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Patterns and predictors of mortality in older people (50 years and above) in Kassena-Nankana District of Ghana, 2007-2010

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Patterns and Predictors of Mortality in Older People (50 Years and Above) in Kassena-Nankana District of Ghana, 2007-2010.

A research report submitted by

Ramadhani Abdul

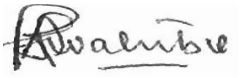
in partial fulfillment of the requirements for the degree of
Master of Science in the Field Population Based Epidemiology
of School of Public Health, Faculty of Health Sciences
University of the Witwatersrand,
Johannesburg, South Africa

Johannesburg, May 2014

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Declaration

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



Ramadhani Abdul

30/ 04/ 2014

Dedication

This work is dedicated to my wife Salima Issa, my daughter Fatma, and my son Fawzan for their great support and prayers during my study period.

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High appreciations go to the INDEPTH Network for the grant to support my MSc training. I would also like to convey my gratitude to the Training committee of Ifakara Heath Institute under the leadership of Dr. Rose Nathan for facilitating the approval of my study.

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ABSTRACT

Background*:* The world population is aging at an increasing rate. One product of this increase is the shift in mortality patterns and causes as a result of change in the age structure of the general population. An understanding of patterns and predictors of mortality in older populations is essential for policy and planning.However, very little is known due to limited research targeting this older population.

Objectives: To identify patterns and predictors of mortality in older people (50 years and above) in the Kassena-Nankana district of Northern Ghana from 2006-2010, and to investigate the association between self-rated health (SRH) and subsequent mortality of older adults.

Methods**:** Longitudinal follow-up of 4584 older people aged 50 and above who participated in a SAGE cross-sectional survey conducted in the Kassena-Nankana District of Ghana in 2007. Mortality rates were estimated using person time (in years) as the denominator, and Kaplan-Meier curves were employed to compare survival between different exposure groups. Cox proportional hazards modeling was used to identify predictors of mortality.

Results*:* Of the 4584 people followed up until the end of 2010, 601 (13.1%) died. Overall mortality rates were 37.5 (95% CI 34.5, 40.6) deaths per 1000 Persons Years (PY). Older males had consistently higher mortality rates than women and the pattern indicate that, the highest mortality rate of 43.3 (95% CI 37.3, 49.9) was observed in

2008. Being married, being female, and living in household with higher socio-economic status were associated with significant reduction of mortality. There was increased risk of mortality among participants who rated their health as bad (HR=2.36 (95%CI 1.57 , 3.54) as compared to those who rated their health as very good (P<0.05).

Conclusions: Despite overall low level of older adult mortality, there were significant difference in mortality magnitudes for different subgroups such as sex, education level, wealth and marital status. The findings also support previous studies that show the ability of SRH to significantly predict subsequent older mortality.

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DEFINITION OF TERMS

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

Older people: For the purpose of this research, older people were defined as people who are 50 years of age or above

Mortality Rate: Defined as number of death over person years in a specified period

NOMENCLATURE:

HIV : Human Immunodeficiency Virus

AIDS: Acquired Immune Deficiency Syndrome

INDEPTH: The International Network for the Demographic Evaluation of Populations and their Health

SRH: Self Reported Heath

SAGE: Study of Global Ageing

WHO: World Health Organization

NHRC: Navrongo Heath Research Centre

SOP: Standard Operating Procedure

IRB: Institutional Review Board

HRS2: Households Registration System Version Number 2

PCA: Principal Component Analysis

KND: Kassena-Nankana District

NCDs Non-Communicable Diseases

NHDSS: Navrongo Health and Demographic Surveillance System

SES: socio-economic status

DSS: Demographic and Surveillance System

1.1 Chapter One

1.1 Introduction

The increasing population of older age people is becoming a great challenge. A United Nations report on populations estimated that the population of older people aged 60 years and above increased threefold from 200 million in 1950 to nearly 606 million in 2000 worldwide (REF). The projection also indicates that this population will reach 1.9 billion by 2050 (1, 2). By 2009, the global estimated proportion of older persons was 11%, and projections indicate that it will reach 22% in 2050 (3). Although developed countries still account for a large number of older people; 1950-2009 data on world population ageing revealed higher rates of increases of older people in less developed countries than developed ones by 68% (3). The number of older people in Africa has been projected to increase from an estimated 38 million in 2000 to about 200 million in 2050 (2). Ghana, for example, has experienced a 283% increase in older people within four decades only, whereby 0.6 million older population in 1960 reached 2.3 million in year 2000. In the rural this rapid change interprets into a rise of elderly population by 3.8%, from 4.1% of all population in 1960 to 7.9% in 2000 (4)

1.1 Problem statement

It is estimated that only 9% of all deaths in low-income countries occur at age 80 years and above while in higher income countries the percentage is as high as 40% (5). This indicates a major difference in survival between older people in high and low income countries. While estimation of cause of death is difficult to establish given the lack of or

unreliable data as many studies suggest (6-9), the older people of Africa are becoming more vulnerable of the situation. Since the demographics in African societies is shifting and populations becoming older, there is a need for comprehensive research to identify gaps in health programs and strategies so as to go hand in hand with the changes. The estimated life expectancy at birth in African countries between 2000 and 2005 was 51.3 years for males and 52.1 years for females (10), which suggests that very few individuals survive to older ages. Mortality and poor survival among older people in most African countries may be attributed to several factors that need to be identified; but insufficient or unreliable data in Africa complicates the situation (6). In 2006 the Panel on Policy Research and Data Needs to Meet the Challenge of Aging in Africa came up with several suggestions aimed at improving life and health needs for older adults. Among the recommendations was a request to conduct further research on older people (8). The same call was also made by Chuks (11) when presenting on aging in Ghana. My study responds to these multiple calls and hopes to minimize the current existing research gap in aging population.

1.2 Justification

Most public health programs in developing countries are focused on children and younger generations. This may partially be due to the lack of, or limited resources available in these countries, but does not negate the fact that older persons are becoming victims of neglect. Levels and predictors of mortality among older age groups is expected to raise awareness, potentially identify the stage of the epidemiological transition (despite the impact of the HIV epidemic) and suggest measures to be taken to

increase life expectancy and reduce mortality in this age group. Apart from a few data sources in some sub-Saharan countries, the information on causes of adult mortality is either limited, unreliable or doesn't exist (6).

Given the HIV epidemic, perceived evidence of increased prevalence of various lifestyle and risk behavior for NCDs among older Africans (12-15), the little research focus in this age group in sub-Saharan Africa may have unexpected consequences in the near future. In most developing countries, especially in sub-Saharan Africa, little detailed research has been conducted on health status, mortality and related socio-demographic factors among older people. The INDEPTH-WHO SAGE study on older people conducted in Ghana and other parts of Africa, as well as Asia, reveals many health problems as well as the functional inabilities that older people face in their daily activities (16)

Other key findings from multi-site surveys include, inequality in heath status, quality of life and well being among older persons(17-19), the greater association between poor health outcomes and socio-demographic factors (20-22) and increases in disability in relation to older age and other social demographic factors(23, 24). Given the findings from previous studies, there remains a question as to what the future implication of mortality in this group would be if poor health, poverty and other listed complication persist.

Our study takes links data from cross-sectional INDEPTH-WHO SAGE survey and longitudinal demographic and health surveillance. By combining two study designs, this study has a greater advantage over many other studies. The potential of this study is further elevated by the possibility to analyse multiple factors over-time including demographic factors (gender, ethnicity, residence) , physiological factors (overall functional assessment), psychosocial factors (such as perceived satisfaction with life, marital status) and heath related factors. It is expected that findings from this study will be useful in identifying and targeting high risk groups while contributing to this under researched area.

1.3 Literature review

Mortality statistics are considered as a primary input in planning and developing public health policy. Information documenting the patterns and predictors of older adult mortality indicating where these deaths are most likely to occur and why they occur in certain high risk groups is urgently needed. Much research has been conducted on child and middle age mortality, however little research has been conducted on older people mortality (6, 25). These results in a knowledge gap and implications of certain transitions (eg epidemiological transitions) remain unclear. The lack of reliable mortality data in most African countries may underestimate the problem, leaving this group more vulnerable.

1.4.1 Mortality, social inequality, poverty and aging

People of older age in most African countries suffer from social inequality. For example, in some African countries including Ghana, older people are regarded as witches and a burden to society. This is even worse for older women who are often accorded lower status than men (10). This group normally ends up living in social isolation as a result of discrimination and may therefore be affected psychologically. Studies have reported associations between psychological impact in human factors and survival of older adults (26) as well as link between lack of social support and lower survival of older persons (25). These findings conclude that improving social support and physical well being will improve the quality of life and health which is the most comprehensive indicator of healthy survival.

The 1996 report on older citizens in Burkina Faso and the finding from the 1995 survey on the situation of older people in urban areas, report several social and health care issues such as inadequate food, poor housing, lack of income and social exclusion (10). These problems are among key indicator of poverty that must be addressed given a significant association found between inadequacy in having ones basic needs met and mortality in older people (27). These findings require special attention not only in Burkina Faso but also in Ghana which is a close neighbour with very similar prevailing conditions, as well as other countries in sub Saharan Africa.

1.4.2. Aging, disease shift (epidemiology transition) and health system transition

As the proportion of diseases that are communicable become less prominent in sub-Saharan Africa, we will observe an increase in proportion of non-communicable (NCDs)

and chronic diseases, occuring more prominently in the older age groups. We need to take special measures to protect older population from non-communicable diseases.

Projections indicate that about two-thirds of all deaths in developing countries by 2020 could be due to age-associated factors (28). Several studies have so far indicated that there is an increase in the proportion of deaths due to NCDs in less developed countries (29-31), with higher proportions in older people. A study in rural South Africa for example reported that, the mortality from NCDs were ranked the highest cause of mortality in people aged 50 years and above (32).

In Ghana specifically, one study conducted in Accra to assess the epidemiological transitions , indicated a significant change in disease pattern (33). While infectious and parasitic diseases during the 1950s and 1960s were the major cause of morbidity and mortality, it was no longer the case at the beginning of 1990s, when other NCDs such as circulatory diseases, emerged as major causes. These studies provide evidence for shifts in cause and age specific mortality as results of changing disease patterns in sub-Saharan countries. With increasing aging populations and evidence on perceived links between aging and some NCDs (30, 34) such as diabetes , cancer and others,precise cause- specific mortality must be established, and well documented so as to go along with the epidemiological transition as well as heath challenges that we are observing.

Life style related risk factors are not lagging behind. Limited or lack of physical exercise and unhealthy diet due to poverty and illiteracy may play their parts in contributing to the deteriorating heath of older people (25). Poor nutrition too cannot be neglected since it was found to be among the predictors of mortality in older people (35) especially in the rural areas of Africa (36).

Despite ongoing major epidemiological shift evident in Africa as is in the rest of the world, our already debilitated health system remains unprepared to cope with the situation. Among the clearly emerging challenges that most African countries are facing is the fact that while health systems are still struggling and prioritize tackling the burden of communicable disease such as malaria, HIV and TB (33, 37), the NCDs place an enormous additional challenge the health system(38, 39). This situation is termed a "double burden" (33, 40, 41), where the heath system has to respond simultaneously to a largely unresolved communicable disease burden and now emerging non-communicable disease has alarmed health policy makers and other stakeholders to update health policies and strategies.

1.4.3 Mortality, HIV/AIDS and aging

Reports reveal that HIV/AIDS has a severe impact on older people. The impact is categorized as direct when older people themselves are affected with HIV/AIDS; and indirect when they are needed to provide support as caregivers to the young infected family members (42). While people 50 years of age and above are still sexually active,

Altschuler, in his article reports that this group lacks accurate information on HIV/AIDS and receives very little sexual health education (43). Results obtained from this report were consistent with another study which showed lower levels of HIV-related knowledge and awareness in this particular age group as compared to younger ones (44). HIV/AIDS health education program priorities are concentrated on younger and middle-aged people, and in many cases older people are ommited from these programs (42, 45). It must be noted that. less priority given to older people does not reduce their risk of being affected and dying of HIV/AIDS.

Ghana's HIV prevalence in the age group 50 and above stood at 13.6% in 2007 which is slightly below the overall average of Sub-Saharan Africa (14.3%) reported in the same year (46). A study conducted in rural areas in Kenya to assess cause of death in older people aged 50 and above showed that HIV/AIDS was among the leading cause of death, accounting for 27% of all deaths (45) ,

The above mentioned information reveals the increased HIV risk in older people and further enhances the need for research that will facilitate an integration of our older people into our routine programs as is done for other age groups.

1.4.4 Mortality and self-reported heath of older people

The WHO defines health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity (47). Different indicators can be used in evaluating the health of the general population. Functional difficulties due to

health conditions and others are used worldwide as indicators of individual and population health. The way people rate their own health is termed Self Reported Health (SRH), has its uniqueness as an indicator of health status due to its simplicity in terms of measurement and accuracy.

Several studies have indicated an association between SRH and subsequent mortality in older people (26, 35, 48-58). However, these findings have not been conclusive in two regards. First some show an association between low SRH and significant higher risk of mortality as compared to high SRH in both males and females (52, 58), while others show a significant association with mortality in males only (55, 57).

Second, other inconclusive results were also observed when comparing the period between SRH status and subsequent mortality. While Benyamin et el. concluded that a significant association between SRH and mortality exists only in the short term of four years but not nibe years period (58), Vuorisalm et el. indicated the opposite, and concluded that the significant association exists only in the longer term of 10 and 20 years (49). The existence of differential results between these studies investigating the association of SHR and mortality implies the need for further research.

1.4.5 Age-specific pattern and trends for older adult mortality

The general age specific mortality pattern is U-shaped, with high mortality in children, low mortality at middle ages and increasing mortality again at older ages. The pattern and magnitude always differ from one area to another due to different social and

demographic factors. Data on mortality from Agincourt DSS in South Africa show different trends of mortality among older people at different age groups as 50-64, 65-74 and 75 and above (8), and this age band has continued being used by several other studies (59-64). In our study same age categories were applied to see if the same findings can be generalized.

1.4 Research questions

1) What were the patterns and predictors of mortality in older people (50 years and above) in Kassena-Nankana district of Ghana during 2007-2010 period?
2) Was there any statistical association between different levels of SRH and subsequent mortality in older people aged 50 years and above, during the same period of 2007 to 2010, after adjusting for other factors and confounders?

1.5 Study aims

The main objective of this study was to describe the patterns and predictors of mortality in older people (50 years and above) in the Kassena-Nankana district of Ghana over a four years period (2007 to 2010) and to investigate the association between self reported heath and subsequent mortality of these adults.

1.6.1 Specific objectives

1) To describe the social demographic structure of older adult populations in the Kassena-Nankana district during 2007-2010.

2) To assess levels, trends and patterns of older adult mortality in the Kassena-Nankana district during 2007-2010.

3) To explore associations between self-reported health and subsequent mortality in older adults during 2007-2010.

4) To identify predictors associated with older adult mortality in Kassena-Nankana during 2007-2010.

2.0 Chapter two

2.1 Methodology and Materials

2.1.1 Study design

The study is a longitudinal analytical follow-up of a DSS cohort following Study on Global AGEing and Adult Health (SAGE) cross sectional survey. The study uses the secondary data collected by SAGE in 2007 and link other demographic and life status information form routine Demographic and Suveillnce System(DSS). We used health related variables as predictors from the cross-sectional INDEPTH WHO-SAGE survey to estimate the correlation between SRH, as well as other health related complications reported from the survey and subsequent mortality.

2.1.2 Study area

2.1.2.1 Physical geography of the Study area

The Navrongo Heath Research Centre (NHRC) is located in the Kassena-Nankana District (KND) of the Upper East region of Ghana which covers about 1675 square kilometers of land. Its geographical location lies between latitudes $10^{o}30'$ and $11^{o}00'$ north of the equator and between longitudes $1^{o}00'$ and $1^{o}30'$ west of the zero meridian (65). The district is a rural setting with agriculture being the foundation of the area's economy and income.

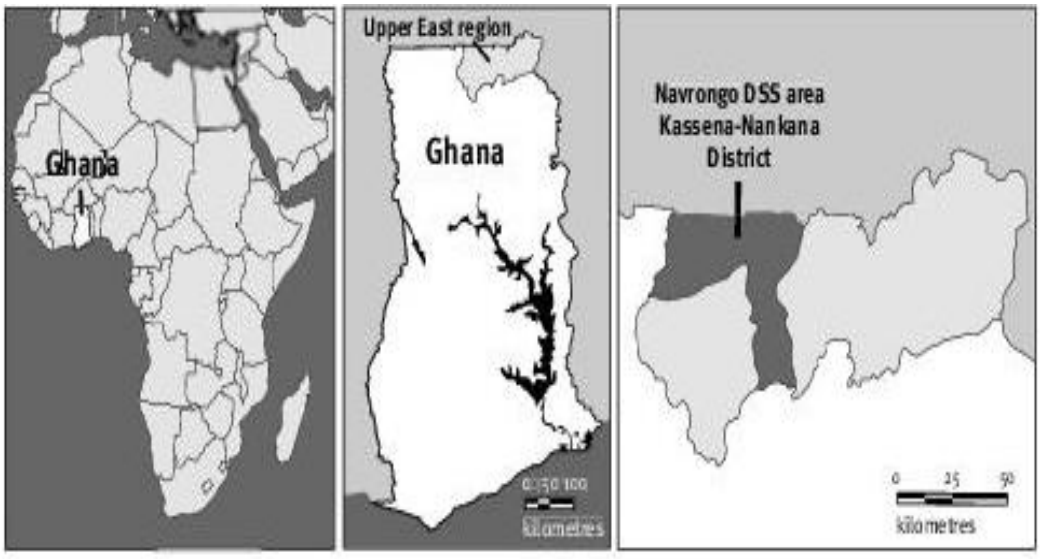


Figure 1: Location of Navrongo in Upper East Region of Ghana. Picture adapted from INDEPTH Network website under site profile of Navrongo DSS site

2.3.2 The Navrongo Health and Demographic Surveillance System (NHDSS)

The NHDSS, like many other demographic surveillance systems (DSS), is a longitudinal household registration system which started in July 1993 mainly to support research activities of the Centre. It is also used as a platform for other nested studies by providing baseline and longitudinal socio-demographic information as well as relevant sampling frame.

2.3.2.1 **Study on Global AGEing and Adult Health (SAGE)**

SAGE is multi-country study aimed at collecting longitudinal information on health and wellbeing of adult population and ageing process. Data from adults aged 50 years and above plus few sample of young adult aged 18 years and above (collected for

comparison purpose) from six countries were collected, the countries participated includes Ghana, Russian Federtion, India, Mexico and South Africa.

2.3.3 Demographic characteristics of NHDSS

The 2010 annual report indicates that the total population recorded was 151,955 representing an increase of 2.91% over the 147,536 population that was recorded in 2007. The data also indicate a slight decrease in total female population from 53% in 2007 to 52.3% in 2010 giving a sex ratio increase from 89 males per 100 females in 2007 to 91 males for every 100 females in 2010. The populationhas been steadily aging and there has been a decrease in the population aged less than 15 years from 38% in 2007 to 36.4% in 2010, while those older than 65 years increased from 4.7% in 2007 to 6.8% in 2010. From 2007 and 2010, a stable crude death rate and a slight decrease in crude birth rates in the population was observed. The crude death rate (CDR) remained almost the same from 10.4 to 10.1 deaths per 1000 population in 2007 and 2010 respectively, while crude birth rate (CBR) decreased slightly from 26.2 births per 100 population to 25.4 births per 1000 population in 2010.

2.4 Sampling strategy

As this is the secondary data analysis, no sampling method was undertaken except we included all participants who completed interview in the primary study. The primary study used single stage simple random sampling technique in drawing a sample size from the core HDSS database. The sample was restricted to only persons who were 50 years of age or above living in the HDSS area. A total of 6074 individuals were selected

to participate in the study. Data collection was integrated into the routine HDSS census data collection in January 2007.

2.4.1 Study population

All people aged 50 years and above by December 2006 who were registered in NHDSS and participated in SAGE survey were our study population.

2.4.1.1 Inclusion/Exclusion criteria

All people aged 50 years and above by December 2006 whose status by end of 2010 was recorded in the NHDSS database either as died, migrated or alive and participated into 2007 INDEPTH-WHO SAGE survey were the main inclusion criteria for our study.

2.5 Tools and Instruments

Two data sources were used in our study. Core NHDSS data collection tools were used in the collecting of basic demographic and household characteristics and standardized WHO SAGE summary version questionnaire used in survey data collection were utilized to extract adult heath related variables.

2.6 Detail of measurements (outcome and explanatory variables)

The main outcome of our study was death coded as binary variable . Three different type of exposure variables were used in our analysis namely, individual level exposure, household level exposure and variables which provide information on adult heath.

2.6.1 Individual level variables

Gender**,** education level (no education, primary/junior secondary, Senior secondary and tertiary)**,** Marital status (never married, married, separated/divorced and widowed), date of birth, age, participant's status (died/alive/migration), date of death and place of death (hospital,heath center,home,traditional healer's home, other).

2.6.2. Households level variables

Location or residency (rural, urban), family size**,** relation to household head , house hold characteristics such as source of drinking water, toilet facility, main material of roof, main material of the wall, type of cooking and lighting source, durable assets ownership variables includes bicycle, electricity, car and motor bike**.** and ethnicity (kasem, nankan,Buli, other).

2.6.3. Creation of socio-economic status (SES)

Socio-economic status index was generated by combining durable assets and other household characteristics variables that were later grouped into one variable (index), categorized into five quintiles to serve as proxy for household wealth. The method of Principal Components Analysis (PCA) was applied. This is a multivariate statistical technique of combining many correlated variables into a smaller number of underlying factors. This method has widely been used and recommended (66-68) despite its minor limitations. In mathematical terms for individual j, the assest Aj can be represented as;

$$A_j = \sum_m \left[W_m \frac{(a_{jm} - a_m)}{S_m} \right]$$

Where

a_{jm} is the value of asset m for household j ,

a_m is the sample mean ,

S_m is the sample standard deviation,

W_m is the weight associated with component and

Aj is the asset index for individual j .

For variables with many categories, a dichotomized version of variable with high and low socio-economic values was created (Table 1). These variables included drinking water sources, toilet facility, main material of roof, main material of wall, type of cooking fuel, and lighting source. We include in the high value category households with any type of toilet facility without considering the nature or material the toilet is built with. This is because of the nature of the study area where majority of the households reported not having any formal toilet facility. Re-categorizations are as shown in table1.

Table 1: Dichotomization of household characteristics.

Variable	High value (coded as 1)	Low values (coded as 0)
Drinking water source	Buying water**:** taps, tanks, hawkers and bottled/satched. Piped water into residence or compound. Well water on residence or compound.	Well water**:** Unprotected public well, bore hole Surface water**:** stream, river, pond and other
Toilet facility	Any type of toilet facility : flush toilet, pit toilet/patrine and	No facility/bush/field

	ventilated improved pit toilet	
Floor material	Polished wood, tiles, terrazzo, cement and carpet	Mud, sand, gravel , wood planks and other
Roof material	Tiles, zinc/iron sheet	Mud roof, grass/thatch and other
Wall material	Cement blocks, iron sheet (zinc)	Mud, wood/board, grass/stocks
Type of cooking fuel	Kerosene/paraffin, gas, electricity or charcoal	Firewood, animal waste, crop residual/saw dust and other
Lighting source	Gas, electricity, solar and candles	Kerosene/paraffin, firewood and other

Other variables included, animal ownership such as horse, pig, rabbit, dog, donkey, goat, sheep and cattle. Durable assets such as fan, bicycle, radio, tv, gas stove, iron, sewing machine, telephone, dvd, mobile phone, refrigerator, tractor, grind mill and kerosene stove.

2.6.4 Assets with missing values and those with very low counts

In creation of SES index, few variables such as ownership of tractor, grind mill, computer , kerosene stove, horse and rabbit that had very low counts (owned by less than 0.8% of all population) were excluded. Another issue raised was missing values in some house hold assets variables which ranged between 1.05% to 1.33% of all samples. Since the missing values were across different rows then exclusion of all

individual with at least one missing house hold characteristics variables would result into higher reduction of our sample size, and hence replacing all missing values with the mean of the individual variables was enforced to overcome this problem. Since the percentage of missing variables was very minimal it was deemed unlikely to have any significant impact on the overall distribution of wealth even though it can be a limitation.

2.6.3 Health variables

Life interference due to functional limitations*:* This was single question aimed at assessing individual overall life interference as results of difficulties s/he had due to heath conditions. The question "Overall, how much did these difficulties interfere with your life?" with five scores (1-None, 2-Mild, 3- Moderate, 4- Severe and 5- Extreme/Cannot do) was used. Prior to this question, the respondents were required to respond to several other questions aimed at assessing heath conditions, emotional problems and physical functioning over past 30 days. The questions asked included ; how much difficulty did participant have with work or household activities; level of difficulty in taking care of household responsibilities; difficulty in joining in community activities such as festival and religious activities; difficulty in concentrating in doing something for 10 minutes; difficulty in walking a long distance such as 1 Kilometre, difficulty in day to day work, difficulty to get dressed, and how much had he/she been emotionally affected by his/her health conditions.

Overall life satisfaction**:** As above with regards to life interference due to functional difficulties question, the participants were also asked to score their life satisfaction. The

question used was "Taking all things together how satisfied are you with your life as a whole these days? "Five scores were provided in the questionnaire as: 1-very satisfied, 2-satisfied, 3- neither satisfied nor dissatisfied, 4-dissatisfied, and 5-very dissatisfied.

Self rated heath (SRH): Here the respondent was asked to rate his/her own health in response to the question "*In general, how would you rate your health today*?" Response categories were 1-very good, 2-good, 3-moderate, 4-bad and 5-very bad.

Other heath related variables included were quality of life and whether the participants had enough money to meet their demands (with response options as completely, mostly, moderate, a little and none at all). We combined 'completely' and 'mostly' to generate a new level as 'mostly/completely' since only 5 participants (approximately 0.1%) indicated 'completely'.

2.7 Quality control

NHRC effectively applied the use of Standard Operating Procedures (SOP's) in daily field data collection and data entry activities. This is one of the best ways of ensuring quality control. Moreover, NHRC uses Household Registration System software (HRS), a system designed specifically for data management purpose of longitudinal population data. The HRS software has built in codes that enable interactive logical checks for inconsistencies during the data entry process as well as providing friendly graphical user environments for error sheet printing for unattended mistakes during data entry .

2.8 Data management and software for data capture.

In all data management disciplines the NHDSS utilizes House Hold Registration System version 2 (HRS2) designed specifically to facilitate longitudinal population-based surveillance through data collection, data management and analysis by computing demographic rates. It is relational database system software programmed in Visual Fox-Pro language. A user-friendly interface facilitates the overall data management process and enables easy data entry and editing, report print out and updating individual and household events on routine basis.

The software also has built-in security with different level of privileges to different users. This makes it easy to track any major changes or discrepancies caused by different users knowingly or unknowingly (audit trail). Other additional built in features include inconsistency checks which ran interactively during data entry or data editing and further ensures overall data quality.

Different structured query languages (SQL) was used to extract only required variables and assist to create dummy tables. The dummy tables were accessed and loaded to stata using open database connectivity (ODBC).

2.9 Data analysis

Stata IC Version 11.1 was used for data cleaning and analysis. Analyses were aligned with the overall research questions through specific as described objectives below.

2.9.1Description of the characteristics of older adults in the Kassena-Nankana district.

Descriptive analysis was performed to provide an overview of the study participants. We presented the tabular description of frequency with percentages for discrete variables and means with standard deviations for continuous variables. Descriptive statistics were also stratified on outcome (Died or Alive)

2.9.2 Assessment of the levels, trends and patterns of older adult mortality in the Kassena Nankana district during 2007-2010

Mortality rates (defined as deaths over person years in a specified period (follow-up)) were calculated. Overall, specific age group; specific ethnic, SRH, wealth and other stratified mortality rates were computed.

$$\text{Mortality rate} = \frac{\text{Death over specified period of followup}}{\text{Person years (PY) over specified period of followup}}$$

Temporal mortality trends were investigated by plotting mortality rates by year for the 2007 to 2010 period, and by using the chi-square test of trend.

2.9.2Identification of Mortality determinants and investigation of the correlation between self-reported health and subsequent mortality in older people.

Survival (time to event) analysis was used. Time were right-censored at end of 2010, if the information about their survival time is not complete. Three conditions for censoring included;

a) If the participant migrated out of the study area before the end of the study period i.e. 31 December 2010.

b) If the participant died after end of the observed period.

c) If the participant did not die during the observation period ((1 January 2007to 31 December 2010)

The Kaplan-Meier was used to estimate the overall survival distribution, and further stratified by other variables, such as sex, SRH, race, ethnicity, marital status in order to compare survival in various socio-demographic groups. The Log-rank test was used to calculate whether or not there was significant difference in survival of the different levels of covariates. The null hypothesis tested for no difference in the survival curves across different levels of the exposure variables.

Cox proportional regression hazards models

The log-rank test cannot accommodate many exposure variables at once, therefore the Cox Proportional Hazard model approach was also used to analyze the independent predictors of mortality as well as for the final multivariable analysis. The model assumes the ratio of hazard rate at time 't' versus baseline hazard is an exponential function of the covariates;

$$\frac{h(t)}{h(t_0)} = e^{(BTxi)}$$

Where, $h(t_0)$ is the baseline hazard, B is the regression coefficient matrix and x_i are covariates.

Those predictors found to be significant in the univariate model (p-value < 0.10) were included in the final multivariable model along with any potential confounders.

2.10 Model adequacy

The adequacy of the model fit was investigated by testing the proportional hazards assumption. We used the overall Schoenfeld residual test as well as influence of individual variables. A log-likelihood test was further used to see if variable could be dropped from multivariable model or not.

2.11 Ethical clearance and research participant protection

Access to the secondary data used in our study was granted by NHRC, permission and approval of the research to be conducted was issued by the University of the Witwatersrand Human Research Ethics Committee with (clearance certificate number **M111152)**, as well as by Institutional review board of the NHRC (ethical approval number **NHRCIRB128)**. The reports from primary study shows that all participants were asked to voluntarily participate with signed informed consent stating the aim, purpose, possible risks and benefits of participating into the study. Participants were free to withdraw from the study at any time. The use of identifier in our analysis instead of personal identity was applied to ensure participant's confidentiality.

3.0 Chapter three

3.1 Results

Out of 6074 drawn, 4584 people participated, thus the response rate was 75.5%. The major reason for non-participation was the inability of the interviewers to meet the targeted respondent after at least three visits to the household. Other reasons included migration, death, and inaccurate information. People who were interviewed were followed up for 4 years from 2007 to 2010 through routine demographic surveillance. By end of 2010 a total of 601 (13.1%) died, 147 (3.2%) migrated out of the DSS area and the remaining about 3983 (83.7%) were still alive as shown in figure 2 below.

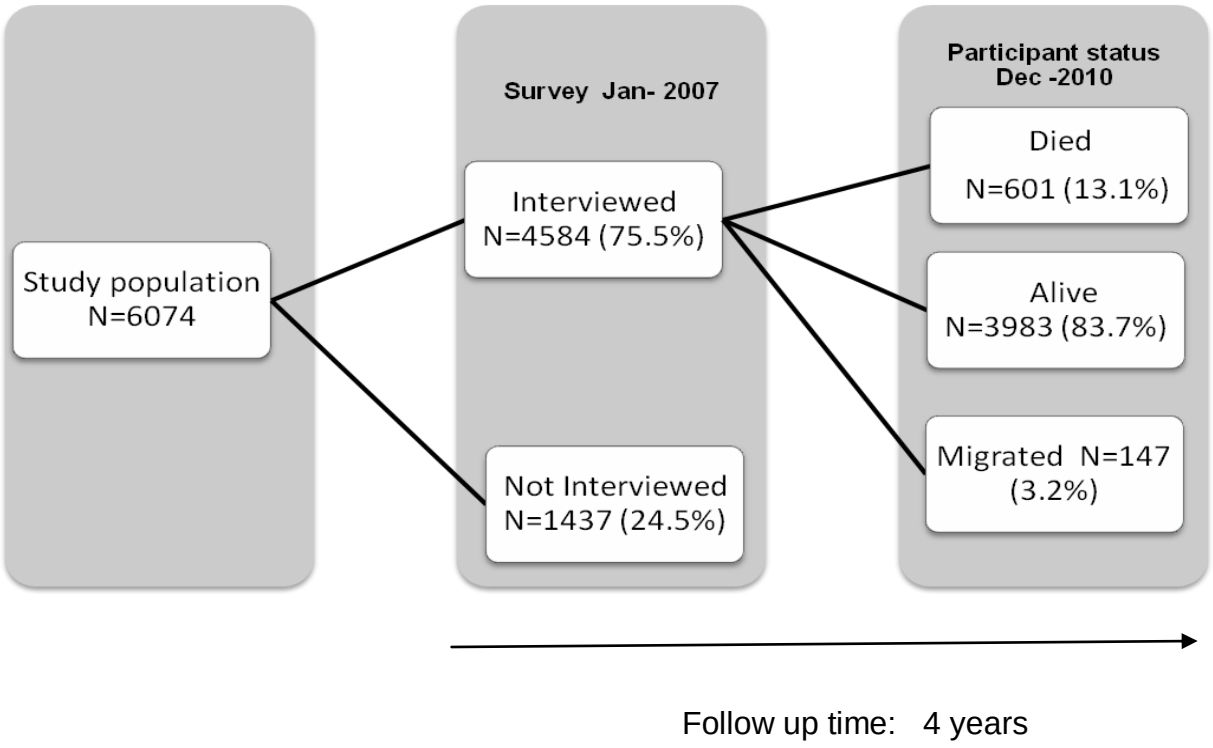


Figure 2: Breakdown of the number of study participants.

3.1 Demographic characteristics of study participants

Table 2 shows the descriptive statistics of the study participants stratified by survival status (either dead or alive) at the end of the study period. The data indicate that the participants who died were older than those who were still alive; the mean age of those who died was higher (67.3 years) compared to 61.9 years for those who were still alive. Higher mortality was observed among rural residents 551 (13.2%) compared to urban residents, of which 48 (12.1%) had died. In terms of gender, 308 (17.2%) males had died during the four years period compared to 292 (10.4%) females. The data also revealed that higherproportion of those who had no education died 507 (17.6%) compared to those who had at least primary level of education 93 (9.0%).

People who were married at the time of interview had lower mortality 274 (10.0%) compared to 326 (17.6%) for those who were either single. Lower mortality was also observed in the household were the head (or language spoken in the household) was of minor ethnic groups 16 (10.4%), than the two major ethnic groups in the area, Nankam 241 (11.7%) or Kassem 259 (13.0%). Those in the lower age group (50-64 years) had lower mortality 223 (7.8%), than the older age groups - 206 (11.8%) for 65-75 years age group and 171 (31.0%) for those 75 years and above. There was no statistical difference in the mean number of people per house hold between participants who were alive and those who died, 6.5 and 6.3 respectively.

Table 2: Demographic characteristics of older people at NHDSS of northern Ghana

Variable	Category	Alive n(%)	Dead n(%)
House hold size		$\bar{x}$=6.5 , SD=4.6	$\bar{x}$=6.3 , SD=4.0
Age (mean,SD)		61.0 , 18.4	67.3, 10.1
Residence	Rural	3633 (86.8 %)	551 (13.2 %)
	Urban	349 (87.9 %)	48 (12.1 %)
Sex	Male	1481 (82.8 %)	308 (17.2 %)
	Female	2502 (89.6 %)	292 (10.4 %)
Age category	50-64	2649 (92.2 %)	223 (7.8 %)
	65-74	953 (82.2 %)	206 (11.8 %)
	75 and above	381 (69.0 %)	171 (31.0 %)
Marital status	Single / living alone	1523 (82.4 %)	326 (17.6 %)
	Married	2460 (90.0 %)	274 (10.0 %)
Education level	Never/No education	3041 (85.7 %)	507 (14.3 %)
	At least primary level	942 (91.0 %)	93 (9.0 %)
Head Ethnicity/Ethnic language spoken by household	Kassen	1738 (87.0 %)	259 (13.0)
	Nankan	1819 (88.3 %)	241 (11.7%)
	Other	138 (89.6 %)	16 (10.4%)
SES	Most poor	774 (84.4%)	143 (15.6 %)
	More Poor	813 (86.6%)	126 (13.4 %)
	Poor	777 (86.8%)	118 (13.2 %)
	Less poor	809 (88.2%)	108 (11.8 %)
	Least poor	810 (88.5%)	105 (11.5 %)

3.2 Social and healthcharacteristics of study participants

Social and health characteristics of study participants are shown in Table 3. The data indicate that a higher proportion of the respondents who rated their heath as bad or very bad during the 2007 survey died (28.4%), compared to 15.8% for moderate, 10.2% for good and about 9.2% for very good category.

People who felt satisfied with their daily life had lower mortality (10.4%), than those at the middle who were neither satisfied nor dissatisfied (14.6%) and even those who were dissatisfied (29.9%). When using overall functional difficulties due to health conditions, 102 (37.8%) of people had died out of those who had severe or extreme inability conditions as compared to other groups of none 54 (9.5%), mild 213 (9.9%), and moderate 208 (15.3%).

Table 3: Social and Heath characteristics of older people at NHDSS of northern Ghana

Variable	Category	Alive, n (%)	Dead, n (%)
Self rated heath (SRH)	Very good	373 (90.8%)	38 (9.2%)
	Good	2035 (89.8%)	232 (10.2%)
	Moderate	1411 (84.2%)	265 (15.8%)
	Bad/Very bad	164 (71.6%)	65 (28.4%)
Overall quality of life	Very good	238 (89.1%)	29 (10.9%)
	Good	1986 (89.7%)	228 (10.3%)
	Moderate	1554 (86,4%)	245 (13.6%)
	Bad/Very bad	204 (67.5%)	98 (32.5%)
Functional Assessment/abilities	None	516 (90.5%)	54 (9.5%)
	Mild	1929 (90.1%)	213 (9.9%)
	Moderate	1148 (84.7%)	208 (15.3%)
	Severe/ Extreme cannot do	168 (62.2 %)	102 (37.8%)
	Missing	221 (90.6 %)	22 (9.4%)
Overall satisfaction	Very satisfied/ Satisfied	2697 (89.6%)	314 (10.4%)
	Neither satisfied nor dissatisfaction	1025 (85.4%)	175 (14.6%)
	Dissatisfied / Very dissatisfied	258 (70.11%)	110 (29.89%)

Enough money to satisfy your needs	Mostly/completely	84 (90.3%)	9 (9.7%)
	Moderate	913 (91.0%)	90 (9.0%)
	A little	2917 (86.0%)	474 (14.0%)
	Not at all	68 (71.6%)	27 (28.4%)

3.3 Place of death of older people.

The data reveal that the majority of older people died at home and very few at the hospital or heath centers. However when stratified by residence it was indicated that low proportion of those who lived in rural areas died at hospital (10.71%) compared to 29.17% of those who live in urban areas (Figure 3).

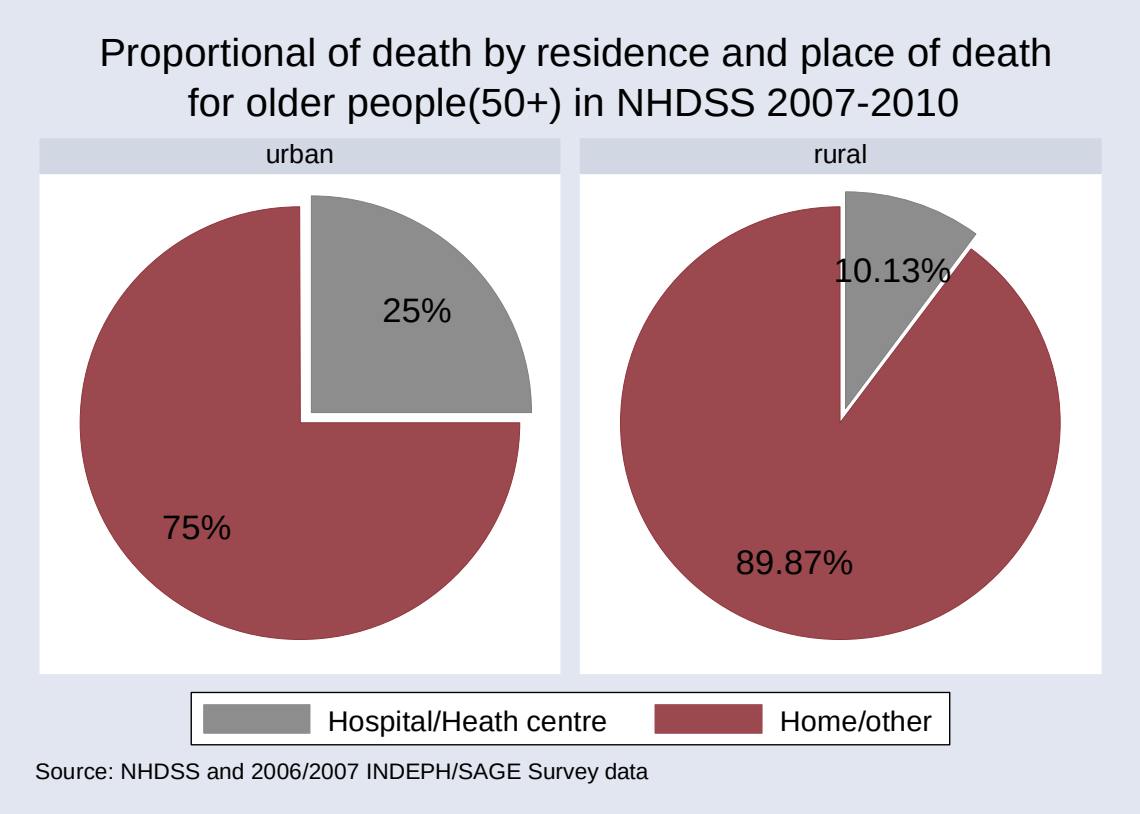


Figure 3: Mortality proportional by place of death and residence

3.4 Wealth proportions of older people of NHDSS by place of death.

Apart from urban/ rural mortality differences, the data also indicate wealth differences in terms of where the older people die. A higher proportion of older people with higher socio-economic status (SES) were more likely to die at the hospital or health center as compared to those with lower SES (Figure 4). Of those who died at the hospital, about 37% were of least poor and 17.8% were of most poor wealth index. The corresponding proportions were 14.8% for least poor and 24.7% of most poor for those who died at home.

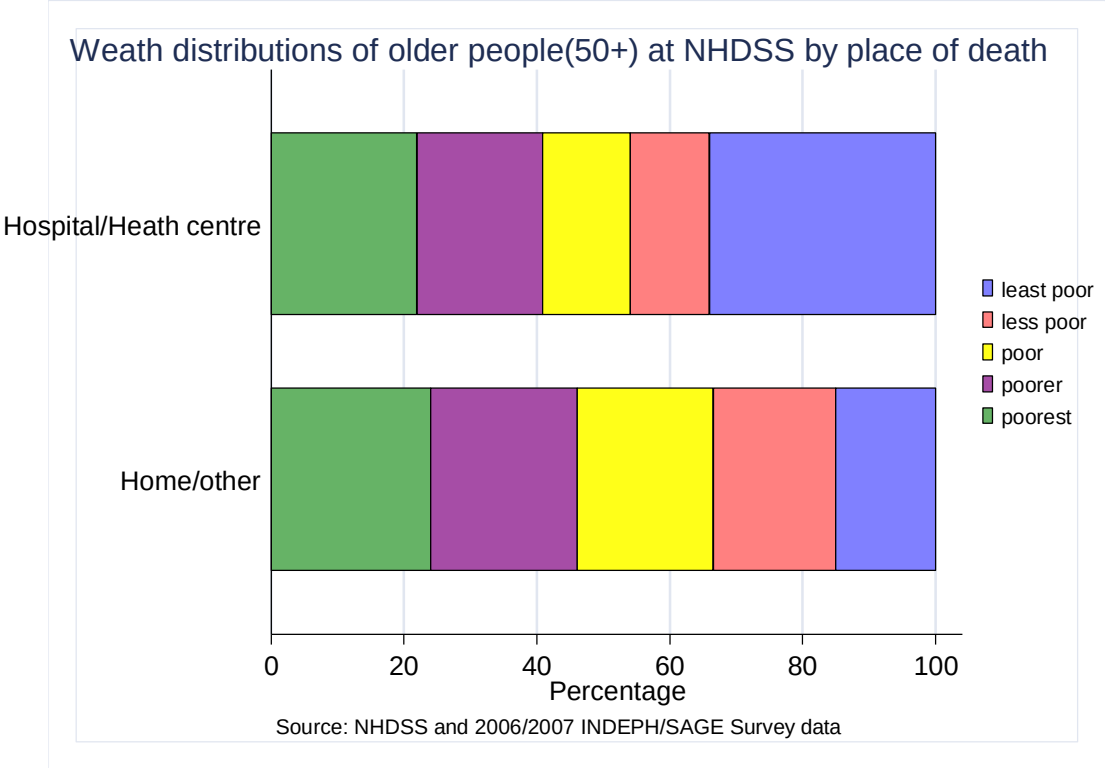


Figure 4: Wealth distributions for older people (50+) of NHDSS by place of death

3.5 Survival probabilities.

Kaplan-Meier survival curves were plotted to observe the survival probabilities for different groups. As overall survival summary statistics of this cohort, all people 4584 contributed to 16002 person years at risk with mean time of 3.5 years, the corresponding mean time for those who deceases were 0.13 years. We noted significant differences in survival between older males and females, with females having higher survival than males (log rank test p value <0.001). For example, within only 2 years of follow-up, 10% of males died compared to only approximately 5% of their female counterparts; and by the end of the study period only about 74% of older males had survived compared to more than 85% of older women (figure 5).

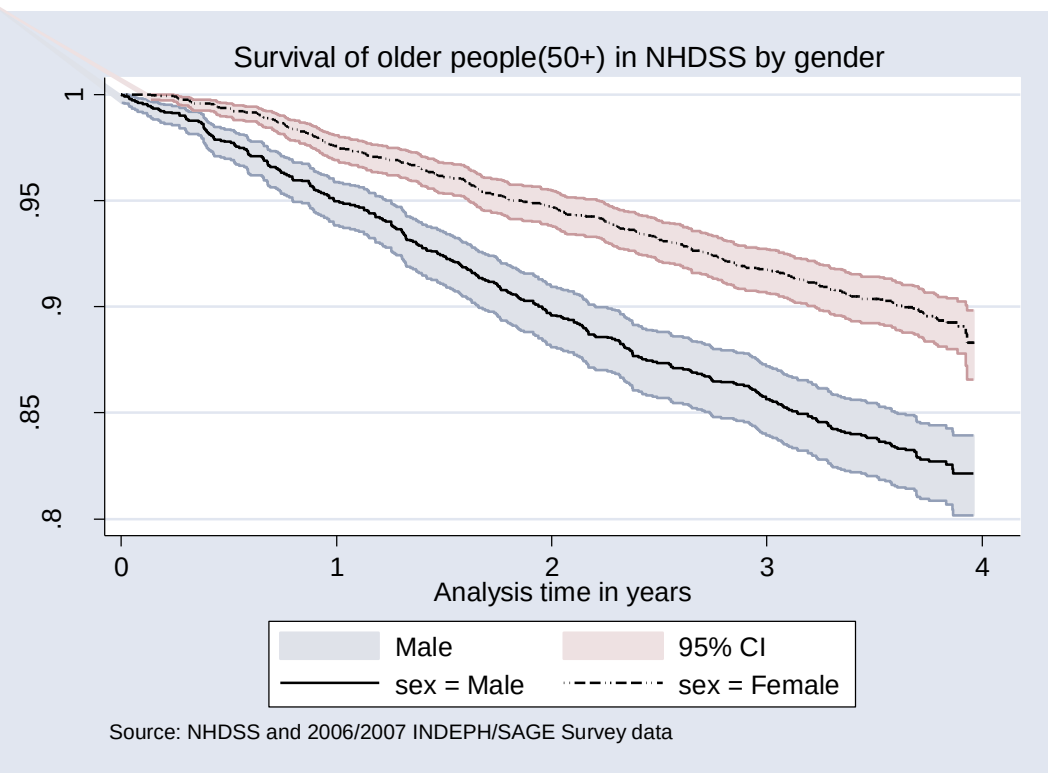


Figure 5: Kaplan-Meier survival curves for older people (50+) of NHDSS by gender

Figure 6 also shows a survival difference by SRH; whereby only 5% of those who rated their health as very good died by the end of the four year period. For the bad/very bad group survival was very poor with about 30% deaths within the period. The log rank test introduced to determine the survival difference in SRH groups indicates a significant difference among different SRH categories ($p<0.001$).

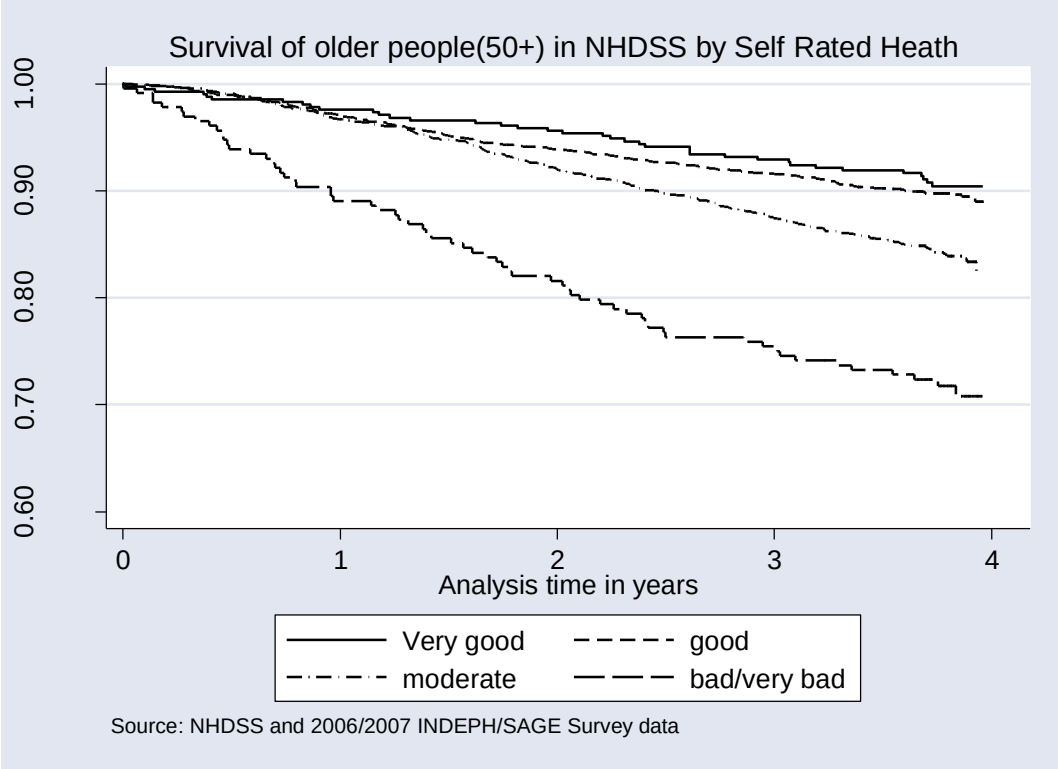


Figure 6: Kaplan-Meier survival curves for older people(50+) by SRH

Appendix 4 is the plot of survival probability by functional assessments; the curve indicates that by end of 4 years only 60% of those with severe or extreme condition survived as compared to more than 90% for those with no functional difficulties.

We also ploted the survival curves by overall health satisfaction. Our curves also indicate that poor survival was also observed among older people who were dissatisfied with their life (Appendix 5). Lastly, survival plots indicated that people who were in the most poor and more poor wealth categories had low survival compared to those of least poor. The Log rank test further revealed that the difference was not statistically significant at p=0.91.

3.6 Level and patterns of older mortality at NHDSS area of northern Ghana

During the four year period the 4584 participants contributed a total of 16,002 person years of observation (out of those who died 1 person was excluded from the final analysis due to data error). The data indicate an overall mortality rate of 37.50 deaths per 1000PY (95% CI 34.5, 40.6). The yearly rates indicate that 2008 recorded the highest mortality rate of 43.34 deaths per 1000PY (95% CI 37.37, 50.00), whereas 2007 recorded the lowest rate of 30.55 (95%CI 25.09 , 36.86) death per 1000 PY (Table 4).

Table 4: Yearly mortality rates per person years of older people in NHDSS

Year	Number of deaths	Person-years (PY)	Mortality/1000PY	95% CI mortality rate/1000PY
2007	109	3567.535	30.553	(25.087 , 36.856)
2008	188	4337.895	43.339	(37.365 , 49.996)
2009	157	4137.645	37.944	(32.241 , 44.366)
2010	146	3959.036	36.878	(31.138 , 43.368)

Mortality rates varied significantly by gender; women had consistently lower mortality rates than men in all 4 years of follow-up (Figure 7). Overall, mortality was low in 2007, increased sharply in 2008, and declined thereafter. This pattern was the same for women; however, for men it is slightly different in 2010 as mortality increased.

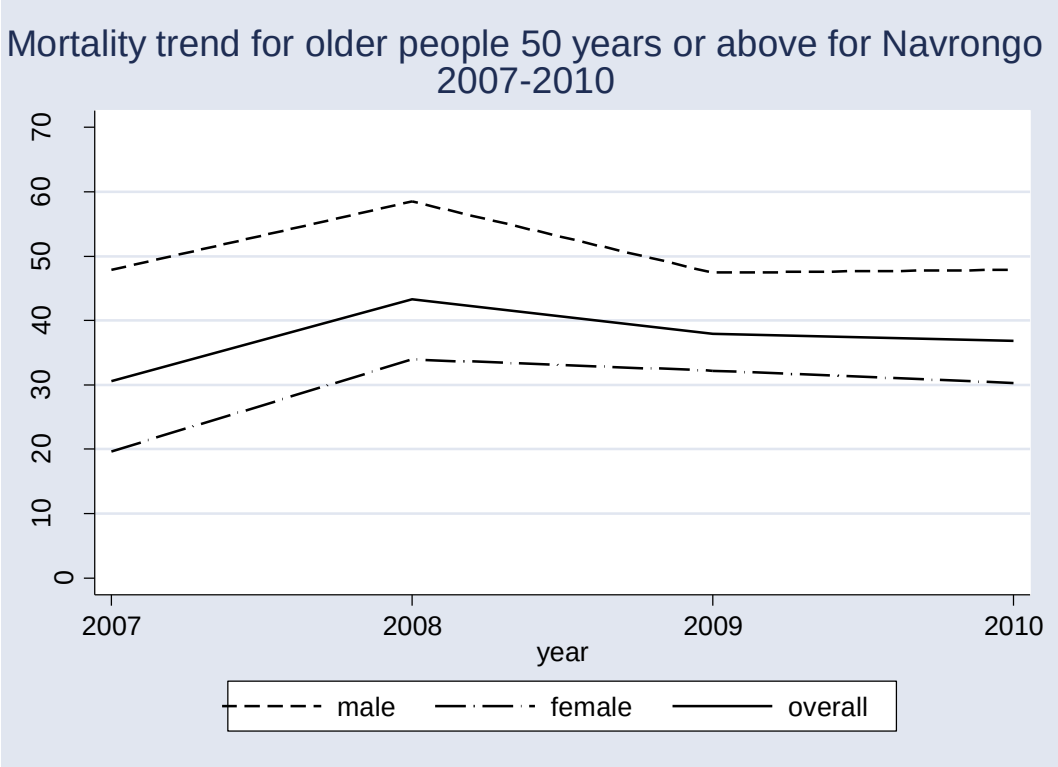


Figure 7: Mortality trends of Older adults (50+) for 4 years (2007-2010).

3.6.1 Mortality rates per different categories of exposure variable

In summary, higher mortality rates were observed in urban (37.69 deaths/1000PY) than rural areas (35.35 deaths/1000PY), in older people who never went to school (41.01 deaths/1000PY) than those who had at least a primary level education (25.39 deaths /1000PY), in those who were unmarried (52.00 deaths/1000PY) than married couples

(28.15 deaths/1000PY), and in those who rated their health as bad/very bad (90.07 deaths/1000PY) than moderate (45.66 deaths/1000PY), good (29.01 deaths/ 1000 PY) or very good (25.70 deaths/100PY).

Other categories with higher mortality rates included older people who were living in households with lowest social economic status (45.57 deaths/1000PY), those who felt dissatisfied with their life (93.82 deaths/1000PY) rather than satisfied (29.61 deaths/1000PY) and lastly were older than 75 years (98.59 deaths/1000PY), than 50-64 (52.10 deaths/1000PY), or 65-74 years (21.62 deaths/1000PY). Detailed mortality rates (with 95% confidence intervals and total number of death per specific category) and their respective person years, appear in Table 5.

Table 5: Mortality rates of older people (50+) for different categories of exposure variables for NHDSS of northern Ghana

Variable	Category	Death	Person Years	mortality rate/ 1000 PY	95% Confidence Interval
Self reported heath	very good	38	1478.34	25.70	(16.98 , 38.10)
	Good	232	7998.06	29.01	(19.42 , 41.65)
	Moderate	265	5804.05	45.66	(33.68 , 61.36)
	Bad/very bad	65	721.66	90.07	(72.37 , 110.63)
Satisfactions	satisfied	315	10640.00	29.61	(20.24 , 42.83)
	Neither satis. Nor Diss.	175	4182.15	41.84	(30.27 , 56.77)
	Dissatisfied	110	1172.40	93.82	(75.96 , 115.03)
Education level	Never	507	12339.84	41.09	(29.42 , 55.62)
	At least primary level	93	3662.28	25.39	(16.18 , 36.90)
Marital status	Single	326	6269.54	52.00	(38.84 , 68.19)
	Married	274	9732.57	28.15	(18.61 , 40.47)
Age groups	50-64	223	10313.51	21.62	(13.79 , 33.31)
	65-74	206	3954.07	52.10	(38.84 , 68.19)
	75 and above	171	1734.54	98.59	(80.46 , 120.52)
Residence	Urban	48	1357.79	35.35	(24.38 , 48.68)
	Rural	552	14644.32	37.69	(26.89 , 52.16)
Wealth quintile	Poorest	143	3138.09	45.57	(33.68 , 61.36)
	poorer	126	3290.66	38.29	(26.89 , 52.16)
	poor	118	3142.47	37.55	(26.89 , 52.15)
	less poor	108	3226.14	33.48	(22.71 , 46.34)
	Least poor	105	3204.76	32.76	(22.71 , 46.34)
Sex	Male	308	6080.87	50.65	(37.97 , 67.00)
	Female	292	9921.24	29.43	(19.42 , 41.65)

3.7 Predictors of mortality in older people of NHDSS (Unadjusted model)

In identifying predictors of mortality in older people, unadjusted Cox proportional hazard regression models were used. Hazard ratios, 95% confidence intervals (CI) and the respective p-values were calculated for individual variables as shown in Table 6. The univariate analysis showed that people in age groups 65-74 and 75 and above have increased risk of mortality (HR=4.58, 95% CI 3.76, 5.59) and (HR=2.40, 95% CI (1.99, 2.90) respectively, than those within 50-64 year age group (P<0.001). Gender is one of the predictors of mortality as older women were 41.8% less likely to experience mortality than older men (HR=0.58, 95%CI (0.49, 0.68); p<0.001).

The results also indicate that being married significantly reduces mortality risk. Mortality risks for married older adults is lower (HR=0.582, 95%CI (0.496, 0.684), p<0.001) than for those who were unmarried. Those older people who had at least a primary level of education were 38.1% less likely to die than those who never went to school (95% CI 0.45, 077; p<0.001). Using household by wealth quintiles as a proxy measure of socio-economic status, the data suggest a decreasing risk of mortality in wealthier households. Individuals who live in the least and less poor households had HR=0.72 (95%CI 0.56, 0.93) and HR=0.74 (95% CI 0.57,0.94) which was significant at p=0.010 and 0.016 respectively, compared to the most poor socio-economic quintiles.

Other significant predictors include, life dissatisfaction HR=3.18 (95%CI 2.56, 3.95) compared to very satisfied, overall interference in life as a result of difficulties due to heath conditions; people who were in the severe/extreme groups were 4.78 95% CI(

3.44, 6.65), moderate 1.65 95%CI (1.22 , 2.22) higher risk of dying compared to those who indicated none.

Looking at the associations of SRH to older mortality, the univariate model showed that the individuals who rated their heath bad and moderate were at higher risk of mortality HR=3.51 (95%CI 2.35 , 5.24; p=0.001) and HR=1.77 (95%CI 1.26 , 2.49; p<0.001) respectively than those with very good SRH groups. Other predictors such as , household size, place of residence and head ethnicity/ethnic language spoken by household were not significant predictors of mortality in older adults in the univariate model.All variables that were significantly associated with mortality in the unadjusted model(P<0.05) were included in the adjusted model, likelihood ratio test was further detects unimportance of including education level into multivariable model thus it was excluded from the final model.

Table 6: Unadjusted/Adjusted Cox model for predictors of older people(50+) mortality in NHDSS.

	Univariable Analysis			Multivariable Analysis	
Variable	**HR (95% CI)**	**P value**		**HR (95% CI)**	**P value**
House hold size	0.99 (0.96 , 1.01)	0.263			
Age (years)	1.003 (1.002 , 1.004)	**<0.001**			
Residence: (reference Urban)					
Rural	1.06 (0.79 , 1.43)	0.679			
Sex (reference: Male)					
Female	0.58 (0.49 , 0.68)	**<0.001**		0.40 (0.34 0.49)	**<0.001**
Age group (reference: 50-64)					
65-74	2.40 (1.99 , 2.90)			2.03 (1.68 2.46)	**<0.001**
75 and above	4.58 (3.76 , 5.59)			3.27 (2.66 4.02)	**<0.001**
Marital status (reference: Single)					
Married	0.54 (0.46 , 0.63)	**<0.001**		0.41 (0.34 0.50)	**<0.001**
Education level (reference Never)					
At least primary level	0.62 (0.49 , 0.77)	**<0.001**		α	
Wealth index (Reference: poorest)					
Poorer	0.84 (0.66 , 1.07)	0.156		0.89 (0.70 1.14)	0.374
Poor	0.82 (0.64 , 1.04)	0.106		0.89 (0.69 1.15)	0.361
Less poor	0.74 (0.57 , 0.94)	**0.016**		0.86 (0.67 1.10)	0.253
Least poor	0.72 (0.56 , 0.93)	**0.011**		0.76 (0.59 0.97)	**0.031**

Table 6 continue

Self Rated Heath (reference: Very good)					
Good	1.13 (0.80 , 1.59)	0.481		1.01 (0.72 1.43)	0.954
Moderate	1.77 (1.26 , 2.49)	**0.001**		1.41 (0.99 1.99)	0.051
Bad/Very bad	3.51 (2.35 , 5.24)	**<0.001**		2.36 (1.57 3.54)	**<0.001**
Ethnicity (reference: Kassem)					
Nankan	0.89 (0.75 , 1.06)	0.195			
Other	0.79 (0.48 , 1.31)	0.361			
Functional assessment/ability *(reference : None)*					
Mild	1.05 (0.78 , 1.42)	0.746			
Moderate	1.65 (1.22 , 2.22)	**0.001**		β	
Severe Extreme/cannot do	4.78 (3.44 , 6.65)	**<0.001**			
Overall satisfaction *(reference: Very satisfied/satisfied)*					
Neither satisfied nor dissatisfaction	1.42 (1.18 , 1.71)	**0.001**		β	
Dissatisfied/ Very dissatisfied	3.18(2.56 , 3.95)	**<0.001**			

β Excluded because they were significant correlated with self rated heath (SRH)

α Likelihood ratio test indicates include this variable doesn't improve the model

3.8 Predictors of mortality and association between (SRH) and older mortality in older people (50+) of NHDSS (adjusted model)

In the adjusted model, female (HR=0.40; 95%CI 0.34 , 0.49; p<0.001), being married (HR=0.41; 95%CI 0.34 , 0.50; p<0.001), living in household with least poor social economic groups (HR=0.74 95%CI(0.59 , 0.97); p=0.031) were still significantly associated with mortality risk reduction (Table 6). The multivariable results also indicated an elevated mortality risk for older ages. People aged 75 years and older and those aged 65-74 age groups had 3.27 95%CI (2.66, 4.02) and 2.03 95% CI (1.68 , 2.46) higher risk of mortality than those aged 50-64 years.

The multivariable model also reveals a continuous significant higher mortality risk for individuals with bad SRH (HR =2.36 (1.57 3.54); p<0.001 than those with very good. Although older people who rated their health as moderate show an increased risk of 41% in adjusted model, the reduction was not significant in the adjusted model (HR 0.59; 95% CI 0.99 , 1.99).

4.0 Chapter 4

4.1 Discussion

The objectives of this study were to describe the social demographics of older adults, identify the predictors of mortality in older people, assess the levels and patterns of mortality, and investigate the association between self-reported heath and subsequent older mortality in older people of 50 years and older living at Kassena-Nankana district of northern Ghana from 2007 to 2010.

4.1.1 Predictors of older adult mortality at NHDSS

In this part, “increasing in age, male sex, living in house with poor socio-economic status, poor self- rated heath, and single marital status” significantly increases risk of mortality. However, neither household size, residence nor Ethnicity of head/ethnic language spoken by household are significant predictors for older mortality. Our findings on age, sex, life satisfaction as predictors of older mortality are consistent with other studies (26, 27, 53, 54, 69). Mortality predictive ability of marital status had inconclusive results in a number of studies (69-73) , a study by Jotheeswaran found no significance difference (68). Whereas, multiple others indicated a significant evidence of the association between marital status and subsequent mortality and thus concluded that living alone or being single marital increases risk of mortality. This study supports many others indicating reduced mortality risk for older married couples compared with unmarried participants (70-73).

When investigating effect modification between gender and SRH, some studies have indicated no gender difference in SRH (74, 75), others suggest a significant interaction between different age groups with SRH (54). No significant interaction in the effect of gender or age group and SRH on mortality were noted in our study possibly due to age difference. Unlike this study where mean age was 62 years, in Sargent's study (54), the mean age was 84.9 years, the significant difference found may be attributed by including very old population.

Older people with at least a primary level of education showed a reduced risk of mortality compared to no education in the univariable model, however its significance diminishes when adjusted by sex, marital status, age, SRH and socio-economic status. Like in this study, many other studies had found that education status was not significant mortality predictor for older people (26, 69, 76). One study suggested a small education difference among older population as a major reason (76), the same reason can also be applicable in this study population since the majority study participants (more than 77%) had no formal education.

Life dissatisfaction and life interference due to function difficulties were associated with elevated mortality risk in older people. Univariable analysis indicated that, older people with poor life satisfaction or high life interference due to functional difficulties were more likely to rate their health badly. However, these two variables were not included to our adjusted model as they were strongly correlated with SRH.

4.1.2 Level and Pattern of Older Mortality

The estimated overall mortality rates for the entire study population was 37.50 deaths per 1000 PY. This rate is lower than to other African countries with similar settings. For example, a study in Burkina Faso found an overall older mortality of 55.8 (7), where as a study in Botswana the rate was as higher at 110 death/1000PY(25). Possible reasons for lower mortality in Ghana compared to other African countries, may be attributed to the low prevalence of HIV (77, 78), availability of older social security programs, and health cost exemption schemes that Ghana practice (79).

Findings in this study concurs with previous studies suggesting gender and age mortality differences (8, 53, 69). Despite the overall low mortality rates, higher mortality rates were experienced in those over the age of 75 (98.6 death/1000PY) than those of 50-64 and 65-74 age groups with rates of 52.1 and 21.6 death/1000PY, respectively.

During the four years period (2007-2010), older males experienced constant higher mortality rates than older females, single marital status experienced about two times higher mortality rates than married couples. This information may alert on group specific intervention rather than considering overall population. The use of secondary data limits from further investigate highest peak of mortality observed in year 2008 for both genders, this finding may prompt for a need for further research.

4.1.3 Association between SRH and Subsequent Older Mortality

The study also demonstrates that the way older people rate their heath strongly predicts subsequent mortality outcome. Our findings of SRH as a significant predictor of older mortality replicates the findings fromother studies (26, 48, 49, 51-56). When adjusted by other social demographic factors after 4 years period of follow-up, older persons who rated their heath as bad had a 2.36 significant higher risk of dying compared to those who rated their heath as very good. The results also confirm the mortality predictive ability of SRH in shorter period of 4 years as supported by Benyamin(58). It is however, contrary to what had been suggested by Vuolisalmi (49) who indicated significant association in longer term of 10 to 20 years only. This study further reveal the importance of integrating the SRH into routine census. Its simplicity in measurement, consistence and accuracy in predicting mortality provides a remarkable hope and alternative to unattained expensive heath diagnosis in Africa.

4.1.4 Older Survival and Psychosocial Factors.

Survival in older people is highly improved with less psychosocial problems. When investigating survival by life satisfaction, only 70% of those who indicated that they were dissatisfied with their life survived as compared to about 90% of those who were satisfied/very satisfied (appendix 5). Furthermore, a univariable analysis indicated a three-fold greater risk of death for older people who show life dissatisfaction than those not satisfied with their life. The results presented in our study concur with previous studies (26, 80-83) which demonstrated a linear association between life dissatisfaction and life interference as a result of function difficulties and mortality. Unlike these studies, most of which were conducted in the developed world, the current study was

conducted in an African setting and hence findings can also inform other developing countries with similar social and demographic contexts.

4.2 Limitations

The following limitations were noted in this study :

a) We were not able to report on cause of death evidence since information for analysis was not available.

b) Therimary study had reported a difficulty were observed in interviewing few older people in some few cases;

c) We couldn't evaluate the effect of Body Mass Index (BMI) in our analyses since height and weight were not included in the short summary version of the SAGE questionnaire. This may have limited our conclusion since BMI may have confounded the effect of other covariates to predict mortality as it were stated in other studies.

d) There may be a measurement bias in measuring SRH as there is evidence of difference in reporting in different demographic groups such as education level.

4.3 Conclusion

One of the major strengths of our study is the investigation of mortality in older groups, the group that has not been the main focus in most research conducted in SSA. The

other strength is the inclusion of different combinations of variables in assessing older mortality including demographic, social, heath, socio-economicand physical functioning variables.

The following are the major conclusions highlighted from our findings:

- 2008 recorded the highest mortality rate; overall mortality rates appear to be low and decrease over time. However there was higher difference in mortality magnitudes among different social-demographic groups such as sex.
- Age, gender male, single(or widowed/widower) marital status, living in household with low socio-economic status and lower education are among significant predictors of older mortality
- The findings confirm previous studies that show ability of SRH to predict subsequent older mortality.
- Other psychosocial factors, such as life dissatisfaction and life interference due to health related functional difficulties, emerge as strong predictors of older mortality.

4.4 Recommendations

The following recommendations are made based on the findings from the study. It is my hope that, if these recommendations are implemented, the survival of our older Africans will be improved.

- There is a need for special programs and interventions for improving perceived physical and social wellbeing, including improving conditions of living place,

enhanced older participation in community activities and decision making process.

- Considering its consistent results in predicting mortality in longitudinal aspects, our study notes the need to integrate SRH indicator variable into our routine demographic census data collection rather than just occasional surveys. A routine report which includes the SRH aspect may give a broader picture of health of the old and hence may prompt policy makers to make decisions necessary for intervention for improved survival.
- There is a need for multicenter analyse, involving the the pooling of data from all sites that conducted SAGE surveys. This will give a broader picture of health of the old people in the regions.
- Limited information on underlying factors for the higher 2008 mortality observed in different groups prompts the need for further investigation. In addition, we recommend further research in this neglected population.

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5.0 Appendices

Appendix 1: Copy of ethical clearance from Human Research Ethics committee (Medics) of University of Witwatersrand

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mr Ramadhani Abdul

CLEARANCE CERTIFICATE	M111152
PROJECT	Patterns and Predicators of Mortality in Older People (50 Years and above in Kassena-Nankana Distrixt of Ghana, 2006-2010
INVESTIGATORS	Mr Ramadhani Abdul.
DEPARTMENT	School of Public Health
DATE CONSIDERED	25/11/2011
M1111520DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 25/11/2011 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Benn Sartorius

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 2: Copy of Institutional Review Board (IRB) approval from NHRC

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

My Ref: nhrcirb/Feb/2012
Your Ref:



Navrongo Health Research Centre
Institutional Review Board
Ghana Health Service
P. O. Box 114
Navrongo, Ghana
Tel/Fax: +233-3821-22348

Email: irb@navrongo.mimcom.org

29th February, 2012

Mr. Ramadhani Abdul
P.O. Box 53
Ifakara, Morogoro-Tanzania

ETHICS APPROVAL ID: NHRCIRB128

Dear Mr. Abdul,

Approval of protocol titled ***"Patterns and predictors of mortality in older people (50 years and above) in Kassena-Nankana district of Ghana, 2006-2010"***

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.

Data obtained for the study should be used for the approved purpose only

The Board should be notified about the actual start date of the project and would expect a final report on your study at the end of the project.

Please note that this approval expires on 28th February 2013.

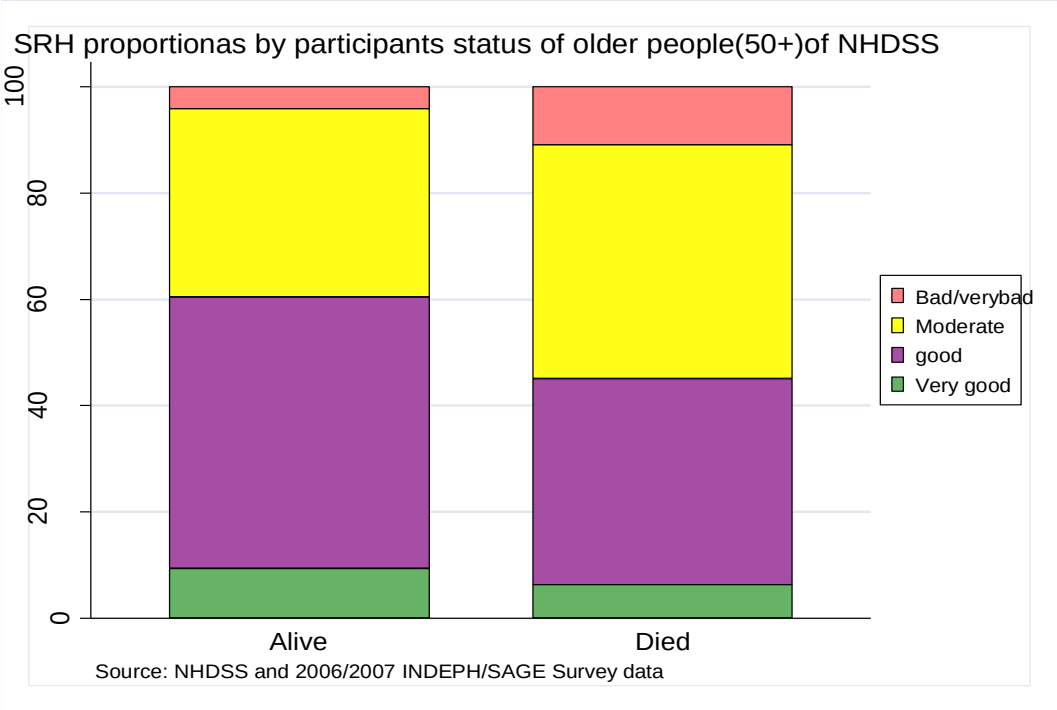
The Board wishes you all the best in this study.

Sincerely,

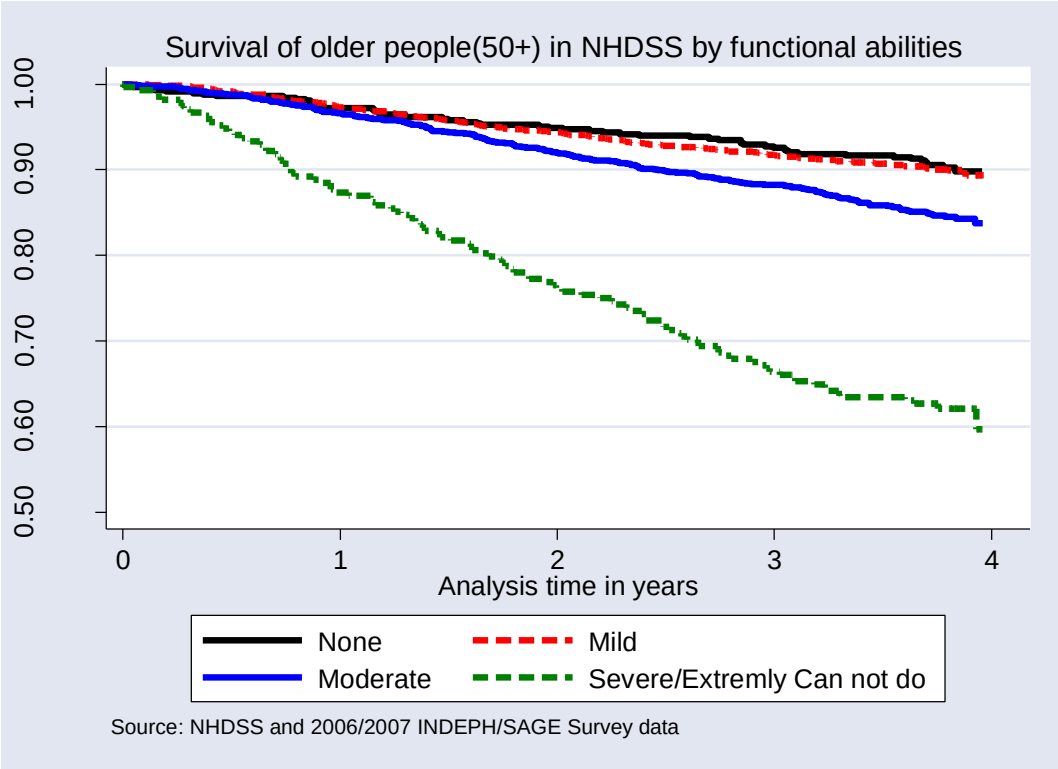
Dr. Nana Akosua Ansah
(Interim Vice Chair NHRCIRB)

Cc: Director, NHRC

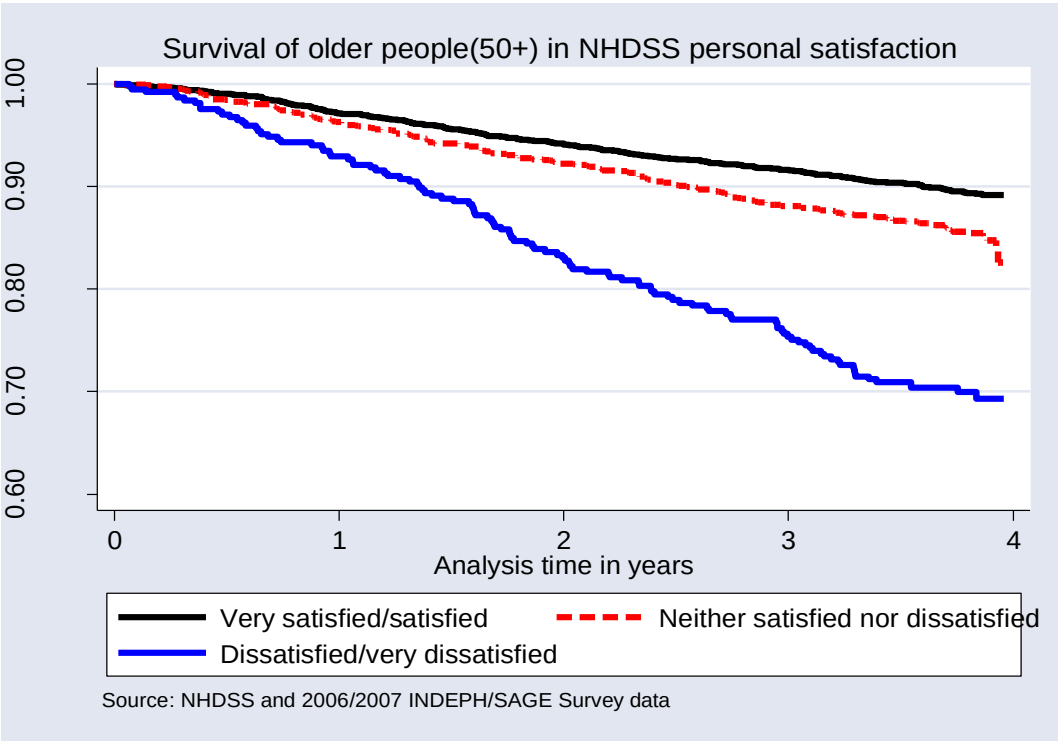
Appendix 3: Histogram for Self reported heath and participants status by end of study period.



Appendix 4: Kaplan-eier survival curves for older people (50+) of NHDSS by functional abilities.



Appendix 5: Kaplan-Meier survival curves for older people (50+) of NHDSS by overall personal satisfaction with health.



Appendix 6: Selected sections and questions of WHO-INDEPTH-NHRC SUMMARY Version questionnaire

Q1000	In general, how would you rate your health today?	1 Very good 2 Good 3 Moderate 4 Bad 5 Very bad
Q1001	Overall in the last 30 days, how much difficulty did you have with work or household activities?	1 None 2 Mild 3 Moderate 4 Severe 5 Extreme/cannot do

Section 1000: Heath State Descriptions

FUNCTIONING ASSESSMENT

These next questions ask about difficulties due to health conditions. Health conditions include diseases or illnesses, other health problems that may be short or long lasting, injuries, mental or emotional problems, and problems with alcohol or drugs. Think back over the last 30 days and answer these questions thinking about how much difficulty you had doing the following activities.

INTERVIEWER: For each question, please circle only one response.

	In the last 30 days, how much difficulty did you have …	None	Mild	Moderate	Severe	Extreme/ cannot do	N/A
Q1025	… in standing for long periods?	1	2	3	4	5	98
Q1026	… in taking care of your household responsibilities?	1	2	3	4	5	98
Q1027	… in joining in community activities [*for*	1	2	3	4	5	98

	example, festivities, religious or other activities] in the same way as anyone else can?						
Q1028	… concentrating on doing something for 10 minutes?	1	2	3	4	5	98
Q1029	… in walking a long distance such as a kilometer?	1	2	3	4	5	98
Q1030	… in washing (bathing) your whole body?	1	2	3	4	5	98
Q1031	… in getting dressed?	1	2	3	4	5	98
Q1032	… in your day to day work?	1	2	3	4	5	98
Q1033	In the last 30 days, how much have you been emotionally affected by your health condition(s)?	1	2	3	4	5	98
Q1034	Overall, how much did these difficulties interfere with your life?	1	2	3	4	5	98

Section 2000: Subjective Wellbeing and Quality of Life

Now, we'd like to ask for your thoughts about your life and life situation.

Q2001	Do you have enough energy for everyday life?	1 Completely 2 Mostly 3 Moderately 4 A little 5 None at all
Q2002	Do you have enough money to meet your needs?	1 Completely 2 Mostly 3 Moderately 4 A little 5 None at all

Please tell us how satisfied you are with the following issues.

		VERY SATISFIED	SATISFIED	NEITHER SATISFIED NOR DISSATISFIED	DISSATISFIED	VERY DISSATISFIED
Q2003	How satisfied are you with your health?	1	2	3	4	5
Q2004	How satisfied are you with yourself?	1	2	3	4	5
Q2005	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
Q2006	How satisfied are you with your personal relationships?	1	2	3	4	5
Q2007	How satisfied are you with the conditions of your living place?	1	2	3	4	5
Q2008	Taking all things together, how satisfied are you with your life as a whole these days?	1	2	3	4	5
Q2009	How would you rate your overall quality of life? **Read responses**			1 Very Good 2 Good 3 Moderate 4 Bad 5 Very Bad 8 *DON'T KNOW*		