Department of Community Health
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Retrospective cohort study in the determinants of child mortality in Butajira Demographic and Surveillance Sites

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A thesis submitted to the School of Graduate Studies Addis Ababa University in partial fulfillment of the requirements for the Degree of Master's in Public Health in the Faculty of Medicine, Department of Community Health.

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Declaration

I, the undersigned, declare that this is my original work has never been presented in this or any other University and that all the source materials used for the thesis have been duly acknowledged.

Name _____

Signature _____

Place _____

Date of submission _____

This thesis has been submitted for examination with my appraisal as a university advisor:

Name _____

Signature_____

Date_____

DEDICATION

This Thesis be /is Dedicated To My Sister, W/zo Wossenylesh,

Who Has Died of a Grave Disease In the Late of April, 2006.

Wossen may your soul/spirit rest in Heaven.

Acknowledgement

I am most grateful to my advisor, Dr. Negussie Deyassa for his unreserved help since the inception of this research. Without him, this thesis wouldn't have been a reality particularly in data processing and analysis. Dr. Negussie was always ready to provide both academic guidance and encouragement. Thank you for the constant support, patience and wisdow you were showing me.

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Abbreviations

MGDs: Millennium Development Goals

HIV: Human Immunodeficiency Virus

AIDS: Acquired Immunodeficiency Syndrome

BRHP: Butajira Rural Health Project

SSA: Sub-Saharan Africa

DSSs: Demographic and surveillance Sites

UNICEF: United Nations Children's Fund

MoH: Federal Ministry of Health, Ethiopia.

PAs: Peasant Associations

UDAs: Urban Dwellers Associations

FGDs: Focus Group Discussion

ID: Identification Number

SPSS: Statistical Package for Social Sciences

EDHS: Ethiopian demographic and Health Survey

Operational definitions

Households: a group of people habitually eating and sleeping together in the same compound and one form was used for each household.

Open cohort system: system of surveillance where in people are freely allowed to go in and out in the study base.

Re-census: the 1999 census of the Butajira Rural Health Project in its all study sites, consisting of nine villages and one urban site.

Cohort: A group of people sharing a common temporal demographic experience who are observed through time. For example, the birth cohort of 2000 is the people born in that year.

Determinants: any factor, whether event, characteristics or other definable entity that bring about change in a health condition, or other defined characteristics.

Infant Mortality Rate: number of deaths during the first year of life per 1000 live births.

Under five mortality: number of deaths among children <5 years old per 1000 live births observed in the population of children who are <5 years old..

Demographic surveillance system: A geographically defined population, under continuous demographic monitoring, with timely production of data on all births, deaths, and migrations.

Abstract

Background: Eleven million children under age of five die annually in the world as a whole, of which over ten million are in the developing world. A large proportion of these deaths are preventable and uncounted. To this end a realistic picture of an epidemiological profile and intervention developments require an understanding of the determinants of child mortality. Moreover, a relatively less expensive and feasible method that can yield reliable and valid data is necessary. Though many studies that have been done to determine factors associated with child deaths, no sound methods were used.

Objective: Therefore, this study was designed to identity factors associated with death of children in the first five years of life.

Method: This study was a retrospective cohort study that took secondary data of BRHP and qualitative study design to supplement on the quality of data collection. All birth cohorts born between Jan 1st to Dec 31st, 2000 were considered as the study population. Data was analyzed using the Cox proportional Hazard model to track survival pattern of children and factors associated with child death.

Results: Infant and under five mortality rates were 83.9 and 118 deaths per 1000 live births. Excess mortality was observed in female children than in males; moreover, multiple births were at increased risk of dying than singleton. Urban children had more (50%) chances of survival compared to rural ones. upon stepwise multivariate Cox regression source of water esp. pipe water, sex of child, multiple births, urban places of residence and availability of radio in the household were found to be independent predictors of child survival.

Conclusions and recommendation: mortality is relatively high and the provision of safe and adequate water supply and promotion of child health should be considered in the area.

1. **Statement of the problem**

Infant and child mortality has long been used as indicator of the level of socioeconomic development of a nation (Feacham & Jamison, 1991; H/Mariam and Tesfaye, 1997). Data indicate that some eleven million children under the age of five die annually in the world as a whole, of whom over ten million are in the developing world (Black et al, 2003). A large proportion of these deaths are due to a few conditions, namely pneumonia, diarrhea, malaria, measles, HIV/AIDS and malnutrition among children younger than five years and asphyxia, preterm delivery, sepsis and tetanus for deaths among neonates (Black, et al, 2003; Bustreo et al, 2003). With the exception of HIV/AIDS, most can be easily prevented and treated, as illustrated by the insignificant child morbidity and mortality they cause in developed countries (Bustreo et al, 2003; Hill and Amouzou, 2004; Jones et al, 2003).

Given the present importance and high priority of child mortality in the globe in general & in Ethiopia, in particular, a thorough understanding of the differentials and determinants of child mortality is needed. Nowadays, efforts are being made to carry out more appropriate analytical work instead of relying entirely on the literature available in this topic. It's believed that such an attempt is likely to provide more accurate results, which would lead to more appropriate interventions.

On the other hand, information on demographic characteristics and health indicator is crucial in planning and evaluation of health services. Reliable and timely collected data on health indicators serve many purposes. They can also be used as a basis for effective policy formulation and implementation. Developing countries often lack those mortality data. Even if, those data are available, they are not of sufficient

quality to provide policy makers and planners with the required information (on levels and trends of disease occurrence).

At present, the most commonly used data basis for planning in developing countries, are mainly surveys and case reports from health institutions and these information sources could only satisfy temporary research needs. It is also a known fact that in health institutions, a large proportion of deaths are not medically attended, and thus, many disadvantaged will be excluded from national statistics. In Ethiopia, as in many developing countries, where there is no vital statistics registration, and low health coverage of 62% (MOH, 1996), health institution-based studies could give unsatisfactory results of underestimation. Therefore, a relatively less expensive and feasible method that can yield reliable and valid data is necessary. Hence, the aim of this study is to describe the demographic characteristics at time of death and identity factors associated with death of children in the first five years of their life.

Rationale

The rationale for selecting this problem area is due to the fact that identification of determinants of mortality in children helps policy-makers and planners to target with feasible interventions in Ethiopia.

2. Literature Review

Infant & child mortality has long been used as indicator of the level of socioeconomic development of a nation. Most of the developed countries have registered low levels of infant & child mortality rates. Rates of decline in worldwide child mortality peaked in about 1980. In 1990-2001, the number of child death fell by 1.1% every year, compared with 2.5% per year during 1960-90. Sub Saharan Africa (SSA) had the highest child mortality in 1970-74, but in the years since has had the slowest fall in rate (UNICEF,2003; Feacham & Jamison,1991, Fantahun M,1998).In 1990, there were 180 deaths per 10^3 live births in SSA & only 9 per 1000 in industrialized countries- a 20-fold difference. In 2000, this gap had increased to 29-fold with mortality rates of 175 & 6 per 1000 children in SSA & industrialized countries, respectively (Black RE et al, 2003). The World Summit for children in 1990 called for a worldwide reduction in child mortality to below 70 deaths per 1000 live births (or a one-third reduction) by the year 2000. Unfortunately, achieving such a reduction in the 1990s was not commensurate with needs and the mortality reduction target was reached for only five of 55 countries in 1990.

In 2002, as part of the Millennium Development Goals (MDGs) for health, nations pledged to ensure a two thirds reduction in child mortality by 2015, from the base year 1990. To this end a realistic picture of a

country's epidemiological profile & the capabilities of its health system are needed before appropriate public health intervention can be developed & implemented. More over, intervention developments require an understanding of the determinants of child mortality. In 1995 it was estimated that 10.5 million children died before reaching their 5th birthday. In 2000 the estimate (global) is 10.8 million. Most surprising is that a very large proportion of all child deaths occur in developing countries - 90% just in 42 countries (Black RE et al, 2003)· Large proportion child deaths are due to pneumonia, diarrhea, malaria, measles, HIV/AIDS, & malnutrition among children younger than five years, & asphyxia, preterm delivery, sepsis & tetanus for deaths among neonates. With the exception of HIV/AIDS, most can be prevented & treated, as illustrated by the insignificant child morbidity & mortality they cause in developed countries (Black RE et al, 2003; UNICEF, 2003; Ali M., 2005).

Child mortality is the result of a complex web of determinants at many levels. According to Mosley & Chen (1984) ". . . child's death is the ultimate consequence of a cumulative series of biological insults rather than the outcome of a single biological event". As a result, they developed what is perhaps the least used part of their framework: a single outcome variable combining both child health & child health status. Mosley & Chen stressed the importance of social science approach /research on child mortality (i.e. the association between socioeconomic status &

patterns of mortality) on top of the medical science approach/research. Based on this framework, they develop proximate determinants that are grouped in to five categories. Maternal factors (age, parity; birth interval); Environmental contamination (air; food/ water/ fingers; skin / soil/ inanimate objects; insect vectors); Nutrient deficiency (calories; protein; micornutrients); Injury (accidental; intentional); Personal illness control (personal preventive measures; medical treatment).

In this conceptual framework, the idea that all background (socioeconomic & cultural) variables have to operate through a limited set of proximate determinants that directly influence the risk of disease & the out come of disease processes(Hill K.; 2003).

Therefore, child survival programs/ interventions are aimed at addressing the more proximate determinants of child mortality while understanding the important role played by distant determinants such as poverty & characteristic of the physical environment (Black RE et al, 2003; Ali M., 2005; Hill K., 2003).

Information on mortality patterns has become a common feature in many developing countries making planning, monitoring & evaluation of health interventions difficult in which Ethiopia is not an exception (Feacham & Jamison, 1991; Fantahun M., 1998). In Ethiopia, infant & child mortalities are estimated to rank among the highest in the world. Moreover, health professionals do not attend illnesses and many deaths

take place out side health institutions. The most common sources of information on morbidity remain reports & records of health institutions which are sometimes incomplete &/or inaccurate (Teka T., 1996; Fantahun M., 1998; Shamebo D., 1994).

Causes of child mortality

According to the WHO prediction, the estimate in 2000 for SSA by causes of deaths is neonatal disorders (25%), malaria (22%), pneumonia (21%), diarrhoea (20%) & AIDS (8%)(Black et al,2003). But, this aggregation may be misleading because some countries have very few AIDS & very little malaria deaths or are severely affected by malaria, AIDS or both. In addition to this, there is wide variation among regions in the globe. Because of this, availability of valid epidemiological information at country level will be an important determinant of success in meeting, in measuring the MDGs for child survival as well as in public health planning(Black RE et al, 2003).

Determinants of infant & child mortality

Various studies have been conducted to show factors affecting child mortality in both developed & developing countries. These factors have been associated with demographic, socioeconomic & environmental factors such as ethnicity, housing condition, crowding, availability of latrine, & early termination of breast-feeding. Demographic variable include age at maternity, birth interval, birth order & survival status of preceding sibling, sex of child, mother's place of residence, maternal

education religion, martial status, income; other studies identified care at delivery, duration of breast feeding, child nutrition, parental education, cultural normal & values as well as community level are known to influence the chances of survival of infant/ child (Hailemariam A.,1997; Shamebo D.,1994;Yohannes K.,Heins F., et al,2001;Katz J, et al,2003).

Identifying these diversified determinants of infant & child mortality is believed to assist in the design of programs for lowering the risk of mortality that prevails in a country. In view of the strong association between infant & child mortality & fertility, lowering infant & child mortality may subsequently lead to fertility decline. So, generally specific in-depth studies dealing with these correlates of infant /child mortality are lacking in our country (Hailemariam A., 1997; Heins F et al, 2001).

Socioeconomic determinants

A study done by Abate (1988) found that the most important correlates in rural areas were ethnicity, religion, region of residence, place of birth, & literacy status of parents. More over, this study (Abate M., 1998) and Hailemariam confirmed that ethnicity & religion were highly correlated. Yohannes (1992) & Makonnen (2000) confirmed that the inverse relationship between mothers educational attainment & infant and child mortality. Education not only influences infant &child survival but also indirectly through its association with a higher socioeconomic status of the household. Therefore, this could be a specific target for polices. Hailemariam & Abate confirm the negative link between work status of

women and infant & child mortality. This is noting that the proportion of surviving children will increase with better socioeconomic well-being in the household. Besides, they are more likely to access to piped water, to latrine & they may pay attention to hygienic practices, etc (Heins et al, 2001; Majumder 1997).

Biological determinants

Birth spacing (length of time interval between births) was found to as a key variable by Abate. Lindstorm et al (1999) revealed that closely spaced births increase the probability of dying in the first months & years of life and attributed the effect to mechanism of resource competition between the index birth & the later born. Certainly the length of breast feeding has an important role (Makonnen et al, 2000; Lindstrom et al, 1999).

Environmental / sanitary conditions

Several other studies including Shamebo (1994) studies in Jimma & Fantahun (2000) have shown the importance of these factors in particular the role of water supply and availability of latrine.

Malnutrition

Several studies in Ethiopia indicated 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. The role of repeated war & famine as to explain the high level of infant & child mortality in this country should not also forgotten. In summary, all

these determinants are consistent with the existing literature of infant and child mortality (Lindstrom et al, 1999).

Trends in Infant & Child Mortality in Ethiopia

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 decrease 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 6 new born is reaching its 5th birthday. According to existing literatures on famine in Ethiopia, it is estimated that the U5MR for refugee population with 316 births 1000 for males & 276 for females. In 1985-86 famine in southern Ethiopia caused a 40% increase in child mortality among children living in traditional & stable societies (Heins F., et al, 2001).

Infant mortality rate based on 1984 census (110 per 1000 live births), and the 1981& 1990 surveys (141 & 105 per 1000 live births respectively) vary. These results could indicate a certain underestimation in the 1984 census. The Ethiopian DHS (97 per 1000 live births) indicates a very positive trend in infant & child mortality over the last years, whereas the estimates for previous periods are higher than known other sources (Heins F., et al, 2001).The recent DHS 2005 preliminary report further warrants the decline in child mortality(EDHS,2005).

3. OBJECTIVES

General objective: To assess determinants of under five mortality in Butajira, Ethiopia.

Specific objective:

1. To describe the socio-demographic and household characteristics of the cohorts
2. To identify factors associated with death of children in the first five years of life in Butajira
3. To Measure infant, child and under five mortality levels in Butajira, Ethiopia

4. Methods & materials

Study Design

This study was a retrospective cohort study that took secondary data of BRHP. The study also used qualitative study design (FGDs) to supplement on quality of data collection with data collectors, field supervisors.

Study area: - This study was conducted in Butajira District which is located 130 kms South of Addis Ababa. The total population of the district, on the basis of the 1994 Census was estimated to be 257,000 (PHCCO/CSA, 1994; Shamebo, 1994). The district population structure shows a typical developing country pattern. The proportion of children under 14 years is 46% & that of people 65 years & older is 1.3%. The district is organized in to 82 Peasant Associations (PAs) & 4 Urban Dwellers Associations (UDAs). The major ethnic group is Gurage. Inset (false banana) is the main staple food in the area. The topography has a combined highland, lowland & in between characteristics (Berhane et al, 1999;Shamebo, 1994).

In addition to Butajira Health center, there are 2 government health stations, 11 private clinics, 11 functional health posts & two hospitals (one governmental and the other non-governmental).

Butajira Rural Health Project (BRHP) was initiated in the area in 1986 with the intent of developing a continuous demographic surveillance

system & of providing a baseline population & sampling frame for other health- related activities that would be carried out in the area (Shamebo, 1994).In addition, mortality, fertility and migration levels and determinants are recorded. The BRHP includes one UDAs & 9 PAs which were selected using probability proportionate to size from the 82 PAs in the district & four UDAs of Butajira town respectively.

In 1986, a baseline Population and Housing Census was conducted and since then, demographic surveillance with continuous registration of vital events (like birth, death, change in marital status, migratory status changes) on monthly basis was being carried out up to 1999 and quarterly thereafter. Basic demographic, social, housing condition & health care utilization characteristics are recorded for each household at entry in to the surveillance system & during any re-census process. The surveillance system operates as an open cohort system and dynamic (Berhane Y. 1999).

Source and Study populations

All children who were part of data base were taken as the source population. All children born from January 1st to Dec 31st, 2000(birth cohorts) in the ten study sites of the BRHP were selected as the study population. The 2000 birth cohorts were taken for this study because it reflects the current situation in the study area and believed to have a good data collection process. Moreover, these births are recent births

that can be followed up to the end of 2005. The survival status of these children was followed up to the 59 months or December 31st, 2005.

Similarly to calculate age specific mortality of children, all births and deaths that occurred in 2004 were included. All live births in 2004 were selected as denominator, and a total of 1478 live births and 174 child deaths were registered.

Sample size and Sampling Procedure

All birth cohorts of Jan 1st to Dec 31st, 2000 were considered as the total sample size for this particular study. These birth cohorts were, specifically, chosen to reflect the current situation of child mortality in the study base.

Data Collection Procedures

The study used the primary data collected by the BRHP. Data was collected from the BRHP data base by linking data sets of the mother and household variables together by using EPI INFO version 6.This has resulted in one spread sheet after which time variables which were not needed for our 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 children.

In the study program, trained field workers (enumerators) living in each peasant associations & Urban dwellers association collected information on births, deaths, changes in marital status, in/out migration, moves within the study kebeles & change of household and housing characteristics. Using a monthly visit to each household up to 1999 and quarterly thereafter. The data collectors were trained on how to complete surveillance forms, and on the principles and procedures of data collection. In addition, they received periodic refresher training on the same topics. Job descriptions & interview guides were provided to the field staff to clearly indicate their duties & responsibilities.

Data Quality Assurance

Data quality assurance mechanisms were well developed at several points, particularly in the field supervision. Four field supervisors each were assigned to 2-3 villages & Butaijra program field coordinator perform the immediate supervision on a daily basis. They do checking of each & every completed surveillance form & visiting a randomly selected 5% of households each month on a weekly schedule time table. The next level of supervision was done by research assistants, who have public health training at master's level. At the highest level supervision is performed by the researchers themselves (Berhane Y et al, 1999).

There is software using dBase IV platform for data entry and, data clerks were entering the data at the project office in Butajira. Data were

cleaned & updated periodically by assistant researchers & principal researchers).

Variables and Scales of Measurement

The Dependent variable is death of child. For child survival duration (in days) was considered between the birth of the child and the death of the child. The child surviving till end of the cohort study contributed a censored case (i.e. surviving beyond five years).Moreover, survival status of these children were followed up to the 59th month. Outmigrating children were also measured till they leave the area.

On the basis of previous work and subject matter knowledge, a set of variables, were selected for the analysis. Based on statistical significance ($P< 0.05$) under univariate analysis and considering potential importance, the following variables were taken as likely covariates:

1) **Child factors/characteristics**: sex of the child, birth type, birth order, preceding child survival status and place of delivery.
2) **Maternal and paternal factors:** age of mother, religion, educational status of mother, ethnicity of mother, marital status, , place of residence(urban/rural), ecological zones, occupation and educational status of the father.
3) **Household factors:** type of house(floor, roof), possession of radio (media exposure), availability of latrine, source of drinking water, availability of separate kitchen, livestock sleeping in same room

with family at night, economic status of the family (Standard of living index), place of waste disposal and family size**.**

4) **Others:** place of delivery, attendance at delivery, etc.

Some of the above mentioned covariates were in their dichotomous forms (coded as a series of dummy variables): place of residence (urban/rural), sex of child (male/female), etc. For the purposes of analysis they were also categorized as dichotomous variables from their nominal scale: mother's occupation (not working/working), possession of radio (no/yes), latrine, etc. All the variables are in the form of fixed covariate with fixed effects.

Among the socio-demographic variables, economic index was calculated based on information on ownership/possession, of livestock and domestic animals, number of "timad" (agricultural land) they had in the household and possession of television that were graded numerically in terms of their value or importance. Scores summated further categorized into scores below 2.39 for low, between 2.39 and 7.30 for moderate and greater than 7.30 for high economic indexes. This was tested for its normality by using the standard curve for symmetry. The economic index is an indication for the overall material well-being of households and it makes sense to take households with high economic index as belonging to a better category.

Death was the outcome variable that was measured (coded as 1 for dying and 0 for survival).

Data Analysis

After the child datasets were linked to their mothers, using mothers ID & household characteristics using EPI Info version 6. Data was analyzed using SPSS Statistical package, Version 11.0. Relative risks (hazard ratio) with 95% confidence interval were used to measure the association of dependent and independent variables. Age specific mortality for neonatal, post-neonatal, infant and child mortality, age specific deaths were used and all live births were used as denominators. Taking into account all the covariates considered in the Cox multivariate analysis, Cox proportional Hazard models with forward stepwise method was used to establish which variables had independent predictive power for mortality.

To track survival patterns of the children, a Cox proportional hazard model (Fisher LD and Van Belle G; Kalbfleisch JD and Prentice R, 1980) was used. This method estimates non-parametrically the distribution of exposure time (days lived) to the likelihood of a child dying at time **t**. Covariates are then allowed to shift this baseline proportionally. Separate proportional hazard models were run to capture the compounding effects of maternal & household characteristics.

$$h(t) = h_o(t) \exp(\beta_i X_i)$$

Where, $h_o(t)$ is the baseline hazard function

$\mathbf{X_i}$ is a vector of covariates

exp βi is the relative risk associated with the i^{th} explanatory variable.

This model is chosen because it can handle censored cases (cases with incomplete exposure i.e. alive children).It is a special case of the more general survival model in that it combines aspects of a life table & regression analysis & allows the formulation of relations between a set of covariates (independent variables) & 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 relative risk associated with the i^{th} explanatory variable. Parameters will be employed using maximum likelihood procedure. Therefore, this model will be employed for examining the determinants of child mortality in this particular study.

5. Ethical considerations

The study was carried out after getting permission from the ethical clearance committee of Addis Ababa University Medical Faculty through Department of Community Health. Since we used the data base of BRHP, prior permission was also obtained from the program managers.

6.0 RESULT

In the year 2000, a total of 49, 000 peoples were active in the data base of which there were 1445 births, 215 deaths, 85 out-migrants. In this study all the 1445 birth cohorts were followed for five years.

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6.1 Socio-demographic Characteristics

6.1.1 Child Population

Out of the 1445 birth cohorts selected for the study, 748 (51.8%) were males. With regard to birth type, there were 1393 (96.4%) singletons and 52 (3.6%) twins or triplets. In this study population birth order of the infant was described, first order births accounted to 174(12.0%), second to fourth order births were,602(41.7%) and fifth or higher order births accounts for 669(46.3%), (Table 1).

Table 1: Descriptive statistics for the study population in Butajira Demographic Surveillance Sites (DSSs), 2006.

Child characteristics	Number	percent
Sex of child (N = 1444)		
Male	748	51.8
Female	696	48.2
Place of delivery (N=1445)		
Home	1372	94.9
Health Institution	73	5.10
Attendant at time of delivery		
Relative	1245	86.2
TBAs	130	9.0
Professional	70	4.8
Birth type		
Singleton	1392	96.3
Twin or triplet	53	3.7
Birth Order		
First birth	174	12.0
2^{nd} – 4^{th} Birth	602	41.7
5^{th} & higher	669	46.3
Preceding child survival status (N= 1270)		
Survived	938	73.9
Not survived	328	25.8
First child	4	0.3

6.1.2 Maternal Characteristics

Illiterate mothers took the highest proportion, 81.9% while those mothers with the ability to read and write and educated accounts for 228 (15.8%) & 33(2.3%) of the mothers included in the study. Most of the mothers

were married monogamously 1154 (79.9%) and those mothers who have been married polygamously constitute 244 (16.9%) of the mothers population in the study base.

The majority 1353 (93.7%) of mothers were not having work while only 91(6.3%) had some sort of work (job). Mother's who were less than 20 years were 19 (1.3%), those between 20 to 34 years account for 820 (56.7%) and those 35 and above 35 years are 606 (41.9%).A significant number 1397 (96.7%) of the mothers were Guragie and a smaller number 48 (3.3%) were either Amhara or Oromo in ethnicity. Moreover, 1229 (85.1%) of the mothers dwell in rural part of the district while 216 (14.9%) resides in urban Butajira (Table 2).

Table 2. Descriptive statistics for the study population in Butajira Study Base, 2006

Mother characteristics	Number	Percent
Mother's Education		
Illiterate	1184	81.9
Read & write	228	15.8
Educated	33	2.3
Mother's marital status		
Monogamous	1154	79.9
Others	291	20.1
Religion		
Christian	324	22.4
Muslim	1121	77.6
Working status (N=1444)		
Working	91	6.3
Not working	1353	93.7
Mother's age		
< 20 years	19	1.3
20 – 34	820	56.7
35 & over	606	41.9
Ethnicity of Mother		
Guragie	1397	96.7
Others	\48	3.3
Place of Residence		
Rural	1229	85.1
Urban	216	14.9

6.1.3 Household Characteristics

Four hundred and forty seven (30.9%) of the households possess radio. In terms of availability of latrine, the majority 1223 (84.6%) of the households were not having latrine. It is found that 679 (47.2%), 586

(40.7%) and 174 (12.1%) of the households in the study area were getting water for drinking purposes from well, river and pipe sources of water respectively. A great majority 1136 (78.6%) of the households weren't having a separate kitchen available for cooking purposes. Nine hundred and sixty nine (66.7%) of households were having a domestic animal /livestock spending the night in the same room where members of the family sleep in the night. Using economic score developed for this study, 898 (62.10%) of the family were classified as having a moderate score and 263 (18.2%) and 284 (19.7%) were classified as low and high economic scores respectively. The dominant type of roof from which the household is made is thatched accounting for 1157 (80.1%) (Table 3).

Table 3.Descriptive statistics for the study population by Household Variables in Butajira Demographic Surveillance Sites, 2006

Household characteristics	Number	Percent
Availability of radio		
Available	998	69.1
Not available	447	30.9
Availability of latrine		
Available	222	15.4
Not available	1223	84.6
Water sources (N=1439)		
Pipe	174	12.1
Well	679	47.2
River	586	40.7
Separate kitchen		
Yes/available	309	21.4
No/Not available	1136	78.6
Livestock's in same house		
Yes	963	66.6
No	482	33.4
Economic position (Family)		
Low	263	18.2
Moderate	898	62.1
High	284	19.7
Type of roof		
Thatched	1157	80.1
CIS[@]	288	19.9

CIS= corrugated Iron sheets

6.2 Child death

6.2.1 Child death in the Cohort

Among the 1445 birth cohorts included in this particular study, 215 (14.9%) child deaths were experienced for the last five years of exposure. These study subjects had contributed 5,957 person-years of which

incidence mortality rate become 36 deaths per 1000 person- years. (Table 4).

Table 4. Prevalence and incidences rates of Deaths in Butajira Demographic Surveillance Sites (DSSs), 2006.

	Death (N= 1445)			
	Prevalence		Incidence rate (per 10^3/ person-year)	
	Number	%	No. Person-time	Rate
Yes	215	14.9	5957 person-years	36.0

Of the total two hundred and fifteen deaths occurred among the cohort of 2000 births, 92(42.8%) occurred in the first months of their life and this gives a prevalence of death in the neonatal period of 42.8% and in the post-neonatal period of 28.8percent. Prevalence of infants' death was calculated to be 71.6% (Table 5).

Table 5: Description of neonatal, infants & under fives mortalities for the total Cohort selected in Butajira DSS, 2006

	No	percent
Neonates	92	42.8
Post neonatal	62	28.8
Infants	154	71.6
Child	61	28.4
< 5	215	-

6.2.2 Age Specific Mortality Rate

For the purpose of calculating age specific mortality rates, all live births in 2004 were selected as denominators and a total of 1478 live births and 174 child deaths were registered. Sixty-four (36.8%) of child deaths, sixty-four (51.6%) of infant deaths occurred in the first months of their life and this gave a probability of death in the neonatal period of 43.3 per thousand live births. Similarly, sixty (34.5%) of child deaths occurred during the post neonatal period to give a probability of death in the post-neonatal period of 40.6 per thousand live births. Moreover, 124(71.25) of child death occurred before children celebrate their first year giving infant mortality rate of 83.9 per 1000 live births. The overall child mortality was calculated to be 117.7 per 1000 live births (Table 6).

Table 6.Description of neonatal, infants & under fives mortalities in Butajira Demographic Surveillance Sites, 2006.(N=1478)

	No	Deaths per 10^3 LBs
Neonates	64	43.3
Post neonatal	60	40.6
Infants	124	83.9
< 5	174	117.7

6.3 Determinants of Child Death

Table 7, 8 and 9 shows the results of proportional hazards models estimating the effects of child, maternal and household characteristics on

child death among those birth cohorts born from January 1st to December 31st, 2000 in BRHP study base. It shows the crude and adjusted statistics.

6.3.1. Child Specific factors

Among the child characteristics, sex of child and birth type were identified as major determinants (predictor) of child mortality in this particular study. When we compare child mortality among those who were females with those who were males, the difference was statistically significant. High mortality occurred in those who were females (HR=1.39; 95%; CI 1.02- 1.91) than males. Upon adjustment for sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water the effect of sex of child was not found to be statistically significant [HR=1.35; 0.96- 1.91].

Birth type was also another variable that showed a positive association with child mortality. Upon comparing mortality among those children who have been born single with those who have been born multiple (twin or above), the difference was highly statistically significant. Less mortality occurred in single born ones than multiple births (HR=0.23; 95% CI; 0.14 – 0.39].Upon adjustment for sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water, this factor was still protective and statistically significant [HR= 0.24; 95% CI 0.14- 0.44).

Though in this study, birth order, survival status of preceding sibling and place of delivery were not associated with child mortality, they were in the expected direction of effect. For instance, birth order of five and above was found to be 26% higher risky than being first born child, and birth order of 2-4th was also observed to be 22% less risky. Place of delivery was found to be protective (HR=0.78; 0.35 – 1.77)(Table 7 below).

Table 7. **Hazard Ratios from proportional Hazard Models of child Mortality for child variables, Butajira DSSs, 2006**.

Variables	No %	CHR (95% CI)	AHR (95% CI)	β(SE)
Child characteristics				
Sex of child				
Male[R]	**108(15.3)**	**1.00**	1.00	
female	**107 (16.4)**	1.39 (1.02-1.91)*	1.36(0.96-1.90)	0 .30(.174)
Birth type				
Multiple[R]	**23 (46)**	**1.00**	1.00	
Singleton	**192(14.6)**	0.23 (0.14-0.39)*	**0.24(0.14 – .44)***	**-1.40(.29)**
Birth order				
First[R]	**24(15.9)**	**1.00**	-	
2- 4th	**72 (12.7)**	**0.78 (0.45-1.36)**	-	7.88(54.35)
5t	**119 (18.4)**	**1.26 (0.75 – 2.11)**	-	8.29(54.35)
Preceding survival status				
Survived[R]	**125 (14)**	**1.00**	-	
Not survived	**62 (20)**	**1.10 (0.76 – 1.62)**	-	-.01(.20)
First child	**2 (50)**	**3.25 (0.45 – 23.29)**	-	1.89(1.06)
Place of Delivery				
Home[R]	**202(15.6)**	**1.00**	-	
Health institution	**13 (18.8)**	**0.78 (0.35-1.77)**	-	0.14(.632)

*** all variables are adjusted for sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water; at P< 0.05 level of significance.**
CRH=crude relative hazard ;ARH=adjusted relative hazards

6.3.2 Maternal determinants /correlates

Place of residence and climatic factors showed a significant association with child survival. Among children whose mothers live in urban areas as compared to those whose mothers live in rural areas. In the crude analysis, more survival (lesser risk of dying) was observed in urban than in rural areas (HR= 0.50; 95% CI; 0.28-0.89).However, adjusting for other factors, place of residence was not found to be significantly associated but protective of child mortality (HR= 0.55; 0.14-2.18).

The other factor that showed significance association was ecological or climatic variable where the child lives. When we compare child survival in highland areas with those children who live in lowland areas of Butajira, living in highland areas was observed to have a protective effect but not statistically significant (HR= 0.79; 0.57 – 1.10).However, when we compare mortality in children of mothers who live in urban Butajira with those whose mothers live in lowland areas of rural Butajira, less mortality was observed in those living in urban than in rural areas. The risks of dying in those children were less by 55% than those children in lowland rural Butajira children (HR= 0.45; 95% CI; 0.25- 0.81).

Moreover, upon adjustment, this factor (ecological variable) had given a way to compare highland child mortality and low land child mortality. Child survival was observed to be higher in those children who lived in highlands than those who lived in low land areas (adjusted HR=0.62; 95% CI; 0.40 -0.96).As a result, highland dwelling was found to be one of

the independent predictor of child survival and showed statistically significant association (Table 8).

Even though it is not statistically significant, children of mothers who were Muslim were having a protective effect on risk of child mortality (HR= 0.90; 0.62 -1.30).

This study revealed that child survival was not associated with educational status, marital status, religion, working status, age of mother and ethnicity of the mother (Table 8).

Table 8. **Hazard Ratios from proportional Hazard Models of child Mortality for Mother Characteristics, Butajira DSSs, 2006.**

Variables	Deaths No %	CHR (95% CI)	AHR (95% CI)	β(SE)
Mother characteristics				
Education				
Illiterate[R]	186 (16.6)	1.00	-	
literate	29 (12)	0.72(0.46– 1.13)	-	0.25(.26)
Marital status				
Others[R]	39 (14.2)	1.00	-	
Monogamous	176 (16.2)	1.21 (0.81-1.85)	-	.28(.23)
Religion				
Christian[R]	53 (18.1)	1.00	-	
Muslim	162 (15.1)	0.90 (0.62, 1.30)	-	-.16(.21)
Working status				
Not working[R]	204 (15.9)	1.00	-	
Working	11 (13.9)	0.96 (0.49, 1.87)	-	1.13(.50)
Age (Years)				
< 20[R]	2 (11.1)	1.00	-	
20 – 34	109 (14.4)	1.89(0.26- 3.55)	-	.38(1.01)
35+	104 (17.7)	2.46 (0.34, 17.7)	-	.51(1.02)
Ethnicity				
Others[R]	11 (23.4)	1.00	-	
Guragie	204 (15.5)	1.24 (0.46, 3.36)	-	.64(.63)
Place of Residence				
Rural[R]	196 (16.8)	1.00	1.00	
Urban	19 (9.5)	**0.50(0.28-0.89)***	0.55(0.14-2.18)	-.59(.70)
Ecological Zones				
Lowland[R]	105 (18.6)	1.00	1.00	
High Land	91 (15.2)	0.79 (0.57, 1.10)	**0.62(0.40-0.96)***	**-.47(.22)**
Urban	19 (9.5)	**0.45(0.25, 0.81)***	**-**	

*** sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water at P< 0.05 level of significance ; CRH=crude relative hazard ;ARH=adjusted relative hazards**

6.3.3 Household characteristics

Table 9 showed that child survival was positively associated with possession of radio, availability of latrine, water source and livestock living in the same room with humans.

When we compare child mortality in households that possess radio with those that do not possess radio in the analysis, child survival was found to be protective and showed statistically significant association. Less mortality had occurred in those children where households possess radio and the risk of dying was observed to have decreased by 56 %(HR=0.44; 95% CI; 0.29- 0.67).This factor continued to exert its effect even after adjustment for sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water had been made (adjusted HR= 0.55; 95% CI; 0.34 – 0.89).

Availability of latrine in house holds revealed a statistically significant association with child survival. In those households that possess latrine, child mortality was found to be 64% lower than those that do not possess latrine (HR=0.36; 95% CI; 0.19, 0.68). But, the role of this factor vanished after it was adjusted for other factors.

Households that used piped water taps as their principal source of water were observed to have less child mortality compared to those households that used river as their source of water. (HR= 0.35; 95% CI; 0.17- 0.73 and after it was adjusted for other household factors (adjusted HR= 0.28; 95% CI; 0.08- 0.94). However, children living in households that used well as source of water were not found to be significantly associated both in the crude and adjusted analysis but in the direction of effect.

In households where livestock's do not spare the night in same room with children were found to show a marginally significant association with child mortality (HR=0.70; 0.49- 1.00) at 95% CI with crude analysis) (Table 9).No statistical significance with adjustment was found.

Among other household variables, family economic status and availability of separate kitchen weren't significantly associated with child survival.

Table 9. **Hazard Ratios from proportional Hazard Models of child Mortality for Household characteristics, Butajira DSSs, 2006**

Variables	Deaths No %	CHR(95% CI)	AHR (95% CI)	β(SE)
Household characteristics				
Availability of radio				
Not avail[R]	175 (18.6)	1.00	1.00	
Available	40 (9.5)	**0.44 (0.29, 0.67)***	**0.55(0.34 – 0.89)***	**-.59(.24)**
Availability of latrine				
Not avail[R]	201 (17.4)	1.00	1.00	
Available	14 (6.8)	**0.36 (0.19, 0.68)***	0.63(0.28-1.45)	-.45(.42)
Water source				
River[R]	106 (19.0)	1.00	1.00	
Well	95 (14.9)	0.85 (0.62, 1.18)	0.73(0.48 - 1.11)	-.31(.21)
Pipe	13 (8.1)	**0.35 (0.17, 0.73)***	**0.28(0.08 – 0.94)***	**-1.29(.62)**
Kitchen (separate)				
Not avail[R]	176 (16.4)	1.00	-	
Available	39 (13.3)	0.80 (0.54, 1.20)	-	.10(.26)
Livestock Same Room				
Yes[R]	158 (17.2)	1.00	1.00	
No	57 (12.8)	**0.70 (0.49, 1.00)***	0.99(0.56-1.76)	-.003(.29)
Economic status				
Low[R]	38 (15.3)	1.00	-	
Moderate	143 (16.9)	1.15 (0.76, 1.74)	-	.24(.31)
High	34 (12.6)	0.73 (0.42, 1.28)	-	-.22(0 .38)
Type of roof				
Thatched[R]	184 (16.7)	1.00	--	
CIS	31 (11.8)	0.65 (0.42, 1.02)	-	-.15(.41)

*** sex, birth type, place of residence, ecological zones, availability of radio, latrine, presence of livestock in same room and source of water at 0.05 level of significance; CIS= corrugated iron sheets; CRH=crude relative hazard ; ARH=adjusted relative hazards**

Up on step wise Cox regression analyses for determinants of child mortality, sex of child, birth type and availability of radio in the household were found to be independent predictors. Being born as female is associated with a 39% higher risk of dying. Children's of those households that possess radio were having a 47% of lower hazard of child deaths (Table 10).

Table 10. **Summary of the Stepwise Cox regression for relative effects of child mortality determinants in Butajira DSSs, 2006**.

Variables	Crude HR (95% CI)	Adjusted HR (95% CI)		
		Model 1	Model 2	Model 3
Sex of Child				
Male[R]	1.00	1.00	1.00	1.000
Female	1.39(1.02- 1.91)*	1.40(1.02-1.93)*	1.43(1.04-1.96)*	1.39(1.01-1.90)*
Birth type				
Multiple[R]	1.00	1.00	1.00	1.00
Single	0.23(0.14-0.39)*	0.23(0.14-0.39)*	0.23(0.14-0.39)*	0.24(0.14-0.41)*
Ecological zones				
Lowland[R]	1.00		1.00	1.00
Highland	0.79(0.57-1.10)		0.81(0.58-1.12)	0.69(0.47-1.02)
Urban	0.45(0.25-0.81)*		0.31(0.15-0.66)*	0.52(0.20-1.38)
Radio				
Not available[R]	1.00			1.00
Available	0.44(0.29-0.67)*			0.53(0.35-0.82)*
Water source				
River[R]	1.00			1.00
Well	0.85(0.62-1.18)			0.71(0.49-1.04)
Pipe	0.35(0.17-0.73)*			0.46(0.16-1.26)

Note: R=reference group; * significant at $p < 0.05$; HR= hazard Ratio

Model 2 adjusted for child plus maternal factors; model 3 adjusted for all factors.

The following figures show the Survival status of children by independent variables that showed statistical significance after adjustment.

Figure 1. **Survival status of children by sex of child, Butajira DSSs, 2006.**

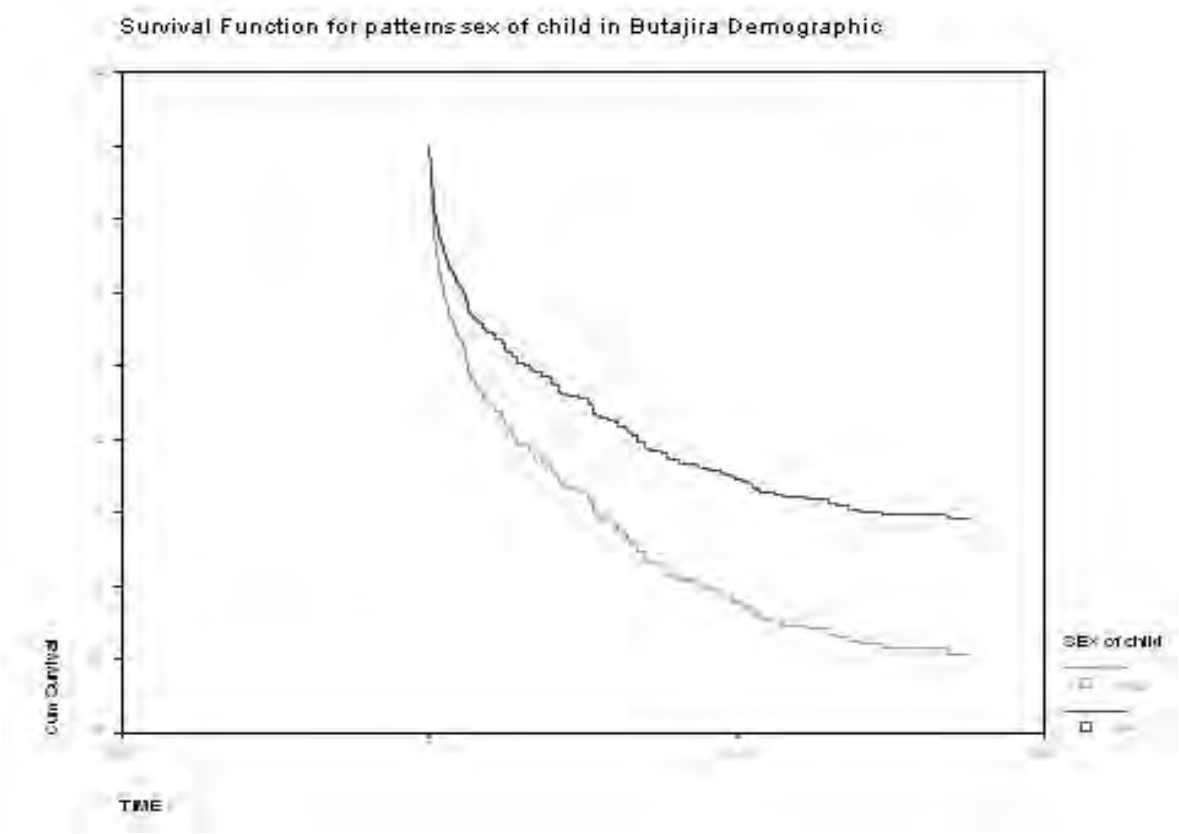


Figure 2: Survival status of children by birth type, Butajira DSSs, 2006.

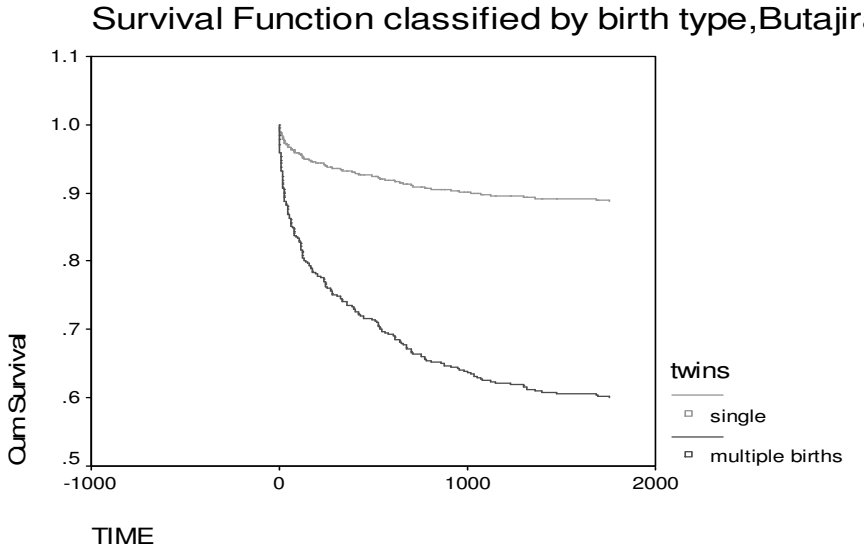


Figure 3. Survival status of children by climatic zone, Butajira DSSs, 2006.

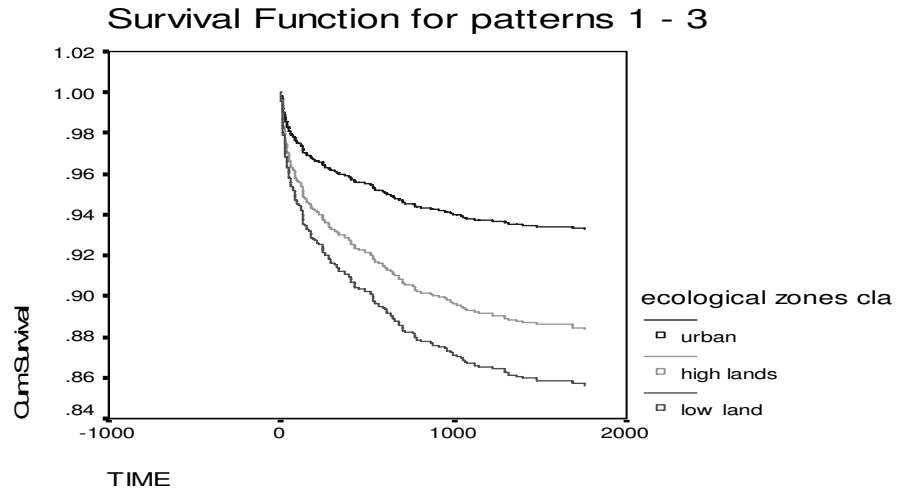


Figure 4. Survival status of children by climatic zone, Butajira DSSs, 2006.

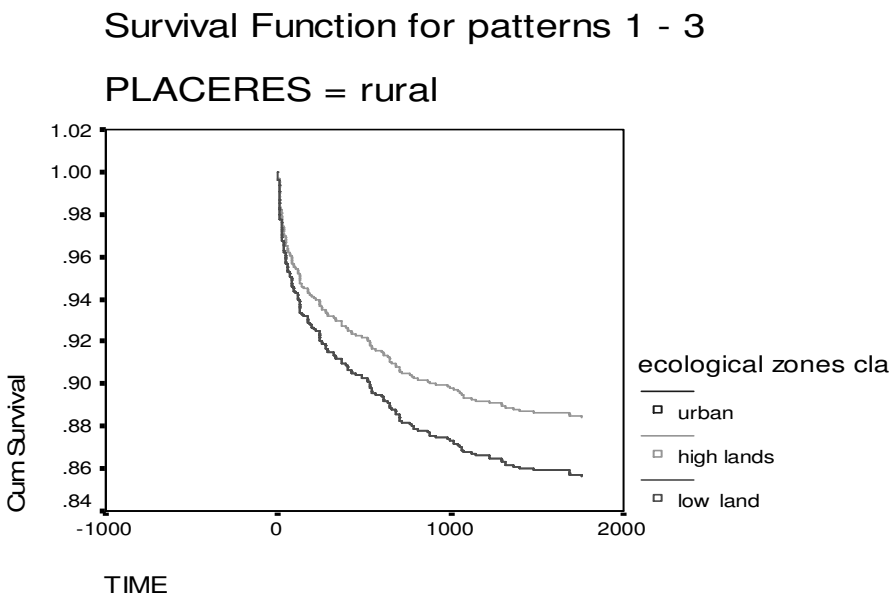
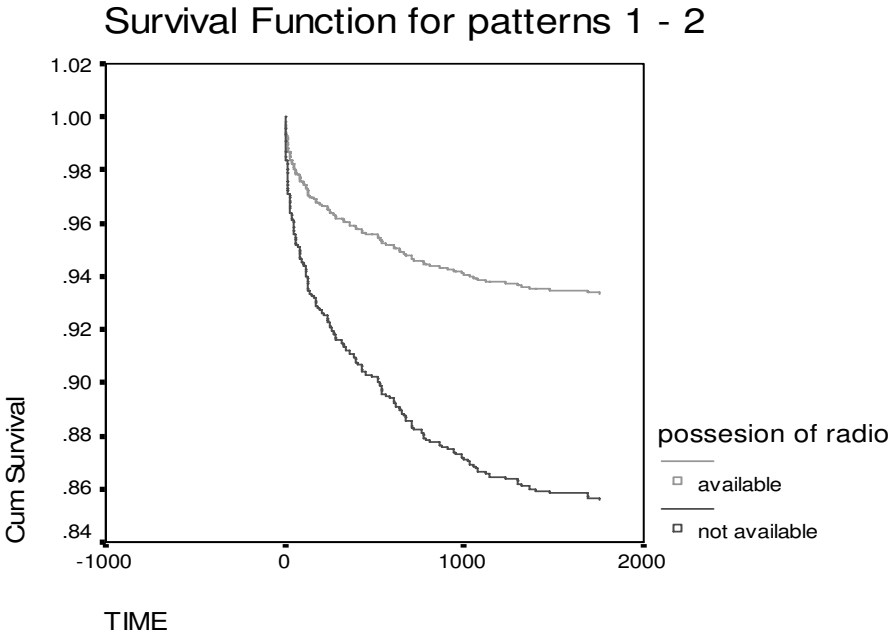


Figure 5. Survival status of children by possession of radio, Butajira DSSs, 2006.



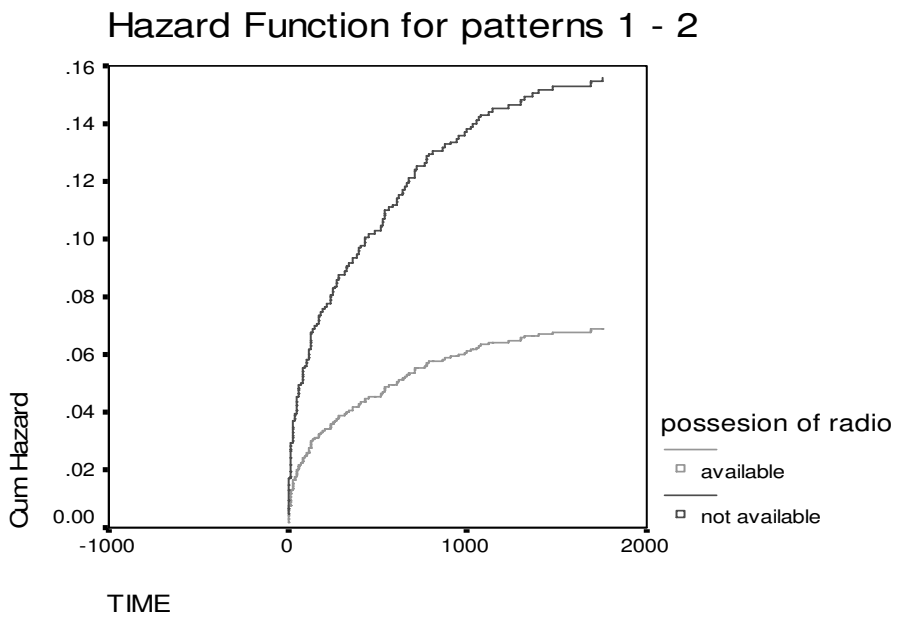
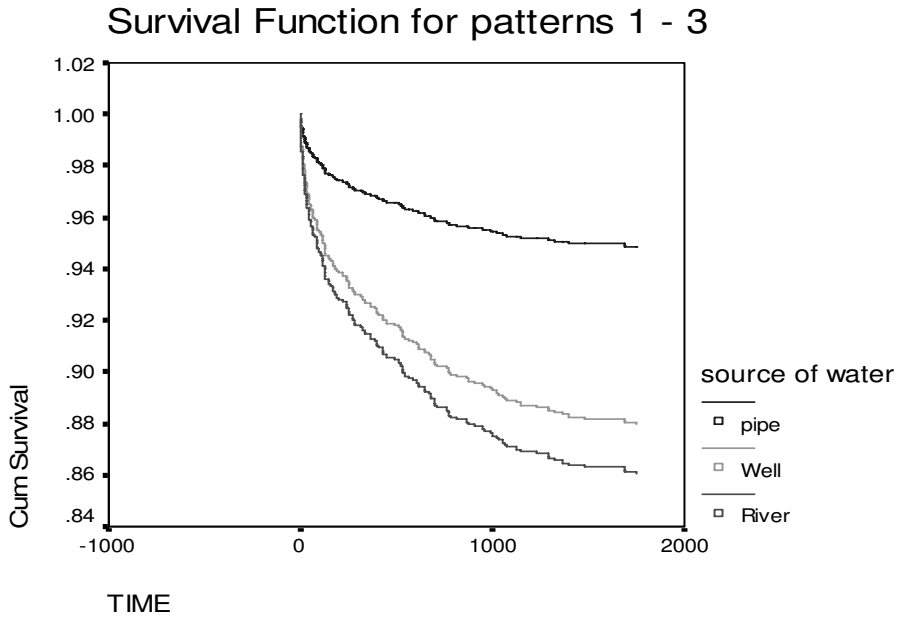


Figure 6. Survival status of children by source of water, Butajira DSSs, 2006.



7. DISCUSSION

Consideration of varying sets of covariates & their varying measurement scales in the data analysis and variations in methods of data analysis do not allow for straight forward comparison of result between the different studies. This retrospective cohort study was done in a demographic surveillance site and there is lack of similar studies, even, in other countries. In view of these limitations, the findings of this particular research will be discussed as follows.

The neonatal mortality rate was found to be 43.3 deaths /1000 live births. This figure is higher than the neonatal mortality reported in preliminary result of Ethiopia Demographic & Health Survey (2005) (EDHS, 2005) which is 39/1000 Live births. This might be due to under reporting of deaths in the EDHS (2005) since it depends on recall over several months. In addition, our 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 (Lawn et al, 2005; Feachem and Jamison, 1991; EDHS). The post-neonatal mortality (40.6/1000 live births) is almost comparable with the 2005 EDHS that reported 38 deaths per 1000 live births. Infant mortality rate,83.9 deaths per 1000 live births, in our study was slightly higher than the 2005 EDHS estimate (77deaths/1000) but it is lower than an earlier study done in South West Ethiopia (Makonnen A.,et

al,2000) and Shamebo (1993), which have revealed 106.3/1000 infant deaths and 101per 1000 live births respectively. Moreover, comparison with other countries (Eritrea, 2006; Uganda 2006; Sudan 2006; Kenya 2006), our result is much higher. This could be explained by the socioeconomic differences in the study settings.

The overall under five mortality rate in this particular study was found to be 117.7 deaths per 1000 live births, which is also lower than the EDHS (2000), 123 deaths per 1000 live births during the period of 2000-2005. Comparing to an earlier study by Shamebo et al (1993), our finding is much lower that may be attributed to initiation of intervention, establishment of health facilities and developmental activities in the study area.

High (excess) mortality was observed in female children than in males. This is similar to studies done elsewhere (Singh C.H, 2004; Nair PM, 2004, Chen LC, et al, 1981), which demonstrated a worse survival chance for female children (baby). The risk of infant mortality was significantly higher (2.28 times higher) for female as compared to male children. This is in contrary to studies done in Butajira (Shamebo D. et al, 1993) & Bangladesh (Kabir A. et al,2001), which showed in most developing countries, male child mortality exceeds that of female mortality (Chen LC, et al,1981).This might be due to fatalistic attitude or the continual existence of female sex discrimination in the allocation of scare health & food resources. Moreover, the role of traditional practices

such as female genital mutilation and others might have contributed to the higher mortality.

Singleton birth type was found to have 77% less risk of dying than multiple births. This finding is consistent with the results of previous studies (Argeseanu S, 2004, Majumder AK, 1997), as multiple births tend to be high risk deliveries and may be due to sibling competition for resources, particularly for mother's milk. Birth type was found as an independent predictor of child mortality after adjusting for sex of child, place of residence, ecological zones, radio availability, water source, latrine availability and existence of livestock's in same room of residence.

On multivariate Cox regression adjustment for urban-rural differential, urban children had more (50%) chances of survival compared to rural children. This finding is similar to many other studies (Singh C.H, 2004; Dweivedi L., et al, 2002; Nair PM, 2004, Shamebo D., 1993).This may be explained by the accessibility of modern medical and health facilities available in urban areas, along with greater awareness of the people; moreover, there may be lack of safe potable water, toilets and, unsanitary housing conditions in the rural Butajira. But, it was not found to be statistically significant after adjustment.

High chances of survival were observed in those children whose mothers live in highlands than in rural lowlands. This is consistent with findings of other studies (Nair PM, 2004; Shamebo D., 1993).This may be explained by the fact that in lowland areas there could be frequent illness

episodes (most notably from malaria, etc), specific nutrient deficiencies and consistent climatic variation.

A number of studies have reported mother's education as an important protective covariate for child survival. However, like to the observation made in this cohort study, Dwivedi et al (2002) and Belayneh (2005) 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 our study area.

Among the household variables, possession of radio in the household was found to be significant predictor of child mortality as compared to those who don't possess radio. This may be explained by the fact that households that possess radio get more information about health & it may also be a sign of good economic status. As far as latrine availability is concerned, it was found to be positively associated with child survival. This is consistent with other studies (Ladusingh L. & Singh C.H, 2004, Kabir A. et al, 2001;, Majumder AK et al ,1997) and is explained by the fact that child will get reduced exposure to pathogens and less unhygienic environment (Tomkins L. et al. 1991; Kabir A. et al,2001;, Majumder AK et al ,1997).

Children living in households that used pipe water were found having a high chance of surviving, and is an independent predictor of child survival in this study. This finding is in agreement with previous studies (Hailemariam A. and Tesfaye M., 1997; Singh C.H, 2004, Kabir A. et al, 2001).

Strength and Limitations of the study

Cohort Study, like all epidemiological study design options, has unique strengths and limitations that need to be considered so as to yield a valid and informative result.

Strengths of this study:

- Being a cohort design by itself and Use of Cox regression analysis
- Availability of relevant and high quality exposure data in adequate detail and is based on longitudinal data.
- Allowed direct measurement of incidence of the outcome of interest (in this particular study, death/mortality in terms of person-years contributed.
- No threats to loss for follow up and bias is minimized.
- missing values can be imputed during the repeated visits

Limitation of the study:

- Validity of the study may be affected by the missing of certain values in variables under investigation.
- Misclassification could be a problem, particularly in categorization of subjects by exposure level-where this could be a source of inaccuracy and is an inherent difficulty in the measurement of variables.

- Problem of contemporaneity (that is, information on variables may refer to the time of survey, but not necessarily to the exposure time of the child.

9.0 Conclusion and Recommendations

In view of the above discussion points, the following conclusions are to be drawn and the research has shown while individual child characteristics are important, household variables are critical in determining the patterns of child survival:

1) The neonatal, infant, and Overall child mortality (under five) rate in our study population were high accounting for 43.3, 83.9 and 117.7 per 1000 live births.
2) factors particularly sex of child, birth type, water source(mainly pipe),availability of radio in the household, and living in ecological residency were independent predictors of child mortality. However, maternal education, age of mothers, place of residence, religion of mother, economic status of the family, availability of latrine, birth order, survival status of preceding sibling and place of delivery.

Recommendations:

1) The provision of safe and adequate water supply should be considered
2) Programs should expand educational opportunities would increase access of people to information and improve their ability to make good use of it.
3) Better approach & care for multiple gestation during antenatal & early infancy period should be considered
4) Strengthening already existing preventive methods to reduce high

level of mortalities!!

5) Further study that employs qualitative research should be Conducted.

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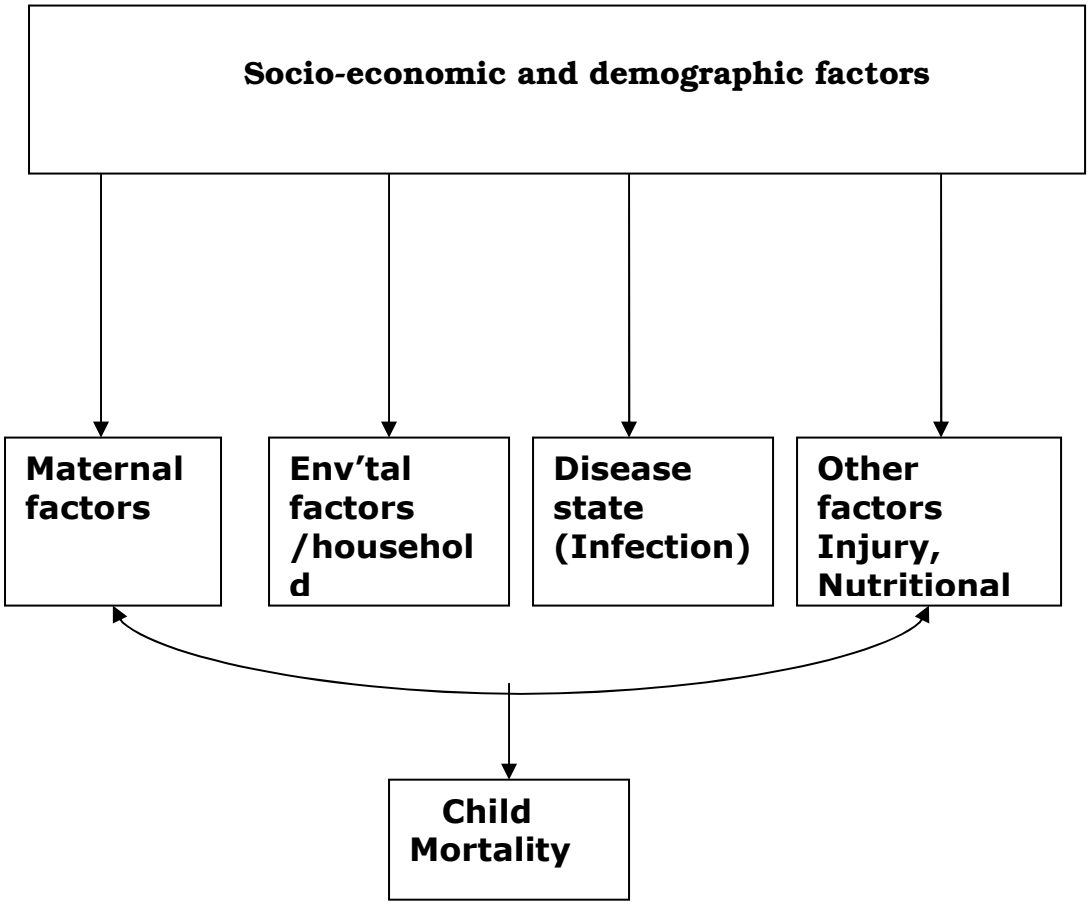
Annex-I: CONCEPTUAL FRAMEWORK FOR THE STUDY OF CHILD MORATLITY, 2005.



Annex-II: Survival curves showing statistical significance at the Crude analysis (Hazard Ratios)

Figure 1. Survival status of children by education of mother, Butajira DSSs, 2006.

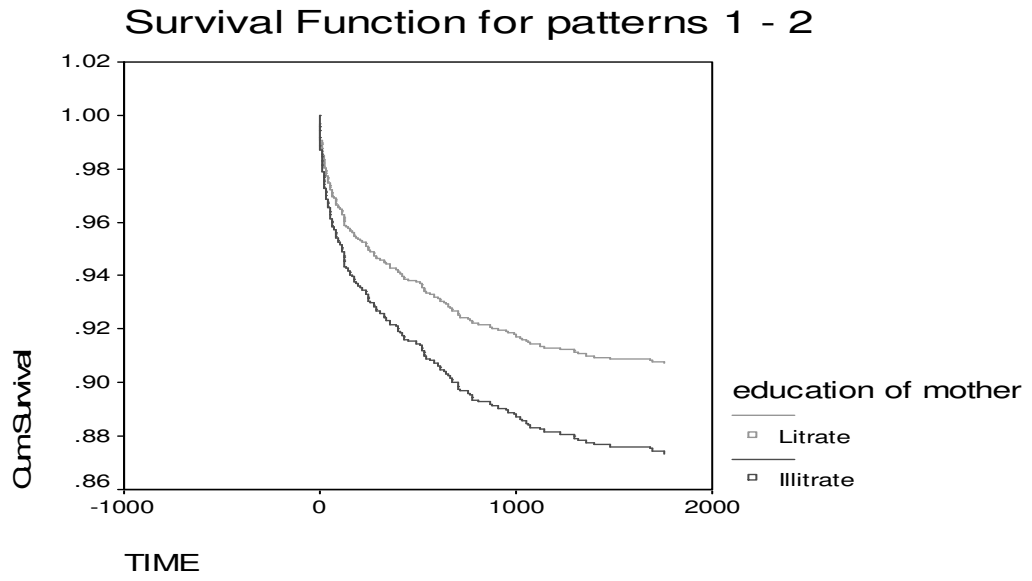
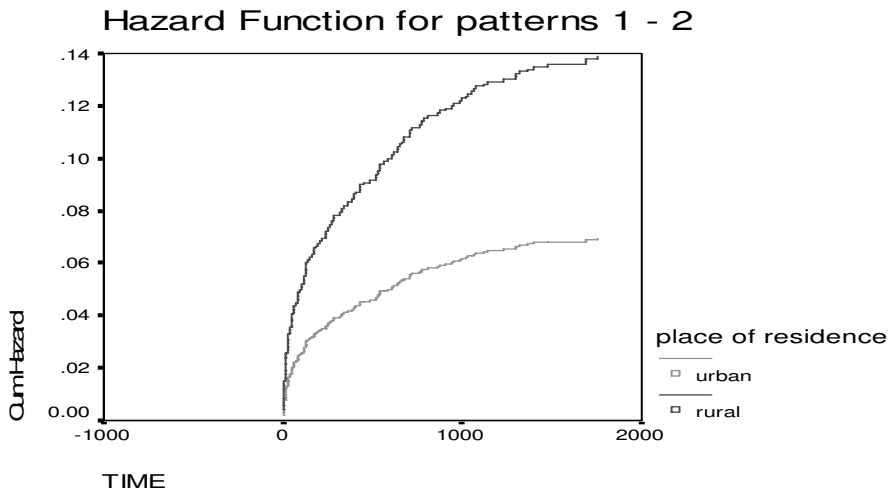


Figure 2. Survival status of children by place of residence, Butajira DSSs, 2006.



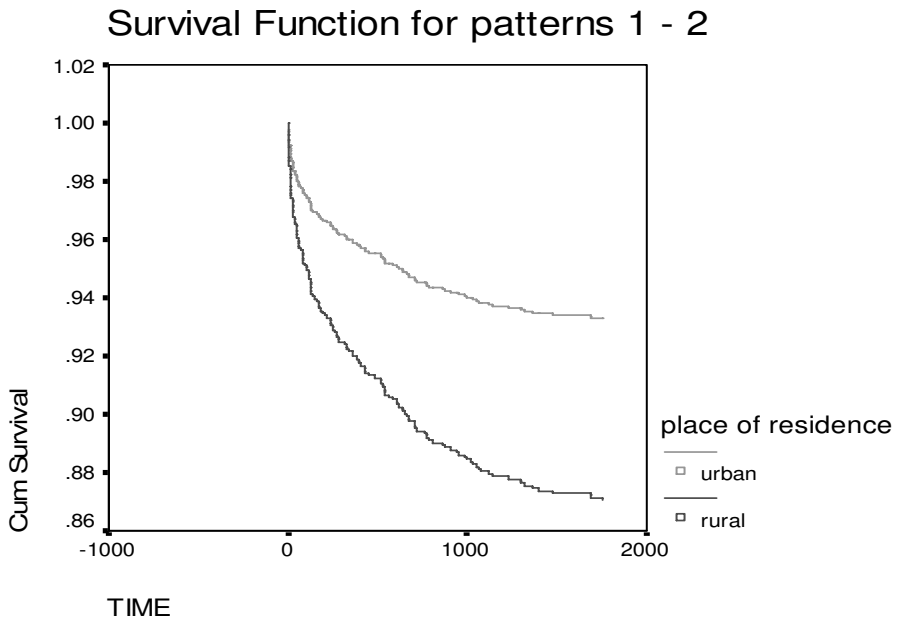
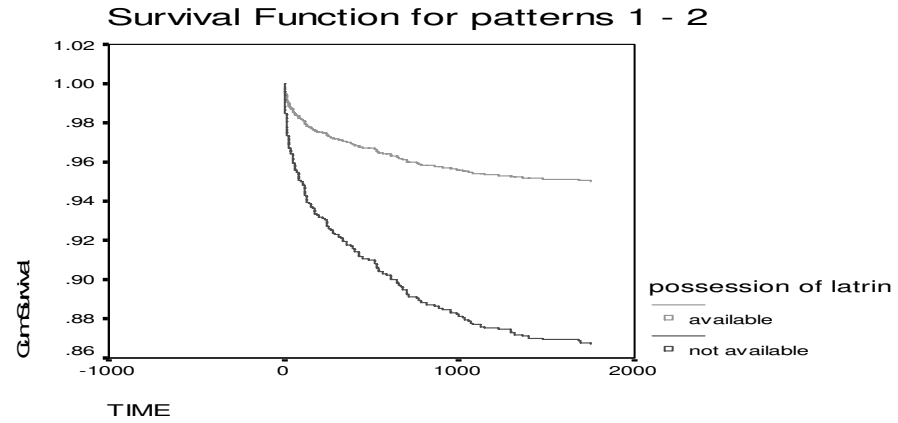


Figure 3. Survival status of children by availability of latrine, Butajira DSSs, 2006.



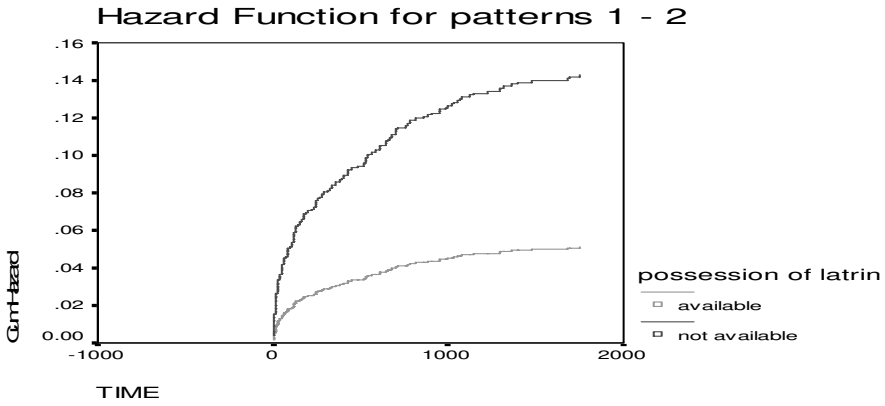


Figure 4. Survival status of children by availability of separate kitchen, Butajira DSSs, 2006.