 2.5) or had to carry out odd jobs to pay for the care (OR: 3.4) were more likely to die [42]. A longer distance to travel (more than 3 kms) and higher costs to reach the health facility were significantly associated with child death. However, after controlling for possible confounding factors, only place of residence retained significance [42].

## Conceptual Framework

The conceptual framework on the causes of childhood mortality illustrates that health outcome is determined by interrelated socio-demographic and socio-economic factors such as child, maternal and house hold factors, environmental factors and affordability of health services. Generally, the risk of childhood mortality is multiple and complex. But the Butajira DSS only comprises of socio-demographic and some socio-economic factors (Figure 1).

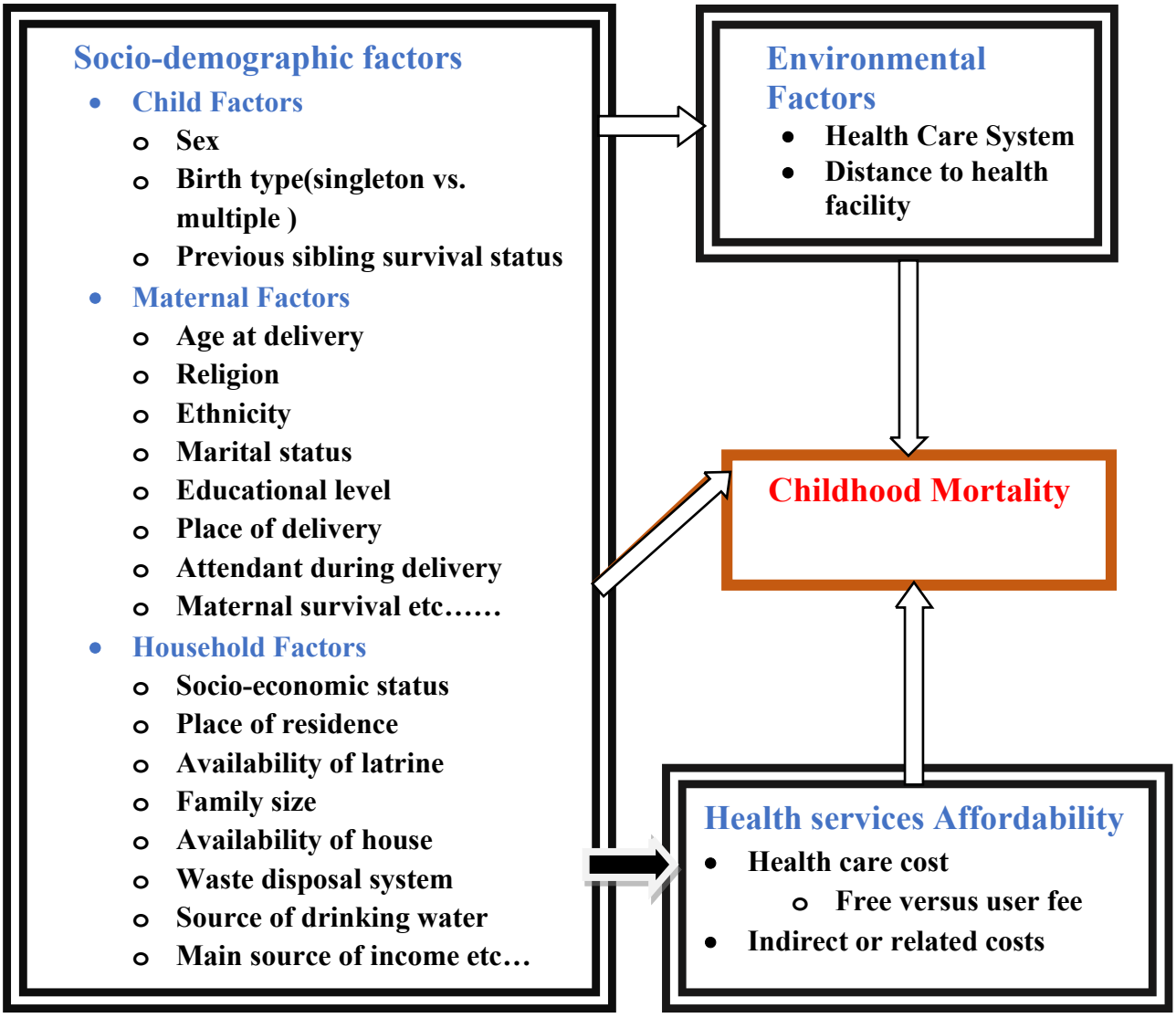



Figure 1. A conceptual frame work on determinants of early child mortality adopted from the Andersen model of access to health services (Andersen 1995) study, and modified after reviewing literatures.

# 3. OBJECTIVES

## 3.1. General Objective

To assess the effect of making primary health care services free at the point of use upon early childhood mortality among children born in Butajira district, south central Ethiopia, from July, 2002 to June, 2008.

## 3.2. Specific objectives

To determine the incidence of neonatal, infant and under-five mortalities

To determine the association between free health care services provision and survival of under-five children

# 4. METHODS and MATERIALS

## 4.1. Study Area and Period

The study was carried out in Butajira District which is part of the Butajira Demographic Surveillance Site (DSS), located in Guraghe Zone, in the Southern Nations, Nationalities and Peoples Regional state (SNNPR) of Ethiopia. The estimated area of the District is 797 $km^2$, of which Butajira Town covers approximately 9 $km^2$. The capital of the study District, Butajira Town is located 135 Kms south of Addis Ababa. The Butajira Rural Health Project (BRHP) was initiated in 1986 with the intent of developing a continuous demographic surveillance system and of providing a baseline population and sampling frame for other health-related activities that would be carried out in the area. In addition, mortality, fertility and migration levels and determinants have been continuously recorded [28, 46]. The BRHP includes one urban and nine rural kebeles which were selected using probability proportionate to size from the 82 rural and four urban kebeles of Butajira Town, respectively. The study was carried out from September, 2013 to June, 2014 (Figure 2).


Figure 2. Geographical Map of the Butajira Demographic Surveillance Area, SNNPR, South Central Ethiopia.

## 4.2. Study Design

A Controlled Quasi-Experimental Study, using Secondary Data from BRHP database and C-MaMiE Mental Health Project, design was used to compare under five mortality among one intervention (free health care service provided children) and three comparison cohorts who did not received free health care services (within 2.5 years before, during and within 2.5 years after the intervention periods).

## 4.3. Source and Study Populations

### 4.3.1. Source Population

Under five children born in the former Meskan and Mareko Districts of Guraghe zone, in SNNPR, from July 1, 2002 to June 31, 2008 in the Butajira Rural Health Program Demographic Surveillance Area (DSA) .

### 4.3.2. Study Population

Under-five children born from July 1, 2002 to June 31, 2008 in the Butajira Rural Health Program Demographic Surveillance Area (DSA) and found in the Butajira DSS data base.

## 4.4. Inclusion and Exclusion Criteria

### 4.4.1. Inclusion Criteria

Children born from usual resident mothers of the Butajira Demographic Surveillance Area during July 1, 2002 to June 31, 2008.

### 4.4.2. Exclusion Criteria: No exclusion criteria

## 4.5. Sample Size Determination

All children who received free health care services and the same number of children, as those in the free health care service, in each control cohort (those did not receive free health care services) were included for analysis. A total of 3,672 children were included for analysis with a ratio of exposed (free health care) to unexposed (no free health care) cohorts of 1:3 i.e. having 918 children in the intervention and 2,754 in comparison cohorts. Although 1006 live births were registered in the C-MaMiE project (the intervention cohort), 88 of those live births have been missed by the DSS.

## 4.6. Sampling Procedures

In the intervention(exposed) cohort there were 918 live births born from 1065 women recruited by C-MaMiE project in Rural Butajira Demographic Surveillance Area from March, 2005 to June, 2006. Those children received free healthcare services provided by the project from pre-birth (pregnancy) to 12 months, and from 24 to 60 months [47]. Using the Butajira DSS database, three comparison live birth cohorts of children from the same community, born in two and half years immediately before and after the intervention cohort, and parallel with the intervention cohort, but have not been exposed to benefits of the C-MaMiE free healthcare were selected. All, 918 children in the intervention cohort and 918 children in each control cohort selected randomly using STATA version 12 statistical software package, were included in the study. All intervention and each control cohorts were assessed when the project child was five years of age.

A total of 18,988 registered births, from 1987 up to 2013 were found in the birth table of Butajira DSS data set. After extracting by their year of birth, from July, 2002 to June, 2008, only 8,183 live birth registers remained. Then a new variable was generated by date of birth, before March 2005, March 2005 to June 2006 and after June 2006. After that, by merging with the BRHP unique child ID registered in the C-MaMiE Project, 918 children found as they received the free health care services. The same number of children as in the intervention cohort, from each of the three comparison cohorts (children born before, during and after the intervention cohort) was then randomly selected from the data set using STATA software. Then the total numbers of children ready for analysis became 3,672. For the baseline maternal and household characteristics, unique mothers' ID and unique location ID were used, respectively. This had resulted in one spread-sheet after which time variables that were not needed for the study were removed. Moreover, time to death data (survival times) were calculated by subtracting date of death from date of birth; as well as taking into account of the survival time of censored observations by subtracting date of out-migration from date of birth of the children.

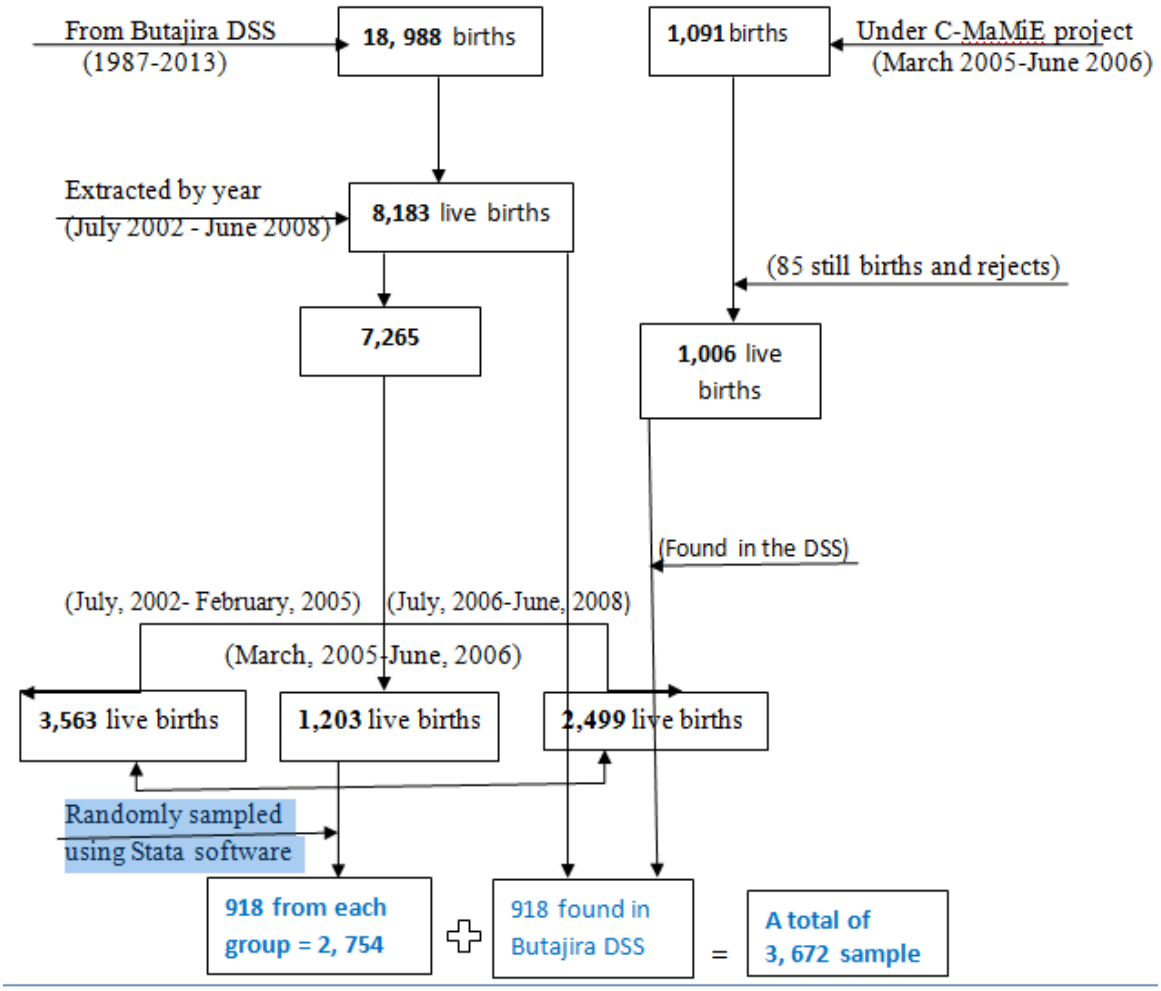



Figure 3. Diagrammatic presentation of the data extraction tool.

## 4.7. Data Collection Procedures

The study used secondary data from Butajira DSS. The data for the study population was collected by trained data collectors under the control of the Butajira DSS supervisors and program coordinators. Data were collected using structured standard questionnaires for each event. Data were collected initially monthly (until 1999) and later quarterly by visiting each household. The surveillance system operates an open cohort system and is dynamic. Household characteristics was collected during census and when a new house is constructed or a marked change in structure was occurring. Other events were recorded by village data collectors who had completed high school, speak the local language and obtained trainings when joined the base and periodically as required [28, 46]. The data collectors in C-MaMiE project were local women with completed high-school education who worked exclusively on the C-MaMiE project and had been trained for a minimum of one week in questionnaire administration (47). For the purpose of comparison only DSS data, for all intervention and each control cohorts, were used to minimize bias, except the BRHP unique child IDs which took from the C-MaMiE project to identify children in the intervention cohort.

## 4.8. Data Quality Assurance

Data entry was done by trained data entry clerks, and questionnaires had been sent back to the field if there were any inconsistencies. Quality control was insured by several checking mechanisms at different stages of the surveillance. One is field supervision; field supervisors (6 persons), each was assigned to 1-2 villages, and project coordinators oversee the data collection procedure over a daily basis. Research assistants performed the next level of supervision. Supervisors needed to interview at least 5% of registered events. Besides they were responsible to record GPS data. Research assistants extracted a sample of recorded events from the database and checked their content and coverage validity at the field. An HRS, designed special software, was used to capture and manage the longitudinal surveillance with an internal consistency system. At the highest level supervision is performed by the researchers themselves [28, 46].

## 4.9. Variables and Scales of Measurement

The dependent variable was death of under-fives children. Child survival duration (in days) was considered between the birth and the death of the child. The child surviving beyond the end of the cohort study contributed a censored case (i.e. surviving beyond five years). Out migrating children were also measured till they leave the area. Data quality was checked by cross tabulation of events and a censoring variables were created to see whether an event occurs or not. The outcome was death of child before five years of age, recorded as a binary variable.

The main independent variable was access to health care services (free and user fee).

The following baseline variables were also taken as likely covariates:

1) Child factors/characteristics: sex of the child, birth type, preceding child survival status.

2) Maternal factors: age of mother, religion, ethnicity, marital status, place of delivery, attendant at delivery, place of residence (urban/rural).

3) Household factors/characteristics: availability of latrine, main source of income, ownership of house, type of waste disposal system, source of water, family size.

## 4.10. Operational definitions

**Neonatal Mortality Rate**: number of deaths of children during their first month of life per 1000 person-years observation.

**Infant Mortality Rate**: number of deaths during the first year of life per 1000 person-years observation.

**Under Five Mortality**: number of deaths among children <5 years old per 1000 person-years observation.

**Free Access to Health Care**: coverage of costs of card registration, medication, investigations and interventions fees by the C-MaMiE project from birth to 12 months and from 24 to 59 months, but not indirect costs like transportation cost, when children in intervention cohort needed medical or health care.

**User Fees**: charges levied by parents or care givers at the point of use for any aspect of health services: registration fee, consultation fee, fees for drugs and medical supplies or any health service rendered.

**Maternal Death:** death of a mother at any time when her child was under-five years of age.

**Censored Cases**: children lost to follow up before five years of age and/or survived beyond five years since birth.

**Household**: a group of people who are living in closely located houses and having the same cooking arrangement.

**Kebele**: the lowest administrative unit in Ethiopia.

## 4.11. Data Processing and Analysis Procedures

The data were cleaned and recoded before analysis. Data exploration was undertaken to see if there were odd codes or items that were not logical and then subsequent editing was made. The children's cohort characteristics was described in terms of mean or median value for continuous data and percentages for categorical data. Univariate analyses were used to describe children's characteristics.

Mortality rates estimation of neonatal, infant and under-fives mortalities was done using the number of deaths and person-years lived which were computed from date of birth and date of death and/or date of exit from the DSS. Because of the limitation of STATA in capturing the children born and died on the same date, one day was added to correct it. Mortality rates along with 95% CI were computed using person-years as denominators. Children with outcomes other than death were censored based on their date of lost to follow-up. Kaplan Meier analysis was used to estimate graphically the survival probabilities. The observed difference in survival time among free health care provided children and three comparison cohorts who did not receive freely, was compared using the log rank test.

Cox proportional hazard regression model was used to determine the hazard ratio (HR) of death for each main baseline predictor. To assess the association between baseline variables and under five mortality, two strategies were used. First, each baseline variable was entered into a separate Cox proportional hazards model. Second, a multivariate Cox proportional hazards model that did not violate assumptions was fitted with the predictors that have $P<0.3$ in the bivariate model. Violation of proportional hazard assumptions was checked by regressing 'Schoenfeld' residuals against time to test for independence between time and residuals (P-value >0.1).Eventually only those variables that remained significant at P-value <0.05 in the final model were retained as independent predictors of survival. All statistical analyses were performed using STATA , version 12 software package.

## Survival Analysis

To track survival patterns of children, a Cox proportional hazard model was used. This method estimates semi-parametrically the distribution of exposure time (days lived) to the likelihood of a child dying at time **t.** Covariates were then allowed to shift this baseline proportionally.

**h (t) = ho (t) exp (βiXi)** Where, **ho (t)** is the baseline hazard function
**Xi** is a vector of covariates
**Exp (βi)** is the HR associated with the $i^{th}$ explanatory variable

This model was chosen since it can handle censored cases (cases with incomplete follow up i.e. alive children). It is a special case of the more general survival model in that it combines aspects of a life table and regression analysis which allows the formulation of relations between a set of covariates (independent variables) and the survival function as in conventional multiple regression. It is used in the analysis of survival data when mortality risks vary among individuals. The factor exp (βi) is the hazard risk associated with the $i^{th}$ explanatory variable. Parameters were employed using maximum likelihood procedure. Therefore, this model, in this particular study, was employed for examining the relationship between the exposure and the dependent variable.

## 4.12. Ethical Considerations

The study was carried out after getting permission from the Research Ethics Committee (REC) of School of Public Health in Addis Ababa University. Since the data base of Butajira DSS was used, prior permission was also obtained from the program. To track those children who got free health care service by the C-MaMiE project, individual IDs of BRHP were taken from the C-MaMiE project. The data has not accessed by a third person except the principal investigator, and had been kept confidentially. The C-MaMiE Project has an agreement with the School of Public Health about use of the Butajira DSS data.

## 4.13. Dissemination of Results

Results will be disseminated to the government health policy makers, different DSS sites including Butajira, C-MaMiE project, Addis Ababa University School of public health, researchers and students through presentations and publication.

# 5. RESULT

A total of 3,672 children, 918 who received free health care services and the remaining 2,754 comparisons (918 from each comparison; born before, during and after intervention cohort), were followed retrospectively for a median follow up of five years. The minimum follow up time was one day and the maximum was five years. Six hundred and eighty (18.5%) subjects died, from those 238 (35%), 272 (40%) and 170 (25%) died within one, between one and twelve and between twelve and fifty nine months, respectively. The rest, 2,992 (81.5%) were alive up to the end of the last censored date. The overall estimated incidence and corresponding 95% CI of neonatal, infant and under-five mortalities were 16.0(14.1-18.1), 34.2(31.3-37.3) and 45.6(42.3-49.1), respectively. The estimated incidence of under-five mortalities were 15.7(12.3-20.0), 98.7(88.3-110.3), 41.2(35.2-48.2) and 39.3(33.5-46.1) per 1000 person-years of observation in the intervention, before arm, during arm and after arm comparisons, respectively.

## 5.1. Socio-demographic Characteristics of Study Subjects

### 5.1.1. Socio-demographic Characteristics of Under-five Children

Out of the 3,672 births selected for the study, 461 (50.2%) of the free health service provided children and 1,472 (53.5%) in user fee children were males. Almost equal number of children in each of the four cohort were males. Similar proportion (95 %) of study subjects were singleton by birth type and relatively low in the before intervention cohort. Very few (8.1%) of the children born in health institutions, the lowest, 46 (5.0%) among the user fees after intervention cohort and the highest, 98 (10.7%) in the intervention cohort. Except the sex of the child, all other child characteristics have statistically significant differences among the cohorts (Table 1).

Table 1. Socio-demographic Characteristics across Coverage Status of Medical Care Fees among Under five Children Born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

| Background characteristics | Free Number (%) | User fees (before[a]) n (%) | User fees (during[b]) n (%) | User fees (after[c]) n (%) | $p>X^2$ |
|---|---|---|---|---|---|
| **Sex of child** | | | | | |
| Male (1,933) | 461(50.2) | 493(53.7) | 505(55.0) | 474(51.6) | 0.170 |
| Female (1,739) | 457(49.8) | 425(46.3) | 413(45.0) | 444(48.4) | |
| **Birth type** | | | | | |
| Singleton (3,488) | 890(97) | 841(91.6) | 870(94.8) | 887(96.6) | <0.001* |
| Twin or triplet (184) | 28(3.1) | 77(8.4) | 48(5.2) | 31(3.4) | |
| **Place of birth** | | | | | |
| Home (3,376) | 820(89.3) | 861(93.8) | 823(89.6) | 872(95.0) | <0.001* |
| Health Institution (272) | 98(10.7) | 57(6.2) | 95(10.4) | 46(5.0) | |
| **Preceding child survival status** | | | | | |
| Survived (2,774) | 716(78) | 625(68.1) | 676(73.6) | 757(82.5) | |
| Not survived (348) | 85(9.3) | 131(14.3) | 76(8.3) | 56(6.1) | <0.001* |
| First child (398) | 105(11.4) | 41(4.5) | 159(17.3) | 93(10.1) | |
| Not mentioned (152) | 12(1.3) | 121(13.2) | 7(0.8) | 12(1.3) | |

***[a]before the intervention period, [b]during the intervention period, [c]after the intervention period, *significant at α=0.05.***

### 5.1.2. Maternal Characteristics of the Study Subjects

The age of mothers during delivery was between 20 and 34 in more than two third of the mothers in all cohorts; 625 (68.1%) before intervention, 626 (68.2%) %) in the intervention, 640 (69.7%) during intervention controls and 618 (67.4) after intervention cohorts. Less than one fourth of the mothers in each of the four cohorts were able to read and write, with the lowest 104 (11.3%) in the before intervention cohort. Three fourth of the mothers in the before intervention cohorts were Muslims by religious affiliation whereas it was only 575 (62.6%) in the intervention, 555 (60.5%) during intervention controls and 530 (57.8%) after intervention cohorts. Majority of mothers' ethnicity, 727 (79.2%), 752 (81.9%), 716 (78.0%) and 724 (78.9%) were Guraghe in the intervention, before intervention, during intervention controls and after intervention cohorts, respectively. Almost half of the mothers in the intervention' and user fees during the intervention cohorts' attended by TTBA or skilled health professionals during delivery whereas in the before and after the intervention cohorts it was only around one third. Seven hundred and sixteen (78%), 625 (68.1), 676 (73.6%) and 757(82.5%) of the children respectively in the intervention, before, during and after the intervention controls had died elder child. Similar proportions of the mothers had parity and gravidity levels of below four, 381 (41.5%), 412 (44.9%), 448 (48.8%) and 387 (42.2%) for parity and 384 (41.8%), 416 (45.3%), 444 (48.4%) and 390 (42.5%) for gravidity consecutively the intervention, before intervention, during intervention and after intervention cohorts. Almost all (98.6%) of the mothers were alive in all cohorts. There were statistically significant differences in all of the maternal characteristics among each cohort, except ethnicity (p=0.184) and maternal survival status (p=0.07) (Table 2).

Table 2. Maternal Characteristics across Coverage Status of Medical Care Fees among Under five Children Born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

| Background characteristics | Free n (%) | User fees (before[a]) n (%) | User fees (during[b]) n (%) | User fees (after[c]) n (%) | p>$X^2$ |
|---|---|---|---|---|---|
| **Age of the mother** | | | | | |
| < 20 years (369) | 75(8.2) | 125(13.6) | 97(10.6) | 72(7.8) | |
| 20 – 34 years (2,509) | 625(68.1) | 626(68.2) | 640(69.7) | 618(67.4) | <0.001* |
| ≥35 years (794) | 218(23.8) | 167(18.2) | 181(19.7) | 228(24.8) | |
| **Mother's Education** | | | | | |
| Illiterate (2,923) | 724 (78.9) | 814(88.7) | 693(75.5) | 692(75.4) | <0.001* |
| Able to read & write (749) | 194(21.1) | 104(11.3) | 225(24.5) | 226(24.6) | |
| **Mother's marital status** | | | | | |
| Monogamous (2,337) | 580(63.2) | 660(71.9) | 525(57.2) | 572(62.3) | <0.001* |
| Others® (1,335) | 343(36.8) | 258(28.1) | 393(42.8) | 346(37.7) | |
| **Religion of the mother** | | | | | |
| Christian (1,313) | 343(37.4) | 224(24.4) | 361(39.3) | 385(41.9) | <0.001* |
| Muslim (2,352) | 575(62.6) | 692(75.4) | 555(60.5) | 530(57.8) | |
| Others(7) | 0(0) | 2(0.2) | 2(0.2) | 3(0.3) | |
| **Ethnicity of Mother** | | | | | |
| Guragie (2,919) | 727(79.2) | 752(81.9) | 716(78.0) | 724(78.9) | 0.184 |
| Others (753) | 191(20.8) | 166(18.1) | 202(22.0) | 194(21.1) | |
| **Attendant of delivery** | | | | | |
| Relative/NTTBAs (1,607) | 494(53.8) | 315(34.3) | 463(50.4) | 335(36.5) | <0.001* |
| TTBAs or HP (2,065) | 424(46.2) | 603(65.7) | 455(49.6) | 583(63.5) | |
| **Parity** | | | | | |
| ≤ 3 (1,628) | 381(41.5) | 412(44.9) | 448(48.8) | 387(42.2) | 0.007 |
| 4-6 (1,224) | 332(36.2) | 281(30.6) | 286(31.2) | 325(35.4) | |
| ≥ 7 (820) | 205(22.3) | 225(24.5) | 184(20.0) | 206(22.4) | |
| **Gravidity** | | | | | |
| ≤ 3 (1,634) | 384(41.8) | 416(45.3) | 444(48.4) | 390(42.5) | |
| 4-6 (1,220) | 331(36.1) | 271(29.5) | 297(32.3) | 321(35.0) | 0.003* |
| ≥ 7 (818) | 203(22.1) | 231(25.2) | 177(19.3) | 207(22.5) | |
| **Maternal survival status** | | | | | |
| Survive (3,621) | 907(98.8) | 898(97.8) | 905(98.6) | 911(99.2) | 0.07 |
| Died (51) | 11(1.2) | 20(2.2) | 13(1.4) | 7(0.8) | |

***[a]before the intervention period, [b]during the intervention period, [c]after the intervention period, NTTBA=Non-trained Traditional Birth Attendant, TTBA=Trained Traditional Birth Attendant ®Not married, married polygamous, widowed, divorced, *significant atα=0.05.***

### 5.1.3. Household Characteristics of the study subjects

Majority (90.4%) of the study subjects lived in rural area; the lowest 760 (82.2%) in the before intervention user fees cohort and the highest 908 (98.9%) in the after intervention user fee cohort. Latrine was available for about one fourth of the households in the three cohorts (intervention, before intervention user fees and after intervention user fees), but only 106 (11%) in user fees during the intervention cohort. Only few, 489 (13.3%) of the households had protected source of water for drinking purpose with the lowest 95 (10.4%) in the after intervention cohort and the highest 161 (17.5%) in the before intervention cohort. The main source of income in majority (80%) of the households in each cohort was agriculture. Nearly half (44.5%) of the households had a family size of five to seven, and was similar among each cohort. Around 85% of each households had own or governmental house (Table 3).

Table 3. House-hold Characteristics across Coverage Status of Medical Care Fees among Under-five Children Born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

| Background characteristics | Free n (%) | User fees (before[a]) n (%) | User fees (during[b]) n (%) | User fees (after[c]) n (%) | P>$X^2$ |
|---|---|---|---|---|---|
| **Place of Residence** | | | | | |
| Urban (354) | 134(14.6) | 158 (17.2) | 52 (5.7) | 10 (1.1) | <0.001* |
| Rural (3,318) | 784(85.4) | 760 (82.8) | 866(94.3) | 908(98.9) | |
| **Availability of latrine** | | | | | |
| Available (801) | 228(24.8) | 236(25.7) | 106(11.6) | 231(25.2) | <0.001* |
| Not available (2,871) | 690(75.2) | 682(74.3) | 812(88.4) | 687(74.8) | |
| **Water sources** | | | | | |
| Protected (489) | 152(16.6) | 161(17.5) | 81(8.8) | 95(10.4) | <0.001* |
| Unprotected (3,183) | 766(83.4) | 757(82.5) | 837(91.2) | 823(89.6) | |
| **Waste disposal system** | | | | | |
| Pit or burning (491) | 153(16.7) | 128(13.9) | 107(11.7) | 103(11.2) | 0.002* |
| Open field(3181) | 765(83.3) | 790(86.1) | 811(88.7) | 815(88.8) | |
| **Main source of income** | | | | | |
| Trade/employee (681) | 190(20.7) | 206(22.4) | 161(17.5) | 124(13.5) | <0.001* |
| Agriculture (2,991) | 728(79.3) | 712(77.6) | 757(82.5) | 794(86.5) | |
| **Family size** | | | | | |
| ≤ 4 (838) | 195(21.2) | 223(24.3) | 202(22.0) | 218(23.8) | 0.549 |
| 5-7 (1,634) | 431(47) | 396(43.1) | 404(44.0) | 403(43.9) | |
| ≥8 (1,200) | 292(31.8) | 299(32.6) | 312(34.0) | 297(32.3) | |
| **Ownership of house** | | | | | |
| Not owned | 104(11.3) | 64(7.0) | 125(13.6) | 55(6.0) | <0.001* |
| Owned | 814(88.7) | 854(93.0) | 793(86.4) | 863(94.0) | |

***[a]before the intervention period, [b]during the intervention period, [c]after the intervention period***

****significant at α=0.05.***

## 5.2. Levels and Determinants of Early Childhood Mortality

### 5.2.1. Levels and Determinants of Neonatal Mortality across Coverage Status of Medical Care Fees

The overall incidence of neonatal mortality was 16.0(14.1-18.1) per 1000 person-years observation. Incidence of neonatal mortality rate was 5.7(3.8- 8.5) among children provided free health care services, 26.2(21.1-32.5) among user fee before intervention, 18.7(14.8 -23.7) among user fee during intervention and 16.1(12.6- 20.7) among user fee after intervention per 1000 person-years of observation (Table 4 and Figure 4).

The NMR was not the same across various childhood, maternal and household characteristics of children. There was higher neonatal mortality incidence rate among male children 18.1(15.3-21.3) compared to females 13.6(11.2-16.7) per 1000 person-years of observation. Multiple birth children have much higher incidence of mortality than singleton with a level of 102.8(78.2-135.3) and 13.0(11.2-15.0) incidents per 1000 person-years, respectively. Children born at and out of health institution had NMR of 24.9(17.2-36.0) and 15.2(13.3-17.4) per 1000 person-years observation respectively. Children whose preceding sibling died had higher, 27.5(19.8-38.1) incidence of neonatal mortality than those having alive previous sibling, 12.9(11.0-15.2). The incidence of NMR among children who were first child of their mothers was 22.7(16.2-31.7) per 1000 person-years observation. There were no significant differences on incidence of neonatal mortality by the other maternal and household characteristics (Table 4).

### 5.2.2. Levels and Determinants of Infant Mortality across Coverage Status of Medical Care Fees

Overall, the incidence of infant mortality rate was 34.2(31.3-37.3) per 1000 person-years observation. Incidence of IMR was 11.4(8.6-15.2) in the intervention cohort, 72.5(63.6-82.6) in user fee before intervention cohort, 32.4(27.1-38.7) in user fee during intervention cohort and 29.7(24.7-35.6) in user fee after intervention cohort, per 1000 person-years of observation (Table 4 and Figure 4).

Children born multiple were at higher rate of infant mortality 157.3(126.0-196.4 than those born single 30.0(27.3-32.9) per 1000 person-years. Children having died preceding sibling had higher infant mortality rate, with a level of 54.2(42.9-68.3), than those with alive preceding sibling, with a level of 30.3(27.3-33.7), per 1000 person-years observation. Children whose mothers died were at higher rate of mortality during infancy than those mothers who were alive with a level of 124.2(79.2-194.7) and 33.4(30.4-36.3) per 1000 person-years observation, respectively. Like that of neonatal mortality, there was no significant differences in infant mortality rate across the other background characteristics of the children (Table 4).

### 5.2.3. Levels and Determinants of Under-five Mortality across Coverage Status of Medical Care Fees

The cumulative under five mortality rate was 45.6 per 1000 person years with 95%CI; 12.3-20.0. Comparing the incidence rate of under-five mortality in each cohort, it was 15.7; 95% CI; 53.0-62.0), 98.7; 95% CI; 88.3-110.3, 41.2; 95%CI; 35.2-48.2 and 39.3; 95% CI; 33.5-46.1 per 1000 person years in the intervention, user fee before intervention, user fee during intervention and user fee after intervention cohorts, respectively (Table 4 and Figure 4).

Similar with NMR and IMR, U5MR was higher among children born multiple, with a level of 177.5(144.0-218.7), than children born single, with a level of 41.0(37.9-44.5) per 1000 person-years observation. Children whose preceding sibling died had higher U5MR, with a level of 66.4(53.8-81.9), than those whose preceding sibling was alive, with a level of 41.4(37.8-45.2), per 1000 person-years observation. Similarly, children whose mothers died had higher U5MR than those whose mothers were alive with a level of 143.8(94.7-218.3) and 44.6(41.3-48.1) per 1000 person-years observation, respectively. Based on the other background characteristics of children, there were no significant differences on U5MR (Table 4).

Table 4. Early Childhood Mortality Rates per 1000 Person-years among Children Born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

| Background characteristics | NMR (95%CI) | IMR (95%CI) | U5MR (95%CI) |
|---|---|---|---|
| **Overall** | 16.0(14.1-18.1) | 34.2(31.3-37.3) | 45.6(42.3-49.1) |
| **Coverage of Medical Care Fees** | | | |
| Free | 5.7(3.8- 8.5) | 11.4(8.6-15.2) | 15.7(12.3-20.0) |
| User fee (Before[a]) | 26.2(21.1-32.5) | 72.5(63.6-82.6) | 98.7(88.3-110.3) |
| User fee (During[b]) | 18.7(14.8 -23.7) | 32.4(27.1-38.7) | 41.2(35.2-48.2) |
| User fee (After[c]) | 16.1(12.6- 20.7) | 29.7(24.7-35.6) | 39.3(33.5- 46.1) |
| **Sex of child** | | | |
| Male | 18.1(15.3-21.3) | 37.4(33.3-41.9) | 47.8(43.2-52.9) |
| Female | 13.6(11.2-16.7) | 30.7(26.9-35.1) | 43.2(38.6-48.2) |
| **Birth type** | | | |
| Singleton | 13.0(11.2-15.0) | 30.0(27.3-32.9) | 41.0(37.9-44.5) |
| Twin or triplet | 102.8(78.2-135.3) | 157.3(126.0-196.4) | 177.5(144.0-218.7) |
| **Place of birth** | | | |
| Health facility | 24.9(17.2-36.0) | 40.8(30.6-54.5) | 45.0(41.6-48.7) |
| Out of health facility | 15.2(13.3-17.4) | 33.6(30.7-36.8) | 52.4(40.6-67.6) |
| **Preceding sibling survival** | | | |
| Alive | 12.9(11.0-15.2) | 30.3(27.3-33.7) | 41.4(37.8-45.2) |
| Died | 27.5(19.8-38.1) | 54.2(42.9-68.3) | 66.4(53.8-81.9) |
| First child | 22.7(16.2-31.7) | 35.3(27.0-46.2) | 48.0(38.1-60.4) |
| Not mentioned | 35.7(22.5-56.7) | 67.5(48.2-94.4) | 81.4(56.0-110.5) |
| **Age of the mother** | | | |
| <20 years | 24.9(17.8-34.9) | 42.5(32.9-55.0) | 55.0(48.8-68.9) |
| 20-34 years | 14.3(12.1-16.8) | 31.4(28.2-35.0) | 43.5(39.7-47.8) |
| ≥ 35 years | 17.6(13.6-22.8) | 39.5(33.2-47.0) | 48.1(41.1-56.3) |
| **Parity** | | | |
| ≤ 3 | 16.7(13.8-20.2) | 35.3(30.9-40.2) | 46.8(41.8-52.4) |
| 4-6 | 13.5(10.7-17.1) | 29.9(25.5-35.0) | 39.9(34.8-45.8) |
| ≥ 7 | 18.3(14.3-23.6) | 38.8(32.7-46.1) | 52(44.8-60.4) |
| **Gravidity** | | | |
| ≤3 | 17.2(14.2-20.7) | 36.2(31.8-41.2) | 47.6(42.5-53.2) |
| 4-6 | 13.3(10.5-16.9) | 29.4(25.1-34.4) | 39.4(34.4-45.2) |
| ≥7 | 17.7(13.7-22.8) | 37.8(31.7-45.0) | 51.3(44.2-59.6) |
| **Assistant of delivery** | | | |
| TTBA or Health Prof. | 14.8(12.4-17.6) | 33.4(29.7-37.5) | 44.5(40.2-49.2) |
| Other | 17.5(14.5-21.0) | 35.3(31.0-40.2) | 47.0(42.0-52.6) |

Table 4. (**Continued**)

| Background characteristics | NMR (95%CI) | IMR (95%CI) | U5MR (95%CI) |
|---|---|---|---|
| **Religion** | | | |
| Christian | 14.5(11.6-18.1) | 31.9(27.5-37.1) | 44.3(39.0-50.3) |
| Muslim | 16.7(14.3-19.5) | 35.3(31.8-39.3) | 46.2(42.1-50.7) |
| Other | 39.7(5.6-281.9) | 79.4(19.9-317.5) | 79.4(19.9-317.5) |
| **Ethnicity of the mother** | | | |
| Guraghe | 16.2(14.1-18.7) | 33.8(30.7-37.3) | 44.6(40.9-48.5) |
| Other | 14.9(11.119.9) | 35.7(29.6-43.1) | 49.6(42.3-58.2) |
| **Maternal marital status** | | | |
| Monogamous | 15.1(12.8-17.8) | 33.8(30.4-37.7) | 44.5(40.4-48.9) |
| Others | 17.5(14.3-21.4) | 34.8(30.1-40.2) | 47.6(42.1-53.9) |
| **Maternal education** | | | |
| Able to read and write | 15.9(12.0-21.0) | 28.5(23.1-35.1) | 41.1(34.6-48.9) |
| Illiterate | 16.0(13.9-18.4) | 35.7(32.4-39.2) | 46.7(43.0-50.8) |
| **Maternal survival status** | | | |
| Survived | 15.8(13.9-17.9) | 33.4(30.4-36.3) | 44.6(41.3-48.1) |
| Died | 32.7(13.6-78.5) | 124.2(79.2-194.7) | 143.8(94.7-218.3) |
| **Place of residence** | | | |
| Butajira Town(urban) | 21.0(14.4-30.7) | 49.0(38.3-62.8) | 63.8(51.4-79.3) |
| Other(rural) | 15.5(13.5-17.7) | 32.8(29.9-36.0) | 43.8(40.5-47.5) |
| **Family size** | | | |
| ≤ 7 | 17.6(15.2-20.5) | 38.5(34.8-42.7) | 52.0(47.6-56.7) |
| >7 | 13.0(10.3-16.4) | 26.5(22.5-31.3) | 34.3(29.7-39.6) |
| **Main income source** | | | |
| Trade/employee | 17.8(13.4-23.6) | 37.4(30.7-45.4) | 48.1(40.5-57.1) |
| Agriculture | 15.6(13.5-17.9) | 33.5(30.4-36.9) | 45.0(41.4-49.0) |
| **Water source** | | | |
| Protected | 19.4(14.0-26.9) | 33.2(30.2-36.4) | 51.7(42.3-63.1) |
| Unprotected | 15.5(13.5-17.8) | 41.5(33.2-51.8) | 44.7(41.2-48.5) |
| **Availability of latrine** | | | |
| Available | 15.7(11.9-20.7) | 33.9(28.1-40.9) | 44.2(37.5-52.2) |
| Not available | 16.0(13.9-18.5) | 34.3(31.1-37.8) | 46.0(42.2-50.0) |
| **Waste disposal system** | | | |
| Pit or burning | 14.6(10.2-21.0) | 31.8(24.8-40.6) | 44.9(36.4-55.2) |
| Open field | 16.2(14.1-18.5) | 34.6(31.5-39.9) | 45.7(42.1-49.5) |
| **House ownership** | | | |
| Rented/cohabited | 18.6(12.4-27.7) | 44.9(34.7-58.0) | 57.2(45.6-71.9) |
| Owed/governmental | 15.7(13.7-18.0) | 33.2(30.3-36.4) | 44.5(41.1-48.2) |

***[a]before intervention, [b]during intervention, [c]after intervention***

The incidence of neonatal, infant and under five mortalities were significantly lower in the intervention cohort (children received free health care services). The following graph shows the levels of mortalities (NMR, IMR and U5MR) among the four cohorts (one intervention and three comparisons) (Figure 5).

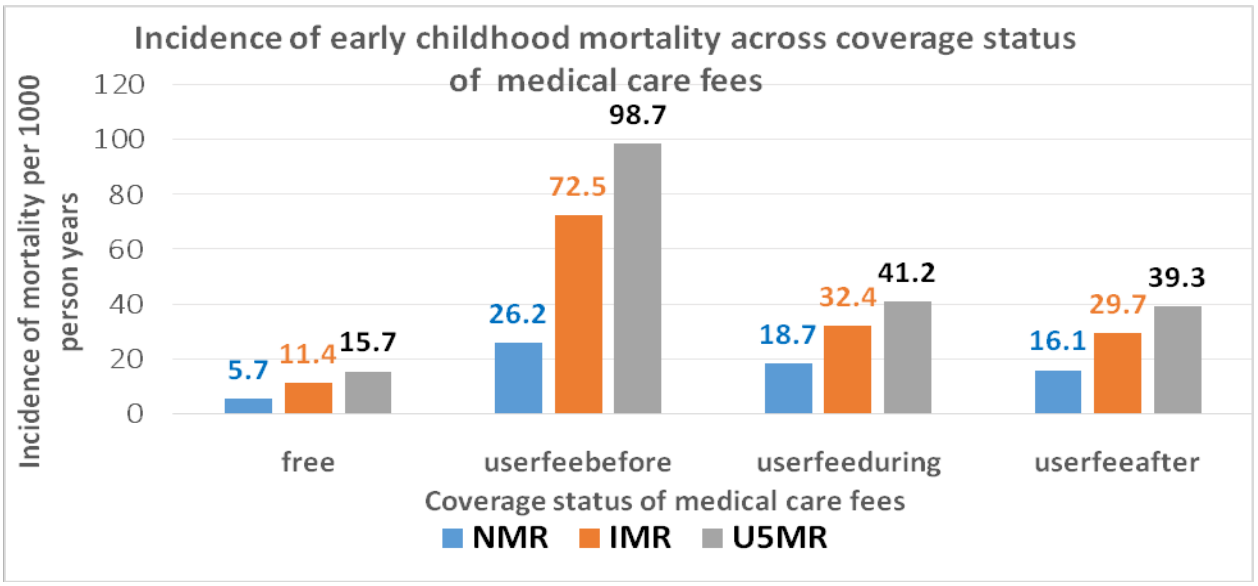
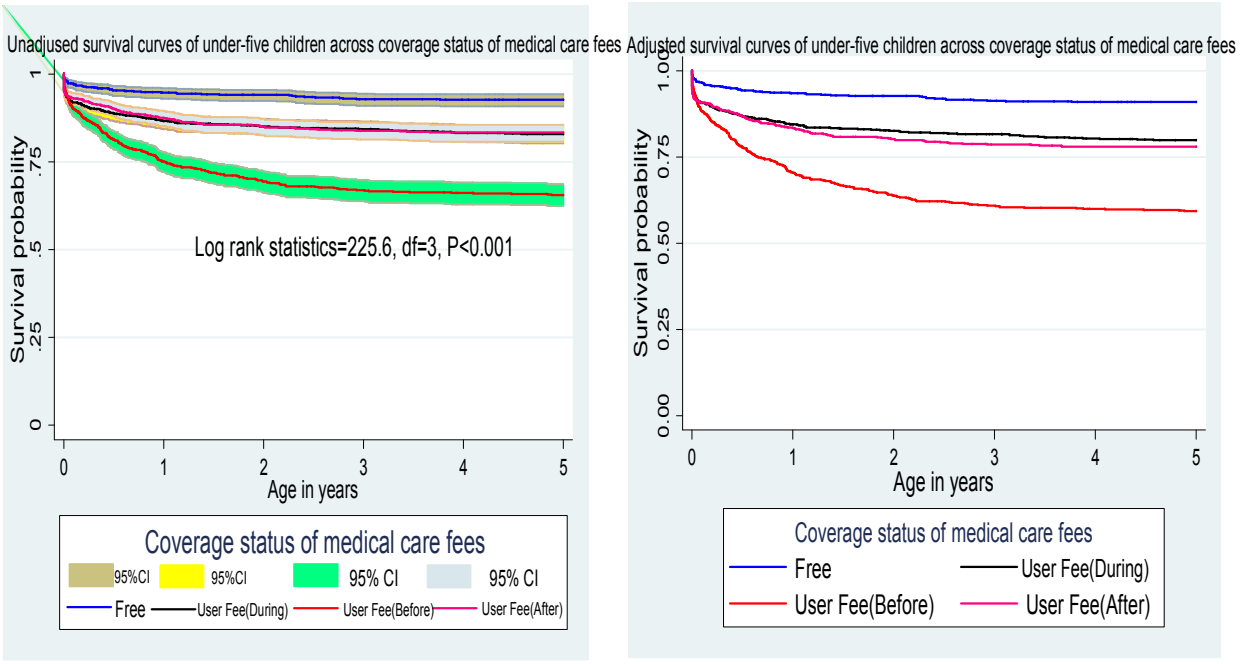



Figure 4. Incidence of early childhood mortality across coverage status of medical care fees among children born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

## 5.3. Effect of Free Health Care Services on Under-five Mortality

### 5.3.1. Survival analysis (Kaplan Meir)

To estimate the survival probabilities of under-five children, Kaplan Meier survival curve was used. The crude survival probabilities were >90% among children who received free health services, about 80% among user fees children during and after the intervention cohorts and <60% among user fee children in the before intervention cohort. The Kaplan Meier survival using log rank test also showed statistically significant differences in survival among the cohorts with log rank statistic of 225.6, df= 3 and $p<0.001$ (Figure 6(a)). In the adjusted survival curve (adjusted for all child, maternal and house hold variables), the survival of free health service provided children was > 90% at the end of five year. But for user fee children, it was about 60% in the before and about 80% during and after the intervention cohorts at the end of the study period ($5^{th}$ year) where all the remaining children become censored (Figure 6(b)).




**(a)** **(b)**

Figure 5. Crude (a) and Adjusted (b) Survival Probabilities of Under-five Children, across Coverage Status of Medical Care Fees, born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

### 5.3.2. Bivariate and multivariate analyses (Cox regression)

In the Bivariate analysis using Cox regression, high mortality occurred among those who did not receive free primary health care services over those who received free health care. Those who did not receive free health care services were 5.4 times (CHR=5.43; 95%CI 4.16, 7.09), 2.5 times (CHR=2.50; 95%CI 1.88, 3.34) and 2.4 times (CHR=2.42; 95%CI 1.81, 3.24) more likely to die, respectively for before, during and after the intervention cohorts, than those who received free health care services. Multiple birth (CHR=3.71; 95%CI; 2.97, 4.65), maternal death (CHR=2.72; 95%CI; 1.78, 4.16), being urban residence (CHR=1.34; 95%CI 1.07, 1.69), death of previous child (CHR=1.54; 95%CI 1.23, 1.94) and having higher number of family members (CHR=0.68; 95%CI 0.58, 0.81) showed significance associations as predictors of under-five mortality.

Variables with P-value < 0.3 in the bivariate analysis were entered in to the final model after checking the proportional hazard assumption of each variable using regressing 'Schoenfeld' residuals (P-value >0.1), against time to test for independence between time and residuals. Accordingly, family size and birth type were variables that violated the assumptions, and entered in to the multivariate model as time varying covariates. Eventually, only those variables that remained significant at P- value <0.05 in the final model were retained as independent predictors of under-five survival.

Six factors became statistically significant predictors of under-five mortality on the multivariate Cox proportional hazard adjusted model. Factors such as type of PHC service provision (AHR=5.87; (95%CI; 4.47-7.72), (AHR=2.45; (95%CI; 1.84-3.28), and (AHR=2.72; (95%CI; 2.03-3.66) for comparison cohorts of before, during and after the free services provision respectively, multiple birth (AHR=1.29; 95%CI; 1.02-1.64), maternal death (AHR=2.10; 95%CI; 1.36-3.23), rural residence (AHR; 0.56; 95%CI; 0.44-0.72), death of previous sibling (AHR; 1.28; 95%CI; 1.01-1.61) and family size (AHR=0.67; 95%CI; 0.57-0.79) were independent predictors of under-five mortality, after controlling for potential confounders (Table 5).

Table 5. Crude and Adjusted Hazard Rates of Under-five Mortality among children born in Butajira DSA, South Central Ethiopia, from July, 2002 to June, 2008.

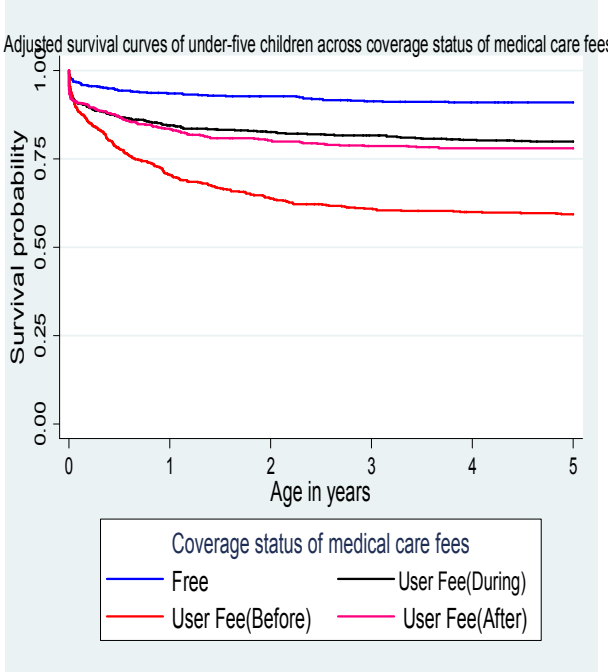
| Background characteristics | Number of death | Person Years | Crude HR (95%CI) | Adjusted HR(95%CI) |
|---|---|---|---|---|
| **Coverage Status of Medical Care Fees** | | | | |
| Free | 66 | 4200.8 | 1 | **1** |
| User fee (Before[a]) | 309 | 3740.9 | **5.43(4.16-7.09)*** | **5.87(4.47-7.72)*** |
| User fee (During[b]) | 154 | 3131.8 | **2.50(1.88-3.34)*** | **2.45(1.84-3.28)*** |
| User fee (After[c]) | 151 | 3844.8 | **2.42(1.81-3.24)*** | **2.72(2.03-3.66)*** |
| **Sex of child** | | | | |
| Male | 371 | 7757.7 | 1 | 1 |
| Female | 309 | 7160.5 | 0.91(0.78-1.06) | 0.96(0.83-1.12) |
| **Birth type** | | | | |
| Singleton | 592 | 14422.3 | 1 | **1** |
| Twin or triplet | 88 | 495.9 | **3.71(2.97-4.65)*** | **1.29(1.02-1.64)*** |
| **Place of birth** | | | | |
| Health facility | 59 | 1126.3 | 1 | ……. |
| Out of health facility | 621 | 13791.9 | 0.89(0.68-1.16) | |
| **Preceding sibling survival** | | | | |
| Alive | 480 | 11602.2 | 1 | 1 |
| Died | 87 | 1311.0 | **1.54(1.23-1.94)*** | **1.28(1.01-1.61)*** |
| First child | 72 | 1501.0 | 1.11(0.86-1.42) | 1.26(0.95-1.65) |
| Not mentioned | 41 | 503.9 | **1.76(1.28-2.43)*** | 1.01(0.71-1.44) |
| **Age of the mother** | | | | |
| <20 years | 75 | 1364.1 | 1 | 1 |
| 20-34 years | 449 | 10312.6 | 0.83(0.65-1.06) | 0.98(0.75-1.29) |
| ≥ 35 years | 156 | 3241.5 | 0.92(0.70-1.21) | 1.16(0.83-1.64) |
| **Parity** | | | | |
| ≤ 3 | 300 | 6409.8 | 1 | 1 |
| 4-6 | 207 | 5184.1 | 0.89(0.74-1.06) | 1.02(0.84-1.24) |
| ≥ 7 | 173 | 3324.3 | 1.14(0.94-1.34) | 1.24(0.97-1.60) |
| **Gravidity** | | | | |
| ≤3 | 305 | 6410.4 | 1 | ……. |
| 4-6 | 204 | 5175.0 | 0.86(0.72-1.03) | |
| ≥7 | 171 | 3332.8 | 1.11(0.92-1.33) | |
| **Assistant of delivery** | | | | |
| TTBA or HP | 304 | 8454.8 | 1 | ……. |
| Other | 376 | 6463.4 | 1.05(0.90-1.22) | |

Table 5. (**Continued**)

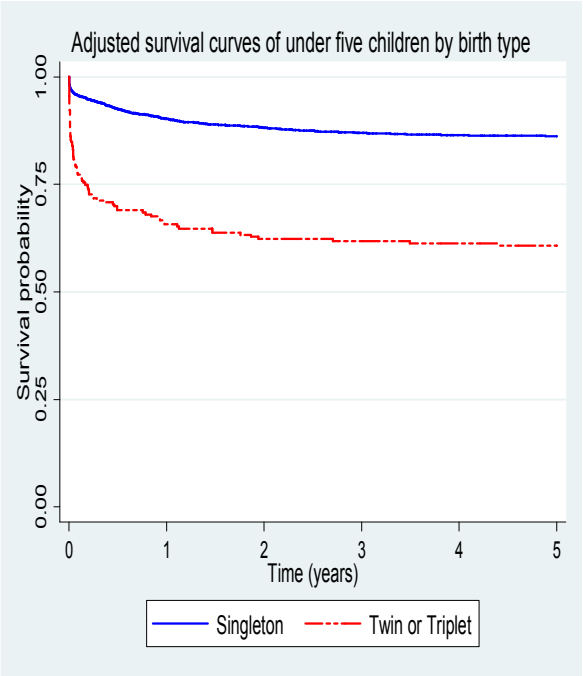
| | | | | |
|---|---|---|---|---|
| **Religion** | | | | |
| Christian | 236 | 5326.0 | 1 | ……. |
| Muslim | 442 | 9567.0 | 1.05(0.90-1.23) | |
| Other | 2 | 25.2 | 1.81(0.45-7.30) | |
| **Ethnicity of the mother** | | | | |
| Guraghe | 530 | 11893.6 | 1 | ……. |
| Other | 150 | 3024.7 | 1.10(0.92-1.32) | |
| **Maternal marital status** | | | | |
| Monogamous | 427 | 9604.4 | 1 | ……. |
| Others | 253 | 5313.9 | 1.05(0.90-1.23) | |
| **Maternal education** | | | | |
| Able to read and write | 127 | 3087.7 | 1 | 1 |
| Illiterate | 553 | 11830.5 | 1.13(0.93-1.37) | 0.97(0.80-1.19) |
| **Maternal survival status** | | | | |
| Survived | 658 | 14765.2 | 1 | **1** |
| Died | 22 | 153.0 | **2.72(1.78-4.16)*** | **2.10(1.36-3.23)*** |
| **Place of residence** | | | | |
| Butajira Town(urban) | 82 | 1284.4 | **1** | **1** |
| Other(rural) | 598 | 13633.8 | **0.74(0.59-0.94)*** | **0.56(0.44-0.72)*** |
| **Family size** | | | | |
| ≤ 7 | 495 | 9527.6 | **1** | **1** |
| >7 | 185 | 5390.6 | **0.68(0.58-0.81)*** | **0.67(0.57-0.79)*** |
| **Main income source** | | | | |
| Trade/employee | 130 | 2703.9 | 1 | ……. |
| Agriculture | 550 | 12214.3 | 0.95(0.79-1.15) | |
| **Water source** | | | | |
| Protected | 96 | 1857.3 | 1 | 1 |
| Unprotected | 584 | 13060.9 | 0.91(0.73-1.13) | 1.01(0.80-1.27) |
| **Availability of latrine** | | | | |
| Available | 141 | 3188.3 | 1 | ……. |
| Not available | 539 | 11729.9 | 1.06(0.88-1.28) | |
| **Waste disposal system** | | | | |
| Pit or burning | 89 | 1984.1 | 1 | 1 |
| Open field | 591 | 12934.1 | 1.03(0.82-1.11) | 1.01(0.80-1.27) |
| **House ownership** | | | | |
| Rented/cohabited | | | | |
| Owed/governmental | | | | |

***[a]before, [b]duringand[c]after intervention, *significant at α=0.05,adjusted for type of health service provision, birth type, survival status of previous sibling, maternal survival status, family size and place of residence.***

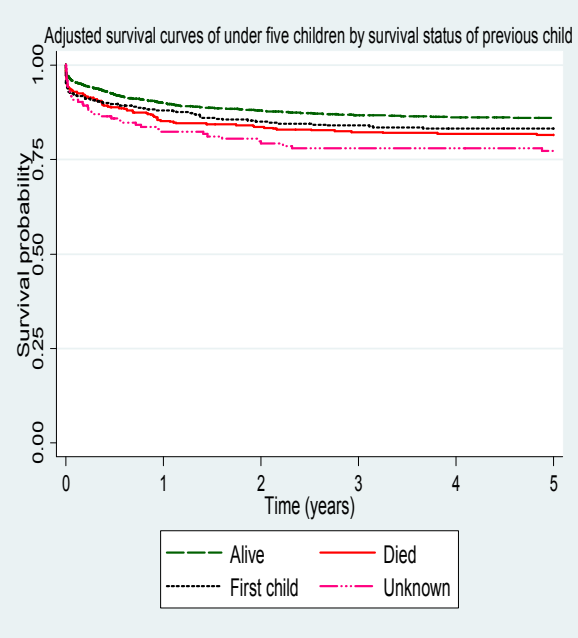
The following figures show the Survival status of under-five children by independent variables that showed statistical significance after adjustment (Figures 7(a-f)).



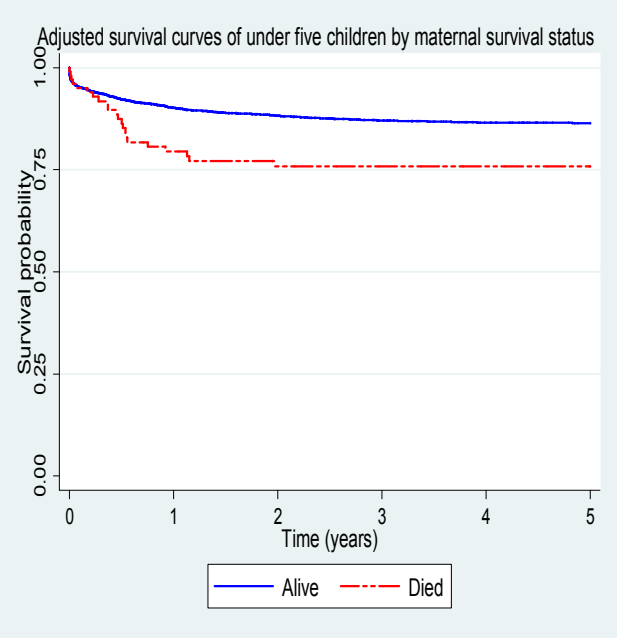

**(a)**



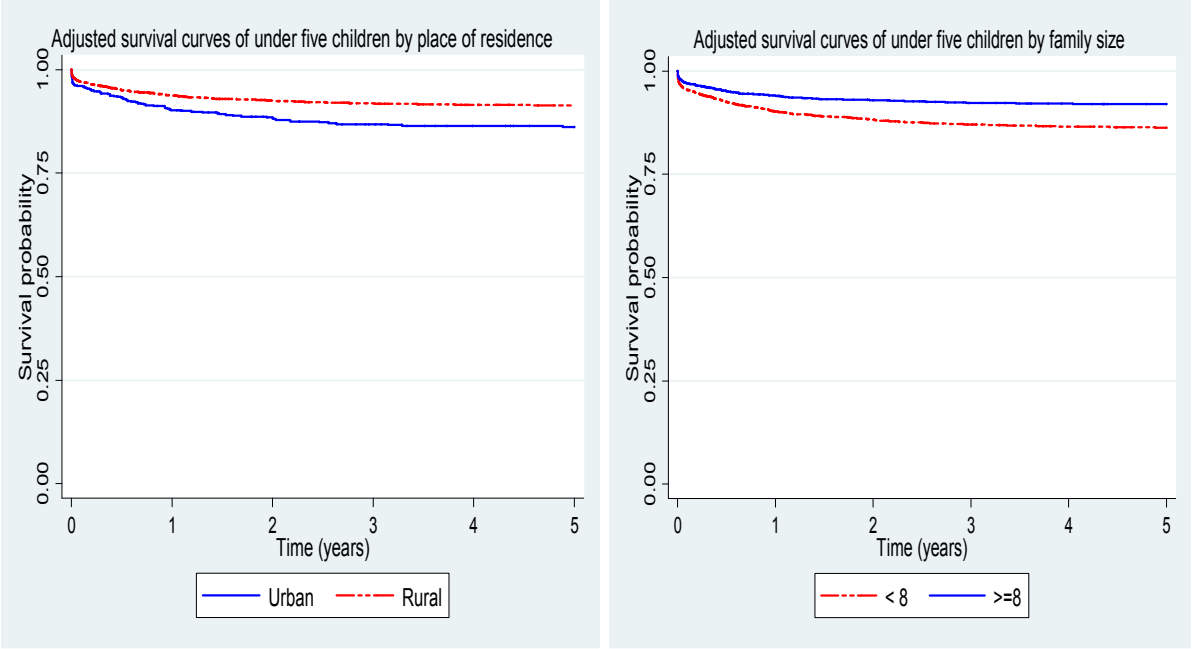

**(b)**




**(c)**




**(d)**




**(e)** **(f)**

Figure 6. Survival status of under five children across (a).coverage status of medical care fees, (b).birth type, (c).survival status of preceding sibling, (d).maternal survival status, (e).place of residence, (f).family size among children born in Butajira DSA, south central Ethiopia, from July, 2002 to June, 2008.

# 6. DISCUSSION

In this study there were high incidences of neonatal, infant and under-five mortalities. The level of under-five mortality was found to be significantly lower among children who received free health care services than each of the three comparisons (before, during and after the intervention cohorts). Birth type, survival status of preceding sibling, maternal survival status, family size and place of residence were found to be other significant predictors of under-five mortality in this study.

The cumulative NMR in this study were found to be 16.0(14.1-18.1) per 1000 person-years observation. This figure is lower than the mortalities reported in preliminary result of Ethiopia Demographic & Health Surveys of 2005 and 2011 (EDHS, 2005 and 2011), which were 39 and 37 per 1000 live births respectively. This might be due to the differences in the denominators; in this study it was person years of observation but in EDHS it was the total live births [36].

The other factor could be because the government gave due emphasis on reduction of neonatal mortality through establishment of health facilities and developmental activities in the study area. The result is also consistent with other earlier studies [9, 23, 31, 48]. In addition, this study has shown that much of the child deaths have occurred in the first months of their life. This is in agreement with the general fact that survival is extremely difficult at this period [25, 49].

IMR and U5MR in this particular study were found to be lower than the respective EDHS reports (EDHS 2000 for the before intervention cohort, EDHS 2005 for the intervention and during the intervention controls and EDHS, 2011 for the after intervention cohort [36].

The incidence rates of under-five mortality per 1000 person-years among children in the user fee cohort during the intervention period in this study was 41.2 with 95%CI of 35.2-48.2. A ten years event history analysis of EDHS before 2011 showed that the incidence of under-five mortality was 29.6 per 1000 person-years [36] which is lower than this study. Another study from Radii DSS, Tanzania, 2005 also declared that U5MR was 26.9 per 1,000 person-years (95% CI; 23.7-30.4) [43]. This could be because of the difference in the study designs; the longitudinal design of this study might record deaths much better than the EDHS survey [27].

The incidence of mortality in this study is significantly higher in each of the user fee cohorts, compared with the intervention cohort. Up on adjustment using Cox regression model, the risk of under-five death in the non-intervention cohorts were all significantly higher than the intervention cohort which showed that without delivery of a free health care services for under five children, services remained inaccessible to many children and under five mortality remained high in the area.

Comparing the intervention and user fees before the intervention cohort, the hazard was higher in the user fees (AHR=5.87; 95%CI; 4.47-7.72). This risk is very much higher than the other comparison cohorts, and hence we can say that the intervention had an impact on the mortality reduction. But, we cannot say that this reduction of mortality was entirely the effect of the free health services provision by the C-MaMiE project, because improvements in the health system of the government, increased awareness of the society, availability and accessibility of health services and the like could share a significant proportion.

Comparing the intervention cohort with user fees during the intervention cohort (AHR=2.45; 95%CI; 1.84-3.28) and user fees after the intervention cohort (AHR=2.72; 95%CI; 2.03-3.66), the hazard rates of under-five mortality are still significantly higher in both comparison cohorts. This indicated that the free health care service provision had a significant impact in reducing under five mortality, even compared to the after the intervention comparison cohort in which a lower mortality was expected.

This is consistent with a study done in Mali which revealed that under five mortality rate among children who utilized free health care services, (0.71 deaths per 10, 000/day; 95% CI; 0.43–0.99), was half of those in user fees (1.47 deaths per 10, 000/day; 95% CI;1.23–1.72) [45]. This might be due to the fact that causes of mortalities in most of the developing countries are infectious diseases, which are preventable and curable easily if PHC services are available, accessible and affordable to children.

But, an experimental study done in Ghana revealed that there was no significant difference in child mortality between free and user fee health care services users, rather free health services provision had a significant impact on health care utilization rate (RR=1.12; 95% CI;1.04–1.20) [4]. This could be because of small number of deaths (9 deaths; five from intervention and four from the controls) and the intervention period, which was six months, was shorter than this study which was five years.

Being a multiple birth had a higher risk of under-five mortality (AHR; 1.29; 95% CI; 1.02-1.64). This is consistent with previous studies [23, 28, 36], as there is a sibling competition for resources, particularly for mother's milk in multiple births. It might also be associated with the difficulties in giving necessary care and support, including keeping personal hygiene, which leads to infectious diseases, like frequent diarrheal diseases, and thereby increased mortality.

Children whose preceding sibling died were at increased risk of dying (AHR; 1.28; 95% CI; 1.01-1.61).This could be explained by maternal nutritional status and chronic maternal health problems, because, they might have negative impact on child's nutritional status. Although it is not significant, a previous study done in 2006 at the same site which showed increased risk in the point estimate (AHR;1.10; 95%CI; 0.76–1.62) [23].

Maternal survival status also has significant association with under-five mortality. Those children whose mothers died were at higher risk of dying (AHR; 2.10; 95% CI; 1.36-3.23). This could be because children whose mothers died might not get appropriate care and support during their childhood period. Similarly, children having higher family size were at lower risk of death. This could be explained by many reasons. One is if the size of the family is higher, then there could be division of labor and the child has high probability of getting care and support by his/her mother or any other member of the family. A cross sectional study done in Mali also stated that children without having care givers (small family size) were at higher risk of mortality (18).

Unexpectedly, rural dwellers were at lower risk of death than urban (Butajira Town)(AHR=0.56; 95% CI; 0.44-0.72**).** This is in contrary with several studies which stated that rural dwellers are at increased risk of death [42, 45]. The EDHS report 2011 also stated that there is a difference in

mortality between urban and rural dwellers, 83 for the urban and 114 for the rural dwellers [27]. In this study the increased risk of death in urban dwellers could most probably be because of the very small sample analyzed in the urban population (354) than the rural population (3,318).

A number of studies have reported that mother's education as an important protective covariate for child survival. However, like to the observation made in this study, other studies (18, 26) also reported that mother's education was not associated with child survival. That could be explained by the similarities in the level of education attained by the mothers in this study.

# 7. STRENGTHS AND LIMITATIONS

## 7.1. STRENGTHS

- Comparability of the intervention using cohorts from the same geographical area.
- Presence of clear and distinct classification of individuals based on their exposure status.
- Reliable outcome measures already established from the Butajira DSS.
- Minimized attrition bias through demonstrated high rates of follow-up, benefiting from the existence of the DSS monitoring system.
- Allowed direct measurement of incidence of mortality in terms of person-years contributed and use of Cox regression analysis
- Use of the Butajira DSS data even for the intervention cohort (given free health services by the C-MaMiE project), to minimize bias.
- Large sample size with strong power and using a statistical software package (Stata version 12) which is strong for analysis purpose.

## 7.2. LIMITATIONS

- Using secondary data, which might have incomplete data, may affect its validity
- Selection bias was possibly introduced during secondary data extraction because children with incomplete records were excluded
- Some background household characteristics may refer to the time of survey, but not necessarily to the exposure time of the child
- Unable to measure the children's rate of utilization for health care services and the cost of the services

# 8. CONCLUSIONS

Neonatal, infant and under five mortality rates in the study area were high and the decrement in trends over time were very low in the study area.

The incidence of under-five mortality among children who received free PHC services was significantly lower than those who did not receive freely and had a better survival. This is persistent in comparing the free health service users' cohort with each of the three comparison cohorts (before, during and after the intervention cohorts).

Multiple birth, maternal death, death of the preceding sibling, lower family size and urban residence were also found to be other independent predictors of under-five mortality. Although these factors can independently increase under five mortality, abolition of user fees for health services can significantly reduce under-five mortality.

# 9. RECOMMENDATIONS

Health policy makers should give more emphasis on abolition of user fee health care services as it is found as one of the methods which significantly reduce under five mortality.

The government should conduct further studies in different sites and settings to support the evidences from this study, and thereby should take an interventional action accordingly.

Researchers should conduct further experimental studies, with randomization, to overcome the limitations of the use of secondary data and lack of randomization in this study. Since this study only measured the effect of free health care provision on under-five mortality, but not the cost used by the free health care providers, further researches should also be conducted to measure the costs.

Health extension workers, community leaders, governmental and nongovernmental organizations should involve in encouraging and giving care and support to under-five children, especially to those whose mothers have died.

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# ANNEXES

## Annex I. Check List for Child, Maternal and Household Characteristics

Table 6. A check list for childhood, maternal and household characteristics in relation with early childhood mortality among children born in Butajira DSA, South Central Ethiopia, from June, 2002 to July, 2008.

| S. No. | Question | Response |
|---|---|---|
| 1 | Date of birth of the child | __\|__\|__\|__\|__\|__\|__\|__\| DD MM YYYY |
| 2 | Date of death of the child | __\|__\|__\|__\|__\|__\|__\|__\| DD MM YYYY |
| 3 | Age at death of child | ..... days |
| 4 | Birth type | 1. Single 2. Twin 3. Triplet |
| 5 | Sex of child | 1. Male 2. Female |
| 6 | Place of delivery | 1. Health institution 2. Home/elsewhere |
| 7 | Death of previous sibling | 1. Yes 2. No |
| 8 | Health service utilization | 1. Free 2. User fee prior to intervention<br>3. User fee during the intervention<br>4. User fee after the intervention |
| 9 | Maternal age | 1. ≤ 20 2. 21-34 3. ≥ 35 |
| 10 | Maternal marital status | 1. Married (monogamous) 2.Married (polygamous)<br>3. Divorced/Separated/ Widowed 4. Never married |
| 11 | Ethnicity of the mother | 1. SNNRP 2. Amhara 3. Oromo 4. Other (specify) |
| 12 | Religion of mother | 1. Orthodox 2. Muslim 3. Catholic 4. Protestant<br>5. No religion 6. Other (specify) |
| 13 | Mother's literacy | 1. Unable to write & read 2. Able to write &read<br>3. Primary 4. Secondary 5. College and above |
| 14 | Place of residence) | 1. Rural 2. Urban |
| 15 | Size of the family | 1. ≤ 7 2. > 7 |
| 16 | Availability of latrine | 1. Yes 2. No |
| 17 | Main income source | 1. Farming 2. Trading / Employee 3. Other (specify) |
| 18 | Water source | 1. Protected Source 2. Unprotected Source |
| 19 | Waste disposal system | 1. Pit or Burning 2. Open field or Farm plot |
| 20 | Ownership of house | 1. Own/Governmental 2.Rented/Cohabited |

## Annex II. Birth registration form of Butajira DSS

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. 11)

**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. TTB 6. No assistant 7. Community health worker (CHW) 8. other (specify) __
19. Did the mother seek health care for complications of delivery like retained placenta and post postpartum 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 (including 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. others (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) _____

## Annex III. Death registration form of Butajira DSS

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 (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 3rdspouse 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 |

## Annex IV. House Registration Formof Butajira DSS

| |
|---|
| 1. Reason for filling out this form ⎕ 1. Surveillance 2. Reconciliation |
| 2. Date of interview **DD MM YYYY** ⎕⎕/⎕⎕/⎕⎕⎕⎕ |
| 3. Name of interviewer and code code⎕⎕ / / |
| 4. Is it a newly built house? ⎕<br>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? ⎕<br>1. Own 2. Governmental / Kebele 3. Rented from Individuals/Private<br>4. Cohabitant (Un-rentablel) 5. Other (specify) _____6. Cohabitant (Paying) |
| 9. Type of roof ⎕<br>1. Thatched 2. Corrugated iron sheet 3. Other (specify) _____ |
| 10. Characteristics of the wall of the house? ⎕<br>1. Wood and mud 2. Wood and stalk/ grass 3. Stone and cement<br>4. Hollow blocks5. Bricks 6. Corrugated iron sheets<br>7. Other (specify) _____ |
| 11. Does the house have a separate kitchen? ⎕<br>1. Yes 2. No 3. Yes, shared |
| 12. How many rooms does the house have (excluding kitchen)? ⎕⎕ |
| 13. Does the house have windows? ⎕<br>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? ⎕<br>1. Yes, well 2. Yes, Pipe 3. No |
| 15. What type of toilet facility does the house have? ⎕<br>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? ⎕<br>1. Yes 2. No |
| 17. Geographical position: North⎕⎕.⎕⎕⎕⎕⎕ East 038°⎕⎕⎕⎕⎕ |
| 18. Housing dimension (‘Tukuls’) Axis ⎕⎕⎕ Radius⎕⎕⎕ Wall height ⎕⎕⎕ ( Cms) |

## Annex V. Flow chart showing the activities of a BRHP data collection