

https://dspace.org/

Socio-economic status and elderly adult mortality in rural Ghana :|bevidence from the Navrongo DSS

Khagayi, Sammy

2010-02-24T07:44:52Z
http://hdl.handle.net/10539/7548

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

SOCIO-ECONOMIC STATUS AND ELDERLY ADULT MORTALITY IN RURAL GHANA: EVIDENCE FROM THE NAVRONGO DSS.

BY

Khagayi Sammy

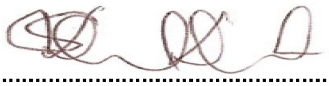
Student Number: 0707087G

A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN THE FIELD OF POPULATION BASED FIELD EPIDEMIOLOGY

Johannesburg, South Africa 2009

DECLARATION

I, Khagayi Sammy 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 of candidate]

15th day of **September** [month], **2009**.

DEDICATION

This work is dedicated to my family, Lawrence (dad), Elizabeth (mum), and my siblings (Ann, Christine Ronny and Claire) simply for being 'FAMILY'; only you know where we have come from. I would also like to dedicate this to the memory of the following mentors and friends in my life as a researcher who passed on; Dr. Alfred Lwoba, Dr. Adazu Kubaje and Dan Omollo Ogola. (May they Rest in Peace)

ABSTRACT

Introduction: In Africa, elderly adult mortality, just like many issues affecting the old has not been adequately addressed by research. This study explored the relationship between socioeconomic status (SES) and elderly adult mortality in an economically deprived region of rural Ghana. **Methods:** Data from the Navrongo DSS was used for the analysis. SES was determined from the asset data using principal component analysis. A total of 15030 adults aged over 60 years were included in the study, out of which 1315 died. We investigated the above relationship using Cox proportional hazards regression methods while controlling for other variables. **Results:** Socioeconomic status (SES) was found not to be a determinant of elderly mortality. Compared to the lowest SES quintile, the adjusted hazards ratios were, 0.94 (95%CI: 0.79–1.12) for second quintile, 0.91 (95%CI: 0.76–1.08) for third quintile, 0.89 (95%CI: 0.75–1.07) for fourth quintile and 1.02 (95%CI: 0.86–1.21) for the highest income quintile. However, living without a spouse [HR=1.98, 95%CI: 1.74–2.25], being male [HR=1.80, 95%CI: 1.59–2.04] and age [HR=1.05, 95%CI: 1.04–1.05] were significant factors for elderly adult mortality. **Conclusion:** These results indicate that companionship, social and family ties in the health of the elderly adults are of more importance than the socioeconomic status of the household. Efforts should therefore be made to support the elderly, such as stipend for the elderly adults, especially those living alone; lowering the provision of free medical care in public hospitals to cover people over the age of 60 and not just 70 year olds and above as is currently done; encourage family care for the elderly relatives through provision of an elderly caretaker allowance among others.

ACKNOWLEDGEMENTS

I would like to acknowledge the INDEPTH-Network for the scientific and leadership scholarship award that enabled me to pursue the MSc. degree program. Thanks to my supervisors, Prof. Clifford Odimegwu and Dr. Cornelius Debpuur for their guidance, mentorship and inspiration during the course of doing this research.

I am indebted to the director of the NHRC, Dr. Abraham Hodgson and all the staff for allowing me to use data from their site, and for making my stay in Navrongo a memorable one. Special mention to the NDSS staff and especially Mr. Azongo and Mr. Wak for the countless hours put in collection and preparation of the data, since running the DSS is a challenging and daunting task and not forgetting the participants who support the research through their continual participation, . Thanks to the data managers, especially Mr. Paul Welaga and Kons for availing the data and being there for any consultations. Thanks to Dr. Patricia for her guidance and input during the writing of the report.

I would like to thank all the lecturers and auxiliary staff of the School of Public Health who enabled the smooth flow of lectures, trips, seminars and the fun events, Siyabonga.

Thanks to all my colleagues in class and at the field site; meeting all of you was worthwhile experience, never to be forgotten.

Above all Thanks to God for his blessings and gift of life, Amen.

TABLE OF CONTENTS

Contents

DECLARATION ii

DEDICATION iii

ABSTRACT iv

ACKNOWLEDGEMENTS v

TABLE OF CONTENTS vi

LIST OF FIGURES viii

LIST OF TABLES ix

LIST OF APPENDICES x

DEFINITION OF TERMS xi

ABBREVIATIONS xii

CHAPTER ONE: Introduction and literature review 1

Background 1

Socio-economic status and mortality 3

Elderly Adult Mortality in Ghana 6

Other factors affecting elderly adult mortality 7

Measuring SES in Health Studies 9

Rationale 9

Theoretical Framework 12

Conceptual Framework 13

Study Aim and Objectives 14

CHAPTER TWO: Methodology 15

Navrongo Demographic Surveillance System 15

Study Design 16

Study Population and Area. 16

Sampling and Study Sample 17
Measurements and Data Sources 17
Data Processing and Management 18
Exposure Variables 18
Outcomes variable 21
Data Processing Methods and Analysis 22
Ethical Considerations 24
CHAPTER THREE: Results 25
Measurement of socio-economic status 27
Elderly Adult Mortality Rates 30
Survival Probabilities 34
Kaplan-Meir Survival Curves for Elderly Adults in NDSS 35
Cox proportional hazards regression and modelling 37
Socio-economic status and Elderly Adult Mortality 37
Other factors affecting elderly adult mortality 40
CHAPTER FOUR: Discussion 42
Elderly adult mortality 42
Socio-economic status and elderly adult mortality 43
Social Relations and elderly adult mortality 45
Other Factors determining Elderly mortality 46
Limitations 49
CHAPTER FIVE: Conclusion and Recommendations 51
REFERENCES 53
APPENDICES 59

LIST OF FIGURES

Figure 1.1: Conceptual framework showing the relationship between factors for elderly adult mortality 13

Figure 2.1: Illustration of the relationship between the exposure and outcome variables 19

Figure 3.1: Graph of SES distribution by household occupancy 28

Figure 3.2: Distribution of SES quintiles by education status 29

Figure 3.3: Age specific death rates by sex 30

Figure 3.4: Age specific death rates by year 33

Figure 3.5: Plot of concentration curve for mortality among the elderly adults ... 34

Figure 3.6: Survival curves for elderly adults in the NDSS by age group 35

Figure 3.7: Survival curves for elderly adults in the NDSS by marital status 36

Figure 3.8: Survival curves for elderly adults in the NDSS by sex 36

LIST OF TABLES

Table 3.1: Demographic and General Population Characteristics 25

Table 3.2: Overall and yearly death rate distribution by different variable categories 32

Table 3.3: Distribution of death rates across the SES quintiles 33

Table 3.4: Cox proportional hazards regression analysis of mortality risk for elderly adults in the NDSS 39

LIST OF APPENDICES

Appendix 1: Map showing the location of the NDSS 59

Appendix 2: Distribution of assets across quintiles 60

Appendix 3: Scoring Factors and distribution of assets in the first component 61

Appendix 4: Approval letter from the NHRC Institutional Review Board 62

Appendix 5: Approval letter from the University of Witwatersrand's Human Research Ethics Committee (Medical) 63

Appendix 6: Comparison of elderly adult mortality in the KND and other regions 64

DEFINITION OF TERMS

- **Household** – a social unit of people who may be related or not who share common cooking, eating and asset arrangement under one recognised family head. (INDEPTH Network).
- **Socio-economic Status (SES) –** hierarchical ranking of the elderly persons households in the community, based on wealth (household assets), and living conditions (house type).
- **Elderly adults –** all the males and females registered in the Navrongo demographic surveillance area above 60 years during the period 2005 – 2006. (Adopted from the UN's definition of elderly/older adults.)
- **Elderly adult mortality–** death of a person over the age of 60 in the years 2005-2006.
- **Demographic Surveillance System** – a set of field and computing procedures that handle longitudinal follow-up of well defined entities or primary objects (individuals, households and residential units) and all related demographic and health outcomes within a clearly circumscribed geographical area. (INDEPTH Network).
- **Resident members** – individuals registered in the NDSS and living in the demographic surveillance area (DSA) continuously for at least 120 days before date of observation.

ABBREVIATIONS

AIDS – Acquired Immune Deficiency Syndrome

DHS – Demographic and Health Survey

DSA- Demographic Surveillance Area

DSS – Demographic Surveillance System

HIV – Human Immunodeficiency Virus

HR – Hazards Ratio

INDEPTH – International Network for the Continuous Demographic Evaluation of Populations and their Health

MDGs – Millennium Development Goals

PY – Person-Time in Years

SES – Socio-economic Status

NDSS – Navrongo Demographic Surveillance System

WHO – World Health Organization

KND – Kassena Nankana District

UN – United Nations

WHO – World Health Organization

CHAPTER ONE: Introduction and literature review

Background

Many countries in Sub-Saharan Africa have young populations, but due to changes in demographic trends and profiles, they are growing steadily with an increasing elderly adult population. Elderly adult mortality therefore becomes a concern for public health planners and policy makers. Meanwhile in Africa, there has been little and in some instances almost no attention paid to the welfare and health needs of the elderly in society (Robinson et al., 2006).

The United Nations' first Millennium Development Goal (MDG) targets elimination of extreme hunger and poverty by the year 2015. However, the latest updates on these MDGs show very poor progress in Sub-Saharan African countries (United Nations, 2008). This is worrying since quality of life and access to proper health care depends on the economic ability of people and especially the elderly adults. Predictions by the World Health Organization (WHO) show that by the year 2030, non-communicable diseases will be the major causes of mortality worldwide and this will occur mostly among adults in the low socio-economic status (WHO, 2002). This means that if African countries are to achieve the set MDG targets, there is the need for more efforts in addressing issues that will reduce or eliminate poverty. In Ghana, although the government has designated the Republic Day as a National Day of the Elderly in recognition of the role they played in fighting for independence, little has been done in terms of policy to look at and improve the lives of the elderly. Furthermore, there is almost no mention of policies or strategies towards elderly adult health in the Ministry of Health's publications.

Due to modernization, and continued westernization of African societies, the social and cultural ties that communities had with the extended families and in effect the elderly have

been broken, such that the elderly are being left to fend for themselves. This in conjunction with increased rural urban migration among the young and middle-ages, the burden of caring for AIDS orphans and poor social security among others, has increased the economic burden on the elderly adults. This in turn affects their health and the struggle to barely survive overrides their health concerns, resulting in avoidable excess mortality (Oppong, 2006).

Lack of data on elderly adult mortality is another big problem facing researchers who would like to engage in useful analysis of elderly adult health in Africa. One way in which this can be achieved is through demographic surveillance sites (DSS) which collect vital demographic event data including mortality information about people in a defined geographical location. Data from these DSS sites can act as a guide for developing countries to look at ways of addressing issues on elderly adult mortality (Baiden, Hogson, & Binka 2006; Chandramohan et al. 2008; Kahn et al. 2007). In many sub-Saharan countries like Ghana, despite the projected growth of the older generation, there is little data on the health of older people nor clear policies by the governments about the health of this ageing population (Kowal et al. 2002; Robinson et al. 2006). Studies have shown a distinct difference in mortality rates among different groups with different income status (an indicator of socio-economic status) among the elderly. They suggested that decrease in mortality in these elderly adults is not just explained by conditions in early life but by their present status (Catalano, 2002; Zimmer, 2006). Thus the need to put more emphasis on the prevailing factors affecting mortality among the elderly and in particular their socio-economic status.

Socio-economic stratification and its effect on elderly adult mortality is therefore, an important issue in public health and epidemiology. Elderly adults are very dependent on

the middle age and working population in many African countries where health systems are not well managed and social security is nonexistent or limited to a few individuals (Oppong 2006). These socio-economic disparities in health outcomes among the elderly adults if addressed, will go a long way in reducing the burden of disease and mortality among people in the lower socio-economic strata (Kunst & Mackenbach 1994) at the same time increase longevity. The increase in elderly populations also brings into focus the issue of dependency ratio in the developing world compounded with the emerging issues of rural – urban migration, break in family ties, less care for the elderly, poor social security and economic hardships (Oppong 2006), which all make life harder for elderly adults. Ghana, with an increasing elderly population therefore needs to look at ways of addressing the socio-economic disparities in old age.

Socio-economic status and mortality

Higher socio-economic status has been shown to reduce exposure factors that lead to morbidity, disability and eventually mortality. This is because higher socio-economic status leads to better health care, comfortable living conditions, less exposure to hazards and better diets (Rogers et al. 2005). Some studies even suggest that people in the higher SES, over the years have been known to practice healthier lifestyles and behaviour (smoking, heavy drinking, sedentary lifestyles) while those in lower SES levels are increasingly embracing them (House et al. 1990) and hence have a higher risk of mortality.

Many studies have shown an inverse relationship between socio-economic status and mortality in adults (Adams et al. 2003; Adler et al. 2008; Ahern et al. 2008; Catalano 2002; Frank et al. 2003; Krueger et al. 2003; Robinson et al. 2006; Zimmer & Amornsirisomboon 2001). Socioeconomic inequity in health has been studied extensively in Europe over a long time and it is now considered an important factor for public health

(Lawlor & Sterne 2007). Using data from 11 different countries in Europe, it was found out that socioeconomic disparities in mortality among the elderly was persistent in each country, and in some it was of similar magnitude as those in the middle ages (Huisman et al. 2004).

Although SES is measured using different variables from place to place, the relationship was found to be the same no matter the criteria used, hence the use of different measures is justifiable. In a cohort study in the USA of different communities, Bassuk et al (2002) found out that SES differentials in mortality were in favour of the higher status whether he used education, income or even occupational prestige. In rural China, which has different characteristics from many developed countries, but more similar to developing ones, it was found that even at very high ages of over 80 years the inverse relationship between SES and mortality still holds (Zhu & Xie 2007). Data from the Matlab DSS in Bangladesh, showed that those who are more affluent or have higher education levels had lower levels of mortality compared to the uneducated or less affluent (Mostafa & Van Ginneken 2000), while another study in Filabavi - Vietnam, confirms the inverse relationship in less developed nations (Nguyen et al. 2005).

Even though absolute differences exist in health between different SES groups as shown in many of these studies, there are other studies that show otherwise. In a study on pneumonia deaths among the elderly in Ontario hospitals in Canada, it was found that there was no difference in mortality between the higher quintiles and a comparative lower quintile (Vrbova et al. 2005). Another study by Hoffmann (2005) shows no differences across SES quintiles among the elderly in the USA, using data from the Health and Retirement Study (HRS). However, these studies were done for cause specific deaths and in specific environments.

In Africa, studies on the effect of SES on mortality and morbidity done in several DSS sites affiliated to the INDEPTH-Network also confirm the effect of SES on mortality. However, these studies were mostly carried out on children (Kahn et al. 2005; Nathan et al. 2005). In Rufiji – Tanzania, children from the poorest households were 46% more likely to die in infancy than those from better households (Mwageni et al. 2005). Another study in Ifakara – Tanzania, showed that infants from the poorest households experienced 50% excess risk of mortality compared to those in least poor households (Nathan et al. 2005). While in a study on children in Navrongo - Ghana, SES was not found to be a very important predictor of mortality among children (Debpuur et al. 2005). These results cannot however be conclusively extrapolated to the elderly adults in one region, hence the need for more research on the effect of SES on the elderly adult mortality.

There is worldwide debate on whether the SES inequalities in mortality converge, persist or increase with old age. Studies on the SES–mortality relationship among elderly adults either follow the cumulative or the convergence hypothesis (Zhu & Xie 2007). In the cumulative school of thought, the differences among socioeconomic strata increase with age (Chandola et al. 2007; Lawlor & Sterne 2007; Ross & Wu 1996), while the convergence school of thought suggests that the difference is small in early adulthood, expands in middle ages and narrows in old age, such that other factors become more important while the influence of SES becomes minimal (House et al. 1990).

Despite these, other studies have found differing effects for the relationship between SES and mortality. A study by Hoffmann (2005) suggests that the effect of SES on mortality decreases with age and becomes uniformly stable across old age. A study done in Finland found increased mortality differentials with age in relation to SES among women, but decreasing mortality differentials among men (Martelin 1994). It is also suggested that

despite a reduction in overall global mortality, the absolute difference in mortality among different socio-economic status groups will keep increasing. There have been suggestions that mortality differentials may persist for a while in many countries (Leclerc et al. 2006; WHO 2002). Since there is little information and attention on the economic status of the elderly and how it affects their wellbeing, especially in Africa, Ghana included, there is need to investigate and come up with measures to mitigate any effects of SES on elderly adult mortality.

Elderly Adult Mortality in Ghana

Measuring adult mortality is one of the biggest problems for health researchers in Africa. Most of the vital registration systems used to collect data on adult mortality are inadequate, rare and not up to date. In many rural areas in Ghana, the people have to go voluntarily to the births and deaths department offices to register births and deaths, which is a daunting task in itself and also require a certain amount of money to be paid. However, the use of verbal autopsies has helped give an insight into the causes of deaths in the developing world and especially in places that employ demographic surveillance. DSS data can also be used to give an indication of levels of elderly adult mortality in developing countries (Hill 2000; Timaeus 1991). A lot of health research in Africa is mainly focused on children, young adults, specific health issues and diseases with little emphasis on elderly adults, whose population is increasing.

Ghana, like other developing countries, has a very high mortality rate among the elderly (Hill 2000; Nyarko et al. 2002). Understanding the association between SES and elderly adult mortality is an important research area and therefore the need to closely monitor this group in the population and hence reduce any excess mortality. Despite the reduction of elderly adult mortality rates in the world, the KND experiences extremely high levels of

elderly adult mortality, with age specific death rates of over 40 per 1000 persons for ages 60-64 to a high of 140 per 1000 persons for ages 80-84 (Bawah et al. 2003). This compares poorly to places like Filabavi in Vietnam with 9.4 per 1000 persons for ages 60-64 and 57.2 per 1000 persons for ages 80-84 (Nguyen et al. 2005); rural Mexico with 13.2 per 1000 persons for ages 60-64 and 77.3 per 1000 persons for ages 80-84 and rural Israel with 5.3 per 1000 persons for ages 60-64 and 74.7 per 1000 persons for ages 80-84 (United Nations 2004). Studies in Ghana and Nigeria also report a high level of imbalance socially and health wise among the elderly adults, hence the need to investigate further, the factors affecting the (Mba 2007; Unanka 2002). They highlight issues like family support, poverty, living arrangements and presence of a spouse to be of great importance in elderly adult health. A report from the Navrongo DSS suggested that poverty, among other factors, could be one of the factors for the high mortality levels among the elderly adults in this population (Bawah, et al. 2003).

Other factors affecting elderly adult mortality

Studies investigating elderly adult mortality have identified several important distal factors; sex, age, race/ethnicity, education status, marital status and family relations were found to affect the elderly adults in different ways.(Bassuk, Berkman, & Amick 2002; House et al. 1990; Krueger et al. 2003). It was noted by Rogers et al (2005) that as early as 1825, Benjamin Gompertz developed a mathematical formula that showed an increase in mortality with increase in age. He emphasized that in any study on mortality, age is an important factor that can never be ignored, otherwise there would be a major bias introduced in the findings. All the above mentioned studies on elderly adult mortality also found age to be an important factor.

Education status has also been found to be an important predictor of mortality in the elderly adults, with a two fold increase in mortality risk for a study done in the USA (Sudore et al. 2006). Furthermore, lower literacy levels were associated with poor management of diseases and other health conditions in the elderly resulting in deaths that could have been avoided. Bassuk et al. (2002) also noted an increased risk of mortality among elderly adults with lower education status no matter the stratification level, whether sex, race or neighbourhood. In the Chinese study by Zhu & Xie (2007), where they investigated education status and its effect on elderly mortality, they found that whether in the rural or urban areas, those who were educated were less exposed to mortality than those who were uneducated. In the urban areas, the educated had 24% less risk compared to the uneducated while in the rural areas the risk was 8% less in favour of the educated.

In other studies, marital status was also found to be an important factor in elderly adult mortality, this was especially elevated amongst the men than women (Goldman, Korenman, & Weinstein 1995; Lund et al. 2002; Nagata, Takatsuka, & Shimizu 2003). This was linked to improved care giving for the married people from their spouses in old age, and the psychological boost experienced from the presence of the spouse (Davis et al. 1992). The importance of social relations and family ties was also very evident in a study in the Matlab DSS in Bangladesh, where they followed up elderly people over the age of 60 years for more than 20 years. Marital status was found to be the most important factor influencing mortality followed by living with close relatives (Mostafa & Van Ginneken 2000). In three communities in Finland, Italy and Germany, family ties were also influential in elderly adult morbidity, which they noted is an influential factor in their health status and hence mortality (Mollenkopf et al. 1997). Living alone was found to increase the risk of mortality by up to 3.4% in elderly adults with acute medical conditions (Forasassi et al. 2009), which may serve to explain why spouses are important in old age.

Measuring SES in Health Studies

Education status, household wealth and housing conditions have been found to be good measures of socio-economic status and can be used as a good indicator of a person's relative status in society as well as income and expenditure. However, there is no standard way of measuring SES and its effect varies from one setting to the other (Martelin 1994). Wealth and asset accumulation at old age is said to be a good indicator of previous lifestyle and hence a valid measure for both previous and current socio-economic status (Bassuk et al. 2002). Studies done using data from DSS and DHS all over the world show that it is possible to ascertain the economic status of people in rural areas using household wealth where information on income or expenditure is hard to come by (Bawah & Zuberi 2004; Debpuur et al. 2005; Nguyen et al. 2005). Use of proxy measures like household assets and other possessions to measure socio-economic status has also been found to be simpler, more straightforward and quite practical compared to income or expenditure and hence can be an effective measure of SES in under developed countries (Morris et al. 1999; Morris et al. 2007; Mueller & Toby 1981; Somi et al. 2008). One of the most widely used modes of constructing a socioeconomic index for measuring socio-economic status is through the principal component analysis (PCA), where all the assets and other indicators are graded and combined to come up with a relative index of SES quintiles based on components constructed from the available variables (Filmer & Pritchett 2001; Vyas & Kumaranayake 2006). This is the method that was used in constructing the SES index in the KND.

Rationale

Research on elderly adult mortality is well documented in the developed world, but in developing countries in Africa, there is lack of adequate information, which in turn leads to the lack of proper policies and systems to cater for the elderly (Timaeus 1991; Timaeus & Jasseh 2004).

Socio-economic status, social relations, geographical factors, demographic characteristics, human and environmental hazards have been found to be distal factors for mortality. They affect mortality indirectly through proximate factors like health behaviour, health conditions and physiological influences (Rogers et al. 2005); making socio-economic status an important predictor of mortality, and hence the importance of understanding the health consequences of socioeconomic inequity. Socioeconomic inequalities have been found to be dynamic and vary between countries, over time and between generations (Vagero & Leinsalu 2005). It is therefore important to understand how the SES - mortality relationship works in developing countries compared to the developed world where most of the studies have been done. Therefore, in a poor and less developed region like the Kassena-Nankana district, there is need to develop a localised SES index using the available indicators such as household assets, source of water, type of fuel used for cooking and house building material among others. Since little has been done to investigate the effect of socioeconomic stratification on the elderly adults in rural Ghana, this study will help bridge that information gap and help inform policy in Ghana.

The changing demographic trends have resulted in postponed mortality leading to prolonged longevity require researchers to understand the effect of SES on mortality among the elderly. In Ghana the proportion of the population above the age of 60 is not very big, but projections show that this will increase in future (Oppong 2006). The population above the age of 60 was slightly over 5% of the total population in the year 2000 and is expected to rise to over 8% by the year 2030 (Ghana Statistical Services 2004) making it ideal to study the elderly population in rural Ghana. This raises the need to investigate the effect poverty on the elderly, and provide knowledge on how they can be self sufficient and more productive even in old age (WHO 2002).

Despite the fact that many studies have been done on the association between mortality and household socio-economic status in developed countries, where conditions are better off than in many poor African countries, this study aims to investigate this association in an extremely harsh and poor environment in Africa where the economic conditions seem homogeneous and poverty is widespread. In the KND, many households have similar type of houses, lifestyles, possessions and face the same environmental and human hazards, however, like any other society, there exists a SES differential which is important. This study was done to investigate if the association between socio-economic status and elderly adult mortality holds for this poor and economically homogeneous region of Ghana. At the same time, it was aimed at confirming whether the SES differentials in mortality increased or reduced in old age.

Theoretical Framework

This study was based on the concept of Roger et al. (2005), which proposes that socio-economic status, geographical factors, social relations, human and environmental hazards are distal factors for mortality in adults. They act indirectly through proximate determinants like nutrition, behaviour, injury prone, living conditions, and in turn cause morbidity and mortality. Socio-economic status is said to determine whether a sick person will seek medicine or spend on other essential immediate needs, at the same time preventive measures and good nutrition are dependent on a family's economic ability hence greatly influencing health needs (Mosley & Chen 1984). Apart from these, people in the lower SES are more exposed to hazards, whether environmental, chemical or even biological, and tend to be generally disadvantaged in terms of quality and quantity of social relations (House et al. 1990).

In this study we investigated how SES affects mortality of the elderly adults in conjunction with other factors, especially age, sex, ethnicity, education and social relations (i.e. if the elderly person lives with a spouse or not and the number of people in that household). The presence of a spouse and other members in the household ensures good care for the elderly person in terms of personal, financial, material support and also offers psychological support which ensures better health (Oppong 2006; Zhu & Xie 2007). We focused mainly on socioeconomic factors, demographic and social relations as a precursor to proximate determinants which eventually affect mortality. Geographical and environmental hazards were assumed to affect everyone equally since the study population is drawn from one region. A graphical illustration is shown below.

Conceptual Framework

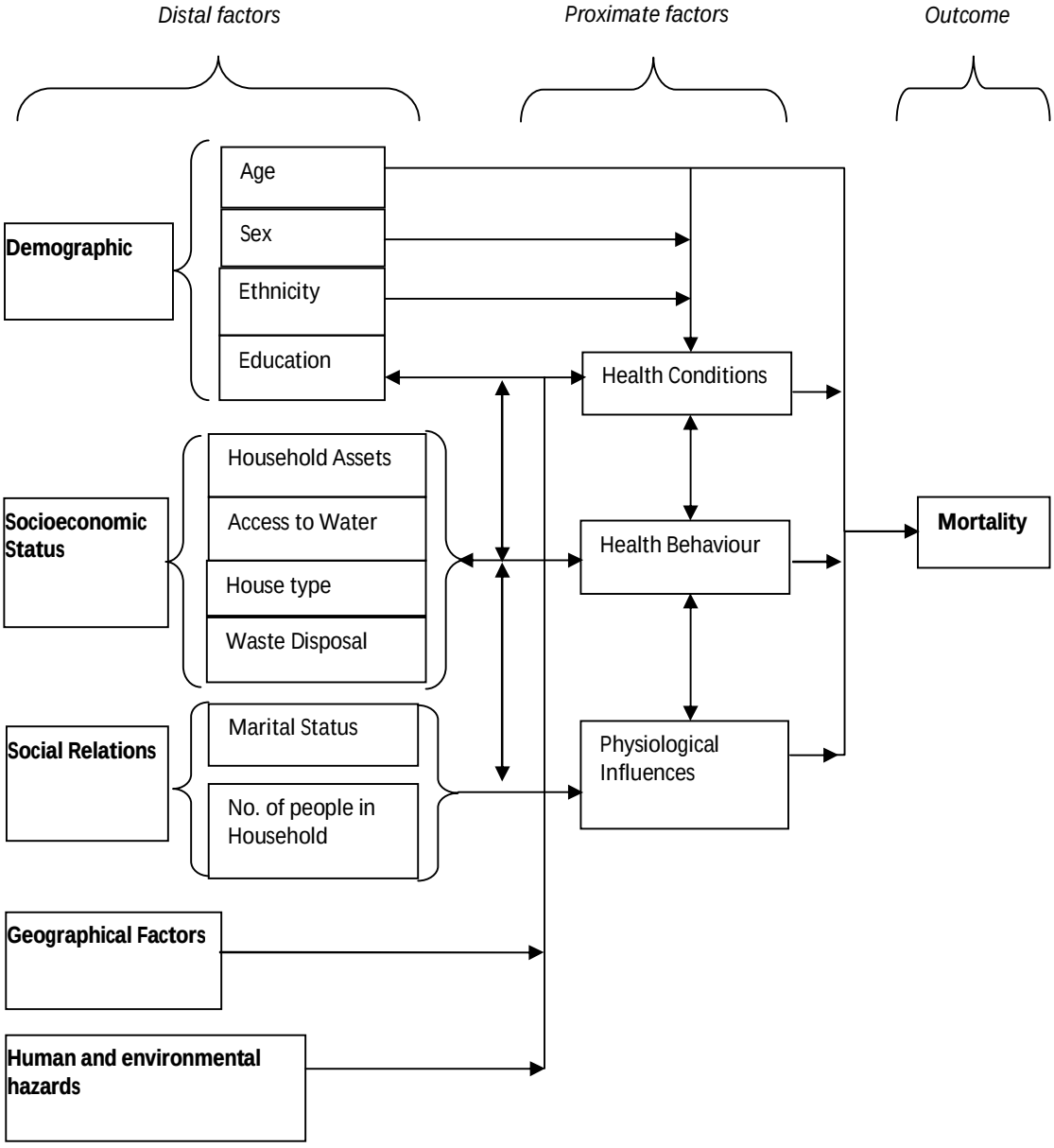


Figure 1.1 Conceptual framework showing the relationship between factors for elderly adult mortality

Study Aim and Objectives

The aim of the study was to investigate the relationship between household socio-economic status and elderly adult mortality in rural Ghana using data from the Navrongo DSS in the years 2005 and 2006.

Specific objectives:

- To determine the elderly adult mortality rates in the Navrongo demographic surveillance area in rural Ghana.
- To construct a household socio-economic index for the elderly adults from household surveys in the Navrongo demographic surveillance area in rural Ghana.
- To assess the relationship between household socio-economic status and elderly adult mortality in rural Ghana.

CHAPTER TWO: Methodology

In this chapter the following are described; setting of the NDSS and how it works, study design, study population and the study area. We also explain how the variables are defined and measured, state the data management and analysis methods used and describe the ethics and the measures taken to ensure data confidentiality during the course of the study.

Navrongo Demographic Surveillance System

The Navrongo Demographic Surveillance System (NDSS) was established by the Navrongo Health Research Centre (NHRC) in July 1993, as its core tool to monitor demographic dynamics in the Kassena-Nankan District (KND) and serve as a platform for launching health research on morbidity, mortality and fertility in the Kassena-Nankana district. The DSS data was first collected during an initial census of the whole study area in July 1993, since then, it is updated after every four months (previously it was done after every three months until 2003) in cyclic phases per year called rounds. The data was collected at the compound level up to 2003, but in 2004 it was changed to household level.

The data is collected using questionnaires answered by the residents of the households or a proxy residing in the same household. The interviewers visit a household to update existing information and collect information on new members (in migrants), out migrants, births, deaths, pregnancies and any other vital information about the resident members; apart from the events, the dates on which they occurred is also recorded. The interviews are guided by a compound registration book (CRB), which is a printed version of the electronic information in the database with all the vital information. The interviewers also collected information on socioeconomic indicators per household. This was done based on the INDEPTH equity tool designed for collecting demographic and socioeconomic data at household level. The data consist of household possessions (land, livestock, electronics, and bicycles), availability of water, garbage disposal, and availability of food. Data validity

and reliability was ensured before and during collection. Thorough pre-test of the questionnaires and randomized field checks during supervision; quality control checks by the supervisors are also done independently to ensure data accuracy and completeness.

Study Design

The study was a secondary data analysis of longitudinal data collected from the NDSS during the period 1st January 2005 to 31st December 2006.

Study Population and Area.

The Navrongo Demographic Surveillance System is located in the Kassena-Nankana District (KND) of Upper Eastern Region of Ghana. It is in an area of 1674 square kilometres along the Ghana - Burkina Faso boarder (Appendix 1). It has an altitude of 200-400m above sea level and generally flat. The climate is hot and dry with two wet seasons. The KND is one of the poorest regions in Ghana due to harsh climate and geographical isolation from the major towns in the country; although agriculture is the predominant income generating activity, erratic rainfall and poor soils contribute to poor harvests which in turn propagate common food shortages (Debpuur et al. 2005). The district is served by one district hospital, five health centres, two religious run clinics, a host of privately run chemists, and many people also visit traditional healers too. The literacy levels are very low; about 64% of the adults (15 years and older), have no formal education, and the level is especially high among females (73%) compared to men (53%). The area is characterised by low population growth due to high rate of migration to the South of the country, especially during the dry season, when there is virtually no farming activity; the migration is mostly among the working age group, which has resulted in an increased elderly adult population. (Bawah et al. 2006; Debpuur et al. 2005; Ngom et al. 2003)

The stable registered population of the Navrongo DSS was about 145000 as at June 2006 from a total of over 30,300 households; The Elderly adults (defined as all adults over the age of 60 years) were slightly over 6% of this population. However, since the population is monitored continuously and keeps changing, the total number of adults included in the study was slightly over 15,000.

Sampling and Study Sample

The study used data on all the male and female residents aged 60 years and above in the years 2005 – 2006 resident in the DSA between 01/01/2005 and 31/12/2006. This is because the NDSS collects data for all the people residing in the KND. In total 15030 out of 15047 elderly adults residing in 12475 households were part of the study contributing 27803 person years (PY) and 1315 deaths (17 elderly adult records were dropped since they had overlapping residential episodes hence contributing to inflated observation person time).

- **Inclusion criteria –** all the elderly adults registered in the demographic study area, over the age of 60 in the years 2005 - 2006, resident in the study area

- **Exclusion criteria –** non resident elderly adults and those who had not celebrated their 60th birthday by the end of the year 2006.

Measurements and Data Sources

In this study, we investigated the elderly population aged 60 years and above during the period 2005-2006 and observed the mortality that occurred to the same group in this period. We included those who had been registered by the turn of 1st January 2005 or turned 60 in the 2 year observation period (01/01/2005 – 31/12/2006) and either, lived through the whole period, died before the end of the period or migrated into the DSA,. The socioeconomic data was collected in the year 2004 at household level; this data was used

as a proxy of socio-economic status and was used to construct the SES index for the elderly adults in the year 2005 - 2006. The socioeconomic data collected in 2004 was taken to be a good measure of SES for the elderly adults since a big proportion of them 14098 (93%), were resident members of these household from the previous years (2004).

Data Processing and Management

The data was captured using Microsoft's Visual FoxPro in to a relational database consisting of various tables linked by a unique individual identifier. The NDSS uses a system developed for the INDEPTH-Network affiliated sites called Household Registration System (HRS), where each registered individual can be tracked and linked to a wide range of data provided they don't go out of the demographic surveillance area (DSA).

For the study, the required variables were extracted into two different tables; individual information and the SES information, which were later transferred to STATA software format. The data was cleaned, checked for consistency and accuracy, duplicates records removed and inconsistent records dropped. The two tables were then merged into one flat file in the long format. Additional variables like age and person-time were generated from the dates of birth and date of death/end date, while some of the variables like sex, household membership, education, and ethnicity were re-coded into suitable formats for analysis.

Exposure Variables

The variables that were collected for this study were grouped in 3 different categories; demographic, socioeconomic and social relations, while those that were not available from the data set but included in the conceptual framework were geographical and human/environmental hazards. The study treated socio-economic status (SES) as the main

exposure variable, mortality as the *outcome* and the other variables (sex, age, education, ethnicity, marital status and household size) as potential *confounders*.

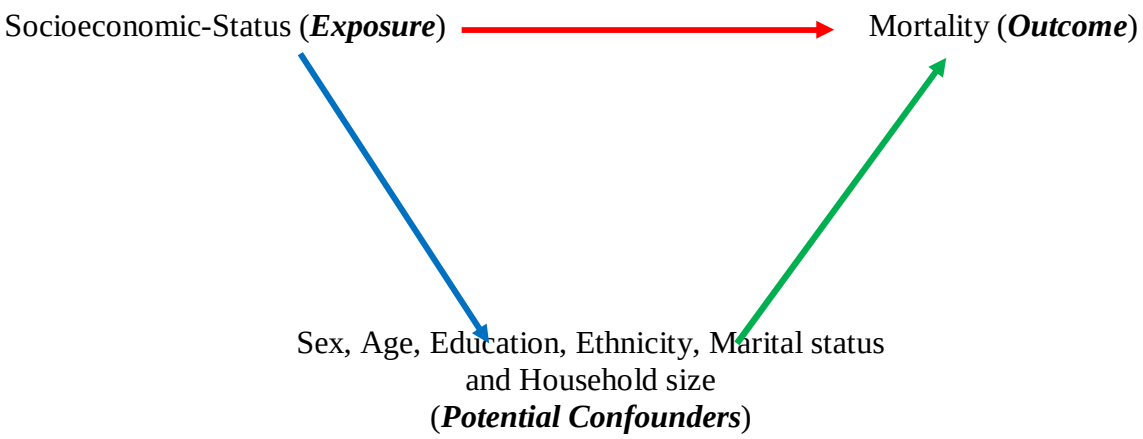


Figure 2.1 Illustration of the relationship between the exposure and outcome variables

Demographic variables

Age – This was calculated by subtracting the date of birth from the date of entry into the study during the period 1st Jan 2005 to 31st Dec 2006.

Sex – The data set had a string variable, "F" for females and "M" for males which was re-coded to binary as 0 and 1 respectively.

Ethnicity – There are four distinct ethnic groups (Kassim, Nankam, Bulsa/Others) in the Kassena-Nankana District, but the data was coded to show the Kassim, which was the dominant group (54%), and the Nankam/others (46%) since the Builsa and others were very small as a comparison group.

Education – This variable was re-coded as either "no education" for those who had never had any formal schooling or "some education" for all those who had at least primary

education, all the way to tertiary levels. This was done so, since very few elderly adults had ever had any formal schooling.

Socio-economic status (SES)

Socio-economic status (SES) was derived from data collected by the NDSS using a standardized questionnaire, that recorded household assets (electronics, car, motorbikes, bicycles, livestock,), access to water, waste disposal methods, house type (ownership, building material used), fuel/lighting type, land ownership and availability of food. These were used as the independent variables in construction of the SES index. The variables were first re-coded into binary format as 0 or 1 to denote the absence or presence of the asset respectively. Using the Principal component analysis technique, as recommended by Filmer and Pritchett (1999) and used in a number of studies (Filmer & Pritchett 2001; Kahn et al. 2005; Mwageni et al. 2005; Nguyen et al. 2005; Vyas & Kumaranayake 2006), we used the first principal component (which explains the most variability in the data) to rank the household into five different quintiles (poorest, poorer, poor, less poor and least poor). The component analysis was based on a formula where each component is a linear weighted combination of all the initial variables such that for a set of components X_1 to X_n;

$PC_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1n}X_n$

$PC_m = a_{m1}X_1 + a_{m2}X_2 + ... + a_{mn}X_n$

Where; X_n is the nth variable out of n variables

a_{mn} is the weight of the mth principal component and the nth variable

(Source; Vyas & Kumaranayake 2006)

It is worth noting that the SES index was based on the households that were occupied by the elderly adults and not all the households in the region. This was done to reduce the possibility of having a biased distribution of the elderly adult population towards one side of the socioeconomic strata probably due to selective mortality in earlier ages. This was done by first dropping those households that did not have a person over the age of 60 years present.

Social Relations

Marital Status – This was either 1 or 0 to denote if the elderly person was living with a spouse or if the elderly person did not have a spouse (widowed, divorced, separated or never married) respectively.

Household Size – This was a numerical value showing the total number of people who were registered in the same household as the elderly person. This was captured at the beginning of the observation period. It was re-coded as 0 for those households that had the elderly person staying alone and 1 for those households that had an elderly person living with at least one other person.

Outcomes variable

Mortality –Death of an elderly adult registered and residing in the study area during the observation period as captured by the surveillance field interviewers. This was captured from the DSS residency tables as "DTH", therefore, for any death in the year 2005/2006 it was captured as 1, while for all the other elderly adults who were part of the study, but survived the whole period it was captured as 0.

Data Processing Methods and Analysis

The data was in a long format, where, for some of the individuals we had multiple records per person. This ensured that we captured movement into and out of the NDSS and the correct time contributed by each person was as accurate as possible. We left censored those who were over 60 years old before the observation period and died or migrated before 1st Jan 2005; right censored those who died or exited the study by outmigration before the end of the two-year observation period. We also ensured period censoring for those who came into the NDSS, migrated out of the area, and came back at a later date.

Data analysis was in two parts, descriptive and analytic. In the descriptive analysis, we had cross tabulation of the different exposure variables and the outcome variable (dead) and came up with the frequency distribution as well as the row percentages. The corresponding chi-square test p-values of the difference in the frequencies were also included for the categorical variables. For the continuous variables, p-values from the t-test of the difference in means between those who died and those who survived the whole observation period were included. Cross tabulation was carried out among different variables of interest and reported on those that had significant results. We also constructed the socioeconomic index based on the household wealth as explained earlier and linked it to the elderly adults. From the merged data we were able to construct death rate tables and their distribution among the different quintiles. A concentration index to show a graphical illustration of the level of health inequality among the different SES quintiles was also plotted. This was done such that there were two lines on the same graph showing the ideal condition (when there is equality) and a second line showing the actual deaths. The value of the concentration index was calculated from twice the area between the two curves ranging from 1 to -1. This was used to explain the proportion of inequality such that the further the value is from 0, the higher the inequality in the area, but if the value is zero it

shows equality. A negative value shows inequality among the poorest compared to the least poor. Lastly, the adult mortality rates based on the number of deaths that occurred during the observation period divided by the total person-time years (PY) were also calculated. For comparison purposes, the specific death rates for each socio-economic quintile were also calculated by taking all the deaths in each quintile divided by the total person-time in years contributed by the elderly adult population of that quintile. Age Specific Death Rates for the different age groups were also calculated based on the number of deaths per age group and the person-time contributed in each group.

The inferential data analysis involved construction of survival probability curves for the whole observation period, and between different categorical variables to determine the survival history of the elderly adults in the NDSS with increase in time. Cox proportional hazards regression models with person-time as the underlying denominator were used to investigate the factors that affect mortality among the elderly. An unadjusted univariate model was used to investigate the effect of the different variables independently on elderly adult mortality. In multivariate analysis, a model investigating the effect of socio-economic status on mortality while adjusting for all the other variables was fitted. The second model in multivariate investigated the effect of SES while adjusting for the other factors that were significant and the last model only had the significant factors of mortality. The analysis was done at the 95% confidence interval. The models were investigated for any interaction between age and the other different variables, then checked if there was any interaction between SES and the various explanatory variables, (none was found to be significant and therefore excluded from the presentation of the results). After fitting each model, they were investigated for time varying covariates.

Ethical Considerations

Ethical clearance for the study was sought and granted from the University of Witwatersrand Committee for Research on Human Subjects (medical). (Appendix 3) Further ethical clearance and permission to use the data was sought from the Navrongo Health Research Centre (NHRC) – Institutional Review Board (IRB), which was also approved. (Appendix 4) Collection, management and use of the original data is explained elsewhere (Nyarko et al. 2002). The data set used for this study was anonymised by the NHRC data managers and does not include personal identifiers and therefore no harm is expected on the study participants. The data will only be used for the purpose of this study and any publications arising from it.

CHAPTER THREE: Results

This chapter presents the results in two parts; the descriptive part and the analytic part. In the descriptive part, the general socio-demographic variables are shown and how they are distributed among the two outcome variables, measurement of SES, and elderly adult mortality rates. In the analytic part, we look at the survival probabilities, the relationship between SES and elderly adult mortality and other factors that influence elderly mortality.

Table 3.1: Demographic and General Population Characteristics

Variable	Total	Dead		Alive		P–Value
		n	(%)	n	(%)	
SES(n,%,)						
Poorest	2892	276	21.8	2616	19.9	
Poorer	2891	252	19.9	2639	20.0	
Poor	2895	240	18.9	2655	20.1	0.251
Less Poor	2881	233	18.4	2648	20.1	
Least Poor	2889	266	21.0	2623	19.9	
Age groups (n, %)						
60-64	5223	276	21.0	4947	36.1	
65-69	4239	317	24.1	3922	28.6	
70-74	2393	234	17.8	2159	15.7	
75-79	1844	219	16.7	1625	11.9	<0.001
80-84	694	116	8.8	578	4.2	
85-89	445	102	7.8	343	2.5	
90+	192	51	3.9	141	1.0	
Sex (n,%,)						
Female	8688	638	48.5	8050	58.7	<0.001
Male	6342	677	51.5	5665	41.3	
Education(n,%,)						
No education	13697	1103	96.5	12594	95.0	0.028
Some Education	696	40	3.5	656	5.0	
Ethnicity(n,%,)						
Kassim	8015	746	56.9	7269	53.3	0.014
Nankam /Other	6933	566	43.1	6367	46.7	
Residence (n, %)						
Rural	13056	1137	89.7	11919	90.4	0.458
Urban	398	130	10.3	1268	9.6	
Household Size(n,%,)						
Single	988	94	7.2	894	6.5	0.379
Multiple	14042	1221	92.8	12821	93.5	
Spouse(n,%,)						
Lives with spouse	7516	511	38.9	7005	51.1	<0.001
No Spouse	7514	804	61.1	6710	48.9	

*The missing values for the categorical variables have been excluded in the descriptions

Table 3.1 presents the descriptive results of the study, with the corresponding chi-square test p–values of the differences in the categorical variables between those who died and those who survived, while for the continuous variables the t-test p-values were used. There were 15,030 elderly adults in the study, contributing a total follow up time of 27,803 person years out of which 1,315 (8.8%) deaths were captured. Out of these, there were 6342 (42.2%) males compared to 8,688 (57.8%) females. The mean follow-up time was 1.85 person years (PY); those who survived the whole observation period had a mean follow-up of 1.93 PY, while those who died had a mean follow-up time of 0.98 PY. Those who survived the whole period had a lower mean age of 68.9 years while those who died had a mean age of 72.5 years and the difference was statistically significant [3.7 (3.3 – 4.1) P<0.001].

Among the lower age groups of 60-64 and 65-69, there was a higher percentage among those who survived the two year observation period compared to those who died, with 4947 (36.1%) and 3922 (28.6%) respectively surviving. In the same age groups, there were smaller proportions among those who died at 276 (21.0%) and 317 (24.1%) respectively. Among the older age groups (70-74, 75-79, 80-84, 85-89, 90+) all the proportions in the death categories were higher than those who survived. (See table 3.1)

There was a relatively higher proportion of males among the dead 677 (51.5%) than among those who survived during the observation period 5665 (41.3%), yet for the females, the relative proportion among those who survived was much higher 8050 (58.7%) than those who died 638 (48.5%).

In terms of socio-economic status (SES), all the elderly adults were distributed almost equally amongst the different SES quintiles (Table3.1). There was a slight reduction in the relative proportion of deaths from the poorest to the less poor quintiles; Poorest (21.8%),

Poorer (19.9%), Poor (18.9%) and Less poor (18.4%), however, there was an increase when we got to the Least poor quintile (21.0%). The difference in the categories were not statistically significant (P-value=0.251). For the other explanatory variables, the differences in proportion between those who died and those who survived were significant for education status of the elderly, living with a spouse and ethnicity, but insignificant for household size and place of residence. There were more elderly adults with no education 13,697 (91%) compared to those who had at least some primary education 696 (5%). There were slightly more elderly adults of Kassim ethnicity 8015 (53.3%) compared to the Nankan/Other ethnicities 6933 (46.1%), while the proportion of those who had spouses or no spouses was 50-50 (Table 3.1). One variable of note was the presence of a spouse, with those who were not living with a spouse having a relatively higher percentage of deaths at 804 (10.7%) compared to those who were living with a spouse, who had a relatively lower percentage of deaths 511 (6.8%). The other groups that had relatively higher percentages of deaths than survival were those without any formal education, those living in single households (alone), those residing in the urban areas and those who were of Kassim ethnicity (See Table 3.1)

Measurement of socio-economic status

The elderly adults were grouped in five quintiles after including household wealth, housing type, food availability, water usage, toilet facilities and waste disposal. A total of 41 principal components were used, and the first component accounted for 16.4% of the total variance, the second component accounted for 8.5% and the third accounted for 5.1% of the total variance of all the variables used. We therefore used the first component to score the weights of each asset and eventually come up with the SES index. Using electricity for lighting and ownership of electrical gadgets were the most important variables in determining the levels of SES among the elderly adults in the KND (Appendix 3).

Comparison of the different quintiles and how the variables were allocated to each quintile shows that there were more assets in the upper quintiles than the lower quintiles; the lower quintiles showed little ownership of almost all the variables included in the analysis while the numbers were higher for the upper SES levels, except for land (for both farming and building), house ownership and goats which were more in households in the lower SES strata. The composition of the different variables allocated to each quintile is shown in Appendix 2. There was a notable lack of sanitation and waste disposal facilities, with over 99% of the household where elderly adults resided lacking toilet facilities, and 94% of these households also lacked proper access to water.

Among the different SES quintiles, there were a relatively higher proportion of the elderly adults living alone being placed in the poorest category (42.0%) in comparison to those who were in households that had more people (18.6%). (See Fig 3.1)

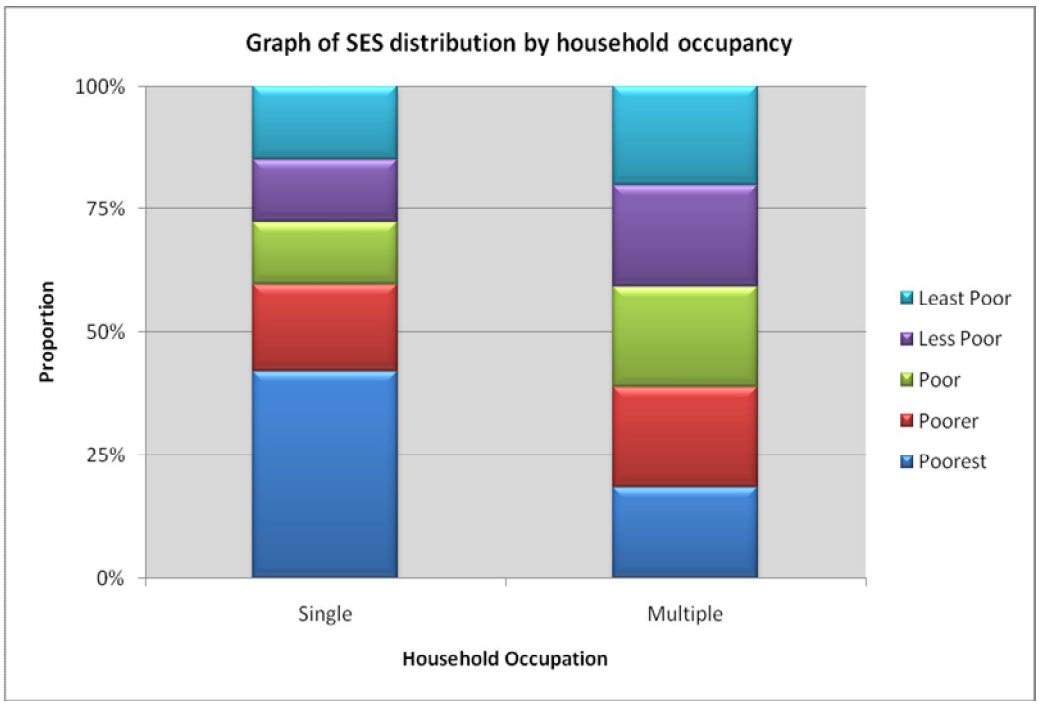


Figure 3.1

A relatively higher proportion of elderly adults with at least primary education were placed in the Least poor category of SES (51.7%) compared to those who had no education (18.3%), while in the poorest category there was also a relatively higher proportion of adults with no education (20.6%) compared to those with some education (8.6%).(Fig 3.2) Elderly adults with no education were spread almost uniformly in proportions across the quintiles, but for those with primary level of education and above, there was a general increase in proportion with increase in SES such that the higher the SES, the higher the proportion of those who had some education. There were also a relatively higher proportion of women living in single person households (7.6%) than males (5.1%).

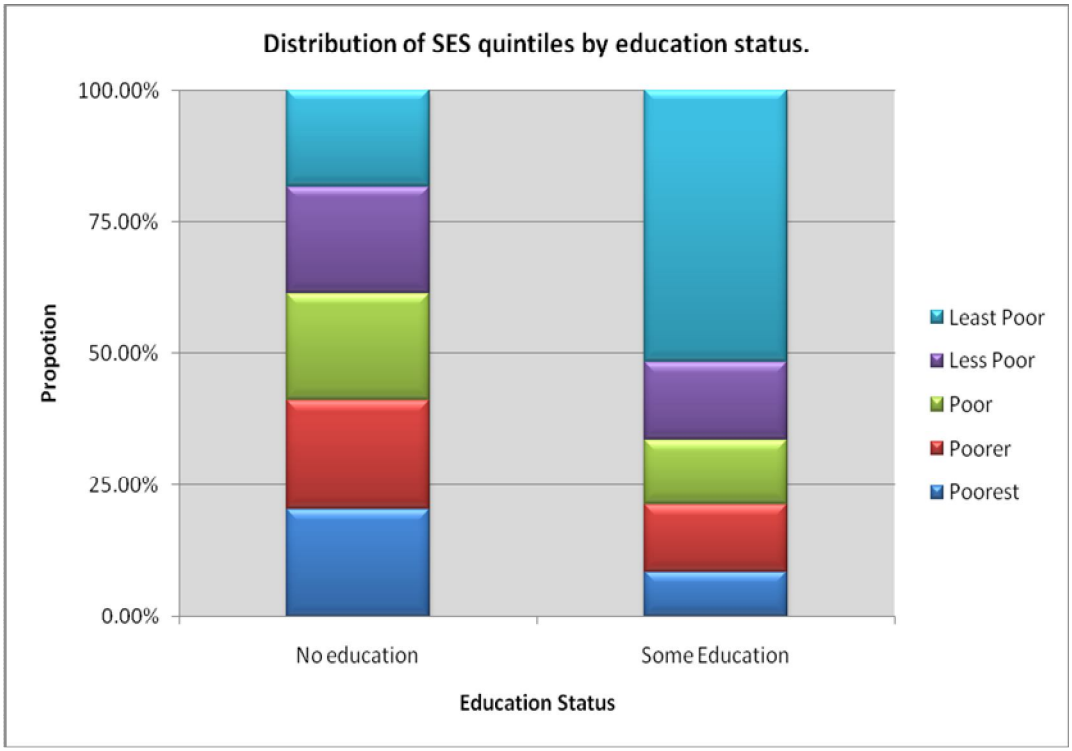


Figure 3.2

Elderly Adult Mortality Rates

The study yielded a total of 27,803 person years of observation time and 1,315 deaths, indicating an overall mortality rate of 47.3 deaths per 1000 PY over the two-year period. However, the death rates per age group ranged from 28.4 deaths per 1000 PY for the 60 – 64 ages to a high of 157.2 deaths per 1000 PY for those aged 90 and above (Fig 3.3).

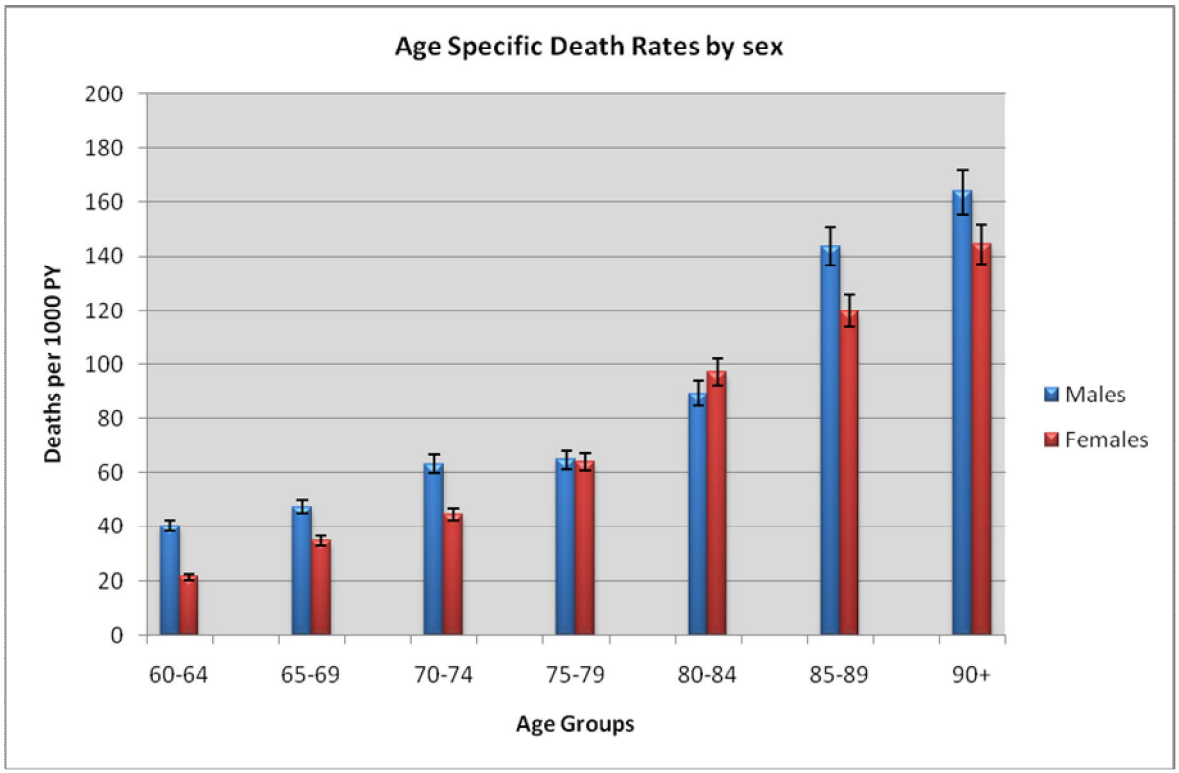


Figure 3.3

There was a distinct difference between males and females during the two-year observation period, such that females had a lower overall death rate of 39.5 deaths per 1000 PY compared to males, who had an overall death rate of 58.1 deaths per 1000 PY. In the age specific death rates by sex, males have a higher death rate than females, but as they age, there is a crossover at 75-79 and 80-84 age groups, with the females having a higher rate than males (Fig 3.4). A higher death rate was observed among elderly adults who were not living with a spouse (59.2 deaths per 1000 PY) compared to those who were living with a spouse (35.9 deaths per 1000 PY). However, it was also noted that among females, there

was a big proportion living without a spouse (68.3%) 5933 than those who were living with a spouse (31.7%), while for the males it was the opposite, with a smaller proportion of them living without a spouse (24.9%) 1581 while those who were living with a spouse being more (75.1%) 4761. There was a general reduction in the death rates across all the explanatory variables mentioned earlier from 2005 to 2006; with the overall yearly rates dropping from 50.2 deaths per 1000 PY in 2005 to 44.1 deaths per 1000 PY in 2006. (Table 3.2)

Table 3.2 Overall and yearly death rate distribution by different variable categories.

Variables	Overall	2005	2006
SES(n,%,)			
Poorest	51.5	61.3	44.9
Poorer	46.4	47.6	45.6
Poor	44.7	53.2	39.8
Less Poor	43.2	46.5	41.4
Least Poor	50.3	57.2	47.4
Sex (n,%,)			
Female	39.5	45.0	36.0
Male	58.1	64.9	54.8
Education(n,%,)			
No education	43.1	50.6	37.8
Some Education	30.7	27.4	37.1
Ethnicity(n,%,)			
Kassim	50.5	57.1	46.4
Nankam /Other	43.9	49.3	41.1
Residence (n, %)			
Rural	46.5	52.6	43.5
Urban	51.2	58.1	46.9
Household Size(n,%,)			
Single	51.8	66.2	39.6
Multiple	47.0	52.4	44.1
Spouse(n,%,)			
Lives with spouse	35.9	40.7	34.2
No Spouse	59.2	65.8	54.0

The same trend observed in the overall death rates among the different variable classification persisted when we split the observation period into two years, showing an overall reduction in all age groups from 2005 to 2006. (Fig 3.4)

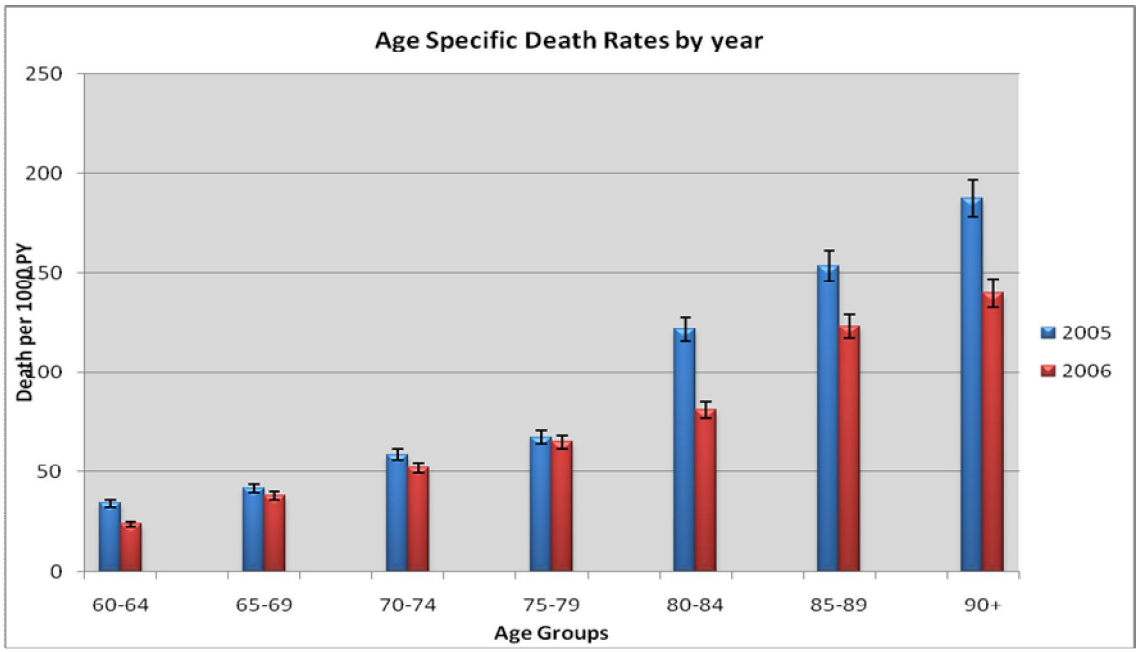


Figure 3.4

In terms of different SES strata, death rates appear to vary, with the poorest having a death rate of 51.7 deaths per 1000 PY, to the less poor having an overall death rate of 43.2 deaths per 1000. However, the trend reversed in the uppermost SES strata with a death rate of 50.3 deaths per 1000 PY although the difference between the different groups was not statistically significant. A concentration index of -0.01 (almost zero) and a poorest-poor ratio of 1.03 shows a very low level of inequality in mortality among the elderly adults in the KND. (Table 3.3) The chi square trend used to check any difference in the different quintiles shows no significance (P=0.251).

Table 3.3 Distribution of death rates across the SES quintiles

Quintile	**Person Years**	**No of Deaths**	**Elderly Adult Mortality Rate/1000 PY (95% CI)**
1ST (Poorest)	5338.9	276	51.7 (45.9 – 58.2)
2ND	5409.5	252	46.6 (41.2 – 52.7)
3RD	5400.1	240	44.4 (39.2 – 50.4)
4TH	5391.1	233	43.2 (38.0 – 49.2)
5TH (Least Poor)	5290.7	266	50.3 (44.6 – 56.7)
Poorest- Poor Ratio			1.03
Concentration Index			-0.01
Chi- Square Trend			0.251

On plotting a concentration index curve to check the level of health inequality (measured by mortality rates) among the elderly adults by SES, there was no significant differences in death rates among the different quintiles, with the concentration curve (showing the death rates by quintile) and the line of equity (showing an ideal situation of no difference between the quintiles) lying on top of each other with a small level of inequality especially among the poorest. (Fig 3.5) A big area between the two curves would normally indicate a high inequality between the poorest and the least poor in the given community, but in our case it is almost negligible (same as table 3.3 above).



Figure 3.5

Survival Probabilities

Overall, there was a steady drop in the survival probabilities of the elderly adults in the NDSS over the two-year observation period. By the end of this observation period, the survival probability dropped from 1.00 to just above 0.9. When we stratified the survival curves by age groups, sex and marital status there was a noticeable difference in the

gradient of the curves; there was a steep drop as the age groups increased, with the lowest age-group (60-64 years) having the least steep gradient while the highest age-group (90+ years) having the steepest gradient (Fig 3.6); Those who were living with a spouse had a less steep gradient than those who were not living with a spouse, (Fig 3.7) and the females had a less steep gradient on the curve compared to males. (Fig 3.8). This shows that males, the older members, and those who had no spouse were more likely to die.

Kaplan-Meir Survival Curves for Elderly Adults in NDSS

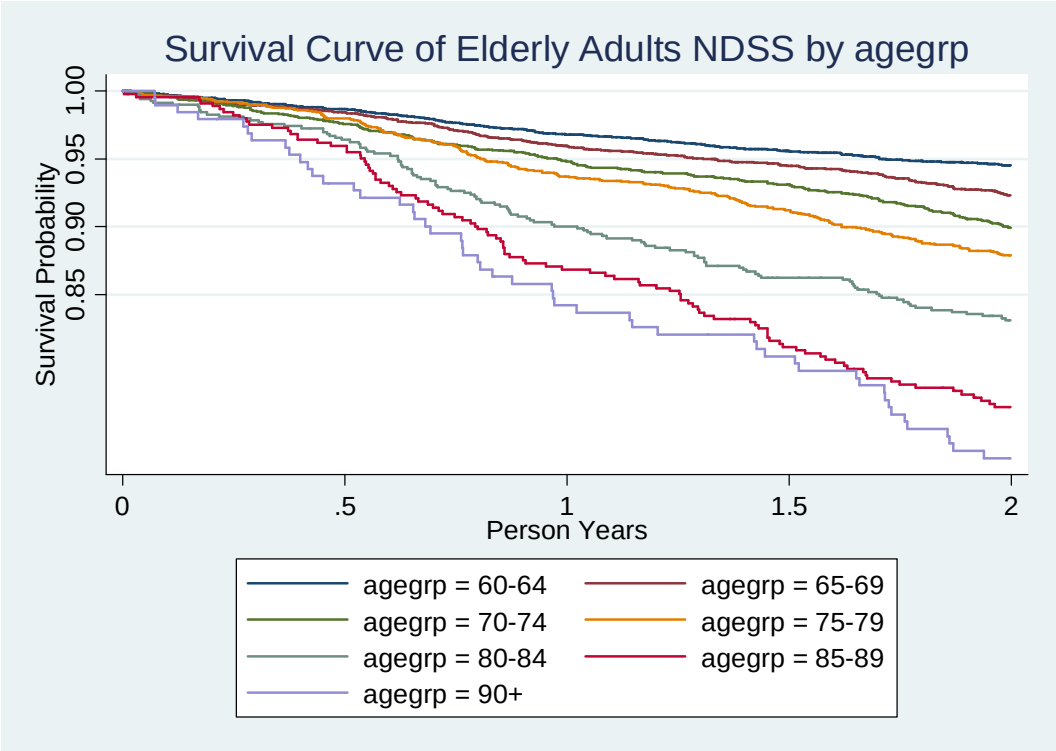


Figure 3.6

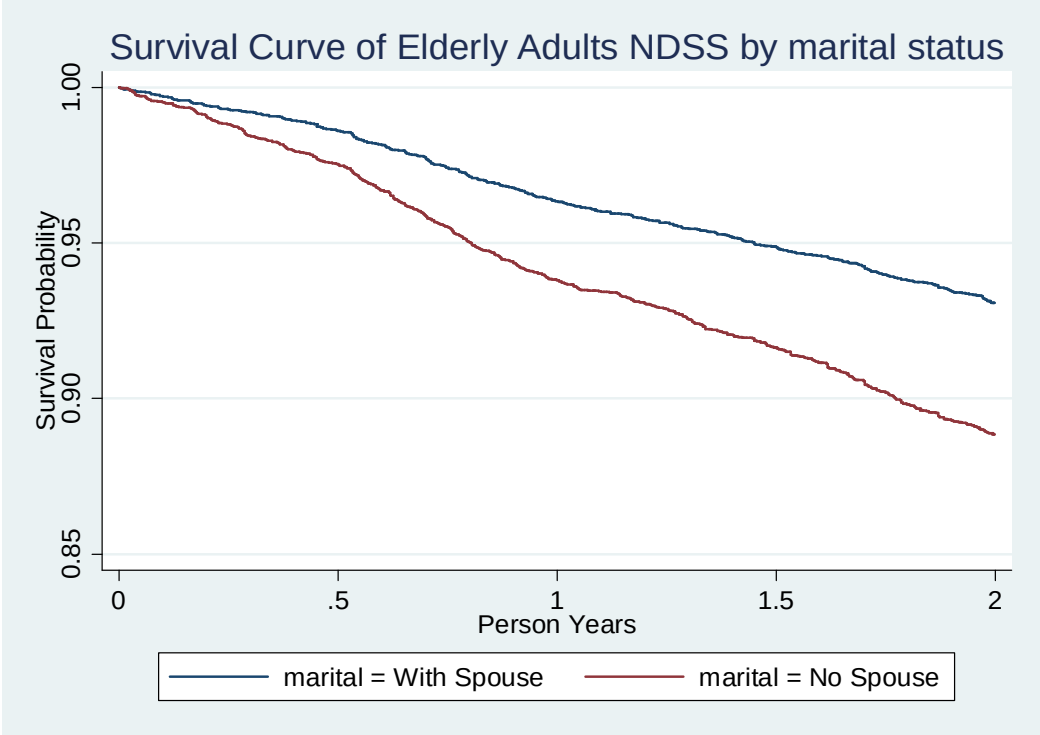


Figure 3.7

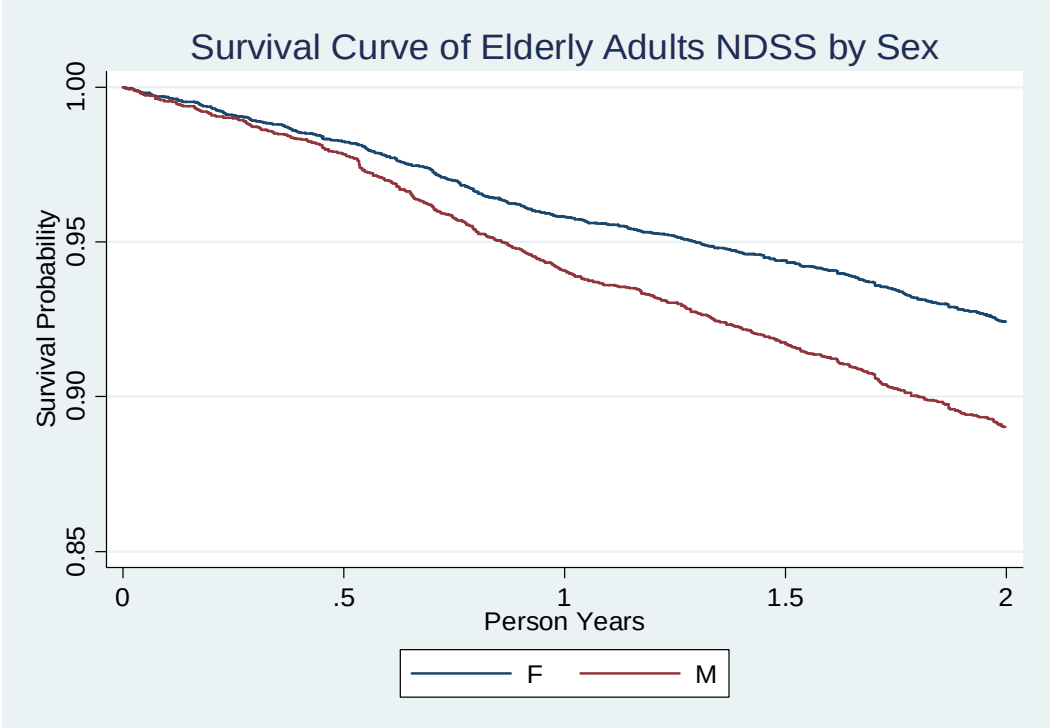


Figure 3.8

Cox proportional hazards regression and modelling

Cox proportional hazards regression modelling was used to investigate the relationship between SES and elderly adult mortality while adjusting for the other independent variables. After fitting the models, the following results were obtained for both univariate and multivariate analysis. (Table 3.4)

Socio-economic status and Elderly Adult Mortality

It was found that those elderly adults in the four upper categories of SES had lower hazard ratios for mortality compared to those in the poorest category. The hazards ratios for mortality reduced with increase in SES for the least poor compared to the poorest. (Table 3.4) A look at some of the results in (unadjusted HR) showed that the poorer were 0.1 times less likely to die compared to the poorest [HR=0.90, 95%CI (0.76 – 1.07) P=0.230]; the poor were 0.14 times less likely to die compared to the poorest [HR=0.86, 95%CI (0.72 – 1.02) P=0.086]; the less poor were 0.16 times less likely to die compared to the poorest [HR=0.84, 95%CI (0.70 – 0.99) P=0.043] and the least poor were 0.03 times less likely to die compared to the poorest [HR=0.97, 95%CI (0.82 – 1.15) P=0.745]. However, these differences were very small and not statistically significant.

The same trend in the univariate analysis was observed when we adjusted for the other variables in the other two models. In multivariate modelling, SES was found not to be a predictor of mortality in the elderly since the hazards ratios among the different levels did not vary from the comparison group in a big way and were also not statistically significant. In model 1 the 2nd, 3rd, 4th, and 5th quintiles had little variation in the protective effect compared to the 1st quintile. The poorer were only 0.04 times less likely to die compared to the poorest [HR=0.96, 95%CI (0.80 – 1.15) P=0.694], the poor were 0.1 times less likely to die compared to the poorest [HR=0.90, 95%CI (0.74 – 1.08) P=0.257], the less poor

0.13 times less likely to die compared to the poorest [HR=0.87, 95%CI (0.72 – 1.05) P=0.138], while the least poor were 1.02 times more likely to die compared to the poorest [HR=1.02, 95%CI (0.84 – 1.25) P=0.829],

Interestingly when SES was included in the second model during the multivariate analysis, there was also no difference between the poorest and the least poor categories (note that the results are not significant - Table 3.4) and the hazard ratios were not much different from the first model.. SES was therefore excluded from the last model that investigated which factors significantly affected elderly adult mortality in the KND.

Table 3.4 Cox proportional hazards regression analysis of mortality risk for elderly adults in the NDSS

		Multivariate (adjusted)		
	Univariate (unadjusted)	**(Model 1)**	**(Model 2)**	**(Model 3)**
Factors	HR (95% CI) P-value	HR (95% CI) P-value	HR (95% CI) P-value	HR (95% CI) P-value
SES				
Poorest	1	1	1	
Poorer	0.90 (0.76 – 1.07) 0.230	0.96 (0.80 – 1.15) 0.694	0.94 (0.79 – 1.12) 0.487	
Poor	0.86 (0.72 – 1.02) 0.086	0.90 (0.74 – 1.08) 0.257	0.91 (0.76 – 1.08) 0.276	
Less Poor	**0.84 (0.70 – 0.99) 0.043**	0.87 (0.72 – 1.05) 0.138	0.89 (0.75 – 1.07) 0.211	
Least Poor	0.97 (0.82 – 1.15) 0.745	1.02 (0.84 – 1.25) 0.829	1.02 (0.86 – 1.21) 0.819	
Age	**1.05 (1.05 – 1.06) <0.001**	**1.05 (1.04 – 1.05) <0.001**	**1.05 (1.04 – 1.05) <0.001**	**1.05 (1.04 – 1.05) <0.001**
Sex				
Females	1	1	1	1
Male	**1.47 (1.32 – 1.64) <0.001**	**1.86 (1.63 – 2.14) <0.001**	**1.80 (1.59 – 2.04) <0.001**	**1.86 (1.64 – 2.10) <0.001**
Education				
No education	1	1		
Some Education	**0.71 (0.52 – 0.98) 0.035**	0.76 (0.55 – 1.06) 0.107		
Ethnicity				
Kasssim	1	1		
Nankam / Others	**0.87 (0.78 – 0.97) 0.012**	0.98 (0.87 – 1.11) 0.766		
Residence				
Rural	1	1		
Urban	1.09 (0.91 – 1.31) 0.333	1.19 (0.96 – 1.48) 0.147		
Household Occupancy				
Single	1	1		
Multiple	0.91 (0.74 – 1.12) 0.363	0.92 (0.73 – 1.15) 0.471		
Spouse				
Lives with spouse	1	1	1	1
Doesn't live with Spouse	**1.65 (1.48 – 1.84) <0.001**	**1.99 (1.74 – 2.29) <0.001**	**1.98 (1.74 – 2.25) <0.001**	**2.03 (1.79 – 2.30) <0.001**

Other factors affecting elderly adult mortality

For all the other factors that were investigated, age, sex, education status, ethnicity and living with a spouse were all statistically significant in the univariate analysis, however, place of residence, and household size were insignificant. In multivariate analysis, age, sex and living with a spouse were statistically significant in all the other models, and therefore included in the final model. (Table 3.4)

Living with a spouse had the highest association with elderly adult mortality among the variables investigated. In the unadjusted model, those who were not living with a spouse were 1.65 times more likely to die compared to those who were living with a spouse, and this was statistically significant, [HR=1.65, 95%CI (1.48 – 1.84) P<0.001]. However on adjusting for the effects of sex and age, the hazards increased such that those who did not live with a spouse were approximately 2 times more likely to die than those who were living with a spouse in all the three different models used [Model 1 – HR=1.99, 95%CI (1.74 – 2.29) P<0.001; Model 2 – HR=1.98, 95%CI (1.74 – 2.25) P<0.001; Model 3 - HR=2.03, 95%CI (1.79 – 2.30) P<0.001]

On investigating the effect of age, it was found that in the unadjusted model for every one year increase in age, there was a 5% more likelihood of mortality [HR=1.05, 95%CI (1.05 – 1.06) P<0.001]. During the multivariate analysis, in all the three models that adjusted for different sets of variables, the hazards ratio remained the same, such that for every increase in age the risk of mortality increased by 5% [HR=1.05, 95%CI (1.04 – 1.05) P<0.001].

Sex was also associated with elderly adult mortality, such that males were 1.47 times more likely to die compared to females in the unadjusted analysis [HR=1.47, 95%CI (1.32 – 1.64) P<0.001]; In the first model of the multivariate analysis when we included all the other variables, the hazards ratio increased to 1.86, and dropped to 1.80 in the second

model that adjusted for SES, sex and living with a spouse. In the third model, when we adjusted for age and living with a spouse, the hazards increased such that males were 1.86 times more likely to die than females [HR=1.86, 95%CI (1.64 – 2.10) P<0.001]. The effect of sex on marital status was such that the hazards for mortality was lower [HR=1.65, 95%CI (1.48 – 1.84) P<0.001], but on adjusting for age it rose by over 20% [2.03, 95%CI (1.79 – 2.30) P<0.001]. Sex was thus found to be a confounding factor in the relationship between living with a spouse and elderly adult mortality.

We then checked for any interaction between age and the other different variables, then checked if there was any interaction between SES and the various explanatory variables, although none was found to be significant and therefore excluded from the presentation of the results.

In conclusion, we noted that there is no influence of SES on elderly adult mortality in the KND, which goes against our theoretical framework. However, there are other important factors, age, sex and marital status, which are of importance in elderly adult survival and hence require more research and investigation in future.

CHAPTER FOUR: Discussion

The aim of the study was to investigate the relationship between household socio-economic status and elderly adult mortality in rural Ghana using demographic data from the Kassena-Nankana District. In our analysis, we found that death rates for the elderly in the KND had reduced compared to the rates from previous yearly reports (Bawah et al. 2003); Socio-economic status (SES) was not a predictor for elderly adult mortality, however living with a spouse, sex and age were statistically significant factors in all the models and hence important factors in determining elderly adult mortality.

Elderly adult mortality

Elderly adult mortality rates in the KND reduced considerably, from a high of 40 deaths per 1000 PY and 140 deaths per 1000 PY for the ages 60-64 and 80-84 respectively in earlier reports, to a low of 28 deaths per 1000 PY and 93 deaths per 1000 PY for the same age groups in the two year observation period (See Appendix 6). The district has been experiencing lower overall mortality with every year, according to the data collected by the NDSS. Data from the latest demographic and health surveys also shows the region to have lower overall mortality levels compared to many areas in the country. This, according to a report by the NHRC, could be due to the mortality diminishing interventions that have been introduced in the district (Bawah et al. 2003). However these mortality rates are still quite high compared to other areas like Filabavi in Vietnam which had rates of 9.37 deaths per 1000 PY and 57.24 in the same age groups of 60-64 and 80-84 age groups (Nguyen et al. 2005). The mortality rates for women are generally lower than men's in this region, and this was also observed in other studies elsewhere (Fukuda, Nakamura, & Takano 2004; Mostafa & Van Ginneken 2000). However from the age of 70-74, there is a change in the death rates, such that women have higher death rates than males. The high death rates in

comparison to other developing countries are a problem that needs to be investigated and dealt with.

Socio-economic status and elderly adult mortality

There was no association between SES and elderly adult mortality in the Kassena-Nankana District. The hazards ratios for all the different SES quintiles (poorer, poor, less poor and least poor) show minimal deviation from the comparison category (poorest); this was especially true between the poorest and least poor groups where the HR was equal to 1, meaning that elderly adults in the KND have almost equal risk of mortality irrespective of SES. Our findings are in tandem with other studies which also showed no relation between SES and elderly adult mortality (Hoffmann 2005; Vrbova et al. 2005). Although these findings are similar to our study, the differences between the settings and context of those studies makes it hard for proper comparisons since they were carried out in more developed countries and from hospital data, while this study was done from continuous community surveillance. In a study done in the same region of the KND, Debpuur et al. (2005) found that SES does not predict child mortality. Although it is not entirely comparable to this study given the age difference of the participants in both studies, it suggests that SES differentials are minimal or SES is not a predictor of mortality in the KND. Similar findings were also observed in a Swedish study, that showed that in middle adulthood, the effect of SES on mortality was quite high but converged among the elderly adults (Merlo et al. 2003).

Our findings were however contradictory to other studies in similar environments which showed an inverse SES-mortality influence among the elderly. In rural Cambodia, rural China and Bangladesh, which have comparatively homogeneous socio-economic regions like the KND, it was found that higher SES was a protective factor for morbidity and

mortality among the elderly adults whether they used education, household wealth or income. Those in the well off categories always had less risk of mortality compared to the lowest comparison group of SES for all ages of the elderly adults (Mostafa & Van Ginneken 2000; Zhu & Xie 2007; Zimmer 2006; Zimmer & Kwong 2004). Our findings were different from our hypothesised influence of SES on elderly adult mortality as stated in the theoretical framework.

When we compared the mortality rates among different groups using the concentration index, the poorest-least poor ratio stood at 1.02, showing little difference between those elderly adults who were in the higher SES quintile and those in the lower quintile. The concentration index, which was used to indicate the levels of inequality depending on how big the value is from 0, was quite minimal (-0.01). From our results, the p-values for the SES hazard ratios were very high in all the models, and all the confidence intervals included unity. We therefore rule out weak association or chance in the lack of any relationship between SES and elderly adult mortality. This alludes to the convergence school of thought where the SES – mortality relationship converges in the elderly population. However, there is need to do a similar study for the whole population in the region and come up with a more concrete comparison for this theory to hold.

The lack of SES effect on elderly adult mortality in the KND could be due to several reasons. Firstly, the general homogeneity in terms of property ownership, house types and material possessions do not accurately bring out the SES differences among the elderly in this area. Secondly, in the elderly adults, biological and physiological determinants may be independent of the SES gradient and hence the lack of effect. Thirdly, the SES effect wears off with more deaths in the lower and middle age groups such that the effect becomes minimal in old age (House et al. 1990).

Although there was no indication of SES being a major determinant of elderly mortality, there is still need to improve the lives of elderly adults in the KND to ensure a more dignified and comfortable ageing, especially among those with very little resources (poorest). This is due to the fact that among those households that had a single occupant (indicating elderly adults living alone) a bigger proportion was in the poorest category.

Social Relations and elderly adult mortality

In this study, living with a spouse, was one of the variables used to measure social support and was found to be the most important factor for elderly adult mortality in the KND. The elderly adults not living with a spouse had a 2 times elevated risk of mortality compared to those who were living with a spouse. In the relationship between marital status and mortality, sex was found to confound the strength of the relationship, with the hazard ratio of mortality for those who were not living with a spouse increasing from 1.65, 95%CI (1.48 – 1.84) p-value<0.001 in the unadjusted analysis to a hazard ratio of 2.03, 95%CI (1.79 – 2.30) p-value<0.001 when we adjusted for sex and age.

Presence of a spouse was found to be more important as a predictor of mortality than even the presence of other household members since having other members of the household was not found to be significant in both the unadjusted and adjusted regression. The results showed that those who were living with other members of the household had a marginal advantage over those living alone (about 8 % less likely to experience mortality), although this was not statistically significant. The high number of women living without

Studies done in Ghana (using the DHS data) and Nigeria also found the presence of a spouse, and family support to be important factors of elderly adult health (Mba 2007; Unanka 2002). Mostafa & Van Ginneken (2000) in Bangladesh also observed that the presence of a spouse was more important than just living with other members of the

household. Social relations and family support were found to be an integral part of the wellbeing of elderly adults lives in other studies elsewhere (Johnson et al. 2000; Murata et al. 2005; Oppong 2006).

In the context of this study, it was hard to explain the mechanisms by which the presence of a spouse affects mortality even though its importance as a predictor of mortality among the elderly was big. As stated in the conceptual framework, and proposed by Lund et al (2002), presence of a spouse is much more important in determining elderly adult mortality than just being married or living with other people in the same household. In trying to explain the effect of spouses on the elderly, one study noted that elderly adults have unique dietary requirements, require specialised care and drug taking assistance. Companionship therefore serves as a buffer against poor diet and appetite as they will aid in feeding and related activities which in effect ensure good health (McIntosh, Shifflett, & Picou 1989) in addition to the psychological boost married spouses have on each other (Davis et al 1992).

Other Factors determining Elderly mortality

From our hypothesis in the theoretical framework, we predicted age, sex, education, and ethnicity to be factors for elderly adult mortality. However, we found that age and sex were statistically significant, hence important predictors of elderly adult mortality. Males were 1.86 times more likely to experience mortality compared to females [HR Adjusted =1.86, 95%CI (1.64 – 2.10) p-value<0.001]. This was similar with the other studies done elsewhere with both comparable and non-comparable environments (Liang et al. 2003; Zajacova 2006). In his book, Roger et al (2005) states that even though other studies have proposed the differences in mortality among different sexes are due to biological factors, there are other factors too, such as cultural, economic and even behavioural that are important as well. In the KND, older men are reportedly more likely to drink local

alcoholic brews than women and even use tobacco more. These are all known factors that hasten mortality and this could probably be one of the reasons why elderly men in the district experience higher mortality than women. Despite this, it was also noted that there were more women living without a spouse than men, which was in tandem with a study done elsewhere suggesting that older men were 3 times more likely to be married than older women. However, overall those who were married had higher levels of survival than the unmarried (Mba 2005).

Age was an important factor in this study as it was found to be significantly associated with mortality at all levels of our analysis. We found a 5 % increase in mortality risk with every single year increase in age for the elderly adults for both the unadjusted and adjusted analysis, and the hazards ratios were the same for all the models. In other studies on elderly adults, increase in age was also found to increase the risk of mortality, making it almost a universal finding, whether in different or comparable settings like the KND (Mostafa & Van Ginneken 2000;Zhu & Xie 2007). In the Chinese study among rural adults, Zhu & Xie (2007) found an almost similar increased mortality risk of 7 % for every single increase in age. As stated earlier from the theoretical framework, Roger et al (2005) emphasised the importance of age in any research on human, thus this finding was as expected. In a study done among a group of elderly adults, age was said to have an inverse effect on mortality such that as we age, the body's physiological functions slows down. It was noted that with age, the homeostasis functions and balance between the cells and body fluids are distorted, thus diseases and other health conditions become common in old age (Mari et al. 2008). In old age, behaviour that enhances good health is also affected. Older people exercise less, are less active which in the end hastens the development of diseases or accidents hence higher levels of mortality.

Education status was statistically significant in the unadjusted analysis, but became insignificant when we adjusted for other factors. The findings indicated that education had a protective effect against mortality with those who had at least primary education having a 30% less chance of dying compared to those who had no formal education at all. The reason for this could be due to the fact that education status is fixed so early in life and thus its effect wears off in old age. Alternatively the very few numbers for those who had no education could be a reason for its insignificance. Other factors that indicated protectivity in elderly adult mortality but were not significant were residing in the rural area compared to urban, multiple household occupancy compared to single household occupancy and being of the Kassim ethnicity as compared to Nankans.

In general, since this study looked at the effect of SES as a proximate determinant of elderly adult mortality as shown in the conceptual framework (see figure 1.1), there could have been the effect of residual confounders which either masked or elevated the effect of the factors measured. This among others could have been the reason why SES was not found to be a strong factor for elderly adult mortality.

Limitations

In interpreting these results the following issues should be taken into consideration. Even though the strength of this study was due to the fact that almost all the elderly adults resident in the entire district participated, comparability of the study to the rest of the country may be limited due to the geographical restriction of the NDSS. This makes it a little less comparable to the rest of the country due to the fact that the respondents may not be a real representation of the elderly adults in the whole country. This has been acknowledged as one of the biggest flaws of DSS data (Chandramohan et al. 2008). Use of proxy respondents could have contributed to a bias in the due to inaccurate or false information.

Since this was a secondary data analysis, there are some variables that would have been important but were not collected, hence their effect was not measured; behaviours and habits such as smoking and alcohol consumption that are known to be strong determinants of morbidity and mortality were not measured; the number of children, who are both residents and non residents which could have had an effect on the health of their parents since having children has been shown to be a very strong factor for elderly adult mortality elsewhere (Mostafa & Van Ginneken 2000). Hence the results may be biased in determining the factors for elderly adult mortality due to the hidden effect of these known confounders. Since this study focused on all effect of SES on all cause mortality, we might have missed out on the way it affects specific causes of deaths, especially the communicable diseases.

Principal component analysis as a measure of SES has several issues. It uses the face value of assets and not the real value hence it does not measure the value but possession. It is also sensitive to common variables in the analysis such that their ownership may not reflect

wealth but the items' availability in that community. Since the PCA only looks at the households concerned, it may not reflect the absolute levels of poverty in that community, which make it hard to compare with other regions in terms of poverty (Vyas & Kumaranayake 2006). The other limitation on the SES would be due to the fact that it was collected a year earlier, and the conditions in the household may have changed for better or worse, and hence giving a false ranking at the time of death.

Despite all the above limitations, it is noteworthy that the results obtained in the study are comparable and consistent with other scientific findings elsewhere, in both similar and non similar setting; hence the authenticity of the results is not highly compromised.

CHAPTER FIVE: Conclusion and Recommendations

Our findings showed that SES does not predict elderly adult mortality in this region although contrary to other studies elsewhere. Even though SES as a factor for mortality has been investigated in many studies, the way the relationship works in the older members of our society should be researched further, not in an isolated manner, but in relation to the whole population in the region.

Principal component analysis has been used in many health related studies in the developing world and found to be adequate (Filmer & Pritchett 2001), hence we considered it appropriate for this study. However, there is need for another mode of measuring SES, such as use of the real value of the assets to be tried in the KND and hence offer a comparative measure which would consequently confirm if indeed SES does not affect mortality.

Although the findings in this study point to the convergence school of thought in the SES mortality relationship, there is need to carry out similar studies in the whole population. This will allow researchers to have a better comparison of all the age groups and the transition from the lower age groups to the older groups and conclusively support it. Further research on the effect of SES on cause specific mortality would be quite helpful in shedding more light on the real situation and help to zero in on the areas of importance to elderly adult survival.

We found that living with a spouse was of greatest importance to survival of the elderly adults in the KND although the mechanisms through which this happens is not very clear and requires more research. As stated earlier, living with a spouse is a stronger factor for elderly mortality than just living with other people in the same household. To further understand these findings, the NDSS should in future include in its collection of data,

behavioural aspects of participants such as nutrition, alcohol and drug use, morbidity information, or enable more links to other projects data which could help in determining the health conditions of its participants.

Many countries in Africa lack the national capacity and resources to provide the essential health services and welfare for the elderly population on a large countrywide scale, there is need to focus on areas that can be easily tackled. There is need to come up with proper legislation and policies to adequately take care of the needs of the elderly adults in Ghana, especially in the KND, which is an economically deprived area. One way of ensuring adequate health care for the elderly is the provision of legislation to encourage the care for the elderly just like it was done in the USA in the late 80s (Doty 1986). The following actions should be considered in policies and programs that are aimed at the health and conditions of the elderly adults.

- Tax incentives for families and households that have elderly adults over a given age
- A better and well running social security system that adequately takes care of adults or old age grants and support funds from the government.
- The government of Ghana, through the Ministry of Health should consider including all the adults over the age of 60 in the scheme for provision of free medical care in public hospitals instead of only those above the age of 70.
- To ensure Ghana achieves an increase in life expectancy, lower overall mortality and ensure equality in health care, there is need for intervention programmes and policies that include both the young and the elderly, and hence achieve the much elusive MDGs.

REFERENCES

Adams, P., Hurd, M. D., McFadden, D., Merrill, A., & Ribeiro, T. 2003, "Healthy, wealthy, and wise? Tests for direct causal paths between health and socioeconomic status", *Journal of Econometrics*, vol. 112, no. 1, pp. 3-56.

Adler, N., Singh-Manoux, A., Schwartz, J., Stewart, J., Matthews, K., & Marmot, M. G. 2008, "Social status and health: A comparison of British civil servants in Whitehall-II with European- and African-Americans in CARDIA", *Social Science & Medicine*, vol. 66, no. 5, pp. 1034-1045.

Ahern, J., Galea, S., Hubbard, A., & Karpati, A. 2008, "Population vulnerabilities and capacities related to health: A test of a model", *Social Science & Medicine*, vol. 66, no. 3, pp. 691-703.

Baiden, F., Hogson, A., & Binka, F. N. 2006, "Demographic surveillance systems and emerging challenges in international health", *Bulletin of the World Health Organisation*, vol. 84, no. 3, pp. 161-256.

Bassuk, S. S., Berkman, F. L., & Amick, C. B. 2002, "Socioeconomic Status and Mortality among the Elderly: Findings from Four US Communities", *American Journal of Epidemiology*, vol. 155, no. 6, pp. 520-533.

Bawah, A. A. & Zuberi, T. 2004, "Socioeconomic Status and Child Mortality: An Illistration Using Housing and Household Characteristics from African Census Data.", *African Population Studies Supplement*, vol. 19.

Bawah, A., James, F. P., Martin, A., Maya, V.-S., Bruce, M., & Fred, B. 2006, "The impact of immunization on the association between poverty and child survival: Evidence from Kassena-Nankana District of northern Ghana", *Policy Research Division Working Paper* no. 218.

Bawah, A., Wontuo, P., Wak, G., Adjuik, M., Hodgson, A., Welaga, P., Azongo, D., Yeji, F., & Binka, F. 2003, *Ten Years of Demographic Monitoring - Levels and Trends of Fertility, Mortality and Migration in Kassena-Nankana District*, Navrongo Health Research Centre.

Catalano, R. 2002, "Economic Antecedents of Mortality among the Very Old", *Epidemiology*, vol. 13, no. 2, pp. 133-137.

Chandola, T., Ferrie, J., Sacker, A., & Marmot, M. 2007, "Social inequalities in self reported health in early old age: follow-up of prospective cohort study", *BMJ*, vol. 334, no. 7601, p. 990.

Chandramohan, D., Shibuya, K., Setel, P., Cairncross, S., Lopez, A. D., Murray, C. J. L., aba, B., Snow, R. W., & Binka, F. 2008, "Should Data from Demographic Surveillance Systems Be Made More Widely Available to Researchers?", *PLoS Medicine*, vol. 5, no. 2, p. e57.

Davis, A. M., Neuhaus, M. J., Moritz, J. D., & Segal, R. M. 1992, "Living Arrangements and Survival among Middle-Aged and Older Adults in the NHANES I Epidemiologic Follow-up Study", *American Journal of Public Health*, vol. 82, no. 3, pp. 401-406.

Debpuur, C., Wontuo, P., Akazili, J., & Nyarko, P. 2005, "Health Inequalities in the Kassena-Nankana District of Northern Ghana," in *Measuring Health Equity in Small Areas - Findings from Demographic Surveillance Systems*, d. D. Savigny et al., eds., Ashgate Publishing Limited, Hampshire, England, pp. 45-65.

Doty, P. 1986, "Family Care of the Elderly: The Role of Public Policy", *The Milbank Quarterly*, vol. 64, no. 1, pp. 34-75.

Filmer, D. & Pritchett, H. L. 2001, "Estimating Wealth Effects Without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India", *Demography*, vol. 38, pp. 115-132.

Forasassi, C., Golmard, J. L., Pautas, E., Piette, F., Myara, I., & Raynaud-Simon, A. 2009, "Inflammation and disability as risk factors for mortality in elderly acute care patients", *Archives of Gerontology and Geriatrics*, vol. 48, no. 3, pp. 406-410.

Frank, J. W., Cohen, R., Yen, I., Balfour, J., & Smith, M. 2003, "Socioeconomic gradients in health status over 29 years of follow-up after midlife: the Alameda county study", *Social Science & Medicine*, vol. 57, no. 12, pp. 2305-2323.

Fukuda, Y., Nakamura, K., & Takano, T. 2004, "Municipal socioeconomic status and mortality in Japan: sex and age differences, and trends in 1973-1998", *Social Science & Medicine*, vol. 59, no. 12, pp. 2435-2445.

Goldman, N., Korenman, S., & Weinstein, R. 1995, "Marital status and health among the elderly", *Social Science & Medicine*, vol. 40, no. 12, pp. 1717-1730.

Hill, Kenneth 2000, *Methods for Measuring Adult Mortality in Developing Countries: A Comparative Review.*, Harvard Burden of Disease Unit Center for Population and Development Studies, 01.13.

Hoffmann, R. 2005, "Do socioeconomic mortality differences decrease with rising age?", *Demographic Research*, vol. 13, pp. 35-62.

House, J. S., Kessler, R., Herzog, R. A., Mero, R. P., Kinney, A. M., & Breslow, M. J. 1990, "Age, Socioeconomic Status and Health", *Milbank Quarterly*, vol. 68, pp. 383-411.

Huisman, M., Kunst, A. E., Andersen, O., Bopp, M., Borgan, J. K., Borrell, C., Costa, G., Deboosere, P., Desplanques, G., Donkin, A., Gadeyne, S., Minder, C., Regidor, E., Spadea, T., Valkonen, T., & Mackenbach, J. P. 2004, "Socioeconomic inequalities in mortality among elderly people in 11 European populations", *Journal of Epidemiology and Community Health*, vol. 58, no. 6, pp. 468-475.

Johnson, N. J., Backlund, E., Sorlie, P. D., & Loveless, C. A. 2000, "Marital Status and Mortality: The National Longitudinal Mortality Study", *Annals of Epidemiology*, vol. 10, no. 4, pp. 224-238.

Kahn, K., Tollman, S. M., Collinson, M. A., Clark, S. J., Twine, R., Clark, B. D., Shabangu, M., Gomez-Olive, F. X., Mokoena, O., & Garenne, M. L. 2007, "Research into health, population and social transitions in rural South Africa: data and methods of the Agincourt Health and Demographic Surveillance System", *Scandinavian Journal of Public Health,* vol. 35, pp. 8-20.

Kahn, K., Collinson, M., Hargreaves, J., Clark, S., & Tollman, S. 2005, "Sosio-economic Status and Child Mortality in a Rural Sub-District of South Africa," in *Measuring Health*

Equity in Small Areas - Findings from Demographic Surveillance Systems, d. D. Savigny et al., eds., Ashgate Publishing Limited, Hampshire, England, pp. 68-86.

Kowal, P. R., Dowd, J. E., Aboderin, I. A., & Madzingira, N. 2002, "Data for older adult populations in sub-Saharan Africa", *The Lancet*, vol. 360, no. 9326, p. 91.

Krueger, P. M., Rogers, R. G., Hummer, R. A., LeClere, F. B., & Huie, S. A. B. 2003, "Socioeconomic Status and Age: The Effect of Income Sources and Portfolios on U.S. Adult Mortality", *Sociological Forum*, vol. 18, no. 3, pp. 465-482.

Kunst, A. E. & Mackenbach, J. P. Mesuring Socioeconomic Inequalities in Health. 1994. Copenhagen, WHO.

Lawlor, D. A. & Sterne, J. A. C. 2007, "Socioeconomic inequalities in health", *BMJ*, vol. 334, no. 7601, pp. 963-964.

Leclerc, A., Chastang, J. F., Menvielle, G., & Luce, D. 2006, "Socioeconomic inequalities in premature mortality in France: Have they widened in recent decades?", *Social Science & Medicine*, vol. 62, no. 8, pp. 2035-2045.

Liang, J., Bennett, J. M., Sugisawa, H., Kobayashi, E., & Fukaya, T. 2003, "Gender differences in old age mortality: Roles of health behavior and baseline health status", *Journal of Clinical Epidemiology*, vol. 56, no. 6, pp. 572-582.

Lund, R., Due, P., Modvig, J., Holstein, B. r. E., Damsgaard, M. T., & Andersen, P. K. 2002, "Cohabitation and marital status as predictors of mortality--an eight year follow-up study", *Social Science & Medicine*, vol. 55, no. 4, pp. 673-679.

Mari, D., Ogliari, G., Castaldi, D., Vitale, G., Bollini, E., & Lio, D. 2008, "Hemostasis and ageing", *Immunity & Ageing*, vol. 5, no. 1, p. 12.

Martelin, T. 1994, "Mortality by indicators of socioeconomic status among the finnish elderly", *Social Science & Medicine*, vol. 38, no. 9, pp. 1257-1278.

Mba, C. J. 2005, "Racial differences in marital status and living arrangements of older persons in South Africa", *Generations Review*, vol. 15, no 2 pp 23-31.

Mba, C. J. 2007, "Gender disparities in living arrangements of older people in Ghana: Evidence from the 2003 Ghana demographic and health survey", *Journal of International Women's Studies,* vol. 9, no 1 pp 153-166.

McIntosh, W. A., Shifflett, P. A., & Picou, J. S. 1989, "Social Support, Stressful Events, Strain, Dietary Intake, and the Elderly", *Medical Care*, vol. 27, no. 2, pp. 140-153.

Merlo, J., Gerdtham, U. G., Lynch, J., Beckman, A., Norlund, A., & Lithman, T. 2003, "Social inequalities in health- do they diminish with age? Revisiting the question in Sweden 1999", *International Journal for Equity in Health*, vol. 2, no. 1, p. 2.

Mollenkopf, H., Marcellini, F., Ruoppila, I., FlaschentrΣger, P., Gagliardi, C., & Spazzafumo, L. 1997, "Outdoor mobility and social relationships of elderly people", *Archives of Gerontology and Geriatrics*, vol. 24, no. 3, pp. 295-310.

Morris, S., Carletto, C., Hoddinott, J., & Christiaensen, M. J. Validity of rapid estimates of household wealth and income wealth for health surveys. [72]. 1999. Washington, International Food Research Policy Institute. Ref Type: Catalog

Morris, S. S., Ranson, M. K., Sinha, T., & Mills, A. J. 2007, "Measuring improved targeting of health interventions to the poor in the context of a community-randomised trial in rural India", *Contemporary Clinical Trials*, vol. 28, no. 4, pp. 382-390.

Mosley, W. H. & Chen, L. C. 1984, "An Analytical Framework for the Study of Child Survival in Developing Countries", *Population and Development Review*, vol. 10, pp. 25-45.

Mostafa, G. & Van Ginneken, J. K. 2000, "Trends in and determinants of mortality in the elderly population of Matlab, Bangladesh", *Social Science & Medicine*, vol. 50, no. 6, pp. 763-771.

Mueller, C. W. & Toby, L. P. 1981, "Measures of Socioeconomic Status: Alternatives and Recommendations", *Child Development*, vol. 52, no. 1, pp. 13-30.

Murata, C., Takaaki, K., Hori, Y., Miyao, D., Tamakoshi, K., Yatsuya, H., Sakakibara, H., & Toyoshima, H. 2005, "Effects of Social Relationships on Mortality among the Elderly in a Japanese Rural Area: An 88-month Follow-up Study", *Journal of Epidemiology*, vol. 15, no. 3, pp. 78-84.

Mwageni, E., Masanja, H., Juma, Z., Momburi, D., Mkilindi, Y., Mbuya, C., Kasale, H., Reid, G., & Savigny, d. D. 2005, "Social-economic Status and Health Inequalities in Rural Tanzania: Evidence from the Rufiji Demographic Surveillance System.," in *Measuring Health Equity in Small Areas - Findings from Demographic Surveillance Systems*, d. D. Savigny et al., eds., Ashgate Publishing Limited, Hampshire, England, pp. 39-52.

Nagata, C., Takatsuka, N., & Shimizu, H. 2003, "The Impact of Changes in Marital Status on the Mortality of Elderly Japanese", *Annals of Epidemiology*, vol. 13, no. 4, pp. 218-222.

Nathan, R., Armstrong-Schellenberg, J., Masanja, H., Charles, S., Mukasa, O., & Mshinda, H. 2005, "Child Health Inequity in Rural Tanzania: Can the National Millenium Development Goals Include the Poorest?," in *Measuring Health Equity in Small Areas - Findings from Demographic Surveillance Systems*, d. D. Savigny et al., eds., Ashgate Publishing Limited, Hampshire, England, pp. 33-43.

Ngom, P., Debpuur, C., Akweongo, P., Adongo, P., & Binka, F. N. 2003, "Gate-Keeping and Women's Health Seeking Behaviour in Navrongo, Northern Ghana", *African Journal of Reproductive Health / La Revue Africaine de la Sant+¬ Reproductive*, vol. 7, no. 1, pp. 17-26.

Nguyen, D. K., Pham, H. D., Ho, D. P., Hoang, V. M., Nguyen, X. T., Bo, E., Vinod, D., & Nguyen, T. K. C. 2005, "Health and Health Care: Equity Aspects in FilaBavi, Vietnam," in *Measuring Health Equity in Small Areas - Findings from Demographic Surveillance Systems*, d. D. Savigny et al., eds., Ashgate Publishing Limited, Hampshire, England, pp. 127-142.

Nyarko, P., Wontuo, P., Nazzar, A., Phillips, J., Ngom, P., & Binka, F. 2002, "Navrongo DSS, Ghana," in *Population and health in developing countries. Volume 1. Population, health, and survival at INDEPTH sites*, O. A. Sankoh et al., eds., International Development Research Centre, Ottawa, pp. 247-256.

Oppong, C. 2006, "Familial Roles and Social Transformations: Older Men and Women in Sub-Saharan Africa", *Research on Aging*, vol. 28, no. 6, pp. 654-668.

Robinson, T., Mosha, F., Grainge, M., & Madeley, R. 2006, "Indicators of mortality in African adults with malaria", *Transactions of the Royal Society of Tropical Medicine and Hygiene*, vol. 100, no. 8, pp. 719-724.

Rogers, G. R., Hummer, A. R., & Krueger, M. P. 2005, "Adult Mortality," in *Handbook of Population*, L. P. Dudley & M. Michael, eds., Kluwer Academic/Plenum Publisher, New York, pp. 283-309.

Ross, C. E. & Wu, C.-L. 1996, "Education, Age, and the Cumulative Advantage in Health.", *Journal of Health and Social Behavior*, vol. 37, pp. 104-120.

Somi, M. F., Butler, J. R., Vahid, F., Njau, J. D., Kachur, S. P., & Abdulla, S. 2008, "Use of proxy measures in estimating socioeconomic inequalities in malaria prevalence", *Tropical Medicine & International Health*, vol. 13, no. 3, pp. 354-364.

Sudore, R., Yaffe, K., Satterfield, S., Harris, T., Mehta, K., Simonsick, E., Newman, A., Rosano, C., Rooks, R., Rubin, S., Ayonayon, H., & Schillinger, D. 2006, "Limited literacy and mortality in the elderly", *Journal of General Internal Medicine*, vol. 21, no. 8, pp. 806-812.

Timaeus, I. M. 1991, "Measurement of Adult Mortality in Less Developed Countries: A Comparative Review", *Population Index*, vol. 57, no. 4, pp. 552-568.

Timaeus, I. M., Jasseh, M. 2004, "Adult Mortality in Sub-Saharan Africa: Evidence from Demographic and Health Surveys", *Demography,* vol. 41, no. 4, pp. 757-772.

Unanka, G. O. 2002, "Family support and health status of the elderly in Imo State of Nigeria", *Journal of Social Issues,* vol. 58, no 4 pp. 681-695.

United Nations 2004, *Demographic Yearbook - 2004* UN, New York.

United Nations 2008, *The Millennium Development Goals Report 2008*, United Nations, New York.

Vagero, D. & Leinsalu, M. 2005, "Health inequalities and social dynamics in Europe", *BMJ*, vol. 331, no. 7510, pp. 186-187.

Vrbova, L., Mamdani, M., Moineddin, R., Jaakimainen, L., & Upshur, R. 2005, "Does socioeconomic status affect mortality subsequent to hospital admission for community acquired pneumonia among older persons?", *Journal of Negative Results in BioMedicine*, vol. 4, no. 1, p. 4.

Vyas, S. & Kumaranayake, L. 2006, "Constructing socio-economic status indices: how to use principal components analysis", *Health Policy and Planning*, vol. 21, no. 6, pp. 459-468.

WHO "Active Ageing: A policy framework. A contribution of the WHO to the second United Nations world assembly on Ageing, Madrid 2002".

Zajacova, A. 2006, "Education, gender, and mortality: Does schooling have the same effect on mortality for men and women in the US?", *Social Science & Medicine*, vol. 63, no. 8, pp. 2176-2190.

Zhu, H. & Xie, Y. 2007, "Socioeconomic Differentials in Mortality Among the Oldest Old in China", *Research on Aging*, vol. 29, no. 2, pp. 125-143.

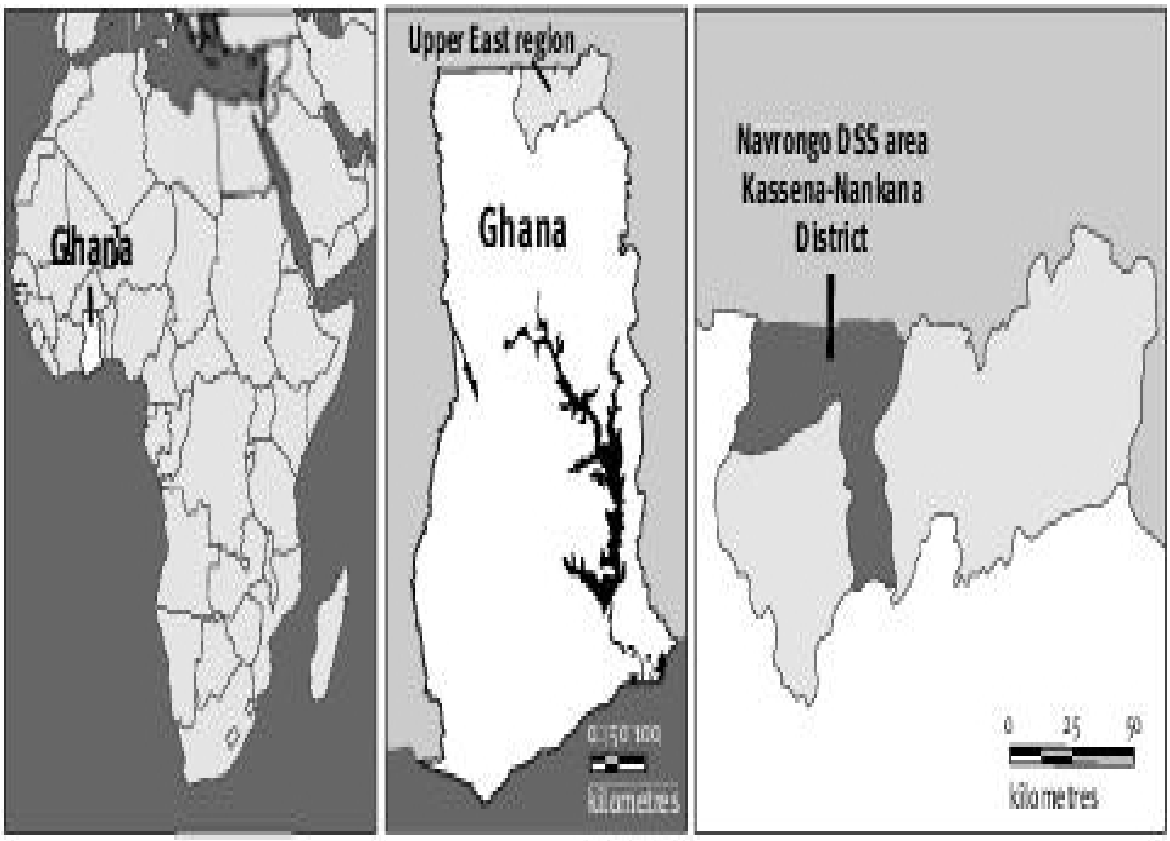
Zimmer, Z. 2006, "Poverty, wealth inequality, and health among older adults in rural Cambodia", *Policy Research Division Working Paper*, vol. 217.

Zimmer, Z. & Amornsirisomboon, P. 2001, "Socioeconomic status and health among older adults in Thailand: an examination using multiple indicators", *Social Science & Medicine*, vol. 52, no. 8, pp. 1297-1311.

Zimmer, Z. & Kwong, J. 2004, "Socioeconomic Status and Health among Older Adults in Rural and Urban China", *Journal of Aging and Health*, vol. 16, no. 1, pp. 44-70.

APPENDICES

Appendix 1: Location of the Navrongo DSS.



Appendix 2: Distribution of the assets across quintiles

Asset	Poorest	Poorer	Poor	Less poor	Least Poor
Water	0	0	4	96	745
Toilet	0	0	0	0	77
Roof	35	437	1018	1468	2352
Wall	0	0	0	30	599
Cooking Fuel	0	0	0	7	65
Lighting	0	0	0	2	856
Land (house)	2731	2557	2496	2364	2237
House ownership	2909	2890	2862	2849	2677
Waste disposal	2907	2838	2786	2808	2599
Bednet	775	1479	1759	1983	1982
Farming land	2909	2887	2753	2654	2229
Enough Land(for food)	2197	1810	1681	1588	1212
Enough Food	975	848	853	893	748
Food Supplement	1724	1930	1909	1912	2016
Enough Food(next 3-4 months)	464	783	844	971	1055
Kerosene Stove	0	0	1	34	305
Car	0	0	0	1	162
Motorcycle	0	0	0	17	556
Bicycle	574	2013	2326	2529	2403
Electricity	0	0	0	4	711
Solar	0	0	0	1	192
Refrigerator	0	0	0	0	436
Television	2	9	12	27	657
DVD/VCD/VCR	0	0	0	72	466
Radio	400	1768	2236	2376	2346
Sewing Machine	1	31	263	839	1443
Stereo	0	29	638	1109	1508
Iron	0	13	176	940	1642
Fan	0	0	0	0	604
Telephone/Cellphone	0	0	0	0	304
Electric/Gas Stove	0	0	0	0	263
Tractor	0	0	0	16	91
Grinding Mill	0	0	0	5	123
Cattle	844	1181	1276	1473	1173
Sheep	889	1261	1475	1695	1457
Donkey	64	170	337	476	546
Goats	1673	1887	2087	2173	1775
Pigs	121	364	494	676	668
Horse	0	4	15	8	18
Rabbits	0	0	10	28	87

Appendix 3: Scoring Factors and distribution of assets in the first component

Asset	Scoring Factor	Mean	Standard Deviation
Water	0.2243	0.0586	0.2348
Toilet	0.1396	0.0053	0.0728
Roof	0.1629	0.3678	0.4822
Wall	0.2039	0.0437	0.2044
Cooking Fuel	0.0882	0.005	0.0704
Lighting	0.3056	0.0595	0.2366
Land (house)	-0.0384	0.857	0.3501
House ownership	-0.0844	0.9818	0.1336
Waste disposal	-0.0641	0.9648	0.9648
Bednet	0.0567	0.5526	0.5526
Farming land	-0.1348	0.9298	0.2556
Enough Land(for food)	-0.0711	0.5871	0.4924
Enough Food	-0.0222	0.2985	0.4576
Food Supplement	0.0277	0.6573	0.4746
Enough Food(next 3-4 months)	0.0487	0.2855	0.4517
Kerosene Stove	0.1076	0.0236	0.1518
Car	0.1618	0.0113	0.1056
Motorcycle	0.2091	0.0398	0.1956
Bicycle	0.0779	0.6819	0.4658
Electricity	0.296	0.0494	0.2168
Solar	0.1198	0.0134	0.1151
Refrigerator	0.3091	0.0302	0.171
Television	0.3023	0.049	0.2158
DVD/VCD/VCR	0.2284	0.0372	0.1893
Radio	0.0873	0.6324	0.4822
Sewing Machine	0.1417	0.1782	0.3827
Stereo	0.1467	0.2276	0.4193
Iron	0.1782	0.1919	0.3938
Fan	0.2907	0.0418	0.2001
Telephone/Cellphone	0.2509	0.0212	0.1442
Electric/Gas Stove	0.2116	0.0182	0.1336
Tractor	0.0756	0.0074	0.0857
Donkey Cart	0.061	0.091	0.2876
Grinding Mill	0.08	0.0089	0.094
Cattle	-0.018	0.4113	0.492
Sheep	-0.0002	0.4693	0.4991
Donkey	0.0251	0.11	0.3129
Goats	-0.0361	0.6642	0.4723
Pigs	0.0224	0.1609	0.3674
Horse	0.0092	0.0031	0.0557
Rabbits	0.0467	0.0086	0.0926

Appendix 4: Approval letter from the NHRC's IRB

In case of reply the number and date of this letter should be quoted.

My Ref. : app079
Your Ref:



Navrongo Health Research Centre
Institutional Review Board
Ghana Health Service
P. O. Box 114
Navrongo, Ghana
Tel: +233-742-22310/80
Fax + 233-742-22320
Email: irb@navrongo.mimcom.net

10th February 2009

Mr. Sammy Khagayi
University of Witwatersrand
School of Public Health
7 York Road
Parktown 2193
South Africa

ETHICS APPROVAL ID: NHRCIRB079

Dear Mr. Khagayi,

Approval of a protocol titled "Socioeconomic status and elderly adult mortality in rural Ghana. Evidence from the Navrongo DSS"

I write to inform you that the NHRCIRB reviewed and approved the above-mentioned protocol.

Please note that any amendment to this approved protocol must receive ethical clearance from the NHRCIRB before its implementation.

You are also by this approval required to submit a final report of your study to the Board for review.

The Board wishes you all the best in this study.

Sincerely,

Dr. John Awoonor-Williams
Chair, NHRCIRB

Cc: Director, NHRC

Appendix 5: Approval letter from the University of Witwatersrand's Human Research Ethics Committee (Medical)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Khagayi

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M080972**
PROJECT	Socioeconomic Status and Elderly Adult Mortality in rural Ghana: Evidence from the Navrongo DSS
INVESTIGATORS	Mr S Khagayi
DEPARTMENT	School of Public Health
DATE CONSIDERED	08.09.26
DECISION OF THE COMMITTEE*	

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

DATE **CHAIRPERSON** .....
p/ (Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr C Odimegwu

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 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 6: Comparison of elderly adult mortality in the KND and other regions,

	Age group (yrs)	**Death Rates**
Navrongo (1993 - 2004)	**60 – 64** **80 - 84**	**40 per 1000 persons** **140 per 1000 persons**
Rural Mexico[2]	60 – 64 80 - 84	13.2 per 1000 persons 77.3 per 1000 persons
Israel[2]	60 – 64 80 - 84	5.3 per 1000 persons 74.7 per 1000 persons
Filabavi – Vietnam[3]	60 – 64 80 - 84	9.37 per 1000 person years 57.24per 1000 person years
Navrongo (2005 - 2006)	**60 – 64** **80 - 84**	**28 per 1000 person years** **93 per 1000 person years**