

https://dspace.org/

# Household socio-economic status as a determinant of under five mortality at Rufiji DSS Tanzania

**Nattey, Cornelius**

**2009-05-22T12:33:06Z**
http://hdl.handle.net/10539/6974

Downloaded from a DSpace repository. https://dspace.org/

**UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**

**FACULTY OF HEALTH SCIENCES**

**SCHOOL OF PUBLIC HEALTH**

**MSc (MED) POPULATION- BASED FIELD EPIDEMIOLOGY**

**A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF THE WITSWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICINE FOR THE YEAR 2007**

**TITLE**:

# Household Socio-Economic Status as a Determinant of Under Five Mortality at Rufiji DSS Tanzania

**STUDENT: CORNELIUS NATTEY (STUDENT NO: 0708085G)**

**phoyocon@gmail.com**

**INTERNAL SUPERVISOR: Prof Kerstin Klipstein-Grobusch (Kerstin.Klipstein-Grobusch@wits.ac.za)**

**EXTERNAL SUPERVISOR: Dr. Honorati Masanja (hmasanja@ihrdc.or.tz), RUFIJI DSS**

**DECLARATION**

I, Cornelius Nattey declare that this research report work is my own work. It is being submitted for the degree of Master of Science in Medicine in the field of Population Based Field Epidemiology in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature.....

Full Name: Cornelius Nattey

...10.day of July, 2008.

**DEDICATION**

This work is dedicated to the Almighty God for his wisdom and grace, my sweet mother and the entire congregation of Revival Flames Bible Church International for their continued prayer support and encouragement during my studies.

**ABSTRACT**

**Background**

Disparities in health outcomes between the poor and the rich are increasingly attracting attention from researchers and policy-makers. However, policies aimed at reducing inequities need to be based on a sound assessment of the nature, magnitude and determinants of the problem, as policy decisions based on intuition are likely to be misguided.

**Objective**

The work investigates the relationship between household socio-economic status and under-five mortality at Rufiji DSS in year 2005. The specific objectives were; 1.To construct wealth and concentration indices for households with children under age five. 2. To measure health inequality by poorest / least poor mortality rate ratio and the use of concentration index 3. To determine significance in gradient of mortality rates across wealth index quintiles by a trend test (chi-square) 4. To assess the magnitude of association between socio-economic status of households and under-five mortality.

**Method**s

Data from Rufiji DSS, Tanzania was used for the analysis. Out of 11,189 children under-five years of age from 7298 households, 251 died in the year 2005. These yielded a total of 9341.6 PYO in 2005 which was used in the analysis. Household wealth index was constructed by use of Principal Component Analysis (PCA), as a proxy measure of each household SES. From this index households were categorized into five quintiles (i.e., poorest, poorer, poor, less poor and least poor). Kaplan-Meier (K-M) survival estimates of

incidence rates were used to estimate mortality rates per 1000 PYO for infants (0-1), children (1-4) and under-fives. Health inequality was measured by poorest to least poor mortality rate ratio and by computing mortality concentration indices. Trend test chi-square was used to determine significance in gradient of mortality rates across wealth index quintiles. Risk factors of child mortality were assessed by the use of Poisson regression taking into account potential confounders.

**Results**

The result indicates that the mortality rate was higher for infants (123.4 per 1000 PYO, 95% CI (104.3, 146.1)) than for children aged 1-4 years (17.3 per 1000 PYO, 95% CI (14.3, 20.9)). Under-five mortality was 26.9 per 1000 PYO (95% CI (23.7, 30.4)). The poorest to least poor ratio were 1.5, 3.8 and 2.4 for infants, children, and under-five year olds, respectively indicating that children in the poorest quintile were more likely to die as compared to those in the least poor household. Computed values for concentration indices were negative (infant C= -0.07, children C= -0.24 and under-five C= -0.16) indicating a disproportionate concentration of under-five mortality among the poor. The mortality rates trend test chi-square across wealth index quintiles were significant for both children ($P<0.001$) and under-five year old children ($P<0.001$) but not for infants ($P=0.10$).

In univariate Poisson regression, children in the least poor households were shown to have a 58% significantly reduced risk of dying as compared to the poorest households [crude RR=0.42, $P < 0.001$, 95% CI (0.27 - 0.62)]. The effect of household socio-economic status attenuated after adjusting for maternal education, maternal age and occupation. Children in

the least poor households had a 52% significantly reduced risk of dying as compared to the poorest households [adjusted RR=0.48, P = 0.002, 95% CI (0.30 - 0.80)].

**Conclusion**

The study shows that household socio-economic inequality is associated with under-five mortality in Rufiji DSS in 2005 and that the survival advantage of under-five year old children is associated with maternal education. Reducing poverty and making essential health services more available to the poor are critical to improving overall childhood mortality in rural Tanzania.

**ACKNOWLEDGEMENT**

First, I want to thank the Almighty God for wisdom, guidance and strength which has seen me through and also I am extremely thankful to my sponsor, INDEPTH NETWORK for the award of this scholarship which enabled me to undertake this course in Wits. Secondly, I would like to express my deepest thanks to Professor Kerstin Klipstein-Grobusch of the School of Public Health, University of Witwatersrand and Dr Honorati Masanja, Ifakara Health and Research Development Centre for their supervision, guidance throughout this research.

Special thanks to Dr. Tint, the academic coordinator for this course, for her support during my studies and to all the lecturers at the School of Public Health, University of Witwatersrand.

I would like to express my profound thanks to the Director and entire staff of Ifakara Health and Research Development Centre for welcoming me into their midst and creating a very conducive learning environment for me to write this report, and more importantly for providing me with the data which serves as the basis for this report. I would especially like to thank Dr. Rose Nathan, coordinator of Msc field attachment, Ifakara Centre, for her assistance and mentorship during my attachment. I would like to thank Mr Matthew Alexander for always being around to make me feel at home. I also thank the entire staff of the Rufiji DSS not to mention Francis Levira, data manager for his immense assistance in resolving most of the data issues.

I would also like to thank my director, Dr. Margaret Gyapong and Dodowa Health Research Centre for giving me the opportunity to study here in South Africa.

I also thank my senior pastor Prophet Diallo Oppong and the entire membership of Revival flames church for their prayer support throughout this programme.

**TABLE OF CONTENTS** **Pages**

Declaration ii

Dedication iii

Abstract iv-vi

Acknowledgement vii

Table of contents viii-ix

Definition of terms x

List of acronyms and abbreviations xi

List of figures and tables xii

List of appendices xiii

CHAPTER ONE: INTRODUCTION, LITERATURE REVIEW, AIMS AND OBJECTIVES

1.1 Introduction ……..……. ……1-4

1.2 Trends in under five mortality……4-5

1.3 Socioeconomic status and child mortality……..6-9

1.4 Measuring health equity…….....9-10

1.5 Research question…….....10

1.6 Aim……...10

1.7 Specific objectives…….....11

CHAPTER TWO: METHODOLOGY

2.1 Demographic characteristics of study area……..12

2.2 Rufiji Demographic Surveillance System……..11-14

2.3 Study population……..14

2.4 Study design……14

2.5 Inclusion and exclusion criteria……...14

2.6 Data source…….....14

2.7 Description and extraction of variables……..14-17

2.8 Data management……17

2.9 Sample for analysis……17-18

2.10 Data analysis…….18-19

2.11 Ethical approval…….19

CHAPTER THREE: RESULTS

3.1 Sociodemographic characteristics .....20-22

3.2 Principal component analysis …….22-25

3.3 Socio-economic status and mortality rates…….....25-29

3.4 Univariate analysis ….....29-33

3.5 Multivariate analysis……33-35

CHAPTER FOUR: DISCUSSION AND CONCLUSION

4.1 Principal component analysis……..36-37

4.2 Measures of health equity……37

4.3 Mortality rates…….37-39

4.4 Factors associated with child mortality……..39-41

4.5 Implications of the study…….41-43

4.6 Limitations of study……43-45

4.7 Conclusion……..45-46

REFERENCES……... 47-53

## DEFINITION OF TERMS

**1. Wealth Index**: Proxy measure of the wealth of households which is based on household characteristics, ownership of assets (house ownership, source of drinking water, electricity, sanitation facility (toilet), floor material type, roof material type etc.)

**2. Concentration index:** Means of quantifying the degree of income-related inequality in a specific health variable. This measures the extent to which a variable is distributed unequally across all five socio-economic quintiles, i.e. the concentration of inequality. The closer the index is to zero, the less concentrated the distribution of inequality.

**3. Infant mortality rate**: the probability that a child born in a specific year will die before the age one expressed per 1000 person years of observation.

**4. Child mortality rate:** the probability of dying between one and four years expressed per 1000 person years of observation.

**5. Under-five mortality** (**U5MR**): the probability of dying between birth and age five expressed per 1000 person years of observation.

**6. Demographic Surveillance System**: This is a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area (INDEPTH Network).

**7 Household:** This is a social group of one or more individual members. They are usually but not always related.

## LIST OF ACRONYMS AND ABBREVIATIONS

**MDG** Millennium Development Goals

**HIV** Human Immunodeficiency Virus

**AIDS** Acquired Immunodeficiency Syndrome

**UNICEF** United Nations Children's Fund

**WHO** World Health Organization

**UNDP** United Nations Population Division

**RDSS** Rufiji Demographic Surveillance System

**DSA** Demographic Surveillance Area

**DHS** Demographic and Health Survey

**CEE/CIS** Central and Eastern Europe and Commonwealth of Independent States

**U5MR** Under-Five Mortality Rate

**SES** Socio-Economic Status

**PCA** Principal Component Analysis

**C** Concentration Index

**INDEPTH** International Network for Continuous Demographic Evaluation of Populations and Their impact on Health in Developing Countries

**HRS** Household Registration System

**TEHIP** Tanzania Essential Health Intervention Project

**PYO** Person Year of observation

**NSGRP** National Strategy for Growth and Reduction of Poverty

**PPR** Poorest to least poor mortality rate ratio

## LIST OF TABLES

Table 1: Socio-demographic characteristics of children, mothers and household heads

Table 2: Distribution of assets and housing condition by wealth index quintiles (%)

Table 3: Distribution of selected variable by wealth index quintiles

Table 4: Under-five (<5 years) mortality rate by wealth index quintiles

Table 5: Infant (0-1year) mortality rate by wealth index quintiles

Table 6: Child (1-4years) mortality rate by wealth index quintiles

Table 7: Incidence rate ratio (IRR) estimates and 95% confidence intervals for factors associated with under-five deaths using univariate model:

Table 8: Incidence rate ratio (IRR) estimates and 95% confidence intervals for factors associated with infants deaths using univariate model:

Table 9: Incidence rate ratio (IRR) estimates and 95% confidence intervals for factors associated with children(1-4years) deaths using univariate model:

Table10: Incidence rate ratio (IRR) estimates and 95% confidence intervals for factors associated with under-five deaths using multivariate models:

## LIST OF FIGURES

Figure 1: A scree plot of principal components and eigenvalues

Figure 2: Under-five mortality rates by wealth index quintiles in Rufiji DSS for the year 2005

## LIST OF APPENDICES

Appendix 1: Map of Tanzania showing the Rufiji Demographic Surveillance Area

Appendix 2: Human Research Ethics Clearance Certificate from Wits

Appendix 3: Ifakara Health Research and Development Centre Institutional Review Board Ethics clearance certificate

Appendix 4: Rufiji DSS Asset Survey, Questionnaire.

Appendix 5: Principal Component Eigenvector Values

# CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

## 1.1 Introduction

Sub- Saharan African countries are confronted daily with myriads of problems in their effort towards development. Prominent among them are diseases, poverty, illiteracy and armed conflict. Diseases like malaria, pneumonia, measles and diarrhoea are the major causes of under-five morbidity and mortality amongst households. Child mortality is an excellent indicator of child health and survival. It can also be viewed as an indicator of overall development, since it reflects the social, economic, and environmental conditions in which children live, including their health care[1]. These estimates are also needed at the international level to inform funding decisions for activities directed toward reducing child mortality.

The fourth Millennium Development Goal (MDG)[2] calls for reducing child mortality. Progress is assessed against the target of reducing by two-thirds, between 1990 and 2015, the under-five mortality rate worldwide. Progress in reducing child mortality from 1990 to 2006, the last year for which comprehensive estimates are available, has been uneven[2]. All world regions, with the exception of West/Central Africa, made some progress. Central and Eastern Europe (CEE), The Commonwealth of Independent States (CIS) , Latin America and the Caribbean, and South-Eastern Asia experienced steep declines, with under-five mortality dropping by more than 50 per cent, which put them on track to meet the MDG target[3].

A group of global child health experts working on these issues met at a workshop in Bellagio, Italy. These scientists, speaking as individuals concerned with child health, produced a series of five articles on child health[4,5, 6,7,8] published recently. The salient

points raised by the ‘‘Bellagio Child Survival study group’’ (thereafter called the Bellagio group) indicated that diarrhoea, pneumonia, and neonatal causes of death were of global importance, with malaria and HIV infections responsible for a large number of deaths in some countries of Africa and Asia. The evidence also indicates that within each country, children from the poorest families are most likely to die and that socio-economic inequalities impacted on child health and survival through multiple pathways. The impact of this unequal distribution of disease burden is compounded by ineffective and dysfunctional health systems that do not reach the poor[9].

Socio-economic status (SES) gaps in child mortality are not simply inequalities; they are also inequities that are unjust and unfair. These inequities are increasingly recognised by the international community[10]. Bilateral donors such as the UK's Department for International Development have put improvement of the health of poor people as their top priority in the health sector,[11] as have WHO[12] and the World Bank[13]. Although this commitment is welcome, far too little attention has been paid to how international agencies and national and sub national governments can combat inequities in child survival.

By contrast with children born to better-off families, poor children are more exposed to risks for disease through inadequate water and sanitation, indoor air pollution, crowding, poor housing conditions, and high exposure to disease vectors[14, 15]. They are also more likely to have lower resistance to infectious diseases because they are undernourished (an underlying cause of about 50% of deaths in children younger than 5 years)[4], to have diets deficient in one or more essential micronutrients (e.g., vitamin A, iron, zinc), to have a low birth weight as a result of poor maternal nutrition, infections during pregnancy, and short birth intervals, and to have recurrent disease episodes [14, 15].

The deprivation of poverty goes beyond low income. Low income is associated with lower levels of education, and lower education is associated with exposure. For example, in a poor household, knowledge can make the difference between taking advantage of piped water to wash hands and not doing so[16]. Knowledge has a role in such things as securing a nutritious diet and making appropriate use of health care services[17]. In India, for example 30% of mothers of children who had not been vaccinated did not know that immunisation was important for the health of their child and a further 33% did not know where to go to have their child vaccinated[18]. Poor people are less likely than their wealthier counterparts to be covered by public or private health insurance, and therefore often face higher health care prices[14]. They tend to live in underserved areas and therefore incur high time costs when seeking health care. The facilities serving poor people are typically less well organised than are those for people who are better off, with inconvenient opening hours and providers who are insensitive to their needs[14.] The care delivered in facilities serving poor communities is also generally of lower quality than that delivered in better-off areas, because health care workers are reluctant to serve in areas in which poor people live, and drugs and inputs are more likely to be in short supply[14]. Poverty thus increases exposure and reduces resistance to disease, a synergy that contributes to the wide inequities in child survival.

In a poor rural area of Tanzania, the poorest children were 27% less likely to seek care from an appropriate provider than the least poor, and children from the poorest families were not as likely as their better-off peers to have received antimalarials for fever or antibiotics for pneumonia[17] .

Socio-economic inequities in child survival thus exists at every step along the path from exposure and resistance to infectious disease, through care seeking, to the probability

that the child will receive prompt treatment with effective therapeutic agents. The odds are stacked against the poorest children at every one of these steps. As a result, they are more likely than their better-off peers to die in childhood.

Public health research is shifting focus to the role of socio-economic indicators in the promotion of health. As such an understanding of the roles that socio-economic factors play in improving health and health-seeking behaviour is important for public health policy. This is because the share of resources devoted to different policy options should depend on their relative effectiveness[19].

Although there have been improvements in health status of Tanzanians where this study was conducted, the levels of infant and child mortality in Tanzania remain unacceptably high. The Tanzania National Strategy for Growth and Reduction of poverty 2005 (NSGRP) [20] document has a development vision whose target is reducing under-five mortality from 154 in 2002 to 79 per 1000 live births by year 2010. Hence understanding of the role socio-economic status plays in child mortality and the under-five mortality indicator will also be useful in ensuring the attainment of the NSGRP target, as these indicators reflect socio-economic development and the quality of life in Tanzania.

**1.2 Levels and trends in under five mortality**

According to the UNICEF's report on the state of the world's children for 2008, the number of children dying worldwide before age five has reached a record low, falling below 10 million for the first time in 2006. This is a 25 per cent drop from the nearly 13 million child deaths in 1990[1]. Of the estimated 9.7 million children who died in 2006, 4.8 million where form Sub-Saharan Africa and 3.1 million from South Asia. By far the highest rates of under-five mortality are found in sub-Saharan Africa (186 deaths per

1,000 live births in West and Central Africa and 131 per 1,000 in Eastern and Southern Africa), where conflict and the spread of HIV/AIDS have undermined hard-won gains in child survival[21].

More moderate levels of under-five mortality are seen in South Asia, at 83 deaths per 1,000 live births, and in the Middle East and North Africa, at 79 deaths per 1,000 live births. By 2006, three regions had achieved under-five mortality rates below 30 deaths per 1,000 live births: East Asia, and Latin America and the Caribbean, and Central and Eastern Europe and the Commonwealth of Independent States (CEE/CIS). By contrast, the 2006 under-five mortality rate was 6 deaths per 1,000 live births in industrialized countries. Every region of the world shows some progress since 1990, which is the baseline for MDG targets. For every 1,000 live births in developing countries in 2006, there were 24 fewer deaths among children under five than there were in 1990. However, the extent to which child mortality has declined varies widely between regions. The 2006 under-five mortality rates estimates in the Middle East and North Africa, East Asia and the Pacific, Latin America and the Caribbean, and CEE/CIS are about half the 1990 estimates. In contrast, the 2006 under-five mortality rate was just 14 per cent lower than the 1990 figure in sub-Saharan Africa[21]. Because of the slow rate of progress in sub-Saharan Africa, this region accounts for an increasing proportion of deaths among children under age five. In 2006, almost half of the world's under-five deaths took place in sub-Saharan Africa, compared with about one-third in 1990. The number of under five deaths in sub-Saharan Africa increased from 4.1 million in 1990 to 4.8 million in 2006, while falling everywhere else. Analysis of background characteristics in 63 developing countries indicates that child mortality is considerably higher among children living in rural areas and in the poorest households[3].

In a developing country like Tanzania, although there has been significant progress made in reduction of under-five mortality rates from 161 per 1000 in 1990 to 118 per 1000 in 2006[21], this reduction is still insufficient if the MDG target is to be achieved by 2015.

### 1.3 Socio-economic status and child mortality

Household socio-economic status is important for child survival because it determines the amount of resources (such as food, good sanitation, and health care) that are available to children[22]. Numerous studies have shown a close association between child mortality and socio-economic status[23, 24, 25, 26, 27].Measures of socio-economic status that are thought to be associated with under-five mortality include: maternal and paternal education; household wealth; parental occupation; and rural or urban residence.

Most indicators of socio-economic status used are income per capita, education, urban/rural residence, work status and household assets. For example, in his pioneering work Preston[23] demonstrated a negative relationship between income and mortality. However, possible other determinants were relevant since the observed relationship between income and mortality shifted over decades and a given income level was associated with better survival for recent decades. Similarly, focusing on 28 developing countries mostly in Asia and Latin America, Hobcraft et al.[27] found that mother's and husband's education; their work status and their type of residence were more or less associated with child survival. Increased socio-economic status – specifically, mother's level of education - was also found to be closely associated with improved child survival in Nigeria,[28] in Nicaragua[29] and Costa Rica[30].

Curtis and Steele[31] (1996), who used Demographic and Health Survey (DHS) data from Bolivia, Peru, Kenya, and Tanzania in their study of neonatal mortality, found that the

level of maternal education was significantly associated with neonatal mortality in all the countries except Tanzania, where rural or urban residence was more important. Desai and Alva[32] (1998) used data from 22 countries participating in the first round of the DHS program. They found that infant mortality was lower among educated women, and that although this effect attenuated with the inclusion of other socio-economic factors in their models, maternal education remained significant.

Lower infant mortality has been reported in households where toilets exist,[33] where piped water is used,[34,35] and where there is electricity[36]. Evidence from the DHS program shows that in nearly all sub-Saharan African countries infant mortality in rural areas is much higher than in urban areas. However, among poorer households in urban areas, child mortality can be as high or higher than rural households[34,36].

Case[37] in a more recent work observed that income exerts a causal effect on health status through several channels, among which she named improved nutritional status, better sanitation, improved living standards, reduction of psychological stress and reduced susceptibility to infections. She further stated that higher income might allow people to spend more time and money seeking out health services for themselves and household members. The study by Filmer et al.[38] further strengthens the case for quantifying the causal impact of income on health outcomes.

McKeown[39] and Fogel[40] for instance submitted that improvements in longevity experienced in the 19th century in the Western world could be attributed more to improvement in nutrition consequent on higher income than to medical advances or public health campaigns. Others[41, 42, 43] have argued that these improvements were more on public health efforts (namely, sanitation, vaccination, and vector control) and advances in health technology such as discovery of more potent antibiotics than on income or income growth.

Szreter in a critique of McKeown's work posited that the return to generally declining mortality in the last third of the nineteenth century reflects the chronology of the most significant improvements in public health and urban sanitation rather than economic growth, rising living standards, and improved nutrition[42]. According to Szreter, that era witnessed the establishment of the Local Government Board; the passing of a series of Public Health Acts; and the implementation of a wide range of preventive measures that included supply of safe water, enforcement of environmental sanitation, and prevention of overcrowding[43]. However persuasive and academically sound Szreter's argument is, it leaves open the question of an indirect relationship between sanitary measures and improved nutritional efficiency[44]. It equally leaves open the question of a possible relationship between economic growth and the execution of preventive public health services.

Mosley and Chen[45] (1984) elaborated a conceptual framework articulating the relationship between socio-economic and biomedical factors on child health and mortality. The novelty of the proximate determinants framework suggested by Mosley and Chen is that mortality as an endpoint is influenced by both biomedical and socio-economic factors, suggesting an integrated approach to the study of child health and survival. Unfortunately, examining the effects of the biological or biomedical factors on child health often requires direct measurement of these factors in the field. For example, we can estimate the effects of malnutrition by using anthropometric measures such as taking weights of children, measuring their heights and upper arm circumferences, and in some cases taking blood samples to measure haemoglobin levels. On the other hand, in the social sciences it is relatively easier to collect information on the social and economic background of respondents in surveys and censuses. These background

variables could serve as proxies for measuring the well-being of the population within households and are assumed to measure the background in which children are conceived, born, or live.

### 1.4 Measuring health equity

Standard economic measures of socio-economic status (SES) use monetary information, such as income or consumption expenditure. However, the collection of accurate income data is a demanding task[46] requiring extensive resources for household surveys; for example, allowances need to be made for households and individuals drawing income from multiple sources. Also, in some instances, an indicator of income is quite difficult to use[47]. For example, income information does not capture the fact that people (and especially the poor) may have income in kind, such as crops which are traded, and measuring income can be difficult for the self or transitory employed (e.g. agricultural work), due to accounting issues and seasonality[48].

Principal Component Analysis (PCA) is a multivariate statistical technique used to reduce the number of variables in a data set into a smaller number of 'dimensions'. In mathematical terms, from an initial set of *n* correlated variables, PCA creates uncorrelated indices or components, where each component is a linear weighted combination of the initial variables[49]. SES index in the absence of income or consumption data can be derived by performing PCA on durable asset ownership, access to utilities and infrastructure, and housing characteristic variables. The main advantage of this method over the more traditional methods based on income and consumption expenditure is that it avoids many of the measurement problems associated with income- and consumption-based methods, such as seasonality and data collection time. Compared with other statistical alternatives, PCA is computationally easier, can

use the type of data that can be more easily collected in household surveys, and uses all of the variables in reducing the dimensionality of the data[50]. Socio-economic categorization is obtained by ranking then classifying households within the distribution into various groupings. The indices derived are relative measures of SES, so while this type of measure is useful for considering inequality between households, it cannot provide information on absolute levels of poverty within a community[48].It can be used for comparison across countries or settings (such as urban/rural), or over time, provided the separate indices are calculated with the same variables.

The poorest/least poor mortality rate ratio, which compares rates prevailing in the poorest quintiles with those in the least poor quintiles are used as measures of SES inequality[51]. This ignores the information contained in the middle three quintiles, which is a limitation but still a very useful measure of inequality.

Concentration indices (CIs) and curves have now become fairly standard measurement tools in the health economics literature on equity and inequality in health and health care[52]. They were first introduced by Wagstaff, Van Doorslaer and Paci[53] and have since been used successfully to describe and measure the degree of inequality in various measures of health[54], e.g., health care utilisation[55], or in health care payments[56]. Wagstaff, Paci and Van Doorslaer[57] have reviewed and compared the properties of the CI with alternative measures of health inequality and concluded that it shares the same properties as one of the two relative index of inequality measures that are used by epidemiologists but that concentration curves have an additional advantage in terms of their visual representation of the location of deviations from proportionality and the possibility to perform checks of dominance relationships[55] .

### 1.5 Research Question

There is no doubt that poverty has a devastating effect on child survival in Sub-Saharan African countries. Although some studies have suggested some association between socio-economic status and child mortality at Rufiji DSS, there is an urgent need to improve the evidence base on child health and poverty. It is therefore important to assess the relationship between socio-economic status of households and under-five mortality at the Rufiji demographic surveillance site (RDSS) in the year 2005.

### 1.6 Aim

The aim is to determine the relationship between socio-economic status of households and under-five mortality at Rufiji DSA for the year 2005.

### 1.7 Specific Objectives

1. To construct wealth and concentration indices for households with children younger than five years of age.
2. To measure health inequality by poorest / least poor mortality rate ratio and the use of concentration index.
3. To determine significance in gradient of mortality rates across wealth index quintiles by a trend test (chi-squared).
4. To assess the magnitude of association between socio-economic status of households and under-five mortality.

# CHAPTER TWO: METHODOLOGY

## 2.1 Demographic characteristics of study area

The Rufiji District has a population size of about 226,000 of which 87,000 (about 38% of the district) are under continuous surveillance. The population densities for the district and survey area are 12.5 and 46 per square km respectively. The mean household size for the whole district is about 5 persons. The district is largely rural although the population is clustered around Utete (District headquarters), Ikwiriri, Kibiti and Bungu townships. Rufiji district is home to several ethnic groups. The largest group is the Ndengereko (who, according to oral tradition, are the original inhabitants of the area), other groups include the Matumbi, Nyagatwa (concentrated in the delta area), Ngindo, Pogoro, and Makonde. The majority of the people are Moslems with few Christians and followers of traditional religions. In addition to local languages, Kiswahili is widely spoken; English is not commonly used in the area. The majority of the people in Rufiji District are subsistence farmers. Farming areas are often located some distance from the family home and make use of periodically flooded alluvial soils. Temporary houses located on this farmland means that some households are often split geographically for up to four months of the year. For polygenous households, this may mean a seasonal 'double' splitting of their membership. Major crops grown include cassava, maize, rice, millet, sesame, coconut and cashew nuts. Fruit such as mangoes, oranges, pineapples, papaya and jackfruit are also grown. Some residents are involved in fishing while others are involved in small-scale commercial activities such as selling wood products (e.g. timber, furniture and carvings).

## 2.2 Rufiji Demographic Surveillance System (RDSS)

The Rufiji Demographic Surveillance System (RDSS) commenced field operations in November 1998. The DSS approach involves continuous monitoring of households and members within households in cycles or intervals, known in the Rufiji DSS as 'rounds'

of four months each. The Rufiji DSS collects information on demographic, household, socio-economic and environmental characteristics of a population of about 87,000 people in 31 villages located in Rufiji District along the coastal area of Tanzania, south of Dar es Salaam in the Rufiji River basin. The Rufiji DSS was established as one of the four major research components of the Tanzania Essential Health Interventions Project (TEHIP). In addition to its research role, its aim is to provide sentinel data to the district health authorities and the Ministry of Health to inform evidence based planning and resource allocation as well as to quantify the burden of disease and document impact of health system interventions and innovations. The Rufiji DSS employs the Household Registration System (HRS), which involves collecting, and documenting data on pregnancies and births, deaths, causes of death, in and out-migrations and socioeconomic status. A team of trained fieldworkers move from household to household to collect this information. Also, a team of field supervisors carry out quality control checks visits on a random sample of these households. Each household in the surveillance area is visited thrice in a year and on each visit, the demographic information of the household is updated. There is also a tracking team of fieldworkers who ensure that people moving within the DSS are reconciled with their records already captured into the database to avoid duplication of individuals moving within the study area. Verbal autopsies are also conducted on all deaths recorded in the DSA for each round of update. Verbal Autopsy (VA) interviews on all DSS registered deaths are conducted by VA trained supervisors using specific standard questionnaires. The interviews are held with one of the adult relatives of the deceased who was well informed of the sequence of events leading to death. Completed questionnaires are then coded independently by two physicians in accordance with a list of causes of death based upon the tenth revision of the International Classification of Diseases. A third

physician is used to independently code in the case of discordant results. When there are three discordant codes, the cause is registered as unknown.

### 2.3 Study Population

The study population includes all active households within the DSA in the year 2005.

### 2.4 Study Design

This study is an analytical cross- sectional study and it will be carried out through secondary data analysis. Repeated annual cross- sectional surveys have been carried out in the RDSS. This study will therefore select suitable variables from this data to answer the above objectives. (Refer to appendix C).

### 2.5 Inclusion and Exclusion Criteria

Only households with children younger than five years of age as at 31st December 2005 residing in the Rufiji DSA where included in the study.

### 2.6 Data Source

Data for this secondary analysis study was extracted from the RDSS database which includes information on all individuals, household head, household assets, and deaths which occurred in 2005.

### 2.7 Description and Extraction of Variables

**Explanatory:**

**1. Socioeconomic status** was measured using an index, based on ownership of assets, water and sanitation facilities, power source and housing quality and constituted the independent variable. The asset approach was used as recommended by Filmer and Pritchett (1998)[58]. In a study conducted in several states of India, Filmer and Pritchett found that the asset index produces comparable results with other measures. The author

noted that the asset index significantly correlated with the state head count index as well as the domestic product per capita distributions.

The assets will be combined into a wealth index using weights derived through principal components analysis (PCA) using Stata 10. PCA involves breaking down assets (eg radio, bicycle) or household service access (eg water, electricity) into categorical or interval variables. The variables are then processed in order to obtain weights and principal components. The results obtained from the first principal component (explaining the most variability) are usually used to develop an index based on the formula: $A_{j=}f_1 \text{ x } (a_{ji}\text{-}a_{i)}/(S_1)_{+.....+} f_N \text{ x}(aj_N - a_{N)}/(S_N)$ . Where $f_1$ is the scoring factor or weights for the first asset (or service), and $a_1$ and $s_1$ are the mean and the standard deviation of the first assets (or service) variable over all households respectively.

Based on this equation SES of households will be assigned to the residents of those households, and the resulting households will be divided into quintiles (i.e. poorest, very poor, poor, less poor, and least poor) that represent the proxies for SES. The following household characteristics and assets were included in the PCA model: floor type of the household, wall type of the room; whether they were locally made with mud or with modern material such as cement, source of power; firewood, kerosene/biogas or electricity, bicycle, car, motorbike, animal possessions; whether household had animals or not.

The model was based on the presence or absence of each asset or the nature of the housing materials .i.e. each asset was dummied with the response, 1 and 0. . We reparameterized variables with more than two categories to generate binary variables to signify presence or absence of a characteristic. We ran the “pca” command in Stata to

generate indices for all listed assets. The generated indices were used to categorise participants into five socio-economic groups or quintiles; most poor, very poor, poor, less poor, and least poor.

**2. Concentration Index**

Health equity in under five mortality will be measured using the concentration index (CI) proposed by Wagstaff et al[53]. It is computed from the mortality concentration curve, which plots the cumulative proportions of children ranked by the household's socio-economic status against the cumulative proportions of under-five mortality. It estimates the extent of socio-economic inequality in mortality. The CI is similar to the relative index of inequality that is frequently used by epidemiologists[55,57,]. The concentration index takes values between -1 and 1. A value of 0 indicates equity in the health variable. A negative value indicates pro poor concentration of health variable among the poor and a positive value indicates the poor are getting less than would be expected had the distribution been equitable.

**3. Other variables**

The other explanatory variables included in the analysis where maternal education, maternal age, maternal occupation, maternal marital status and sex of child.

**Outcome:**

**Under five mortality rate** was measured by dividing the total number of deaths in a wealth quintile by the calculated person-years observed for all under five year old children in that particular quintile for the year 2005. It was expressed per 1,000 person years observed. Mortality rate for infants (0-1 years) and children (1-4 years) who died

in the year 2005 were computed similarly. A binary variable was also generated and took the value 1 if a child died, and 0 if not.

### 2.8 Data Management

The data extraction, cleaning, joining of tables and statistical analysis were done using Stata version 10. Before exporting the data from Visual FoxPro to Stata version 10, data transfer was done using the Stat/Transfer version 7. The variables for this research were selected from four different tables namely members, mortality, family and asset tables. The total number of deaths was obtained from the mortality table of all resident individuals in the demographic surveillance area. The date of birth was obtained from the member table which contains the personal information about the individual. The type and number of assets were also stored in separate tables. From date of birth, ages where computed as at 31st December, 2005 and only members who where less than five where kept for the final analysis. All these tables were linked together by household or person unique identifiers and the required variables for analysis were then selected and stored in a separate table. This ensures that every member is linked to a particular household and also accommodates households with more than one member. The data was entered using the HRS2 software which is built from the screen and menu builders of FoxPro development environment. Data cleaning involved the checking of quality of the data in terms of missing values, internal consistencies and validity of responses.

### 2.9 Sample for analysis

The study sample involved all children younger than five years as at 31st December, 2005 in the Demographic Surveillance Area (DSA) of RDSS. 13,648 children younger than five years of age found in 13,307 households were eligible for inclusion in this study. However, after merging of personal data with household socio-economic status

characteristics, 11,189 children in 7,298 households yielding 9,341.57 person years of observation were included in this analysis. A total of 837 deaths were recorded in the DSA during 2005 out of which 289 where children younger than five years of age. Information for 251 deaths of children younger than five years of age and their household was available for this analysis.

### 2.10 Data Analysis

#### 2.10.1 Wealth index

A wealth index was constructed for each household using PCA as described by Filmer and Pritchett[58.] Households were then categorized into five equal groups (i.e. poorest, poorer, poor, less poor and least poor). We constructed separate indices for infants (<1 year), children (1-4 years) and for children younger than five year of age.

#### 2.10.2 Mortality rates

Person years of observation from 1st January, 2005 to 31st December, 2005 were computed for all children younger than five years of age born or present during this time period. The computations also took into account in and out migrations. Mortality rates were estimated separately for infants, children and under five year old children by Kaplan-Meier (K-M) survival estimates of incidence (mortality) rates and were expressed per 1,000 person years of observation.

#### 2.10.3 Measurement of Inequality

Two measures of health equity were used in this study. First, we used the concentration index (CI) calculated by a method proposed by Kakwani et al (1998). This measures the extent to which a variable is distributed unequally across all five socio economic quintiles i.e. the concentration of inequality. The concentration index takes values between -1 and 1.A value of 0 indicates equity. A negative value indicates pro poor

concentration of health variable among the poor and a positive value indicates the poor are getting less than would be expected had the distribution been equitable[59]. Secondly, we calculated the poorest/least poor ratio which compares rates prevailing in the poorest quintiles with those in the least poor quintiles. This ignores the information contained in the middle three quintiles. Trend test (Chi- squared) was used to determine the significance of any gradient in the inequality across wealth quintiles.

### 2.10.4 Univariate and multivariate analysis

Both univariate and multivariate Poisson regression analysis where used to determine the association between SES, maternal characteristics and mortality in children younger than five years old. Potential confounders such as mothers education, mothers age and mothers occupation were controlled for in the multivariate model Corresponding p-values were calculated to test for statistical significance at 5% level.

## 2.11 Ethical Approval

Ethical approval was obtained from the Human Research Ethics Committee of University of the Witwatersrand with Protocol Number M071144 (appendix 2). Ethical approval was given for the use of the RDSS dataset by the Ifakara Health Research and Development Centre Institutional Review Board with number IHRDC/IRB/A022 (appendix 3). A copy of the findings of this report was already presented to Ifakara Health Research and Development Centre for dissemination at Rufiji DSA, in accordance Institutional Review Board guidelines for conducting health research.

## CHAPTER THREE: RESULTS

This chapter presents the results of the analysis for this study. The analyses are in three parts. The first parts involve the construction of wealth index for the year 2005 by the use of PCA and estimation of mortality rates by Kaplan-Meier (K-M) survival estimates of incidence (mortality) rates expressed per 1000 person years of observation across wealth index quintiles. The second part involves the measurement of health inequality by computing mortality concentration indices, poorest to least poor ratio. Chi-Squared trend test was used to determine the significance in gradient of mortality rates across wealth index quintiles. The third part involves investigating the association by the use of Poisson regression taking into account potential confounders.

### 3.1 Socio-demographic characteristics

The socio-demographic characteristics of children, mothers of children and household head are presented in table 3.1. In 2005, data were available for 11,189 children under five years of age living in 7,298 households. There were a similar proportion of boys (49.9%) and girls (50.1%) during the period under study. The age of children ranged from 0.1 to 4.9 with a mean age of 2.4 years. 2427(21.7%) children were less than one year in 2005. Approximately one out of three households was headed by a female. Slightly less than half (46.7%) of the heads of household had primary education compared to 33.6% without education. The occupational profile showed that over half 7,096 (63.3%) of the household heads were into farming or animal husbandry, 2,563 (23%) were casual workers, 151 (1.4%) were unemployed while 1,351 (12.1%) where into other forms of employment. The family structure revealed that 7,837 (63.1%) were married. The ages of mothers ranged from 14 to 47 with a mean age of 26.6 years (SD 7.8).The majority of the mothers where 21-29 years 4,454 (39.8%). 7,180 (69.8%) of

mothers where married. 5,695 (51%) had attained primary education whiles 4,777 (43%) had no school education. Approximately three quarters of women were engaged in farming and animal husbandry as their occupation.

**Table 3.1 Socio-demographic Characteristics**

| Variable | frequency | Percentage |
|---|---|---|
| **Sex of child** | | |
| Male | 5,604 | 50.1 |
| Female | 5,585 | 49.9 |
| **Age of child** | | |
| <1 | 2427 | 21.7 |
| 1-2 | 2,155 | 19.3 |
| 2-3 | 2,260 | 20.2 |
| 3-4 | 2184 | 19.5 |
| 4-5 | 2163 | 19.3 |
| **Household head sex** | | |
| Male | 7,750 | 69.3 |
| Female | 3,439 | 30.7 |
| **Head education** | | |
| No education | 3,726 | 33.6 |
| Primary education | 5,221 | 46.7 |
| Secondary education | 470 | 4.2 |
| Non- formal education | 537 | 4.8 |
| Others | 1,199 | 10.7 |
| **Head marital status** | | |
| Not married | 972 | 8.7 |
| Married | 7,837 | 63.1 |
| Widow/divorced/separated | 1,142 | 10.1 |
| Other | 1,238 | 11.1 |
| **Head occupation** | | |
| Not employed | 151 | 1.4 |
| Farming/Animal husbandry | 7,096 | 63.3 |
| Casual worker | 2,563 | 22.9 |
| Student | 28 | 0.3 |
| Others | 1,351 | 12.1 |
| **Maternal Age** | | |
| Under 20 | 2,791 | 24.9 |
| 21-29 | 4,454 | 39.8 |
| 30+ | 3,648 | 32.6 |
| Missing | 296 | 2.7 |
| **Maternal Education** | | |
| No education | 4,777 | 42.7 |
| Primary education | 5,695 | 50.9 |
| Secondary education | 376 | 3.4 |
| Non-formal education | 43 | 0.4 |

| | | |
|---|---|---|
| Missing | 298 | 2.6 |
| **Maternal marital status** | | |
| Not married | 1,905 | 17.0 |
| Married | 7,180 | 69.8 |
| Widow/divorced/separated | 1,089 | 9.7 |
| Other | 89 | 0.8 |
| Missing | 296 | 2.7 |
| **Maternal Occupation** | | |
| Not employed | 763 | 6.8 |
| Farming/Animal husbandry | 8,457 | 75.6 |
| Casual worker | 1,710 | 15.3 |
| Student | 87 | 0.8 |
| Others | 172 | 1.5 |

### 3.2 Principal components analysis

There were 41 principal components according to the number of asset items included in the analysis. The first principal component accounted for 16% of the total variance with an eigenvalue of 6.4. The second component accounted for 6% of the total variance of all variables with an eigenvalue of 2.4. The complete results are summarised in fig 3.1. The eigenvector values of the first component are presented in appendix 5.

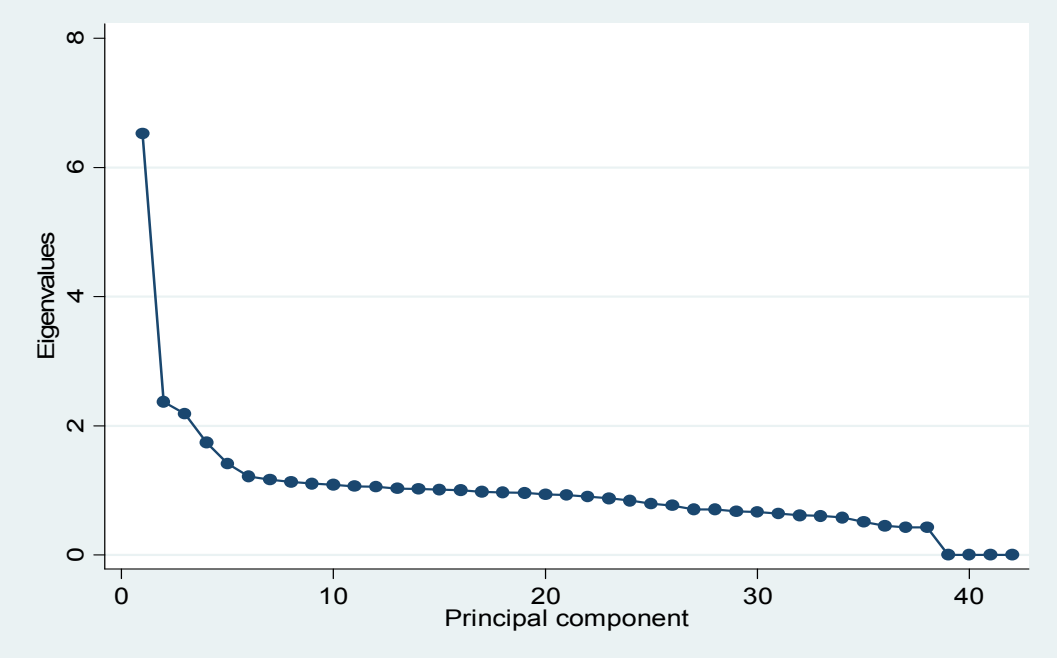



**Fig 3.1 A Scree plot of principal component and eigenvalues**

### 3.2.1 Distribution of index component by socio-economic status

Table 3.2 indicates that the categorization of households in wealth index quintiles differentiate households in the various strata quite well. The proportion of households possessing a given characteristic according to the socio-economic status of that household is given in Table 3.2. In general the poorest are below average regarding possession of most of the items or services to which the better off have access. For example in terms of asset ownership 38% of the poorest have a bicycle as compared with 72% of the least poor, about two times more. This is similar to radio, vehicle and motorbike. Thus, as expected, the better off are likely to own more assets than the poorest. The exception is for poultry where the poorest have more than the least poor. The observation is consistent with the direction of the scores. Like asset ownership, housing condition tend to reflect the economic status of the household. The pattern for energy source, roof type, floor type, and wall type are similar to that above. Households ranking lower in the index are more likely than the better off to use firewood (100%) and bamboo for their roof.

### 3.2.2 Socio-economic status index

Based on the asset or item scores, a wealth index value was assigned to each household and its members. Subsequently households and their members were categorized into wealth index quintiles based on value of the wealth index. The distribution of the wealth index and the population of under-fives are presented in table 3.3 below. 2251 (20.1%) of the under-five children where in the poorest quintile while 2235 (19%) where in the least poor quintile category. The poorer, poor, and less poor were 2246 (20.1%), 2218 (19.8%) and 2239 (20%) respectively. This is presented in figure 3.2 below.

**Table 3.2 Distribution of assets and housing conditions by wealth quintiles (%)**

| Variable | Poorest | Poorer | Poor | Less Poor | Least poor |
|---|---|---|---|---|---|
| hoe | 100 | 99.96 | 98.87 | 96.56 | 86.98 |
| matchet | 100 | 98.35 | 96.57 | 92.99 | 83.67 |
| bicycle | 38.43 | 54.72 | 68.12 | 69.41 | 72.17 |
| vehicle | 0 | 0 | 0 | 0.09 | 1.88 |
| motorbike | 0 | 0.58 | 0.77 | 1.07 | 1.16 |
| radio | 55.75 | 78.5 | 79.4 | 79.37 | 87.61 |
| refrigerator | 0 | 0 | 0 | 0.45 | 6 |
| television | 0 | 0 | 0 | 0.58 | 4.52 |
| clock | 2.84 | 37.58 | 57.66 | 51.99 | 73.02 |
| sofa | 0 | 0 | 0.23 | 1.56 | 33.69 |
| bed | 98.09 | 98.66 | 98.75 | 98.88 | 99.06 |
| video | 0 | 0 | 0 | 0.45 | 4.61 |
| mattress | 0 | 18.25 | 54.1 | 62.57 | 90.69 |
| wardrobe | 0 | 0 | 0.18 | 3.26 | 33.2 |
| pump | 0 | 0 | 0 | 0 | 1.25 |
| livestock | 0 | 0.22 | 0.27 | 2.1 | 6.58 |
| Sewing machine | 0 | 0.09 | 1.22 | 3.44 | 8.81 |
| chicken | 51.8 | 58.1 | 56.31 | 50.11 | 44.34 |
| Bed net | 1.33 | 32.55 | 56.9 | 50.87 | 78.66 |
| satellite | 0 | 0 | 0.05 | 0.89 | 1.97 |
| Ceiling fan | 0 | 0 | 0 | 0.09 | 9.17 |
| iron | 0 | 0 | 1.58 | 8.84 | 36.78 |
| Earth/mud floor | 100 | 100 | 99.68 | 96.74 | 32.53 |
| Wood floor | 0 | 0 | 0.27 | 0.27 | 0.4 |
| Tiles floor | 0 | 0 | 0.05 | 1.21 | 1.12 |
| cement floor | 0 | 0 | 0 | 0.76 | 59.51 |
| Other | 0 | 0 | 0 | 1.03 | 6.44 |
| Cement/ coral block wall | 0 | 0 | 0 | 1.79 | 25.64 |
| Mud/bricks/wood wall | 0 | 4.41 | 8.39 | 13.13 | 15.79 |
| galvanise/mud stick wall | 92.98 | 82.55 | 83.32 | 78.65 | 56.38 |
| grass/cardboard wall | 6.66 | 8.37 | 5.05 | 3.53 | 0.94 |
| other | 0.36 | 4.67 | 3.25 | 2.9 | 1.25 |
| Concrete/cement roof | 0 | 0 | 0 | 0.27 | 0.27 |
| Iron or asbestos roof | 0 | 0 | 11.45 | 60.38 | 84.38 |
| Bamboo/wood/grass roof | 100 | 97.55 | 84.9 | 31.35 | 12.21 |
| Others | 0 | 2.45 | 3.65 | 7.99 | 3.13 |
| Electricity/gas power | 0 | 0 | 0 | 1.16 | 0.27 |
| Firewood power | 100 | 100 | 99.86 | 96.83 | 62.6 |
| Kerosene/biogas power | 0 | 0 | 0 | 1.47 | 34.45 |
| Crop residue/grass | 0 | 0 | 0 | 0.49 | 2.68 |
| Other | 0 | 0 | 0.14 | 0.04 | 0 |

**Table 3.3 Distribution of some selected variables by wealth index quintiles**

| Quintile | Number of household | Mean SES score | Household Asset (%) | | |
|---|---|---|---|---|---|
| | | | Hoe | Radio | sofa |
| Poorest | 2,251 (20.1%) | -1.8 | 100 | 55.8 | 0 |
| Poorer | 2,246 (20.1%) | -1.4 | 99.96 | 78.5 | 0 |
| Poor | 2,218 (19.8%) | -0.90 | 98.87 | 79.4 | 0.2 |
| Less poor | 2,239 (20.0%) | -0.04 | 96.56 | 79.4 | 1.6 |
| Least poor | 2,235 (20.0%) | 4.03 | 86.98 | 87.6 | 4.5 |

### 3.3 Socio-economic status and mortality rates of children

**Table 3.4 Under-five (<5yrs) mortality rate by wealth quintile**

| Quintile | Under 5 Person Years Observed (PYOs) | Deaths < 5yrs | Under 5 Mortality Rate/1000 PYOs (95% CI) |
|---|---|---|---|
| 1ST ( Poorest) | 1891.6 | 77 | 40.7 (32.6 , 50.9) |
| 2ND (Poorer) | 1878.1 | 53 | 28.2 (21.6, 36.9) |
| 3RD (Poor) | 1846.7 | 48 | 25.99 (19.6, 34.5) |
| 4TH (less Poor) | 1857.4 | 41 | 22.07 (16.3 , 30.0) |
| 5TH (Least Poor) | 1867.7 | 32 | 17.13 (12.1, 24.2) |
| **TOTAL** | **9341.6** | **251** | **26.9 (23.7, 30.4)** |
| **Chi- Square Trend** | | | **P< 0.001** |
| **Poorest- Least Poor Ratio** | | | **2.4** |
| **Concentration Index** | | | **- 0.16 (-0.24, -0.08)** |

The relationship between socio-economic status and overall under-five mortality is summarised in table 3.4. The findings reveal that mortality rate is highest in the poorest

quintile with 40.7 per 1000 PYO; 95% CI (32.6, 50.9) and lowest in the least poor quintile with 17.1 per 1000 PYO; 95% CI (12.1, 24.2). There was a general decrease in mortality rates as wealth index quintile increases. It further reveals that children in the poorest quintile were 140% more likely to die before reaching their fifth birthday than those of the least poor households from a poorest to least poor ratio of 2.4. There was a statistically significant inverse trend such that child mortality rate declines with increase in the socio-economic status of the household (P<0.001). The mortality concentration index -0.16, 95% CI (-0.24, -0.08) also showed a pro poor concentration of under-five mortality. The under-five year old children in the poorest households have similar inequitable poor-least poor risks of dying. Hence under-five mortality is associated with socio-economic status in the current study. The mortality rates where stratified by infant and child as presented below.

**Table 3.5 Infant (0-1 year) mortality rate by wealth quintile**

| **Quintile** | **Infants Person Years Observed (PYOs)** | **Deaths 0-1 yr** | **Infant Mortality Rate/1000 PYOs (95% CI)** |
|---|---|---|---|
| 1ST ( Poorest) | 233.4 | 37 | 158.5 (114.9 , 218.8) |
| 2ND (Poorer) | 234.4 | 26 | 110.9 (75.5 , 162.9) |
| 3RD (Poor) | 221.4 | 27 | 122.0 (83.6, 177.8) |
| 4TH (less Poor) | 207.1 | 24 | 115.9 (77.7, 172.9) |
| 5TH (Least Poor) | 197.5 | 21 | 106.3 (69.3, 163.1) |
| **TOTAL** | **1093.8** | **135** | **123.4 (104.3, 146.1)** |
| **Chi- Square Trend** | | | **P= 0.10** |
| **Poorest- Least Poor Ratio** | | | **1.5** |
| **Concentration Index** | | | **-0.07 (-0.13, 0.0003)** |

Table 3.5 shows infant mortality rates across the different wealth quintiles. The findings reveals that mortality rate was highest in the poorest quintile with 158.5 per 1000 PYO; 95% CI (114.9, 218.8) and lowest in the least poor quintile with 106.3 per 1000 PYO; 95% CI (12.1, 24.2) The finding also shows an inconsistent trend between second 110.9 per 1000 PYO, 95% CI (75.5, 162.9) and third 122.0 per 1000 PYO, 95 % CI (83.6, 177.8) wealth quintile. Although there was a general decrease across wealth quintiles and there was no statistical significance of the trend (P =0.10). Children in the poorest households were about 50% more likely to die in infancy than those in the least poor from the poorest to least poor ratio of 1.5. The mortality concentration index of -0.07, 95% CI (-0.13, 0.0003) is an indication of a pro poor concentration of infant mortality. This further confirms the difference in infant mortality rates amongst poorest and the better off. The overall infant mortality rate was 123.4, 95% CI (104.3, 146.1).

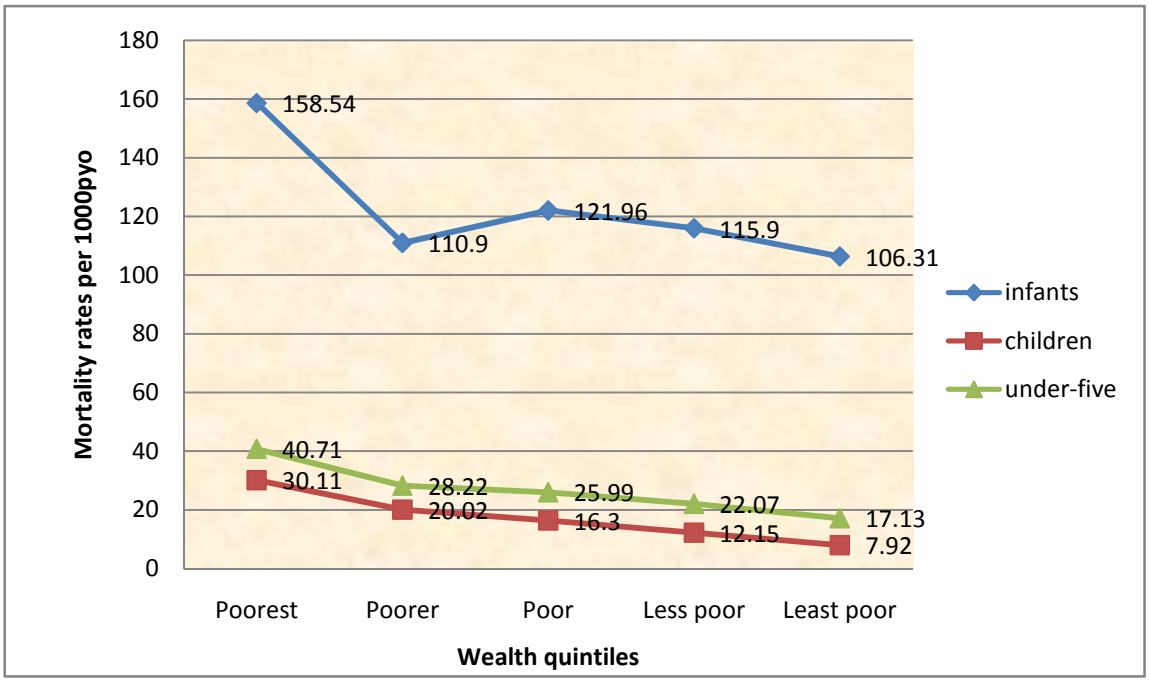
**Table 3.6 Child (1-4 years) mortality rate by wealth quintile**

| **Quintile** | **Child (1-4) Person Years Observed (PYOs)** | **Deaths 1-4 yr** | **Child Mortality Rate/1000 PYOs (95% CI)** |
|---|---|---|---|
| 1ST ( Poorest) | 1228.8 | 37 | 30.1 (21.8 , 41.6) |
| 2ND (Poorer) | 1248.5 | 25 | 20.0 (13.5 , 29.6) |
| 3RD (Poor) | 1226.9 | 20 | 16.3 (10.5, 25.3) |
| 4TH (less Poor) | 1234.8 | 15 | 12.2 (7.3, 20.2) |
| 5TH (Least Poor) | 1262.5 | 10 | 7.9 (4.3, 14.7) |
| **TOTAL** | **6201.5** | **107** | **17.3 (14.3, 20.9)** |
| **Chi- Square Trend** | | | **P< 0.001** |
| **Poorest- Least Poor Ratio** | | | **3.8** |
| **Concentration Index** | | | **-0.24 (-0.13, -0.35)** |

Table 3.6 shows child mortality rates across the various wealth quintiles. The findings reveal that mortality rate was highest in the poorest quintile with 30.1 per 1000 PYO; 95% CI (21.8, 41.6) and lowest in the least poor quintile with 7.9 per 1000 PYO; 95% CI (4.3, 14.7). There was a general decrease in mortality rates as wealth index quintile increases. The findings showed an inverse trend which is statistically significant (P< 0.001) such that child mortality rate declined with increase in the socio-economic status of the household. Poorest to least poor ratio of 3.8 indicates that children in the poorest households were about 280% more likely to die than those in the least poor. The mortality concentration index -0.24, 95% CI (-0.13, -0.35) also showed a pro poor concentration of child mortality. Hence child mortality was associated with household wealth quintile in this study, with the poorest households having higher probabilities of child death than the least poor. The concentration indices further confirmed the difference in infant mortality rates amongst poorest and the better off. The overall child mortality rate was 17.3, 95% CI (14.3, 20.9). The under-five in the poorest household had similar inequitable poor-least poor risks of dying just like the children (1-4yrs).This indicates that the differentials noted for children (1-4yrs) shaped the relationship between socio-economic status and under-five mortality.

It is worth mentioning that overall, the highest mortality rate was amongst the infants with 123.4 per 1000 person year of observation. The overall child mortality rate was the lowest 17.3 per 1000 person years of observation. The under-five mortality rate was quite low comparing it to the infants 26.9 per 1000 person years of observation. The mortality rates are presented in Fig 3.3.

**Fig 3.2 Rufiji under- five mortality rates by wealth quintiles**




### 3.4 Univariate analysis for under-five

Univariate Poisson regression was carried out to investigate the relationship between socio-economic status and mortality, sex of child, maternal education, maternal age, maternal marital status and maternal occupation. This was carried out for children under-five, infants (<1years) and children (1-4 years) and the results are presented in the Table 3.7. The relative risks are described as incident rate ratio.

**Table 3.7 Univariate analysis for risk factors of under-five mortality**

| Variable | IRR | 95% CI | P- value |
|---|---|---|---|
| **Wealth index** | | | |
| Poorest (Reference) | 1 | | |
| Poorer | 0.69 | 0.48 - 0.98 | 0.040 |
| Poor | 0.63 | 0.45 - 0.92 | 0.015 |
| Less poor | 0.54 | 0.37 - 0.79 | 0.002 |
| Least poor | 0.42 | 0.27 - 0 .63 | 0.000 |
| **Sex of child** | | | |

| | | | |
|---|---|---|---|
| Male (Reference) | 1 | | |
| Female | 0.81 | 0.63 - 1.03 | 0.088 |
| **Maternal Education** | | | |
| No education (Reference) | 1 | | |
| Primary | 0.70 | 0.52 - 0.95 | 0.021 |
| Secondary | 0.23 | 0.06 - 0.93 | 0.039 |
| **Mothers Age (years)** | | | |
| Under 20 (Reference) | 1 | | |
| 21-29 | 0.86 | 0.63 - 1.19 | 0.37 |
| 30 + | 1.03 | 0.75 - 1.42 | 0.86 |
| **Marital status** | | | |
| Not married (Reference) | 1 | | |
| Married | 0.72 | 0.50 - 1.03 | 0.073 |
| Divorced/separated | 1.30 | 0.82 - 2.06 | 0.263 |
| Others | 1.86 | 0.51 - 5.35 | 0.398 |
| **Maternal Occupation** | | | |
| Not employed (Reference) | 1 | | |
| Farming/Animal husb | 0.58 | 0.34 - 0.98 | 0.046 |
| Casual worker | 0.53 | 0.28 - 0.98 | 0.045 |
| Student | 1.23 | 0.36 - 4.25 | 0.742 |
| Others | 0.96 | 0.35 - 2.65 | 0.940 |

In a univariate Poisson regression model, wealth index was inversely associated with the risk of children under-five years of age dying. Children in the highest wealth category, had a lower risk of dying as compared to the children in the poorest wealth index category. Children in the poorer households had a 31% reduced risk of dying as compared to those in the poorest households [crude RR= 0.69, P=0.04, 95% CI ( 0.48 - 0.98)] , Children in the poor households had a 37% reduced risk of dying as compared to those in the poorest households [crude RR=0.63, P= 0.015, 95% CI (0.45 - 0.92)], Children in the less poor households had a 46% reduced risk of dying as compared to those in the poorest households [ crude RR= 0.52, P=0.002, 95% CI (0.37 - 0.79)], Children in the least poor households had a 58% reduced risk of dying as compared to those in the poorest households [crude RR=0.42, P < 0.001, 95% CI (0.27 - 0.62)].

Children with mothers attaining primary education had a 30% reduced risk of dying as compared to mothers with no education [crude RR=0.70, P = 0.021, 95% CI (0.52 - 0.95)]. Children with mothers attaining secondary education had a 77% reduced risk of dying as compared to mothers with no education both were statistically significant [crude RR=0.23, P= 0.039, 95% CI (0.06 - 0.93)].

Results for Infants and children (1-4 years) are presented in tables 3.8 and 3.9. For infant mortality, no association was observed between socio-economic status, sex of child, maternal age, maternal education, maternal marital status and maternal occupation in a univariate Poisson regression model (table 3.8).

**Table 3.8 Univariate analysis for risk factors of infant mortality**

| Variable | IRR | 95% CI | P- value |
|---|---|---|---|
| **Wealth index** | | | |
| Poorest (Reference) | 1 | | |
| Poorer | 0.65 | 0.40 - 1.10 | 0.114 |
| Poor | 0.72 | 0.40 -1.20 | 0.22 |
| Less poor | 0.76 | 0.50 - 1.30 | 0.34 |
| Least poor | 0.71 | 0.40- 1.20 | 0.22 |
| **Sex of child** | | | |
| Male (reference) | 1 | | |
| Female | 1.3 | 0.93-1.90 | 0.11 |
| **Maternal Education** | | | |
| No education (Reference) | 1 | | |
| Primary | 0.64 | 0.41 - 0.98 | 0.045 |
| Secondary | 0.51 | 0.12 - 2.00 | 0.34 |
| **Mothers Age (years)** | | | |
| Under 20 (Reference) | 1 | | |
| 21-29 | 1.05 | 0.65 - 1.70 | 0.84 |
| 30 + | 1.33 | 0.84 - 1.10 | 0.22 |
| **Marital status** | | | |
| Not married (Reference) | 1 | | |
| Married | 0.88 | 0.53 - 1.50 | 0.63 |

| | | | |
|---|---|---|---|
| Divorced/separated | 2.04 | 1.04 - 4.0 | 0.03 |
| Others | 2.2 | 0.82 - 5.8 | 0.117 |
| **Maternal Occupation** | | | |
| Not employed (Reference) | 1 | | |
| Farming/Animal husb | 2.1 | 0.66 - 6.68 | 0.21 |
| Casual worker | 1.4 | 0.40 - 5.10 | 0.57 |
| Student | 9.4 | 2.40 - 35.40 | 0.001 |
| Others | 3.06 | 0.70 - 13.70 | 0.143 |

**Table 3.9 Univariate analysis for risk factors of child mortality**

| Variable | IRR | 95% CI | P- value |
|---|---|---|---|
| **Wealth index** | | | |
| Poorest (Reference) | 1 | | |
| Poorer | 0.65 | 0.39 - 1.10 | 0.09 |
| Poor | 0.50 | 0.30 - 0.80 | 0.009 |
| Less poor | 0.52 | 0.31 – 0.90 | 0.019 |
| Least poor | 0.33 | 0.17- 0.62 | 0.001 |
| **Sex of child** | | | |
| Male (reference) | 1 | | |
| Female | 1.21 | 0.80 -1.80 | 0.31 |
| **Maternal Education** | | | |
| No education (Reference) | 1 | | |
| Primary | 0.60 | 0.41 - 0.90 | 0.035 |
| Secondary | 0.50 | 0.12 - 0.60 | 0.045 |
| **Mothers Age (years)** | | | |
| Under 20 (Reference) | 1 | | |
| 21-29 | 0.70 | 0.42 - 1.30 | 0.07 |
| 30 + | 0.70 | 0.43 - 1.10 | 0.13 |
| **Marital status** | | | |
| Not married (Reference) | 1 | | |
| Married | 0.5 | 0.30 - 0.80 | 0.003 |
| Divorced/separated | 0.80 | 0.40 - 1.60 | 0.55 |
| Others | 1.02 | 0.14 - 7.50 | 0.98 |
| **Maternal Occupation** | | | |
| Not employed (reference) | 1 | | |

| | | | |
|---|---|---|---|
| Farming/Animal husb | 0.40 | 0.20 - 1.10 | 0.004 |
| Casual worker | 0.50 | 0.40 - 5.10 | 0.083 |
| Student | 0.60 | 0.08 - 4.9 | 0.670 |
| Others | 0.70 | 0.20 - 3.30 | 0.68 |

For child mortality an inverse association with wealth index was observed in a univariate Poisson regression model (table 3.9). Children in the least poor households had a 67% reduced risk of dying as compared to those in the poorest households [crude RR=0.33, P < 0.001, 95% CI (0.17 - 0.62)].

Children with mothers attaining primary education had a 40% reduced risk of dying as compared to mothers with no education [crude RR=0.60, P = 0.035, 95% CI (0.40 - 0.90)]. Children with mothers attaining secondary education had a 50% reduced risk of dying as compared to mothers with no education [crude RR=0.50, P= 0.045, 95% CI (0.12 - 0.60)].

### 3.5 Multivariate analysis of under-five mortality

**Table 3.9**: Multivariate analysis adjusted for maternal education, maternal age, maternal occupation.

| **Variable** | **IRR** | **95% CI** | **P- value** |
|---|---|---|---|
| **Wealth index** | | | |
| Poorest (Reference) | 1 | | |
| Poorer | 0.82 | 0.55 - 1.30 | 0.37 |
| Poor | 0.66 | 0.43 - 1.03 | 0.68 |
| Less poor | 0.61 | 0.33 - 0.39 | 0.031 |
| Least poor | 0.48 | 0.30 - 0.77 | 0.002 |
| **Maternal Education** | | | |
| No education (Reference) | 1 | | |
| Primary | 0.76 | 0.62 - 0.90 | 0.008 |

| | | | |
|---|---|---|---|
| Secondary | 0.30 | 0.22 - 0.88 | 0.006 |
| **Mothers Age (years)** | | | |
| Under 20 (Reference) | 1 | | |
| 21-29 | 0.84 | 0.58 - 1.23 | 0.39 |
| 30 + | 0.94 | 0.64 - 1.40 | 0.80 |
| **Maternal Occupation** | | | |
| Not employed (reference) | 1 | | |
| Farming/Animal husb | 0.56 | 0.30 - 1.04 | 0.068 |
| Casual worker | 0.62 | 0.32 - 1.20 | 0.16 |
| Student | 1.31 | 0.36 - 4.80 | 0.68 |
| Others | 0.83 | 0.29 - 2.30 | 0.73 |

*adjusted for maternal education, maternal age and occupation

In a multivariate Poisson regression model adjusted for maternal education, maternal age and maternal occupation the observed association between socio-economic status and under-five mortality was attenuated. Maternal age and occupation where not significant in the univariate analysis but were adjusted for due to what literature has to say about their association with child mortality.

Children under-five in the poorer households had a 18% reduced risk of dying as compared to those in the poorest households but this was not statistically significant [adjusted RR= 0.82, P=0.37, 95% CI (0.55 - 1.30)]. Children under-five in the poor households had a 34% reduced risk of dying as compared to those in the poorest households this was also not statistically significant [adjusted RR=0.07, P= 0.219, 95% CI (0.43 - 1.03)], Children under-five in the less poor households had a 39% reduced risk of dying as compared to those in the poorest households [adjusted RR= 0.61, P=0.031, 95% CI (0.40 - 0.96)]. Children under-five in the least poor households had a 52% reduced risk of dying as compared to those in the poorest households [adjusted RR=0.48, P = 0.002, 95% CI (0.30 - 0.80)].

Children under-five with mothers attaining primary education had a 24% reduced risk of dying as compared to mothers with no education [adjusted RR=0.76, P = 0.008, 95% CI (0.62 - 0.90)]. Children with mothers attaining secondary education had a 70% reduced risk of dying as compared to mothers with no education [ adjusted RR=0.30, P= 0.006, 95% CI (0.22 - 0.88)] after adjusting for socio-economic status, maternal age and maternal occupation.

# CHAPTER FOUR: DISCUSSION AND CONCLUSION

The study explored the relationship between household socio-economic status and under-five mortality in rural Rufiji in the year 2005.The study illustrates that socio-economic inequality in under-five mortality was present at Rufiji DSS in the year 2005. The findings show a high infant mortality rate (123.4 per 1000 person years) present in the Rufiji DSS in the year 2005. Concentration indices computed indicated a pro poor concentration of health outcome mortality i.e. a disproportionate concentration of under-five mortality among the poor. The study observed a statistically significant inverse association between socio-economic status of households and under-five mortality in both univariate and multivariate analysis showing that the better off are less likely to die and that inequality is more pronounced for children (1-4yrs), poorest to poor ratio of 3.8.

The findings could have been expected as previous evidence from other studies has suggested a relationship between socio-economic inequality and under-five mortality. It provides further evidence for the important role household socio-economic status in under-five mortality. Children whose mothers where educated experienced better survivorship than those whose mothers where not educated in this study for the year 2005.

## 4.1 Principal component analysis

PCA was applied to a set of asset and household variables that have a relationship with socio-economic status. The first principal component, accounting for most of the variance among asset and service variables was employed to obtain an index as a proxy of socio-economic status of the households. Based on the value of the asset and

household variables as well as using scoring weight obtained from these variables each household and it members was assigned to a specific quintile.

The study also verified the internal consistency of the index constructed by examining its distribution against the wealth quintiles of the household variables that had been used for its creation. The results reveal expected patterns on how the asset and household variables change with the quintiles. This was noted for variables such as vehicles, video, bicycles, radio, sofa, wardrobes and use of firewood. The only exception is poultry (chicken) and hoe where the poorest had more access than the better off. This may be due to the fact of a rural setting, were such assets are likely to be owned by the indigenous and probably not people who are new comers most of whom are salaried workers. In general the index appears to be useful in capturing some material well being at household level.

**4.2 Measures of health equity**

The two methods employed in this study to measure socio-economic wealth inequality where the poorest to least poor mortality rate ratio (PPR) and the concentration index. Although the PPR ignores the information contained in the middle three quintiles, which is a limitation, the values 1.5, 3.8 and 2.4 for infants, children, and under-five respectively indicate that children in the poorest quintile are more likely to die as compared to those in the least poor household.

The concentration indices of C= -0.07 for infants, C= -0.24 for children and C= -0.16 for under-five, indicates a disproportionate concentration of under-five mortality among the poor. This is consistent with the PPR calculated above. This makes these measures useful and reliable in a rural setting like Rufiji and can be used in measuring health equity in similar DSS settings.

### 4.3 Mortality rates

Table 3.6 shows infant mortality rate across the different wealth quintiles. The finding shows an inconsistent trend between the second and third wealth quintile as shown in figure 3.3. The reasons for this inconsistency are not known but may be due to differences in heterogeneity of scores within the wealth quintiles. Children in the poorest households are about 50% more likely to die in infancy than those in the least poor. If the socio-economic status of the poorest were improved to the level of the least poor 52 per 1000 infants could be saved annually (difference in rate).

Table 3.5 shows child mortality rates across the various wealth quintiles. The findings show an inverse trend which is statistically significant ($P< 0.001$) such that child mortality rate declines with increase in the socio-economic status of the household as depicted in figure 3.3. If the socio-economic status of the poorest were improved to the level of the least poor 22 per 1000 children could be saved annually (difference in rate).

The relationship between socio-economic status and overall under- five mortality is summarised in tables 3.4 and figure 3.3. The findings reveal that mortality is highest in the poorest quintile and lower for the other quintiles. The pattern observed is similar to the child mortality rates. If the socio-economic status of the poorest were improved to the level of the least poor 24 per 1000 children could be saved annually (difference in rate). The under-five in the poorest household have similar inequitable poor-least poor risks of dying just like the children (1-4yrs). This indicates that the differential noted at the children (1-4yrs) have shaped the relationship between socio-economic status and under-five mortality. Hence child mortality has some association with household socio-

economic status, with the poorest households having higher probabilities of under-five death than the least poor.

Although infants experienced higher mortality rates as shown in table 3.5 comparing to children aged 1-4 years as in tables 3.6, their concentration index (C= -0.07) was lower than that of children (C= -0.24) ie mortality was not clearly located in the poorer households for infants compared to children aged 1-4 years. This may be as a result of breast milk sustaining infants in poor settings while after weaning the impact of lower nutrition, poor child care and low stimulation emerges.

The highest mortality rate was amongst the infant 123.4 per 1000 person year of observation. The overall child mortality rate was the lowest 17.3 per 1000 person years of observation and under-five mortality rate was lower than the infant mortality rate i.e. 26.9 Per 1000 person years of observation.

Reducing mortality and improving the health of young children has long been a concern of the international community. One of the eight Millennium Development Goals (MDGs) adopted after the Millennium Summit in 2000 is to reduce child mortality (MDG4). Donors and development agencies, the United Nations and national governments around the world committed themselves to the goal of reducing the under-five mortality rate by two-thirds between 1990 and 2015 (UN Millennium Declaration). Two of the key indicators for monitoring progress towards this goal are the under-five mortality rate (U5MR) and the infant mortality rate (IMR) (UN Development Group, 2003)[21]

Infant mortality, which includes deaths during the first year of life, is a potentially

important indicator. This is because mortality tends to decline more slowly among infants than among children age 1 to 4. As the rate of under-five mortality decreases, infant deaths—especially neonatal deaths—make up an increasing proportion of all under-five deaths. Reducing mortality during the first year of life is essential to achieving the MDG4, and thus tracking infant mortality becomes extremely important[21]. The findings confirm the call for reduction in infant mortality which was very high 123.4 per 1000 PYO in Rufiji DSA in 2005 comparing with the national figure of 74 per 1000 live birth in 2005.

**4.4 Factors associated with under-five mortality**

In previous research, it has been suggested that children born to poor mothers in rural areas faces great challenges of survival. They are often born at home, without any contact with the health system. The mothers might have been aided at delivery by a neighbour or family member or by no one at all. In Africa, for example, less than 40 percent of women deliver with a skilled attendant. This figure is even lower in South Asia[60].

An analysis of 50 developing countries found that children born to mothers in the poorest fifth of a population were almost 30 percent more likely to die as compared to those in the richest fifth. The same analysis found that children born to mothers in rural areas were 21 percent more likely to die compared to those in the urban area[60].

Disparities within some countries are especially dramatic. For example, in India, children born to the poorest mothers die at a rate that is 56 percent higher than babies born to the richest mothers60 and in Bolivia, the newborn mortality rate is 70 percent higher among the poor. In Bolivia, Niger, Peru and Vietnam, babies born in rural areas die at a rate that is 50 percent higher than those born in urban areas[60].

The study observed a statistically significant association between the asset quintiles for under-five mortality rate (P<0.001). Children in the poorest households experienced excess risk of death as compared to in the least households. The unvariate and multivariate Poisson regression models established a decreased risk of dying for children in the highest wealth category. The findings are consistent with other numerous studies establishing a close association between household socio-economic status and under-five mortality[61, 62, 63] and provides further evidence that wealth inequality is an important risk factor of child mortality.

Children born to mothers with little or no education are at greater risk during birth, during the vulnerable early days, and throughout their lives. Mothers who missed out on schooling are more likely to be poor, to get pregnant younger, and more often, to have more children, to be less knowledgeable about family planning and HIV prevention and to be less prepared to look after the health and well being of their babies[64]. Mothers with less education are less likely to receive skilled medical care during pregnancy and childbirth. In Egypt, for example only 33 percent of women with no education receive any prenatal care, and only 17 percent receive regular prenatal care, while 75 percent of women with secondary or higher education receive prenatal care and 60 percent receive regular care[65]. And in Nigeria, only 15 percent of births among uneducated women are assisted by trained medical personnel, compared to 56 percent, 74 percent, 88 percent of births among women with primary, secondary and higher education, respectively[66]. According to data from 35 recent demographic and health surveys, children born to mothers with no education are more likely to die or to be malnourished than children of mothers who have secondary education or higher even when controlling for the other factors[67]. Educated women are more likely to be mothers who are healthy, well

nourished, economically empowered and resourceful when it comes to caring for themselves and their babies. Educated women tend to have fewer children, healthier pregnancies and safer deliveries. Their children are more likely to survive childbirth, the vulnerable first hours and days of life and the critical first five years[68]. The findings of these study establishes a decreased rate of mortality amongst mothers with some education comparing with mothers with no education but in the multivariate model was significant hence consistent with literature.

When girls give birth before their bodies are fully developed, there is an increased risk of death for both mothers and child. Pregnancy related deaths are the leading cause of mortality for girls 15-19 years old worldwide, wether they are married or not. Those younger than 15 years of age are five times more likely to die in childbirth than women in their twenties. Their children are less likely to survive. If a mother is under 18, her child's chances of dying during the first year of life are 60 percent higher than those of a baby born to a mother older than[1]. The findings of this study are consistent with previous research although not statistically significant. This may be partly due to the majority of mothers (41%) being in their twenties.

**4.5 Implications of study**

The findings have several policy implications. The Tanzania National Strategy for Growth and Reduction of poverty 2005 (NSGRP) document has a development vision target of reducing infant mortality from 95 in 2002 to 50 per 1000 live births by year 2010[20]. In 2006, the year for which comprehensive estimates are available, the infant mortality rate was 74 per 1000 live births[1]. The poorest household in the DSA are experiencing an infant mortality rate of 158.5 per 1000 PYO and will therefore need to reduce the current mortality rates by about 69 percent to achieve the national target by

2010. This poses a great challenge to the implementers of national policies to target those socio-economic groups which have a longer way to go to achieve the national target by year 2010. When national mortality reduction targets are set, disparities within the population should be considered as well instead of references on national averages alone.

The same NSGRP document calls for a radical approach towards bridging the gap between the under privileged poor and the better off in relation to health care utilization and health outcomes. The findings further call for more pragmatic strategies or approaches for reducing health inequalities. These could include reforms in the health sector to provide more equitable resource allocation. Improvement in the quality of the health services offered to the poor and redesigning interventions and their delivery to ensure they are more inclined to the poor. Such measures are crucial if health equity goals at the community level are to be achieved.

Macroeconomic and microeconomic policies that succeed in raising average income without having adverse effects on its distribution are thus likely to have payoffs in terms of improved child survival. The same is true of policies aimed at improving the living standards of the poor. Social protection programs can act as antipoverty programs as shown by the South African pension program. By the end of 1993, the pension had become an important source of income for non-whites and has been found to have improved the health not only of the pension recipient but of other members of households where resources are pooled[69].

Making health services and other health determinants less expensive in a way improves health utilization and outcomes among the poor. The cost of health care can be lowered through variety of means including health insurance, health card fee waivers, and

vouchers. Wether public, private or community based insurance often increases the use of health service.

Health services accessibility to the poor should be adequately improved. One way is to reduce the travel time to existing health facility. Geographic resource allocation formulas have the potential to increase the resource endowments of facilities serving the poor. These have provided means of reducing inequalities in resources between poor and better off in regions in industrialized countries.

The survival advantage of under-five year old children associated with maternal education calls for expansion in female education within the DSA. This however is a long term strategy which will benefit future mothers. Health education and health outreach activities should be stepped up within the DSA in the immediate run. Although women should be the main targets of such programmes, it should be extended to include fathers as well and the DSA at large. Although mothers are responsible for childcare, their relationship with the significant others define the limits of possibilities of healthy behaviour. Thus health activities that do not involve these significant others may not achieve the desired results. Health programs that strengthen the capacity of mothers by providing them and their families with information, skills, resources and technologies to promote child health will need to be implemented.

### 4.6 Limitations of study

The first potential limitation of the study is the difficulty in establishing temporality of events, socio-economic inequality and under-five mortality. The study could not establish whether the deaths occurred before or after the household assets were acquired. The study did not have information on whether the household lost its assets as a result the subsequent death of the child or not. There is also a possibility of an

endogenous relationship between under-five mortality and socio-economic inequality. There could be factors such as education that influence both risk of child mortality and the risk of asset ownership. Some households are advantaged by education, drive and existing human capital. This creates a positive selection (i.e. talent, drive and nutrition) that is good for asset accumulation and also good for offsetting child mortality

A second limitation is while asset-based measures are increasingly being used, there continues to be some debate about their use. Importantly, a key argument revolves around their interpretation. These measures are more reflective of longer-run household wealth or living standards, failing to take account of short-run or temporary interruptions, or shocks to the household. Therefore, if the outcome of interest is associated with current resources available to the household, then an index based on assets may not be the appropriate measure.

The final potential limitation of this analysis is that it does not adjust for the weight of child at birth due to RDSS having no data on birth weight. In previous research it has been suggested that children with low birth weight has increased risk of dying and low birth weight is also associated with children in the poorest quintile[68].There are other variables (e.g. family size, mothers haemoglobin and nutritional status ) which were not also available for this analysis.

### 4.7 Conclusion

Finally the study shows that the PCA approach is surprisingly sensitive to differences in socio-economic status. The gradients are sufficient to predict health outcomes such as under-five mortality and although the source population may appear to be broadly homogenous with regards to poverty.

To strengthen our understanding of economic status in rural Tanzania, the socio-cultural perceptions of wealth in the specific communities need to be examined. Given that the current approach to measuring economic status is largely dependent on the use of household possessions, it will be relevant to understand the importance communities attach to the possession of various items. This will be useful in determining which items to include in constructing a wealth index and in modifying our current data collection instruments and hopefully, put us in a better position to contribute towards monitoring the impact of national policies in reducing inequalities.

The endogeneity mentioned under the data limitation can also be addressed using longitudinal data approach for example employing a “difference in difference” or “fixed effects” model. The difference in model assesses wether mortality changes when socio-economic status changes controlling for other factors. This will bring more rigour to the evidence presented

The study also leads to the conclusion that household socio-economic wealth inequality is strongly associated with under-five mortality. Mother’s education was also found to be significantly associated with of under-five mortality. Reducing poverty and making essential health services more available to the poor are critical to improving overall childhood mortality in Rufiji DSA in rural Tanzania in the year 2005. Measures to address or reduce health inequalities are needed in order to improve child survival in setting like Rufiji.

**REFERENCES**


[1] UNICEF 2008: Report of the State of the world children, child survival

[2] United Nations General Assembly: Working Paper No. A/RES/55/2

[3] UNICEF 2007: A World fit for children Statistical Review, Number 6

[4] Black RE, Morris SS, Bryce J. Where and why are 10 million children dying every year? Lancet 2003; 361: 2226–34

[5] Jones G, Steketee RW, Black RE, et al. How many child deaths can we prevent this year? Lancet 2003; 362: 65–71.

[6] Bryce J, Arifeen S, Pariyo G, et al. Reducing child mortality: can public health deliver? Lancet 2003; 362: 159–64.

[7] Victora CG, Wagstaff A, Schellenberg JA, et al. Applying an equity lens to child health and mortality: more of the same is not enough. Lancet 2003; 362:233–41.

[8] The Bellagio Child Survival Study Group: Knowledge into Action for Child Survival. Lancet 2003; 362: 323–7.

[9] Bhutta ZA.2004. Beyond Bellagio: Addressing the challenges of sustainable child health in developing countries. Arc Dis Child ;89;483-487 doi:10.1136/adc

[10] Claeson M, Bos ER, Mawji T, Pathmanathan I. Reducing child mortality in India in the new millennium. Bulletin World Health Organisation 2000; 78: 1192–99

[11] UK Department for International Development. Better health for poor people. London: Department for International Development, 1999.

[12] World Health Organization. The World Health Report 1999: making a difference. Geneva: WHO, 1999.

[13] World Bank. Health, nutrition and population sector strategy. Washington: World Bank, 1997

[14] Wagstaff A, Bryce J, Bustreo F, Claeson M, and the WHO-World Bank Child Health

and Poverty Working Group. Child health: reaching the poor. Am J Public Health (in press).

[15] World Health Organization/World Bank Working Group on Child Health and Poverty. Better health for poor children: a special report. Geneva: WHO, 2002.

[16] Jalan J, Ravillion M. Does pipe water reduce diarrhoea for children in rural India? Washington: World Bank, 2001

[17] Schellenberg JA, Victora CG, Mushi A, et al. Inequities among the very poor: health care for children in rural southern Tanzania. Lancet 2003; 361**:** 561–66.

[18] Pande R, Yazbeck A. Beyond national averages for immunisation in Indian: income, gender and regional inequalities. World Bank, 2002.

[19] Case A:"Health, Income and Economic Development". Annual World Bank Conference on Development Economics, 2001/2002 (Proceedings). Washington 2002.

[20] United Republic of Tanzania: National Strategy for Growth and Reduction of Poverty (NSGRP),website: http ://www.tanzania.go.tz/nsgrf.html

[21] UNICEF, WHO, The World Bank and UN Population Division, 'Levels and trends of Child Mortality 2006: Estimates developed by The Inter-Agency Group for Child Mortality Estimation', New York, 2007

[22] Millard A. 1994. A causal model of high rates of child mortality. Social Science and Medicine 38:253-268.

[23] Preston SA. 1975. "The changing relation between mortality and level of economic development" Population Studies. 29(2):2231-2248.

[24] Preston SA. 1985. "Mortality and Development Revisited" in Da Vanzo, Habicht, Hill and Preston, Quantitative Studies of Mortality Decline in the Developing World

(World Bank Staff Working Papers Number 683, Population and Development Series Number 8). The World Bank, Washington, D.C. 1985.

[25] Hobcraft JN, McDonald JW, Rutstein SO. 1984. "Socio-economic factors in infant and child mortality: A cross sectional comparison", Population Studies, Vol. 38 (2), pp: 193-223.

[26] Hill K. 1985. "The Pace of Mortality Decline since 1950" in Da Vanzo, Habicht, Hill and Preston, Quantitative Studies of Mortality Decline in the Developing World (World Bank Staff Working Papers Number 683, Population and Development Series Number 8). The World Bank, Washington D.C. 1985.

[27] World Bank. World Development Report 1993: Investing in Health. Oxford University Press: New York, NY.

[28] Caldwell JC. 1979." Education as a factor in mortality decline: an examination of Nigeria data" Population Studies, Vol. 33, pp:395-413

[29] Sandiford P, Cassel J, Montenegro M, Sanchez G.1995. "The impact of women's literacy on child health and its interaction with access to health services", Population studies, Vol 49 (1), pp: 5-17

[30] Haine MR, Avery RC. 1982. "Differential infant and child mortality in Costa Rica: 1968-1973", Population Studies, Vol. 36 (1), pp: 31-43

[31] Curtis SL, Steele k. 1996. Variations in familiar neonatal mortality risks in four Countries. Journal of Biosocial Science 28:141-159.

[32] Desai S, Alva S. 1998. Maternal education and child health: Is there a strong causal relationship? Demography 35:71-81.

[33] Davanzo J, Butz WP, Habicht JP. 1983. How biological and behavioural influences on mortality in Malaysia vary during the first year of life. Population

Studies 37:381-402.

[34] Brockerhoff M. 1990. Rural-to-urban migration and child survival in Senegal. Demography 27:601-616.

[35] Brockerhoff M, Derose LF. 1996. Child survival in East Africa: The impact of preventive health care. World Development 24:1841-1857.

[36] Madise NJ, Diamond I. 1995. Determinants of infant mortality in Malawi: An analysis to control for death clustering within families. Journal Biosocial Sciences 27:95-106

[37] Case A: "Health, Income and Economic Development". In Annual World Bank Conference on Development Economics, 2001/2002 (Proceedings). Washington Edited by: Boris Pleskovic, Nicholas Stern. 2002.

[38] Filmer D, Hammer JS, Pritchett LH: "Weak Link in Chains: A Diagnosis of Health Policy in Poor Countries" World Bank Research Observer 2002, **15**(2)**:**199-224.

[39] Mckeown T. The Modern Rise of Population. New York: Academic Press; 1976.

[40] Fogel RW: "Economic Growth, Population Theory and Physiology: The Bearing of Long Term Processes on the Making of Economic Policy". American Economic Review 1994, 84(3):369-395

[41] Preston SH. The Changing Relation Between Mortality and Level of Economic Development. Population Studies 1975, 129(2):231-248.

[42] Preston SH. Causes and Consequences of Mortality Declines in less Developed Countries in the Twentieth Century. In Population and Economic Changes in Developing Countries. Edited by: Easterlin RA. Chicago: University of Chicago Press; 1980

[43] Szreter S. The Importance of Social Intervention in Britian's Mortality Decline c 1850 – 1914: A Reinterpretation. Discussion Paper No 121 1986.

[44] Penney S. The Retreat of Tuberculosis 1850 – 1950 (Smith B – Author) A Book Review. Canadian Historical Review 1989., 70(3):[PubMed Abstract]

[45] Mosley WH, Chen LC. 1984. "Analytical framework for the study of child survival in developing countries," in W.H. Mosley and L.C. Chen (eds.), Child Survival: Strategies for Research, Population and Development Review, a Supplement to vol. 10.

[46] Montgomery MR, Gragnolati K, Burke A, Paredes E. 2000. Measuring living standards with proxy variables. Demography 37: 155–74.

[47] Cortinovis I, Vela V, Ndiku J. 1993. Construction of a Socio-Economic Index to Facilitate Analysis of Health in Data in Developing Countries. Social Science and Medicine 36:1087–97.

[48] McKenzie DJ. 2003. Measure inequality with asset indicators. BREAD Working Paper No. 042.Cambridge, MA: Bureau for Research and Economic Analysis of Development, Center for International Development, Harvard University.

[49] Seema V, Lilani K. " Constructing socio-economic status indices; how to use principal components analysis" London : Oxford university press in association with the london school of hygiene and tropical medicine. 2006 doi:10.1093/heapol/

[50] Jobson JD. 1992. Applied multivariate data analysis. New York: Springer-Verlag

[51] Indepth Network 2005: Measuring health equity in small areas; Findings from demographic surveillance systems. Ashgate publishing company.

[52] Wagstaff A,Van Doorslaer E. 2000. Equity in health care financing and delivery, In: AJ Culyer and JP Newhouse (Eds.) Handbook of Health Economics, North Holland, 1803-62.

[53] Wagstaff A, Van Doorslaer E, Paci P.1989. Equity in the finance and delivery of health care: some tentative cross-country comparisons. Oxford Review of Economic

Policy 5(1), 89-112.

[54] Van Doorslaer E, Wagstaff A, Bleichrodt H, et al.1997. Income-related inequalities in health: some international comparisons, Journal of Health Economics, 16(1), 93-112.

[55] Van Doorslaer E, Wagstaff A, Van der Burg H, et al. 2000. Equity in the delivery of health care in Europe and the US, Journal of Health Economics 19(5), 553-83.

[56] Wagstaff A, Van Doorslaer E, Van der Burg H, et al. 1999. Equity in the finance of health care: some further international comparisons, Journal of Health Economics, 18, 263-290.

[57] Wagstaff A, Paci P, Van Doorslaer E, 1991. On the measurement of inequalities in health.Social Science and Medicine, 33, 545-557.

[58] Filmer D, Prichett L, 1998. Estimating wealth effects without income of expenditure data- or tears:An application to Educational Enrollements in States of India.World Bank Policy Research Working Paper

[59] Kakwani E, Wagstaff A, Van Doorslaer E. 1997. Socioeconomic inequalities in health: Measurement, computation and statistical inference, Journal of Econometrics 77 pp.87-103

[60] Save the Children, State of the World's Mothers 2006:Saving the lives of mothers and newborn (Westport, Connecticut:2006) pp.10

[61] Preston SA. 1975. "The Changing Relation Between Mortality and Level of Economic Development" Population studies. 29(2):2231-2248

[62] Hobcraft JN, McDonald JW, Rutsein SO. 1984. "Socio-economic factors in infant and child mortality: A Cross Sectional Comparison", Population studies, vol 38 (2), pp:193-223

[63] Hill K. 1985. "The Pace of Mortality Decline since 1950 in Da Vanzo, Habicht,Hill and Preston, Quantitative Studies of Mortality Decline in Developing World ( World Bank Staff Working Papers Number 683,Population and Development Series Number 8). The World Bank, Washington, D.C. 1985.

[64] Save the Children, State of the World's Mothers 2004: Children Having Children ( Wesport, Connecticut:2004) pp. 13-14

[65] El-Zanaty, Fatma, Ann Way. 2001. Egypt Demographic and Health Survey 2000.(Calverton, Maryland: Ministry of Health and Population [Egypt], National Population council and ORC Macro

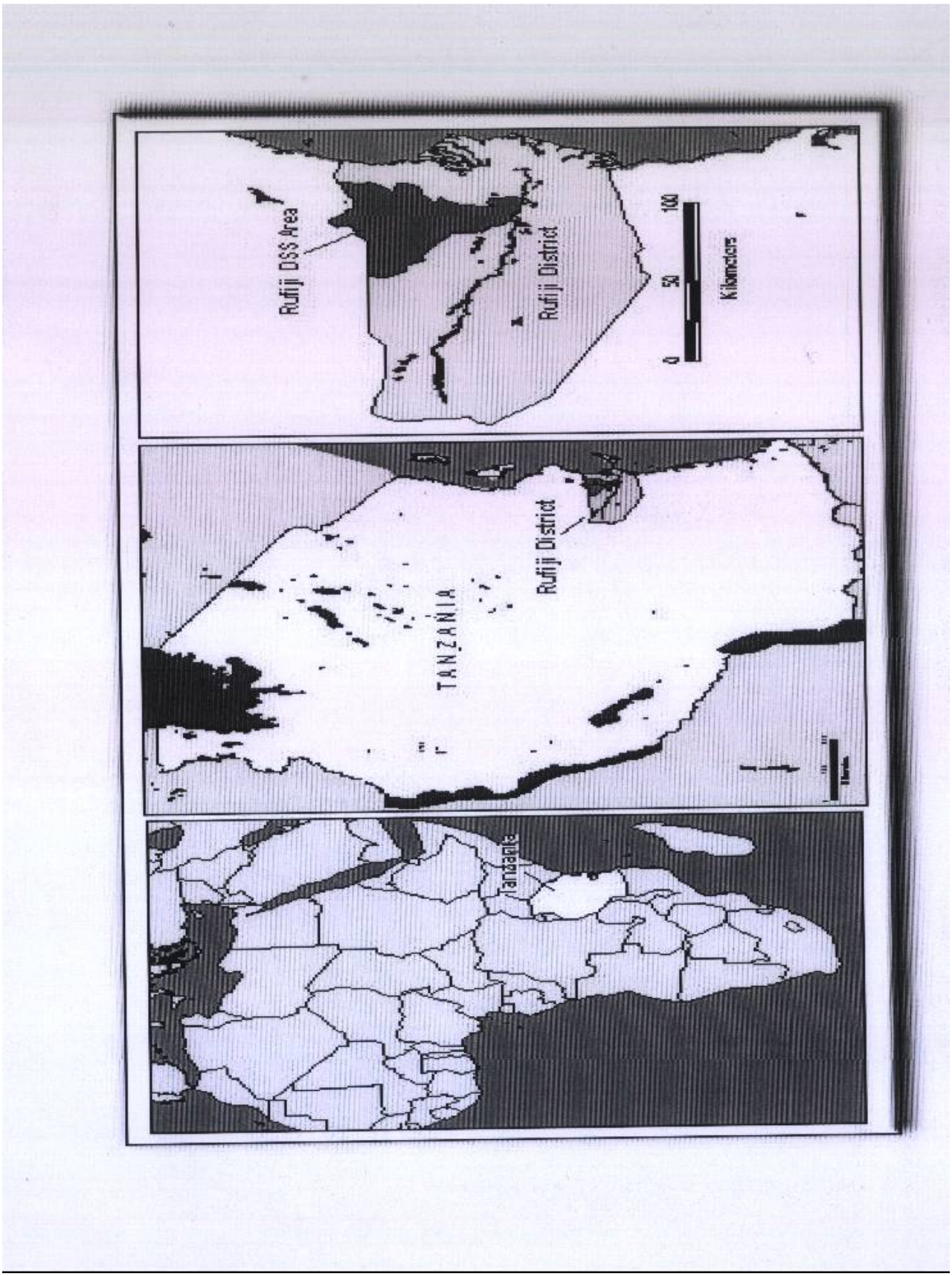
[66] National Population Commission [Nigeria]. 2000. Nigeria Demographic and Health Survey 1999.(Calverton, Maryland: National Population council and ORC Macro)

[67] Basic Education Coalition. Teach a child, Transform a Nation. (Washington: 2004)

[68] Save the Children. State of the World's Mothers 2005: The Power and the Promise of Girls Education (Westport, Connecticut:2005) pp.11-13

[69] Case A.2001 Does Money Protect Health Status? Evidence from South African Pensions. Princeton NJ, Woodrow Wilson School, Princeton University

APPENDIX 1


Rufiji DSS Area
Rufiji District
0
50
100
Kilometers
TANZANIA
Rufiji District
Tanzania

APPENDIX 2

**UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**

Division of the Deputy Registrar (Research)

**HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)**
R14/49 Nattey

| | |
|---|---|
| **CLEARANCE CERTIFICATE** | **PROTOCOL NUMBER M071144** |
| **PROJECT** | Household Socio-Economic Status as a Determinant of Under Five Mortality at Rufiji DSS, Tanzania |
| **INVESTIGATORS** | Mr C Nattey |
| **DEPARTMENT** | School of Public Health |
| **DATE CONSIDERED** | 07.11.30 |
| **DECISION OF THE COMMITTEE*** | APPROVED UNCONDITIONALLY |

**Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.**

**DATE** 07.12.07 **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof KK Grobusch

---

**DECLARATION OF INVESTIGATOR(S)**

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX 3

INSTITUTIONAL REVIEW BOARD
IFAKARA RESEARCH AND DEVELOPMENT CENTRE
P.O.BOX 53
IFAKARA, TANZANIA
irb@ihrdc.or.tz
Tel: +255 (0) 23 2623164 or +255 (0) 22 2774714
Fax: +255(0) 22 2771714

National Institute of Medical Research
P. O. Box 9653
Dar es Salaam
Email; headquarters@nimr.or.tz

18th October 2007

Cornelius Nattey
Ifakara Health Research
P. O. Box 78373
Dar Es Salaam

**IHRDC/IRB/No. A022**

**INSTITUTIONAL CLEARANCE CERTIFICATE FOR CONDUCTING HEALTH RESEARCH**

On 10th October 2007, the Ifakara Health Research and Development Center Institutional Review Board (IHRDC IRB) reviewed the study entitled: **"Household Social Economic Status as a determinant of underfive mortality at Rufiji DSS Tanzania"** Version date: **21st September 2007**, submitted by the Supervisor, Dr. Honorati Masanja

The following documents were reviewed:

1. Protocol - version date 21st October 2007
2. CVs

The study has been approved for implementation after IRB consensus.

This certificate thus indicates that; the above-mentioned study has been granted an Institutional ethics clearance to conduct the above named study in Rufiji Tanzania.
The Principal Investigator of the study must ensure that, the following conditions are fulfilled during or after the implementation of the study:

1. PI should submit a six month progress report and the final report at the end of the project
2. **Any amendment**, which will be done after the approval of the protocol, must be communicated as soon as possible to the IRB for another approval.
3. The IHRDC IRB must receive any ethical approval by other review Boards
4. All research must stop after the project expiration date, unless there is prior information and justification to the IRB.
5. There should be plans to give feedback to the community on the findings
6. Any publication needs to pass through the IRB.

***The IRB reserves the right to undertake field Inspections to check on the protocol compliance***

JOYCE K. IKINGWIRA

**Signature**
**Chairperson**

**Signature**
**Secretary**

APPENDIX 4

**Rufiji Demographic Surveillance System (RDSS)**
**Socio Economic Indicators**

**Interviewer** ☐☐
**Date of Interview** ☐☐/☐☐/☐☐
**Village** ☐☐☐ **Household Number** ☐☐☐☐

1. Does anyone in this household own any of the following items?

*( Write in the box1if answer is yes or 2 if answer is no )*

| | | | | | |
|---|---|---|---|---|---|
| 1. Bicycle | ☐ | 2. Car | ☐ | 3. Motocycle | ☐ |
| 4. Radio | ☐ | 5.Refrigerator or freezer | ☐ | 6. Television (TV) | ☐ |
| 7. Watch | ☐ | 8.Own land | ☐ | 9.Sofa | ☐ |
| 10. Bed | ☐ | 11.Electric Iron. | ☐ | 12.Video | ☐ |
| 13. Mattress | ☐ | 14.Wardrobe | ☐ | 15. Water pump | ☐ |
| 16. Cattle | ☐ | 17. Sewing Machine | ☐ | 18.Poultry | ☐ |
| 19. Mosquito net | ☐ | 20. Satellite dish | ☐ | 21.Ceiling fan | ☐ |
| | | | | 22. Mobile phone | ☐ |

2. Is the house owner a member of household? *( write 1 if answer is yes and 2 if answer is no )* ☐
1. Yes 2. No

(NB from question 3 to 9 write in the box the correct answer)

3. What are the floors of this house made of?
1. Earth / Mud 2.Wood
3.Tiles 4. Cement
5. Other ……..... ☐

4. What are the walls of this house made of?
1. Stone, Coral Block, Cement block, Burnt bricks
2. Mud bricks (plastered or unplastered), Wood
3. Galvanised, mud & stick, mud ☐
4. Grass, card board
5. Other ……..... ☐

5. What is the roof of the house made of?
1.Tiles, concrete, cement
2. Galvanised iron or asbestos ☐
3. Bamboo, wood, mud, grass ,thatch, plastic or papers, tins
4. Others ……..

6. How many rooms are used for sleeping in this household? ……..

7. What is the main source of energy for cooking in this household?

1. Electricity, gas, solar 2. Firewood
3. Kerosene fuel, Biogas, charcoal
4. Crop residue, coconut husks, sawdust, grass, chaff, animal dung
5. Other……..

8. What is the main source of water for this household (general use of water)
   1. Piped into residence
   2. Private well in the house
   3. Public wells and pipes
   4. Vendor
   5. River, canal, spring, dam
   6. Other ……..

9. What is the main toilet facility for this household?
   1. Private flush
   2. Shared flush
   3. Vip or pit
   4. Normal pit latrine
   5. Neighbourhood or bush
   6. Other……

Checked by

APPENDIX 5

| Variable | Value |
|---|---|
| hoe | -0.1267 |
| matchet | -0.1105 |
| bicycle | 0.0623 |
| vehicle | 0.0892 |
| motorbike | 0.0376 |
| radio | 0.0676 |
| refrigerator | 0.1805 |
| television | 0.1595 |
| clock | 0.1327 |
| sofa | 0.271 |
| bed | 0.0086 |
| video | 0.1637 |
| mattress | 0.1963 |
| wadrobe | 0.2448 |
| pump | 0.1191 |
| livestock | 0.0846 |
| sewing machine | 0.1063 |
| chicken | -0.0251 |
| bednet | 0.1561 |
| satellite | 0.0804 |
| ceilingfan | 0.224 |
| iron | 0.2181 |
| Earth/mud floor | -0.3015 |
| Wood floor | 0.0038 |
| Tiles floor | 0.0166 |
| cement floor | 0.3017 |
| Other | 0.0485 |
| Cement/ coral block wall | 0.2358 |
| Mud/bricks/wood wall | 0.0443 |
| galvanise/mud stick wall | -0.1384 |
| grass/cardboard wall | -0.0348 |
| other | -0.0078 |
| Concrete/cement roof | 0.0243 |
| Iron or asbestos roof | 0.2378 |
| Bamboo/wood/grass roof | -0.233 |
| Others | 0.0004 |
| Electricity/gas power | 0.0037 |
| Firewood power | -0.2657 |
| Kerosene/biogas power | 0.2662 |
| Crop residue/grass | 0.048 |
| Other | -0.0013 |