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Nikoi, Christian Ashong

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THE ASSOCIATION BETWEEN SOCIOECONOMIC STATUS AND ADULT MORTALITY IN RURAL KWAZULU-NATAL, SOUTH AFRICA

BY

CHRISTIAN ASHONG NIKOI

STUDENT NO: 317855 (chrisnikoi@hotmail.com)

A RESEARCH PROTOCOL 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 MEDICINE IN THE YEAR 2009.

(Wits Johannesburg, South Africa 2009)

DECLARATION

I, Christian Nikoi 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. 

...**10**…day of ....**OCTOBER**....., **2009**.

DEDICATION

This work is dedicated to the Almighty God for his divine wisdom, grace and guidance throughout this course. It is also dedicated to my most cherished family who through thick and thin provided all the support to make my educational dream come true; most especially my brother Solomon who thought, encouraged and inspired me to learn mathematics; may his soul rest in perfect peace.

ABSTRACT

Introduction: Although socioeconomic inequality in health and mortality is currently on the top of the epidemiologic debate, studies however on the subject among adult population in Africa has been hampered due to the long absence of data in many countries. With the present reliable records of deaths from emerged demographic surveillance systems on the continent, adult mortality can now be accurately estimated. **Objectives:** The study's main objectives were 1. To calculate and show trend in adult mortality rate in ACDIS between 2001 and 2007. 2. To measure the association between mortality and individual's socio-economic status in the ACDIS. **Methods:** Individuals were selected based on age (15-64 yrs) and residency (Resident in the DSA on 1st January 2001). The total number of adults who met the criteria was 33,677; out of whom 4,058 died during the seven years follow up period. Mortality rates were computed using Kaplan-Meier survival estimates expressed per 1000 PYO. Household wealth index was constructed by use of PCA. The association between SES and adult mortality was assessed using Cox proportional Hazard model controlling for potential confounders such as age, sex and marital status. **Results:** The High group of the socioeconomic quintile had the highest mortality rate of 22.2 per 1000 PYO, 95% CI (20.7 - 23.7). There was no significant trend in the rates among the SES groups. After adjusting for the potential confounders; the effect of socioeconomic status in the highest SES category was 0.10 times less likelihood for death compared to the lowest SES group [HR=0.90, p=0.042, 95% CI (0.81 - 0.99)]. **Conclusion:** This study revealed that adult socioeconomic status is not significantly associated with adult mortality. Reducing the gap between the rich and the poor might not be the effective way in reducing adult mortality.

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DEFNITION OF TERMS

1. **Wealth Index:** A proxy measure of one's standard of living derived based on household living characteristics' including toilet type, source of drinking water, and access to electricity as well as ownership of assets such as car, bed, fridge, bicycle etc.
2. **Adult mortality rate:** The probability that a 15 year old person will die before celebrating his/her 65^{th} birthday expressed per 1000 person years of observation (PYO).
3. **Demographic Surveillance System:** A combination of field and computer operations in which individual and household demographic records (births, deaths, migrations etc.) are captured and updated on a continuing basis within a geographically defined area.
4. **Eingenvalues:** The percentage of variation in the total data that is explained by a principal component.
5. **Principal Component Analysis (PCA):** A multivariate statistical technique used in creating uncorrelated indices, where each index created is a linear weighted combination of the initial variables.
6. **Socioeconomic Status:** A hierarchy of wealth quintals (Lowest, middle, Highest etc.) dividing groups of people into different levels of living standards.
7. **Household:** An individual or group of individuals who are usually but not all the time related forming a social unit.

LIST OF ABREVIATIONS AND ACRONYMS

ACDIS	Africa Centre Demographic Information System
ACDSA	Africa Centre Demographic Surveillance Area
ACHPS	Africa Centre for Health and Population Studies
MDG's	Millennium Development Goals
UN	United Nations
INDEPTH	International Network for Continuous Demographic Evaluation of Populations and Their impact on Health in Developing Countries
HIV	Human Immunodeficiency Virus
AIDS	Acquired Immune Deficiency Syndrome
SES	Socioeconomic Status
WHS	World Health Statistics
US	United States
UK	United Kingdom
AMR	Adult Mortality Rate
DSS	Demographic Surveillance System
PCA	Principal Component Analysis

DSA	Demographic Surveillance Area
STD's	Sexually Transmitted Diseases
VA	Verbal Autopsy
ICD	International Classification of Diseases
PYO	Person Year of Observation
SSA	Statistics South Africa
DPRU	Development Policy Research Unit
UNDR	United Nations Development Report
WHO	World Health Organization
ART	Anti-retroviral Treatment
uaHR	Unadjusted Hazard Ratio
aHR	Adjusted Hazard Ratio

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CHAPTER ONE: INTRODUCTION, LITERATURE REVIEW, & OBJECTIVES

1.1 Introduction

Adult mortality has for long been neglected as a public health issue in many countries around the globe especially in sub-Saharan Africa, where the countries have been battling with other developmental issues. Most countries on the continent have little on adult mortality. Countries who have made some efforts to collect some information have not bothered to even process it to make it useful. With limited availability of census data and the absence of any other routinely collected demographic information, countries especially in Africa have a hard task to work at meaningful development to the extent of meeting the millennium development goals.

One of the Millennium Development Goals (MDGs) is to eradicate extreme poverty and hunger; reduce by half the proportion of people living on less than a dollar a day and to reduce by half the proportion of people who suffer from hunger (UN MDGs report, 2007). The UN MDG report (2007) has indicated that although the proportion of people living on one dollar a day or less has declined from 45.9 per cent to 41.1 per cent since 1999, reaching the MDG target of halving the extent of extreme poverty by 2015 is still no where yet in sight and requires that the current pace is nearly doubled should this be possible. Report on Africa's MDG strides is not very encouraging. The report indicates that at the midway point of achieving the Millennium Development Goals, sub-Saharan Africa is not on track to achieve any of the Goals. And although there have been major gains in several areas and the Goals remain achievable in most African nations, even the best governed countries on the continent have not yet been able to make sufficient progress in reducing extreme poverty in

its many forms. This goal will be achievable by having a strong healthy working adult population who can produce enough food. With an adult population not living long enough to fulfill this most desirable national need, a country only faces the challenge of living in a cycle of poverty, hunger, disease, and short life expectancy something that the African continent have for long fought to redeem itself from.

Lopez (1984) has in his classical model of adult mortality shown (as many other later studies have confirmed) that, an individual's probability of dying is being primarily a function of sex, age, health, genetic endowment, and the environment, all of which determine the risk of morbidity or accident. These factors work together and are influenced by a complex and ever changing set of social and historical determinants (INDEPTH, 2002). Adult health which often precedes mortality according to Lopez is influenced by three main factors; the environment, human behavior and ill health carried from childhood into adulthood. Effects of chronic lifestyle conditions have recently been a global burden of disease issue. In developing countries however, threats of infectious diseases still thrives (Unwin et al. 2001) and HIV/AIDS remains a major cause of death in adulthood.

Just before the HIV/AIDS epidemic, plausible levels of male adult mortality, as measured by the probability of dying between age 15 and 60 have ranged typically between 0.518 for males and 0.437 for females in 2000 (Lopez et al., 2006). Current indicators are out of those ranges in several sub-Saharan African countries especially in those with high HIV prevalence rates (Ngom and Ezeh, 2003). In Southern Africa however, where the HIV/AIDS epidemic is advanced, male adult mortality levels ranged from 57 percent in South Africa to 72 percent in Zambia. In all countries of this region, except South Africa, less than 40

percent of survivors to age 15 would not celebrate their 60th birthday under current adult mortality. Generally, adult mortality worsens as HIV prevalence increases (Pierre Ngom, 2003).

Mortality patterns of adults in Southern Africa and especially in South Africa are influenced by the still-large infectious disease burden; the emerging chronic disease burden; the high rates of mortality from external causes; and the overwhelming impact of HIV AIDS on the mortality profile of the country (Unwin et al, 2001). Pierre Ngom's (2003) in a study noted that South Africa is among the high HIV prevalence group with (20.1%) of adults infected and the country also suffers the most adult deaths of about 350,000 due to HIV/AIDS. Thus differentials in contemporary adult mortality levels are in part explained by the HIV/AIDS epidemic and South Africa is one such typical example. The survival of adults largely lies in the ability of the health systems on the African continent to provide immediate and quality health care to people. However socioeconomic status could play a good role in averting the deaths which in many ways are avoidable.

1.2 Socioeconomic determinants of Adult mortality

Socioeconomic status has become a very major factor in the fight against morbidity and mortality. Literature has suggested that individuals with higher socioeconomic status often turn to have higher survival than those with lower socioeconomic status (House et al, 2002; Rogers, Hummer, & Krueger, 2005). Socioeconomic status of an individual is most definitely crucial for adult life and survival because it determines the amount of resources (such as food, good sanitation, and health care) that can be available to the individual which in turn suggests the kind of physical and environmental elements one will be exposed to and his/her ability to save his life from dying from infections and diseases. A number of studies have shown a close association between adult morbidity/mortality and socio-economic status (e.g, Preston (1975), Preston (1985), Hobcraft (1984), Hill (1985), World Bank World

Dev. Report 1993). One prime example is Preston (1975) who in his work demonstrated a negative relationship between income and mortality. Hobcraft (1984) also found that mother's and husband's education; their work status and their type of residence were very much associated with household survival. (Bassuk et al. 2001) in a study of the effect of socioeconomic status (SES) on mortality found higher SES, whether measured by education, by household income, or by occupational prestige, was generally associated with lower mortality.

A recent examination of cause-specific death data using cause-deleted life tables revealed an increase in the probability of dying between ages 15 and 50 associated with HIV-related causes of up to 127 percent for males and 153 percent for females (Clark et al., 2007). Plotting the age-specific HIV-related (including TB) mortality rates from those sites at the beginning 1990s and again at the end of the decade reveals three distinct age-patterns of HIV-related mortality, one describing an urban setting in Dar-el-Salaam, one for rural settings in Tanzania, and one for the comparatively young and rapidly growing epidemic in South Africa (Ngom, 2003).

McKeown's has attributed generally declining mortality in the last third of the nineteenth century to economic growth, rising living standards, and improved nutrition but this idea has been criticized by Szreter who believed that declining mortality is rather a reflection of the chronology of the most significant improvements in public health and urban sanitation and not economic growth (Szreter 1986). Both are however holding different tail ends of the same fact because improved public health for it to result in reduced mortality will need an accessing of that facility and the fact that mortality has generally declined indicates there has been access to the improved health care facilities something which is only possible through increased wealth (economic growth) and risen living standards. But what is

important in that discus is that socio-economic status does have an association with the risk of mortality.

Case (2002) has also recently observed that income does have a causal effect on health status through many different channels. Some of these channels she named include improved nutritional status, improved living standards, better sanitation, reduced susceptibility to infections and decreased psychological stress. Since adult mortality in most cases are not observed as a sudden event but in most cases as a result of a gradual phenomenon often beginning with infections leading to disease conditions and finally death, this observation has much relevance for adult mortality as well. However, the need for some adequate quantification of the effect of socioeconomic status on health outcomes cannot be overemphasized.

Jakovljevic (2001) in a study of socioeconomic status in health research have indicated serious problems in the measurement of socioeconomic status (SES)-frequently included in clinical and public health studies as a control variable and less frequently as the variable(s) of main interest. This he has indicated could affect research findings and conclusions, with implications for practice and policy. For instance, the collection of accurate income data is a demanding task (Montgomery et al 2000) requiring extensive resources for household surveys; which still needs allowances to be made for households and individuals who draw income from multiple sources. However, in some cases, income as an indicator of SES measure is quite difficult to use (Cortinovis 1993). Results from a study by Filmer, et al (2002) have also laid such strong emphasis for the need to properly quantify the causal impact of similar indicators of the outcomes of health.

In many of the studies that have measured socioeconomic status; the socioeconomic indicators often used to measure the socioeconomic status of adults include singularly or a combination of individual's level of education, individual's employment status, his/her income earnings as well as expenditure, individual's residential environment, his/her housing characteristics including access to living facilities like water and electricity and finally ownership of assets such as car, bicycle, television sets, cattle etc. In many developing parts of the world particularly in Africa, determining one's socioeconomic status provide a very daunting challenge. The challenge lies in the fact that in many countries on the continent, data is largely unavailable making the indicators of socioeconomic status very difficult to measure.

In addition many employments have a seasonal nature with irregular income earnings making data collected often inaccurate and unreliable. Migration patterns often influenced by job seeking and trading are also very high, again providing a challenge in measuring the real residential and living environment of adults to determine their living and environmental exposures and outcome. In view of this, what most studies that measures some socioeconomic indicators have done is to use one of the many indicators as a proxy measure of one's socioeconomic status. However in many cases these studies have only drawn the socioeconomic link with particular diseases in question by way of finding necessary interventions for those diseases and not so much drawn the socioeconomic link with adult mortality. The present difficulties confronting the measurement of socioeconomic status requires that many more studies be conducted in this area especially one that draws a link with Adult mortality.

1.3 Evaluating the socioeconomic element of Mortality in Africa

Different frameworks have been used to assess the relationship between SES and adult mortality as far back as medieval times. During the agrarian and industrial revolution times food supply was used to establish the relationship (Malthus, 1830). Later on shelter and living space as proxy for living standard was used to measure association between SES and mortality. Most recently the discus has been on how income and earnings predict mortality (Preston, 1983). However with increasing technology and widespread of medical facilities, health technologies, as well as health personnel's mortality has been increasingly dissociated from economic level. Critics argue that mortality is more responsive to public heath factors rather than earnings (Hagen, 1962; Denny, 1965). However most epidemiologists have focused more on how the socioeconomic variable is being measured rather than giving up on the fact that socioeconomic status could predict mortality.

Whereas Preston & Bennett have proposed a census-based method for estimating adult mortality (Preston & Bennett, 1983), Timaeu have emphasized on the need to collect adequate mortality data as well as paying attention to how HIV/AIDS could impact on deaths in populations that are affected by the disease and further the need to adopt other measurements like the orphan hood method (Timaeu, 1993; Timaeu, 1997). With the advent of Demographic Surveillance Systems around the globe, the use of household asset has gained more popularity especially in sub-Saharan Africa in measuring association between SES and mortality. Evidence on the African continent have however only indicated that socioeconomic status is very much associated with health and access to health services in many ways (INDEPTH, 2005) but evidence on the association between SES and adult

mortality is still not very clear. Currently in Sub-Saharan Africa a major Adult health priority area is that of lifestyle related non-communicable as well as infectious diseases. Prime among these diseases is HIVAIDS. The current stage of South Africa's epidemiological transition and thus faces a complex mix of these infectious and lifestyle related non-communicable diseases. Among them are Obesity, cancer, cardiovascular and diabetes. It is also interesting to note that smoking and alcohol use is quite very common especially in South Africa.

Currently the main indicators that are being used to measure socioeconomic status (SES) to draw out an association with morbidity and mortality include: education, household wealth (especially income), occupation, type and area of residence and lifestyle.

There are however real difficulties in accurately measuring socioeconomic status using all the above indicators in many countries in Africa due to seasonality of employment, informal nature of income earrings, frequent migrations as well as unstructured housing systems. The income and expenditure approach to measuring SES is almost impossibly in most African countries especially in the rural areas where the only measure of SES is household wealth. With the current emergence of Demographic Surveillance Systems on the continent measuring socioeconomic inequalities in adult health and mortality using household wealth is now made possible through the use of DSS data.

1.4 Statement of the Problem

The global burden of disease remains high in the African continent whereas the Millennium Development Goals also remains a difficult target to achieve for most countries on the continent.

About 155 experts from some 50 countries who form one of the world's largest public health collaborations have recently published what they believe is a plan as to how to tackle the world's deadliest diseases. In their 2007 published health priority report, the top 20 research areas and policy priorities in chronic non-communicable diseases included heart disease, stroke, diabetes, and most cancers which is said to account for up to 60% of all deaths worldwide. These experts have indicated that a concerted action is very much needed to avert at least 36 million premature deaths by 2015 without which the largely lifestyle-driven diseases will kill some 388 million people in the next ten years. And 80% of the forecasted deaths will be in the developing world (Daar et al, 2007). Their recommendations in their broad areas were raising public awareness, enhancing economic legal and environmental policies, modifying risk factors, engaging business and community, mitigating health impacts of poverty and urbanization and reorienting health systems. The report has indicated the need to increase the availability and consumption of healthy food, the need to study and address how poverty increases risk factors; and also a more major move of health professional training and practice towards prevention.

A recent report released by the WHS indicates that, most sub-Sahara African countries are still lagging behind in provision of quality health care. Most countries fall in the low category of their Health workforce and the health systems resources is generally low. The number of Physicians per populations as at 2006 is on the average about 2 Physicians to 10,000 populations (WHS, 2008). The global Ratio of nurses and midwives to physicians is 2.9 whereas the ratio in the African region generally high 8.1. This however does not seem to translate properly into quality health care. Number of pharmaceutical personnel per 10,000 population density is less than 1 in most countries. Most Governments on the

continent depend more heavily on external sources for health expenditure. The continent on the average financed only 45% of its total expenditure on health in 2005, and an additional 10% came from external sources. The rest did hang in the balance somehow as health authorities struggled to provide the needed finance. In 2005 only 8% of Governments total expenditure went into services and this figure has come up only 1% since the year 2000 (World Health Statistics 2008). These unimpressive health service statistics makes the health policies of Governments on the continent something to be very much concerned about.

Empirical data on adult mortality is urgently needed; being the only reliable way to effectively guide adult health policies. Collecting data on Adult mortality is most definitely the starting point; something that the South African government has worked very hard on through its government Statistical System being Statistics South Africa (SSA). However more adequate information on the spatial distribution and causes are much more needed in the rural parts of the country where deaths often go unreported. Again the socioeconomic inequalities of the causes need to be assessed in order for adult health care and safety policy to be much more focused and directed towards the right ends.

1.5 Rational of the Study

Adult mortality is widely talked about in many literatures. However the commitment of most governments on the continent regarding the problem still leaves much to be desired. The lack of accurate and routinely collected data on adults deaths makes it worrying. Many studies have reported on the association between SES and different kinds of diseases (Sternfeld et al. 2002; Jakovljevic et al, 2001) and many studies on the methods and

processes of measuring SES especially using assert components have been quite well documented (Filmer & Prichett, 2001; Seema et al, 2006). However very few studies in Africa have sort to drawn the relationship between the two SES and adult mortality (Ngom P & Clark S, 2003; Bassuk et al. 2002; Rogers, Hummer, & Krueger 2005). This situation has been mainly due to lack of reliable national data on SES and adult mortality which has been among many things due to the many difficulties that exists in collecting data on socioeconomic indicators which include good registration systems and stable sources of finance for the exercise (Montgomery et al, 2000). With the present DSS collecting very reliable data on the continent an accurate measure of the association between SES and adult mortality is possible (McKenzie D.J., 2003). Looking at the big role that socioeconomic status could play in reducing morbidity and mortality and the fact that data is currently available in DSS on the continent, the need to investigate association between socioeconomic status and adult mortality cannot be ruled out.

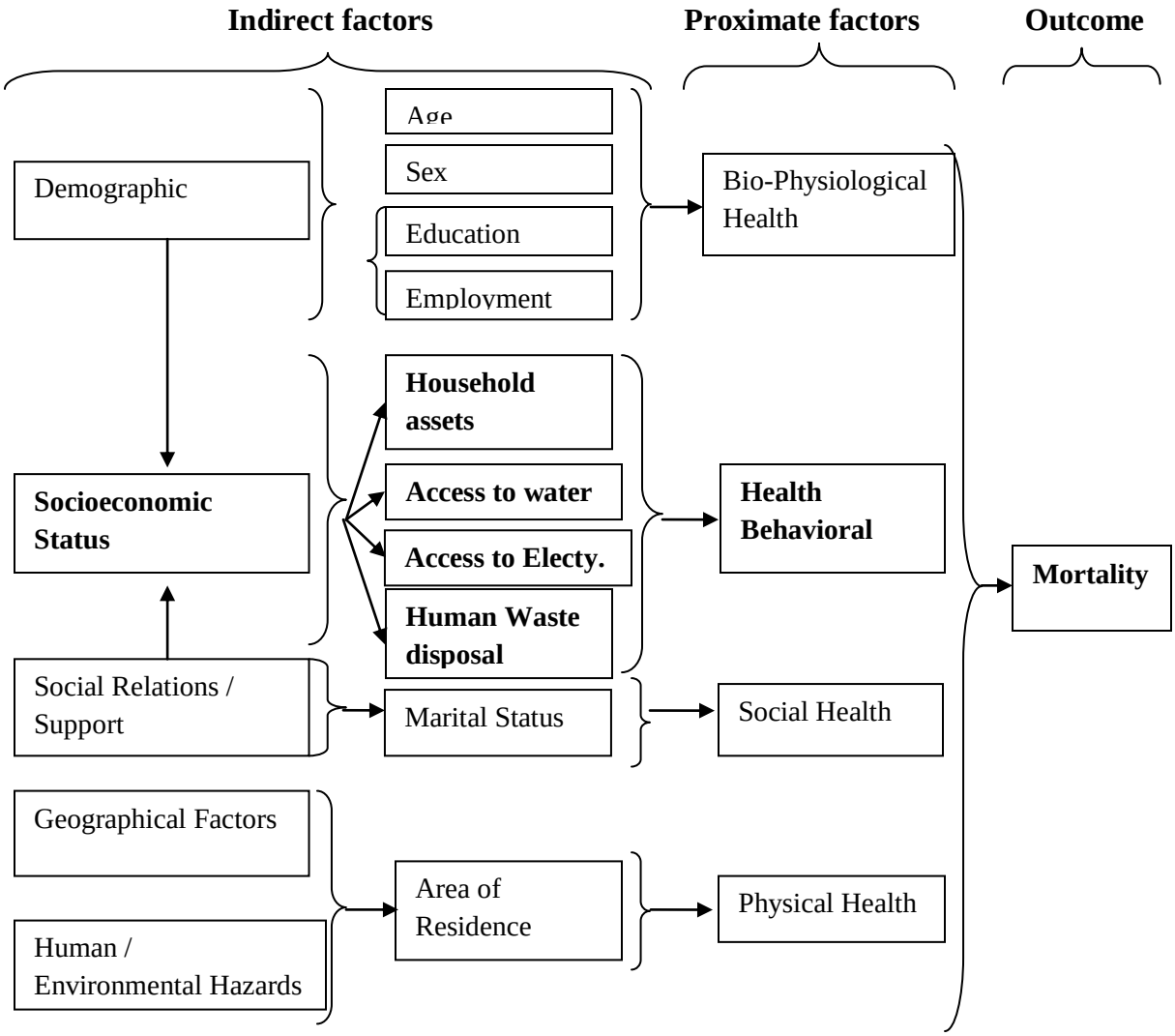
1.6 Theoretical Framework

This study was conducted based on a theoretical concept proposed by Roger et al. (2005). The theoretical concept as proposed by Roger et al holds that; the causal pathway to Adult mortality flows from distal factors such as geographical factors, human and environmental hazards and socioeconomic influences. These factors in tern flows through proximate determinants like living conditions, behaviour, injury prone, nutrition, which in turn causes morbidity and mortality. The first role of socioeconomic status is such that it can determine whether or not a person can and will seek health care as well as be able to meet his immediate nutritional and sanitary needs in a bit to prevent morbidity and consequence

mortality (Mosley & Chen 1984). Secondly socioeconomic status does also determine an individual's level of exposure to health and disease as many more socioeconomically disadvantaged individuals are noted (House et al. 1990) to also have higher exposures to health and mortality hazards due to their occupational and residential environment.

This study thus set out to investigate the association between socioeconomic status and adult mortality taking into account the role of other indirect factors in this relationship. Other indirect factors such as geographical location and environmental situation were assumed to affect the population equally whereas demographic factors such as age, sex and marital status were controlled in the measurement of this relationship.

Conceptual Framework



1.7 Study Question

Is there an association between socioeconomic status and adult mortality among the population covered within the Africa Centre demographic surveillance area between 2001 and 2007?

1.8 Aim

The aim of this study is to establish the variation in adult mortality that can be explained by individual's socioeconomic status. More importantly the study aims to provide a fairly accurate measure of the association between socioeconomic status and adult mortality in a rural African community using information from demographic surveillance system.

1.9 Specific Objectives

1. To calculate adult mortality rate and show the trend in ACDIS between 2001 and 2007.
2. To estimate individual wealth index by quintiles as proxy for SES using PCA of three measuring indicators; individual assets, access to water, electricity and waste disposal in ACDIS between 2001 and 2007.
3. To measure the association between adult mortality and individual's socio-economic status in the ACDIS between 2001 and 2007.

CHAPTER TWO: METHODOLOGY

2.1 Demographic characteristics of study area

The Africa Centre Demographic Information System (ACDIS) is being carried out in the northern part of the Hlabisa (UmKhanyakude) district in the Kwazulu-Natal Province of South Africa. The ACDIS Demographic Surveillance Area (DSA) covers an approximate area of 430 square kilometres and has a population of about 90,000 with a total of some 11,000 households housed in over 12,000 bounded structures. The average number of household members is 8 persons per household and an average of 4 children (below 18yrs) per household. Household residency is 72% (64,800) (resident within the DSA) and 28% (25,200) of the members reside elsewhere. Although three quarters (i.e. 8,250) of the households are headed by men, only 65% (5,363) of these men are resident. The Hlabisa district is a mixture of rural, peri-urban and urban settlements (also known as townships). Its inhabitants are predominantly ethnic Zulu's and more Zulu speaking as well. The major religion in the region is Christianity but there are lots of traditional religious believers as well.

On the average of 16% (14,400) of the population change residence within the DSA at least once a year and half of this figure (7,200) move in and out of the DSA at least once in a year. Most of the people in the district are involved in small scale commercial activities like trading in food items, clothing and other household ware. Others are also involved in farming activities working in the large crop and tree plantations owned mostly by private farmers where they grow food crops and tree plants for export and other wood materials for local building construction. Depending on the locality where one is residing and the location of the farms and the trading centres; this economic activity may mean continual commuting

between the towns and villages or seasonal migration mainly due to the need for generating the household means of livelihood. The study area is located closer to the coast and also endowed with large game reserves which frequently attract a lot of tourists from the neighbouring towns like Durban and Richards's bay. The study area is also noted for a high rate of HIV/AIDS prevalence of about 40% (36,000) above the national average of 30%, the disease which accounts for more than half of the cause of death in the province.

2.2 Africa Centre Demographic Information System (ACDIS)

The Africa Centre for Health and Populations Studies which was established in 1997 through a joint project of the University of KwaZulu-Natal and the Medical Research Council of South Africa and a generous funding from Wellcome Trust began data collection in the year 2000. The centre which is located near the town of Mtubatuba in the northern part of the Hlabisa district of KwaZulu-Natal province conducts research on population and health related issues in the DSA. It collects demographic, socio-economic and heath data from 11,000 households surveying a population of approximately 90,000 in 28 Izigodi's (villages). The research of the Africa Centre covers three integrated areas: a) Population Studies, b) Child Health and c) HIV Prevention and Treatment. The Population Studies also known as demographic surveillance involves the registering, tracking and monitoring of households and its members in a continuous cycle of two visits a year in an interval of 6 months duration. Using a team of trained field workers for data collection and a tracking team it registers and keeps track of new individuals and households, updates demographic variables, and records all pregnancies, births, deaths, socio-economic information and migrations.

The Child Health studies focuses on critical health issues among mothers and children, including comparing the effects on child health of breast feeding or formula-feeding in a context of high HIV infection rates; testing the effectiveness of Nevirapine in preventing mother-to-child transmission of HIV; and identifying ways of improving child health through the provision of inexpensive micronutrient supplements. The Africa Centre through a Durban-based virology laboratory genotypes strains of HIV and sexually transmitted diseases (STDs) and studies vaccines and microbicides for HIV prevention. The centre has since 2004 offered anti-retroviral treatment to approximately 8,300 people living with HIV AIDS; an exercise which has proven very useful in reducing mortalities due to HIV AIDS by some 26% in the DSA.

The centre also collects detail information on deaths through a Verbal Autopsy (VA) questionnaire. A Verbal Autopsy (VA) team made up of Physicians and Nurses collects and collates the VA information. After a death is picked and reported by the DSS field team, the information is forwarded into the VA database and then the VA team collates and sets out to collect the VA information. The interviews are held with one of the adult relatives of the deceased who was well informed of the sequence of events leading to death. Completed questionnaires are then coded independently by two physicians in accordance with a list of causes of death based upon the tenth revision of the International Classification of Diseases (ICD). A third physician is used to independently code in the case of discordant results. When there are three discordant codes, the cause is registered as unknown.

The centre which aims to make data as widely available as possible has a good balance of the interest of data subjects, controllers and users through good ethical practice. It does this through a roundtable ethical review process by local and oversees experts who explores in

an open and relaxed fashion the ethical challenges and ambiguities confronting research in developing countries and the centre for that matter. The ethics review committee of the Nelson R. Mandela School of Medicine, University of KwaZulu-Natal reviews all studies to ensure that ethical guidelines are followed. The centre also participates in the Wellcome Trust's funded scheme of biomedical research in developing countries which was launched in October 2002 (ACDIS, 2007).

2.3 Study population

The study population were all adults from ages 15-64 living within the Africa Centre Demographic Surveillance Area (ACDSA) between the years 2001 and 2007.

2.4 Study design

This study is a prospective closed cohort study using longitudinal data collected over seven years. The study makes use of the strength of longitudinal data collected to carry out a secondary data analysis of deaths and SES from 2001 to 2007 with reference to the base-population of the year 2001.

2.5 Inclusion and exclusion criteria

Only persons who are between the ages 15-64 and resident in the ACDSA on January 2001 were included in the study. Persons resident in the ACDSA who did not fall between ages 15-64 years or were not resident within the ACDSA on January 2001 were both excluded from the study. A total of 33,677 adults met this criteria and were included in the study.

2.6 Data source

Data for this secondary analysis was extracted from the ACDIS relational database which contained information on individual and household memberships, births, deaths, residence status, and household assets linked in a relational form.

2.7 Description and extraction of variables

2.7.1 Socioeconomic Status (SES)

Socioeconomic status was measured using an index, constructed mainly based on ownership of assets, power source, water and sanitation facilities and quality of housing and level of education through principal component analysis. Principal Component Analysis (PCA) is a multivariate statistical technique which can create indices that are not correlated, where each indices is a linear weighted combination of the initial variables (Seema, 2006). Filmer and Pritchett (1998) after conducting a study in many states of India concluded that the asset approach to measuring SES produced results there were comparable to other measures and thus recommended the approach. Each asset index measured and recorded in the database is combined into a wealth index and principal components analysis was used to generate weights (Seema et al, 2006).

The component analysis was based on a formula where each component is a linear weighted combination of all the initial variables. A long list of all assets across the entire SES data (Water, bed, bicycle, sofa, TV set etc.) were outlined in Stata and a binary codes of (1) indicating presence or (0) indicating absence were created for each asset. Where the asset had more than one level of measurement scale with the exception of water and toilet type; the asset was recoded into binary of either having quality needed for all who fall into higher categories of having as present (1) or where it falls short of the threshold or absent they were recoded as absent (0). After the indexes have been created, each individual was assigned to his/her proper household wealth index using their household Id's. The first principal component was then used to divide individuals into quintals of Lowest, low, middle, High and Highest which became the proxy measure of the socioeconomic status.

The distribution of wealth among the SES quintiles was then assessed checking for trends in the distribution across the SES quintiles.

2.8.2 Adult Mortality

Adult (aged 15-64) mortality rate: This was measured by dividing the total number of deaths in a wealth quintile by the calculated person years observed between 2001 to 2007 for all deaths occurring within ages 15-64 in that particular quintile. And this was expressed in 1000 person years observed. The total number of deaths occurring within ages 15-64 for the follow up period was drawn from the main mortality dataset of ACDIS. To aid the modelling process the outcome variable (death) was given binary codes where (1) means died and (0) means alive.

2.8.3 Other Variables (Confounding)

Other variables most necessary in the analysis which serve as mainly variables to control for confounding and other effect modifications include age, sex, education, marital status and employment. Age was categorised into 10 year groups (15-24, 25-34 to 55-64) during the descriptive analysis but was included as a continuous variable during the modelling part of the analysis. Sex was coded as male (0) and female (1). Education was categorised into four main groups; those with no education (none), those with primary education, then secondary and the last was tertiary level. Marital status also had 5 categories; those who were married, those who were single, separated, divorced and then the widowed.

2.9 Data management

The original data for this study was captured using ACDIS-pro (a custom made data capturing system by the centre) and stored in MySQLServer database system. The data

extraction was done using Microsoft SQL server 2005. The data for the study are stored in a relational database in MySQLServer. The data were stored in different tables; household memberships table, individuals table, socioeconomic table, deaths table and these tables were linked through a unique identification number/codes which ensured that individuals were linked across all the tables to their respective correct information. The data needed for the study was drawn from the different tables where they were stored using SQL 2005 into big table and then stored as one separate table first in SQL which was later exported into Stata version 10 for cleaning and analysis. Age was calculated using the time difference in years from the date of birth until 1st January 2001. The number of deaths was computed from the total observations recorded in the deaths tables by restricting the counts to the specific ages of interest of the computed ages generated. The data was cleaned by checking on how valid responses given to questions are, missing values, and the internal consistency of responses given as well as recoding of new and useful variables such as age. All these checks were guided by the original questionnaires used in collecting the different information.

2.10 Sample for data analysis

The study sample involved all adults whose age fell between 15-64 years as at 1st January 2001 (start of the cohort) who were also resident within the ACDSA at the start date of 1st January 2001. On the average 86,000 persons live within the DSA at any point in time out of whom some 66,127 persons who together belonged to 11,000 households were qualified for inclusion into the study. A total of 33,677 persons met the criteria of age and residency for inclusion into the cohort at the start of January 2001 who then became the prospective cohort for the study. This number was then followed up over the seven year period to detect

the outcome of death. A total of about 6924 exited out of the initial cohort of 33,677 at different time points of the follow-up period. Those who exited were on the average followed up for 3.14 years and differed significantly in terms of their mean age and sex characteristics from those who remained and completed the seven year cohort (Appendix 8). However since the study was a closed cohort, the participants who exited were not traced and re-entered into the cohort after they have exited; their outcome however at the time of exit was known and treated as such during the analysis.

The numbers in the follow-up period gave a total of 180804.7 person years of observation (PYO). In total 10,077 deaths were recorded within the DSA between 1st January 2001 and 31st December 2007. Out of this number 4,359 were adults aged 15-64, but 301 of the adult deaths did not have matching SES information after cleaning and merging and thus 4,058 deaths with the complete SES information were used for the analysis.

2.11 Data analysis

2.11.1 Descriptive Statistics

Demographic Information: The characteristics of the study population in terms of age, sex, marital status, socioeconomic status, level of educational attainment and employment categories was shown by their numeric values and proportions.

Wealth Indexes: PCA was used to construct wealth index for each person based on their individual household wealth indices. The results was then categorised into quintals of (Lowest, Low, Middle, High and Highest). A screeplot of eingenvalues was constructed to show the amount of variation in the wealth distribution explained by each component used. The proportion of adults who owned each asset was shown. A further distribution of adults

among the different wealth quintiles by their education and marital categories were also shown.

2.11.2 Inferential Statistics

Adult Mortality Rates: Mortality rates were calculated for all adults who met the inclusion criteria. Kaplan-Meier estimates (K-M) were used for computing the Mortality rates. The overall mortality rates for each year from 2001 to 2007 were generated and the significance in the mortality trend was tested for. Next the mortality rates within the 7 year follow-up period (2001 to 2007) by the specific wealth quintiles were also generated and the results were compared among the different SES quintiles. The sex specific rates in each wealth quintile was also investigated and shown. The quintile specific rates between two age groups (below 40 years and above 40 years) were also further investigated to check for the impact of HIV/AIDs on mortality between the two age groups. The reason for the age cut of point was due to the fact that HIV/AIDs have been reported to be high among adults aged below 40 years in the study area.

Univariate and Multivariate Analysis: Cox Proportional Hazard regression models were used in both univariate and multivariate analysis in assessing the association between socioeconomic status and adult mortality. Three main models were fitted. The first was a univariate model to assess which variables independently predict mortality in order to be included in the multivariate model. The second was the multivariate model where all the independently predictive variable were combined to adjust for each other; and the third was a stratified multivariate model by two main age groups; (those less or equal to 40 years and those more than 40 years) to check for variability in the death hazards due to SES among the

different age groups. A model was also fitted for only deaths due to other causes other than HIV/AIDs or TB to take away any hidden effects of HIV/AIDS interventions in order to access the predictability of SES in adult mortality. The result for this last model was however excluded since the model was found to violate the proportional hazard assumption (Appendix 7). Potential confounding variables of age, sex, education, marital status, employment were controlled for in each of the multivariate models.

2.12 Ethical approval

Ethical approval with certificate reference number M080975 for the study was received from the University of the Witwatersrand; from the Human Research Ethics Committee (Appendix 2). The Ethics Committee of the ACDIS also reviewed the study and gave ethical clearance for the study and permission for the usage of the secondary data for the research work (Appendix 3). The original longitudinal study however from which the secondary data was used for this study received ethical clearance from the Medical Research Council of South Africa (Appendix 4).

CHAPTER THREE: RESULTS

This chapter presents the results for this study. The analysis was carried out for a seven year follow-up periods from 2001 to 2007, to look at the changing trend of adult mortality and more importantly to measure the relationship between SES and adult mortality. The results are presented in three sections. The first part shows the trend in overall adult mortality rates for the period and how these rates differ by socioeconomic status. The rates were computed using Kaplan-Meier estimates of mortality incidence during the period expressed per 1000 person years of observation across the five quintiles. A chi-square trend of the mortality rates across the quintiles is also shown. The second section involves the construction of wealth index using PCA and compares the distribution of asset components across the five quintiles with mean estimates of index scores by quintiles. The third section shows the measure of association between adult mortality and socioeconomic status using Cox proportional hazard estimation with 95% level of significance and compares the Hazard ratios of the SES quintiles controlling for confounders such as age, sex and marital status.

3.1 Socio-demographic Characteristics

Table 3.1 shows the socio-demographic characteristics of the study population. The total cohort size was 33,677 for the seven year period. The sex distribution showed that the proportion of females were slightly higher than males, 57% for females compared to 43% for males. For the age distribution, over two-thirds were younger adults (<35yrs) 65%, and the rest were in the older category (35yrs and more). The marriage distribution showed much more single individuals more than two-thirds 70%, than the married group 19% and very small proportions in the other marital status groups. Almost half of the study

participants have completed their secondary education at the time of the study 46%, with about a fifth having primary education as their highest level of education 27%, and a 10th having no education 12%. Referring to the employment status of the participants, only about a quarter of the participants were employed and earning some income 24%, with the majority not earning any regular income. The cause of death reveals an interesting picture. More than half of the deaths were due to HIV and TB (60%), with the rest due to all other causes together.

Table 1: Socio-demographic characteristics of Adults in ACDSA

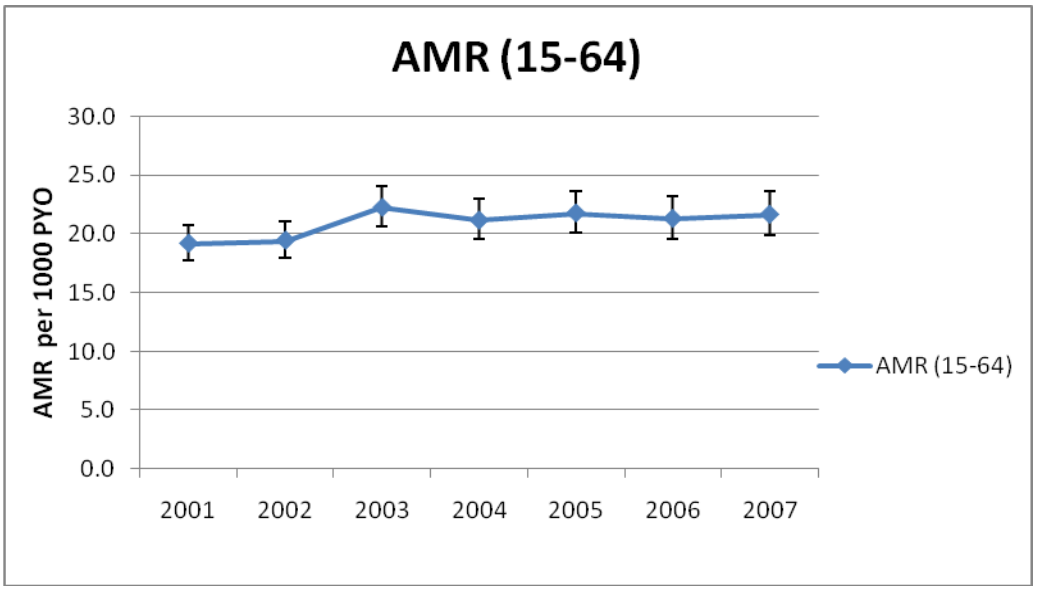
Variable	Freq. (%) 2001-2007	
Cohort Size	33,677	
Death		
Died	4,058	12.05
Alive	29,619	87.95
Sex		
Male	14,416	42.81
Female	19,261	57.19
Age (mean, min, max)	(30yrs, 15, 63)	
15-24	14,297	42.45
25-34	7,490	22.24
35-44	5,819	17.28
45-54	3,639	10.81
55-64	2,432	7.22
SES		
Lowest	5,571	18.01
Low	5,795	18.73
Middle	6,261	20.24
High	6,837	22.10
Highest	6,472	20.92
Marital Status		
Married	6,295	18.69
Separated	818	2.43
Divorced	74	0.22
Single	23,620	70.14
Widowed	1,560	4.63
Unknown	1,310	3.89

Education		
None	4,201	12.47
Primary	8,929	26.51
Secondary	15,635	46.43
Tertiary	1,064	3.16
Unknown	3,848	11.43
Employment		
Employed	8,146	24.19
Unemployed	25,531	75.81
Cause of death		
HIV AIDS	2,173	54.0
TB	129	6.0
Other	1,623	40.0

3.2 Adult Mortality Rate

The overall deaths registered at the end of the seven years numbered 4,058(12%) of the initial number who started the cohort 33,677. The overall all-cause mortality rate recorded from 2001 to 2007 went up briefly from 19 per 1000 PYO in 2001 to 19.5 per 1000 PYO in 2002, and from there went up to 22.5 per 1000 PYO in 2003. Since then the rate has remained fairly stable fluctuating between 21&22 per 1000 PYO.

Fig 1: Overall Adult Mortality Rate, 2001 to 2007 in ACDSA



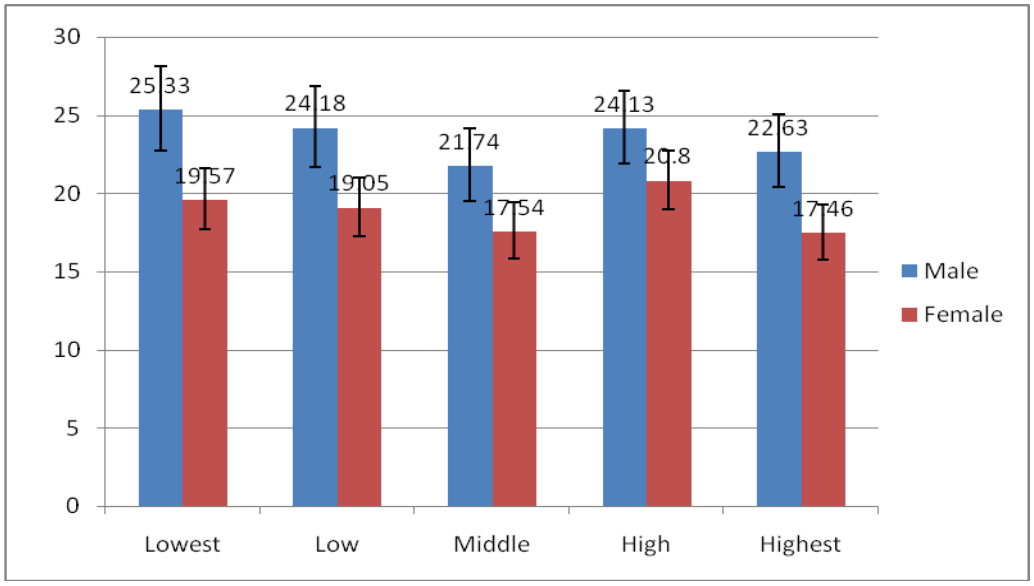
The mortality rates recorded is presented in Table 2. The results show that the High group of the socioeconomic quintile has the highest mortality rate of 22.2 per 1000 PYO, 95% CI (20.7 - 23.7) followed by the Lowest group with the lowest rate recorded in the middle poor group of 19.3 per 1000 PYO, 95% CI (17.9 - 20.8). A Lowest to Highest ratio of 1.11 is revealed by the results indicating that the Lowest group had a 11% more likelihood of dying when compared to the Highest group. The results however showed no statistically significant trend in the rates so that the mortality rate does not necessarily increase or decrease with increase in socioeconomic status (p=0.1924). The overall mortality rate was 20.85 per 1000 PYO, 95% CI (20.2 - 21.5).

Table 2: Overall Adult Mortality Rate by SES category in ACDSA

SES Quintile	**Adult person years Observed**	**Deaths**	**AMR / 1000 PYO 95% CI**
Lowest	32965.5	723	21.93 (20.39, 23.59)
Low	34042.5	720	21.15 (19.66, 22.75)
Middle	36924.8	713	19.31 (17.94, 20.78)
High	39894.4	886	22.21 (20.79, 23.72)
Highest	36977.5	728	19.69 (18.30, 21.17)
Total	**180804.7**	**3770**	**20.85 (20.19, 21.52)**
Chi Square Trend			**p = 0.1924**
Lowest to Highest ratio			**1.11**

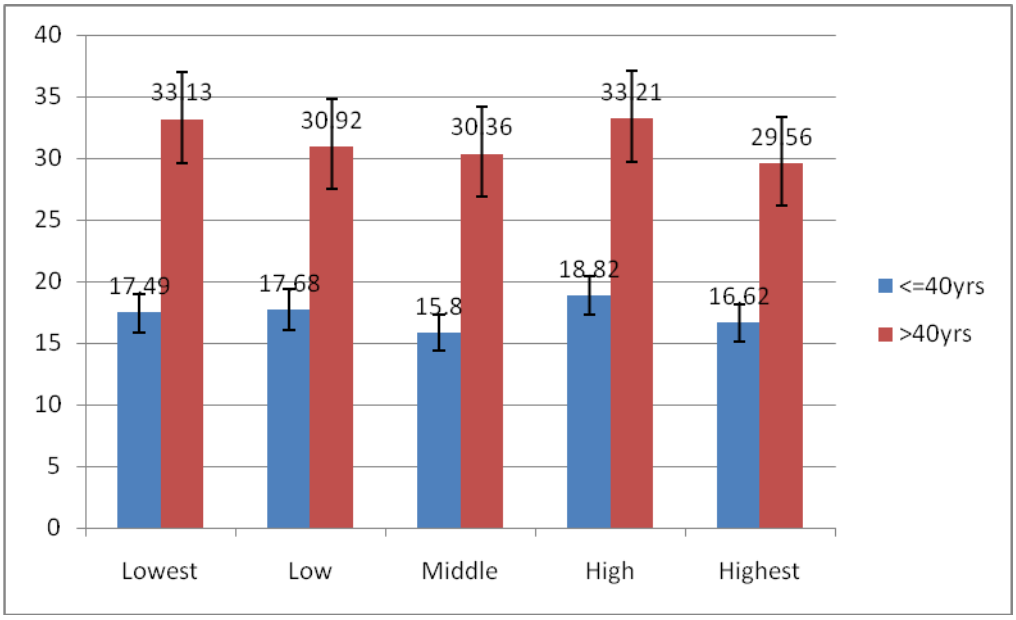
A further look at the mortality rates by age and sex showed that there were differences among the sexes and age groups. The rates in each SES quintile showed to vary by sex and age group regardless of the SES quintal you belong to. The variation was such that the rates for the males were significantly higher than that of the females in all the SES quintiles.

Fig 2: Adult Mortality Rate by SES category & sex in ACDSA



The variation in rates is showed in Fig 2. In the Low SES quintile there was a mortality rate difference of 6 per 1000 PYO between males and females. And this amount of variation was similar in all the other SES categories. The difference was also statistically significant as showed by the confidence bands in fig 2 in that, the confidence bands did not cross each other. The sex difference in rates was however not significant for the High SES category.

Fig 3: Adult Mortality Rate by SES category & age in ACDSA



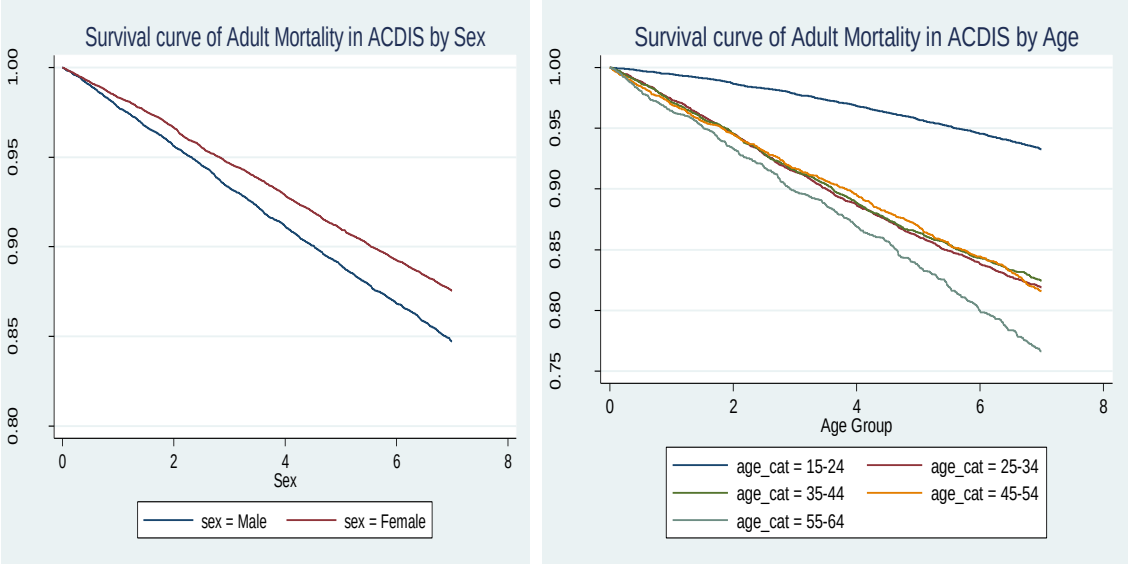
Individuals in two main age groups younger (<=40yrs) and older (>40yrs) had varying rates across all the SES quintiles as shown in Fig 3. For each SES quintile the rates for the older adults was on the average two times that of the younger adults.

3.3 Survival Probabilities

On the whole the survival for males and females decreased at a constant rate with time. However the rate of decrease in survival was lower among females than the males. In other words the females had better survivals than the males throughout the follow up time.

The survival also varied with age group with a fairly constant change over time. On the whole the lowest age group 15-24 had the highest chances of survival whereas the older age group 55-64 had the lowest chances of survival. The other age groups (25-34, 35-44 and 45-54) however had very similar survival rates such that regardless of which of these three remaining age groups you belong to, your chances of survival does not change very much.

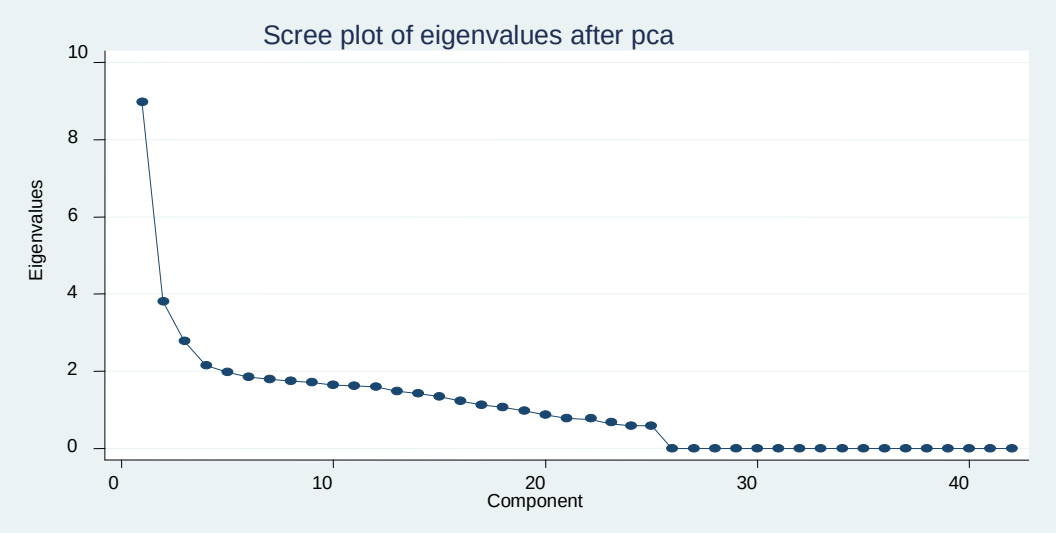
Figure 4: Kaplan-Meir survival curves for adults in the ACDIS



3.3 Distribution of wealth by socioeconomic index quintiles

With a relatively equal distribution of households across the wealth quintiles (18%, 19%, 20%, 22% and 21% respectively from Lowest to Highest group); the means SES index score was -3.041 for the Lowest group, -0.889 for the middle poor group and 4.970 for the Highest group. In a screeplot of the components, the first principal component explained 21% of the total variation in the wealth distribution with an eigenvalue of 9.0. The second principal component explained 9% of the total variation of the distribution with an eigenvalue of 3.8. The third component explained 7% of the total variance with an eigenvalue of 2.8. The rest of the components each explained less than 5% of the total variance with eigenvalues less than 2.2.

Figure 5: Plot of eigenvalues and asset components in ACDSA



The distribution of assets across wealth quintiles is showed in Table 3.5. Twenty-one asset components were used to generate the SES index for the specific period. The results showed variation in the distribution of wealth across the SES groups. In the first period, the proportion of people who owned TV set (0%-Lowest, 24%-poor, 91%-Highest), fridge (0%-Lowest, 40%-poor, 97%-Highest) and gas cooker (14.7%-Lowest, 48.5%-poor, 73%-Highest) were all more among the higher SES quintiles showing that, adults in the higher SES quintiles were very much more likely to own such assets than those in the lower groups. The proportion with assets such as bicycle (12%-Lowest, 16%-poor, 14%-Highest), radio (72%-Lowest, 67%-poor, 47%-Highest), were fairly evenly across all the wealth quintiles showing that, all the adults in the different quintiles had almost equal likelihood to own such assets. At least half or more of the people in the High and Highest quintiles (52%-High, 70%-Highest) were likely to use piped water as their source of drinking water whereas a fifth and a third of the individuals in the lowest SES category were more likely to use a river or a dam as their source of drinking water. Most of the adults in the higher SES

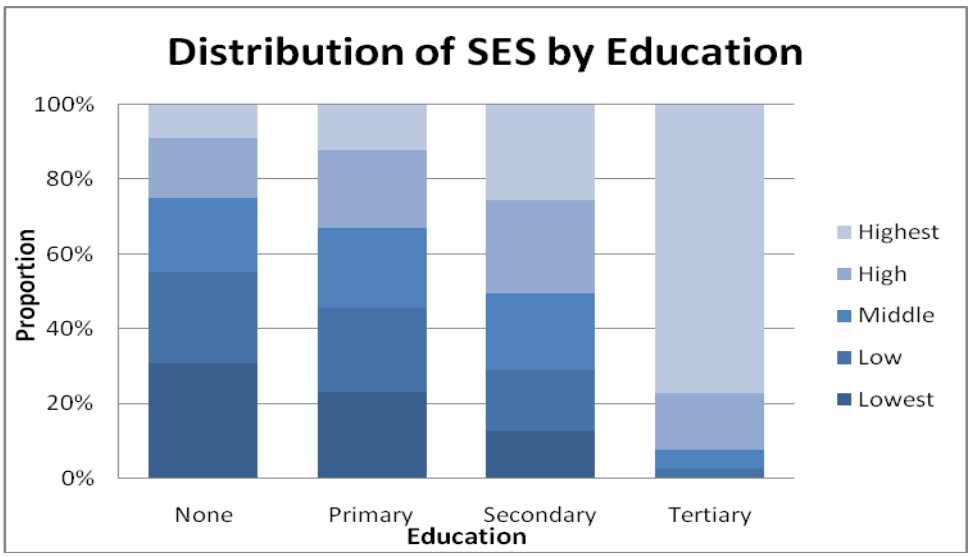
category were more likely to have electricity (75%-High, 95%-Highest) whereas only less than 1/100th (0.7%-Lowest) of the lowest group were likely to use electricity in their homes. Other assets like video sets had very largely unequal distribution with virtually no ownership of that asset among the Lowest (0%-Lowest, 0%-Low) group whereas a relatively bigger proportion of the Highest (37%) group owned it. Almost 9 out of 10 adults (87%-lowest) in the lowest SES group and a little over half of the adults in the Low SES group (57%-low) had completely no toilet facility in their homes and are likely to use the open space. A third 27% of the adults in the Highest SES category are likely to use flash toilet, whereas the likelihood of using flash or chemical toilet is nil in the lowest SES groups.

Table 3: Distribution of household assets by SES quintiles for adults in ACDSA

	Lowest	**Low**	**Middle**	**High**	**Highest**
Asset	(%)	(%)	(%)	(%)	(%)
TV set	0.00	5.39	24.89	61.07	91.16
Fridge	0.05	6.88	40.70	79.78	97.74
Gas cooker	14.79	36.69	48.49	53.80	73.75
Bicycle	11.88	14.80	16.66	15.52	14.92
Radio	72.32	65.12	67.92	64.82	47.13
Table & Chair	73.36	87.97	90.47	89.22	92.32
Piped water	12.62	33.73	41.60	51.77	70.33
Well / Borehole water	31.34	28.91	26.98	24.99	16.05
River/ Dam/ Rain water	55.26	36.39	30.56	22.10	12.93
No water	0.13	0.03	0.00	0.10	0.11
Flash Toilet	0.00	0.01	0.80	1.95	27.43
Chemical Toilet	0.50	3.11	6.37	6.69	7.32
Bucket/ Pit latrine	12.20	39.86	59.87	73.58	61.82
No Toilet	87.30	57.02	32.96	17.78	3.43
Electricity	0.71	22.48	45.96	76.92	95.92
Block maker	5.59	10.07	14.98	17.00	17.71
Car	0.00	2.23	8.12	15.68	35.30
Electric cooker	0.00	0.03	0.33	2.84	28.84
Electric kettle	0.00	0.05	4.68	31.50	80.45
Kombi/Lorry/Tractor	0.00	0.03	0.47	0.85	1.43
Primus cooker	91.62	78.59	84.97	77.84	45.34

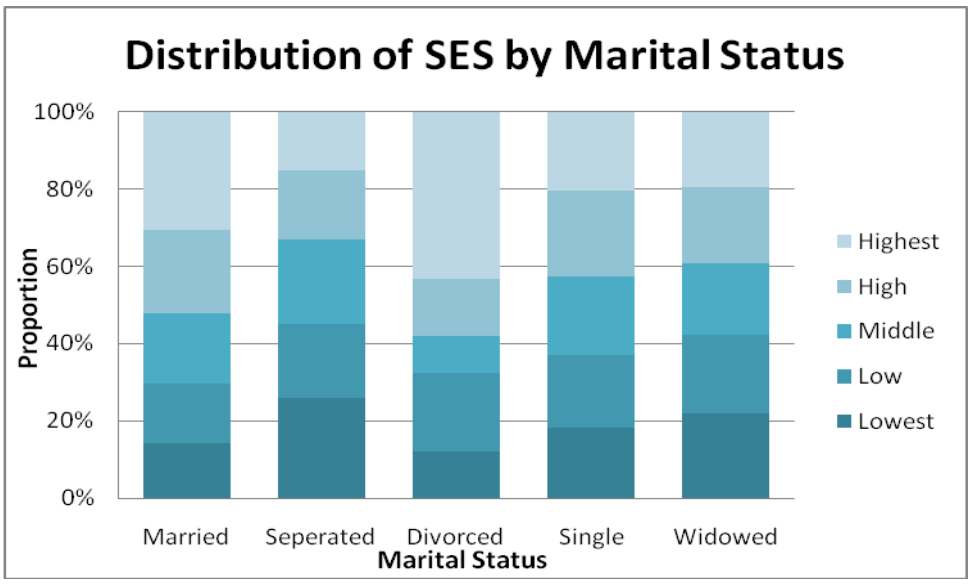
Sewing machine	4.33	11.05	19.21	25.71	33.06
Table + Chair	73.36	87.97	90.47	89.22	92.32
Telephone	0.00	1.49	6.25	16.27	47.45
Cell phone	0.18	16.31	27.54	44.27	76.00
Video	0.00	0.00	0.11	1.75	37.38
Wheelbarrow	36.40	46.80	52.72	60.03	52.29

Figure 7: Distribution of SES of adults in ACDSA by education



The distribution of assets varied with education. Adults with higher education (secondary and tertiary) had more assets than adults with lower level of education. Up to about 80% of adults who had tertiary education also had higher SES level with about 16% having the next highest level of socioeconomic status. On the other hand about 50% of the adults with primary or no education fell in the low and lowest SES categories. Thus the lower SES groups were concentrated among adults with little or no education. This distribution shows that socioeconomic status varied with level of education in the ACDSA.

Figure 8: Distribution of SES of adults by marital status in ACDSA



The distribution of socioeconomic status did not vary much with marital status. Adults were fairly evenly distributed among the various SES quintiles regardless of their marital status. A little more of the adults who were married 31% fell in the highest SES quintile compared with only 20% among those who were single or widowed. A bigger proportion of the adults who were divorced 42% had the highest socioeconomic status as well with very low proportion 15% having the lowest socioeconomic status among the divorced group.

3.4 Univariate Analysis

An independent association between adult mortality, SES, and other explanatory variables such as sex, age, marital status, education and employment was investigated using a cox proportional hazard model. The independent models were fitted for each explanatory variable for the entire seven year follow-up period assessing the significance of their hazard ratios in predicting adult mortality. Table 3.8 shows the results of the independent association.

Table 4: Univariate Cox Model for adults in ACDSA

Variable	Unadjusted HR, 2001-2007	95%CI	(p-value)
Sex			
Male	1		
Female	0.80	(0.75, 0.85)	0.000
Age	1.03	(1.028, 1.032)	0.000
SES			
Lowest	1		
Low	0.96	(0.87, 1.07)	0.492
Middle	0.88	(0.79, 0.97)	0.016
High	1.01	(0.91, 1.11)	0.800
Highest	0.90	(0.81, 0.99)	0.042
Marital Status			
Married	1		
Separated	1.20	(0.98, 1.45)	0.072
Divorced	1.58	(0.91, 2.73)	0.102
Single	1.01	(0.93, 1.09)	0.801
Widowed	1.56	(1.36, 1.78)	0.000
Education			
None	1		
Primary	0.73	(0.67, 0.80)	0.000
Secondary	0.53	(0.48. 0.58)	0.000
Tertiary	0.41	(0.32, 0.52)	0.000
Employment			
Employed	1		
Unemployed	0.82	(0.76, 0.87)	0.000

Results from the hazard model showed no particular trend in the association between SES and adult mortality. SES was significant in only two groups. Adults in the Low SES category were 0.04 times less likely to die compared to adults in the Lowest group [uaHR=0.96, p=0.492, 95% CI (0.87 - 1.07)]. The poor category had a significantly higher reduction in the likelihood of dying than the Low group. Adults in the poor category were 0.12 times less likely to die compared to adults in the Lowest group [uaHR=0.88, p=0.016, 95% CI (0.79 - 0.97)]. The High group had relatively similar ratios with the Lowest group.

Adults in the High group were 1.01 times more likely to die compared to the adults in the Lowest group [uaHR=1.01, p=0.800, 95% CI (0.91 - 1.11)].

The last group was the Highest. During the first period, adults in the group were 0.10 times less likely to die compared to Lowest group [uaHR=0.90, p=0.042, 95% CI (0.81 - 0.99)].

3.5 Multivariate Analysis

In the multivariate Cox proportional hazard model the association between SES and adult mortality was measured adjusting for potential confounders such as sex, age, and marital status each of which shown to be independently associated with adult mortality in the model in table 4 above. SES in the multivariate model was significant in only one SES group and not significant in the rest of the SES groups.

In the Low SES category adults were 0.03 times less likely to die compared to the Lowest group but this was not was not significant [aHR=0.97, p=0.662, 95% CI (0.87 - 1.08)]. In the middle group adults were 0.06 times less likely to die compared to the Lowest group but the hazard was also not significant [aHR=0.94, p=0.279, 95% CI (0.84 - 1.05)]. The High on the other hand had a significant 1.13 times higher hazard for death compared to the Lowest group [aHR=1.13, p=0.021, 95% CI (1.01 - 1.25)]. And in the Highest category adults were 1.09 times more likely to die [aHR=1.09, p=0.128, 95% CI (0.97- 1.22)] but this higher risks was also not significant.

The proportion hazard rule was investigated and found that the model did not violate the rule, global test p=0.3335.

Table 5: Multivariate Cox Model for adults in ACDSA

Variable	Adjusted HR, 15-64 yrs	95%CI	(p-value)
Sex			
Male	1		
Female	0.75	(0.70, 0.80)	0.000
Age	1.04	(1.040, 1.046)	0.000
SES			
Lowest	1		
Low	0.97	(0.87, 1.08)	0.662
Middle	0.94	(0.84, 1.05)	0.279
High	1.13	(1.01, 1.25)	0.021
Highest	1.09	(0.97, 1.22)	0.128
Marital Status			
Married	1		
Separated	2.05	(1.66, 2.53)	0.000
Divorced	1.57	(0.88, 2.78)	0.121
Single	2.15	(1.95, 2.38)	0.000
Widowed	1.35	(1.17, 1.56)	0.000
Education			
None	1		
Primary	1.04	(0.94, 1.15)	0.358
Secondary	1.01	(0.90, 1.13)	0.816
Tertiary	0.67	(0.53, 0.85)	0.001
Employment			
Employed	1		
Unemployed	0.91	(0.84, 0.98)	0.013

The result was further stratified by two main age categories; the first category was among those who were between 15 to 40 years and the second group was those between 41 to 64 years. The results are presented in table 6. After stratifying the results by age category, SES showed a significantly higher hazard ratio in the higher SES categories in both age groups but the ratios were a little higher among the older adults. In the low SES quintile, adult in the lower age group were 1.01 times more likely to die [aHR=1.01, p=0.939 95%CI (0.87 –

1.15)] whereas the older adult in the same SES category were 0.03 times less likely to die [aHR=0.97, p=0.743 95% CI (0.81 – 1.15)].

In the middle poor category the young adult were were 0.07 times less likely to die [aHR=0.93, p=0.337 95% CI (0.80 – 1.07)] where as the older adults in the same SES quintile were 1.02 times more likely to die [aHR=1.02, p=0.813 95% CI (0.85 – 1.21)]. The High and Highest SES categories had higher hazard for death than the lower and Lowest SES groups. Among the High SES group, the younger adults showed a significant 1.15 times more hazard for death [aHR=1.15, p=0.044 95% CI (1.00 – 1.31)] whilst the older adults were 1.21 times more likely to die [aHR=1.21, p=0.030 95% CI (1.01 – 1.42)] which was also significant.

Table 6: Stratified Multivariate Cox Model for adults in ACDSA by two age groups.

Variable	Adjusted HR, 95% CI, (p-value) 15-40 years			Adjusted HR, 95%CI, (p-value) 41-64 years		
Sex						
Male	1			1		
Female	1.03	(0.94, 1.12)	0.469	0.45	(0.39, 0.50)	0.000
SES						
Lowest	1			1		
Low	1.01	(0.87, 1.15)	0.939	0.97	(0.81, 1.15)	0.743
Middle	0.93	(0.80, 1.07)	0.337	1.02	(0.85, 1.21)	0.813
High	1.15	(1.00, 1.31)	0.044	1.21	(1.01, 1.42)	0.030
Highest	1.11	(0.96, 1.28)	0.146	1.16	(0.96, 1.40)	0.114
Marital Status						
Married	1			1		
Separated	1.70	(1.27, 2.28)	0.000	1.84	(1.35, 2.51)	0.000
Divorced	1.57	(0.13, 6.79)	0.960	2.17	(1.19, 3.95)	0.011
Single	1.95	(1.95, 2.38)	0.000	1.82	(1.60, 2.05)	0.000
Widowed	1.45	(1.24, 1.69)	0.000	1.74	(1.47, 2.06)	0.000
Education						
None	1			1		
Primary	0.68	(0.58, 0.80)	0.000	0.95	(0.83, 1.07)	0.396
Secondary	0.53	(0.45, 0.61)	0.000	0.97	(0.82, 1.15)	0.773

Tertiary	0.32	(0.23, 0.44)	0.000	0.58	(0.37, 0.91)	0.019
Employment						
Employed	1			1		
Unemployed	1.61	(0.55, 0.66)	0.000	1.25	(1.11, 1.40)	0.000

In the Highest SES quintile younger adults were 1.11 times more likely to die compared to their counterparts in the Lowest SES category [aHR=1.11, p=0.146 95% CI (0.96 – 1.28)], but again the older adults had a higher increased hazard for death 1.16 times more [aHR=1.16, p=0.114 95% CI (0.96 – 1.40)]. The hazards in both age groups of the Highest SES quintile were all insignificant. The proportional hazard rule was again investigated and both models showed not to have violated the rule; global test p=0.3907 for the model of the younger age group (15-40 year) and p=0.1436 for the model with the older age groups.

CHAPTER FOUR: DISCUSSION AND CONCLUSION

This study attempted to look longitudinally at adult mortality over a seven year follow-up period and examined how socioeconomic status could be a determinant of the adult mortality. The results found have shown some varying differences in adult mortality across the different SES groups. In measuring the association between SES and adult mortality the result showed no clear pattern in the hazard of adult mortality with SES and the hazard ratios were similar for each SES group. SES was found not to be a significant predictor of adult mortality; it was only significant in the fourth SES quintile. Factors such as age, sex and marital status were all found to have confounding effect on the relationship between SES and adult mortality.

The predictability of SES for adult mortality was expected since recent report seems to suggest that there exist some association between the two (Doblhammer et al, 2009). Why SES did not predict adult mortality among this study population is not very clear. However it could be due to the homogeneity of the study population especially in terms of lifestyle and asset ownership making the choice of components in measuring wealth differences to be a no-straight-forward task.

4.1 Levels and Trends in Adult Mortality

The results for adult mortality rates showed only slight differences in the overall yearly mortality rates over the seven year follow-up period. Among the SES groups the results showed no particular trend in the rates. The overall mortality rate within the seven year follow up period was 20.8 per 1000 PYO. Among the SES groups the rates were high for the Lowest SES groups, 22 per 1000 PYO, and slightly lower for the Highest groups, 19.7

per 1000 PYO. The other SES groups registered values that ranged between the figures recorded for the higher and lower groups. The rates recorded showed that mortality does not change significantly with change in level of SES. The Lowest to Highest ratio was 1.11. The close range of the mortality rates is most definitely be responsible for the statistical insignificance of the differences in the rates p=0.1924. However the rates did vary significantly between males and females and between the younger and older adults across all the SES groups. In terms of public health relevance of how many deaths can be removed should the SES gap be bridged; only 2 per 1000 PYO will be eliminated. This figure compared to the national rate of 600 per 1000 seems very small (SSA, 2005). The rates recorded showed significant differences between males and females. Males generally had higher rates compared to females. The rate for the males was 23 per 1000 PYO whilst females recorded 18 per 1000 PYO. The rates showed a trend in the age ($p<0.0001$) in which the older age groups had higher mortality rates so that mortality happen to increases with age. This is actually to be expected since many studies have revealed such trend.

4.2 Socioeconomic inequality in adult wealth

This study set out to measure the inequality of household wealth among the study population. The inequality was measured in three different ways. First of all the proportions of asset ownerships among the study population in each wealth quintile was measured. Secondly the mean index scores were also generated. Thirdly the distribution of the wealth index scores for the principal components was also generated for the entire study population. In addition the eigenvalues which shows the proportion of variation in wealth distribution that is explained by each component was also shown. The results generally

indicate an unequal distribution of assets among the study population in which the wealthiest group had higher proportions in terms of ownership of most assets. The mean index scores for the Lowest group was -3.041; whilst the Highest group had 4.970 showing a very wide gap between the rich and the poor. The distribution of the index scores further revealed a very high concentration of the lower scores indicating a higher proportion of the population being in the lower SES group where the higher death rate was registered. This was further revealed by the Lowest to Highest mortality ratios of 1.11. This indicates a higher risk for death among the Lowest group compared with the wealthiest. These results are consistent with what other studies have found about the big disparity in the wealth distribution among South African adults (UNU-WIDER, 2008; DPRU, 2007; Leite et al, 2006).

Research reports indicated that there have been substantial decline in the poverty (by the South African definition of poverty) margins at the national level between the year 2000 to 2004. The decline has however been attributed to massive expansion of the country's social grant system. Whilst this is good there is a growing concern among economic experts about the long term sustainability of this social intervention as a means of poverty reduction. Reports indicate that whilst the collective income of the poor (by the South African definition of poverty) was only R27 billion in 2000, the grants have since expanded by R22 billion. However, because there are limits to what the expansion of the grant system as a means of poverty alleviation can do, the report has emphasized the importance of economic growth with job creation as the most reliable means for sustaining the decline in poverty (DPRU, working paper, 2006). This calls for measures from the South African policy

makers that will promote a more permanent change in socioeconomic status of the South African population.

4.3 Socioeconomic determinants of adult mortality

Earlier studies carried out have observed some association between SES and mortality in almost all age groups. The findings have suggested an inverse relationship of SES with mortality where mortality is said to decrease with increasing level of SES. Although the results of this study indicate that the observed association between SES and Adult mortality does exist, the findings however show no clear direction of the association with regard to changing level of SES. After measuring adult mortality, this study observed no statistically significant association between SES and adult mortality. There was one exception however in the fourth level of SES had statistically significant association with adult mortality, but this does not show much especially when the three other SES quintiles were insignificant.

After the population was stratified into two age groups (less than 40 years and above 40 years) SES remained significant in only the fourth SES quintile. SES as a single variable did show that the hazard of death does decrease with increasing SES level. However when SES was combined with other explanatory variables, the observed association was such that the hazard of death was marginally higher for all SES groups and the fourth SES quintile remained statistically significant. This change in the observed protective nature of SES with increasing level to a more hazardous variable when combined with other explanatory variables show that, SES on its own is not a variable that determines adult mortality within the Hlabisa district of KwaZulu-Natal. Other variables such as sex, age and marital status were seen to be the hidden variables that actually explains adult mortality within the district

rather than SES, thus they were confounders to the relationship between SES and adult mortality in the district.

After adjusting for the confounders, the hazard of death among adult females in the district was observed to be 25% less when compared to adult males. This is consistent with much literature that has indicated sex differences in health and mortality with higher mortality for males than females (Case and Paxson 2005). Though women often live longer than males, women on the other hand are also more likely to pick chronic diseases and be in a state of ill health for a very longer period of time than males (Sternfeld et al. 2002; Grundy and Sloggett 2003) The death hazard observed among the different age groups showed dramatic increases in the hazard with increasing age. The hazard of death generally increases by 4% with every one year increase in age. Age is a well-known factor that explains health and mortality. Its biological dimension is that as adults grow older, their body cells turn to weaken and suffer functional difficulties (Kaplan and Kronick 2006, Grundy and Sloggett 2003) thus becoming more prone to ill health and disease which often turn to be chronic. Mortality has also been identified to increase exponentially with age (Thatcher et al. 1998), going up to about 10% for each additional year of age. The role of socioeconomic status in age related mortality is that mortality can be delayed to later years of adulthood with wealth making possible access to nutrition and good healthcare.

Marital status also did confound the relationship between SES and adult mortality which is also consistent with literature since marital status is been found to be a predictor of adult mortality. Single adult were in this study observed to be on the average twice more likely to die when compared to adults who are married (115% more). Adults who were on the other

hand divorced had 57% more likelihood to die when compared to those who are married. Whereas adults whose spouses have died had a 35% more risk to death when compared with adults who are married. A study conducted in three countries, Bulgaria, Finland and the US have indicated similar results where unmarried persons regardless of their sex generally had higher probabilities of dying compared to married in all the three countries (Kohler et al. 2008).

4.4 Implications of findings

Recent overall deaths records in SA show that, mortality has increased by 57%; from 318, 287 in 1997 to 499,268 in 2002. The increase have been partly attributed to population growth but much more also to improved death registration. The record indicates that the number of adult deaths (i.e. persons aged 15 years and above) increased by 62%; from 272,221 in 1997 to 441,029 in 2002. The current estimated adult mortality rate in South Africa is 600 per 1000 (Statistics SA, 2005; WHO, 2006).

Though this study found no association between SES and adult mortality, SES still remains an important factor for investigation in understanding adult mortality in South Africa. Social and economic research conducted in South Africa show that socioeconomic inequalities still exist in the country making access to social services very difficult especially among the black population (UNU-WIDER, 2008; DPRU, 2007).

The current South African policymakers face a great task to substantially reduce the apartheid legacy of high inequality and poverty. The post-apartheid government did make a strong policy commitment to spend on social security, in order to create jobs and narrow of the gap between 1st class and the informal parts of the economy aiming at reducing the

narrow unemployment rate to below 15% in 2014. The debate about the success and failure of the inequality reduction program is still ongoing with contrasting conclusions as to whether job creation or jobless growth has taken place in the South African economy (Stellenbosch Economic Working Papers: 2008). Though previous reports indicated numerous fluctuations in employment, recent labor force survey (LFS,2004b) reports have indicated some improvement with little "feminization" of the labor force (Casale 2004; Casale, Muller & Posel 2004). The decline however needs a more rapid boost before the goal of reducing the narrow unemployment rate to below 15% in 2014 could be realized.

The South African government have had a hard task of finding ways of helping the poorer groups in a way that influences their lifestyle and health choices in order to reduce chronic ailments, crime as well as mortality to reasonable levels. The most recent report released by the SSA about the leading cause of death is that available in 2001. The top 5 causes include; certain infectious & parasitic diseases (A-B), Diseases of the circulatory system (I), Symptoms & signs etc. n.e.c. (R), Diseases of the respiratory system (J) and External causes of morbidity and mortality (V-Y). These top 5 causes accounted for just under three-quarters (72%) of all deaths in 2001. Where as diseases of the circulatory system decreased from 17.3% in 1999 to 16.1% in 2001, certain infectious and parasitic diseases was observed to have increased, from 16.8% in 1999 to 19.9% in 2001, while diseases of the respiratory system increased also from 10.1% in 1999 to 12.3% in 2001 (Statistics SA, 2005). What is worth noting about the main causes of death is that they are mostly lifestyle related diseases carrying with it a socioeconomic element across the country.

The adult population which is also the working group holds the key in bringing the needed transformation that will bridge the gap between the rich and the poor groups even as the government on its own cannot possibly do everything to bridge the gap. The government thus needs stronger policies that will be effective in raising the levels of income among the lowest groups without favoring so much the rich to result in more inequality. In the past decade the SA government has made so much effort at reducing the gap between the rich and the poor through housing resettlements and other social grants such as child and adult pension scheme to help make up for the poor and underprivileged. The adult pension scheme has especially proven very useful. Reports indicate that by the end of 1993 the pension had become a very important source of income among the marginalized black population and has been found to have very much improved the health and increasing the life years among the black adult population (Case, 2002). Despite all these efforts there's still so much more to do to bridge the gap between the richer and Low groups.

Although this study found no significant association between SES and adult mortality, SES still remains a major factor that determines of access to health and health seeking behaviors which later impact on mortality. What the finding of this study seems to imply or suggest is that, in terms of measures to reduce adult mortality, working to bridge the gap between the rich and the poor might not be an effective way to reduce adult mortality. The finding show that on the average only 3 deaths per 1000 PY would be eliminated should the Lowest group be elevated to the level of the rich (the difference between Lowest and Highest mortality rate). This finding should be taken with much caution so that SES is not completely ignored in tackling adult mortality considering the socio-cultural environment of the study population. For instance one confounding factor that this study found quite important in

tackling adult mortality with respect to the study population is marriage which showed to have a significantly reduced effect on adult mortality among the study population. Again age was also another confounding factor that was found in measuring the relationship between SES and Adult Mortality. Education in this study was also revealed to be a confounding factor in the relationship between SES and adult mortality in the Hlabisa District. Studies have indicated that education does predict mortality (Hoffman, 2008; Freedman and Martin, 1999; Minicuci and Noale, 2005) and the confounding result of it in this study does confirms the reports of it for adult mortality in South Africa which was regardless of the prevailing high levels of HIV pandemic. In view of the confounding effects of the above mentioned factors in the relationship between SES and adult mortality; any attempts to tackle adult mortality will call for a more comprehensive look at those factors rather than SES.

The South African Government is still battling to reduce its current adult mortality to reasonable levels. The figure currently stands at about 600 per 1000 with a life expectancy of 48years (World Health Statistics, 2006). Such a high mortality rate and a low life expectancy call for more pragmatic approaches to reducing the mortality burden. The clues seem to point more to HIV AIDS than any other factor. South Africa has a typically high HIV AIDS burden and the onset of which has shifted the concentration of mortality to its middle-aged adults; a phenomenon which was also observed in this study. Further in this study, deaths due to HIV AIDS accounted for more than half (54%) of the overall adult deaths in the Hlabisa district showing the weight of impact that the HIV AIDS disease has on the South African population. Though the Government has made strong efforts to ensure that the rate of infection with the disease is greatly reduced, the hard effort is yet to

materialize in lower infection rates. The availability of ARTs has currently greatly reduced the deaths due to HIV AIDS and the Hlabisa district has also witnessed such reductions in adult mortalities from HIV AIDS. Presently in SA, next to HIV AIDS as cause of adult death is a huge list chronic diseases such as diabetes, obesity, cancer and cardiovascular which are in many ways lifestyle related. For instance the major known means of HIV AIDS transmission is through unprotected sexual intercourse something that is influenced by the lifestyle of individuals. Obesity and cancer are in many ways linked to diet and choices of foods. Obesity coupled with little physical exercise can lead to a lot of cardiovascular diseases. Since lifestyle is related with SES, the role of SES in reducing these mortalities is therefore very prime among South Africans.

There's obviously so much more to do in order to bridge socioeconomic inequality gap to increase adult healthy years of life in South Africa. The major move is obviously trying to curb the high rates of HIV AIDS infection to avoid its consequent deaths since the disease is single handedly responsible for more deaths than any other cause. Though the government is frantically working at this; there's still room to do more. First of all there's the need to enhance health care utilization among the poor by making health care readily available and more affordable. This can be done through a public based health insurance system, fee waivers for sections of the adult population, or provision of health care vouchers for particularly economically deprived adults. Accessibility of health care and health education by the poor through the provision of health facility within accessible range would also be very important in reducing the travel distance. This will help eliminate the travel time and cost to health facilities in especially deprived rural settings like Hlabisa district.

4.5 Limitations of study

There have been debates about the use of household assets in measuring SES. The main argument which makes the main limitation of the study is that household assets are a measure of long-term household wealth and does not account for short term interruptions in the measure.

Secondly the asset component used in measuring SES did not consider the importance that the study population attaches to each of the components and therefore the most useful components that captures the wealth differences in the study population might not have been given the full chance to bring out the needed measure of household wealth differences.

Thirdly the study was carried out on the assumption that the independent variables were time invariant and thus they were not treated as time varying covariates; the covariates used were those measured at the start date of the study i.e. 1st January 2001. Variables such as age, marital status and education are however time varying whose nature might have caused slight measurement inaccuracies in this study.

4.6 Strengths of the study

The first strength of the study is that it was a prospective cohort study which was measured longitudinally over a period of seven years. The long duration (7 years) of follow up to the observed event (death) makes the measurements in the study quite reliable and the measured association fairly predictive.

The use of PCA also gives the study an advantage over the use of income and consumption expenditure because it largely eliminates most of the measurement problems associated with

measuring income and expenditure which includes recall bias, seasonality (of income acquisition and expenditures) and data collection time. Another advantage of PCA is that it is fairly easier for computations and often works well with household surveys data's; thus in the absence of income or consumption data in rural KwaZulu-Natal, PCA was most useful. PCA also makes use of all the SES variables in reducing the dimensionality of the data (Jobson, 1992). The PCA based on the household characteristics ranks and classifies/categorizes each household within a distribution into various Socio-economic groups. The result generated indicates the relative measures of SES, which is very useful not only because it provides information on different levels of poverty within a community (McKenzie, 2003) but more importantly because it shows the considerable inequality between one household and another. Another good thing about the PCA is that it can be used for special comparison between countries or national sub-regions as well as over time when the same variables are used in calculating the separate period indices.

Thirdly one bias which could affect the results were identified and controlled. Missing SES information which was initially 8% of the study sample was reduced to only 2% of the total sample by obtaining SES information that was available in other rounds of DSS data since SES was tested and found not to have changed significantly during the seven year follow up period (Appendix 9). Again the 2% missing SES data was investigated and found not to be systematically missing because they were found to be fairly evenly distributed among the study sample especially in terms of their ages and sexes.

Again the outcome of individuals who were censored due to migration was in most cases known whether they were alive or dead; as a result of the very strong tracking system existing within the ACDIS. Individuals who migrate externally were tracked as far as Durban in KZN and Gauteng province to establish their outcome, and if died specific details of when, where, and how they died were obtained through the use of verbal autopsy.

Interactions between SES and all the control variables which could affect the relationship between SES and adult mortality were also investigated and in most cases no interactions were found not to be present in the relationship.

More importantly the study shows that the needed data and knowledge on adult mortality in the sub-saharan region of Africa is obtainable through the use of information from demographic surveillance. The study also offers information about the role of socioeconomic inequality in terms of its impact on poverty reduction on the mortality situation of South Africa; which in many cases will help to guide policy makers on development priority areas.

4.7 Conclusion

The use of PCA in constructing SES seems not to have been sensitive to differences in socioeconomic status in the Hlabisa district and therefore might not have been sufficient in determining adult mortality. Other methods in generating SES could be useful in making the measure of the association between SES and adult mortality more robust.

In rural populations like the Hlabisa district of KwaZulu-Natal, the measure of SES is mainly based on household asset ownerships since it's more difficult to collect expenditure

and income variables. However because in rural populations there exists some homogeneity in the asset ownership there is the need to understand how rural communities attached importance to each asset component to help determine which components are most useful to include in constructing the PCA. This might hopefully reveal a better association between SES and adult mortality once the most important components are used in the PCA.

This study leads therefore to the conclusion that adult socioeconomic status is not significantly associated with adult mortality. Bridging the SES gap between the rich and the poor might therefore not be effective in tackling adult mortality. This finding notwithstanding, there would be the need to still combine SES with other factors in reducing adult mortality considering its inseparable link with the other factors. Public health provision as well as education measures that can help encourage marriage as well as healthy lifestyle will be most useful in addressing adult mortality in such rural areas.

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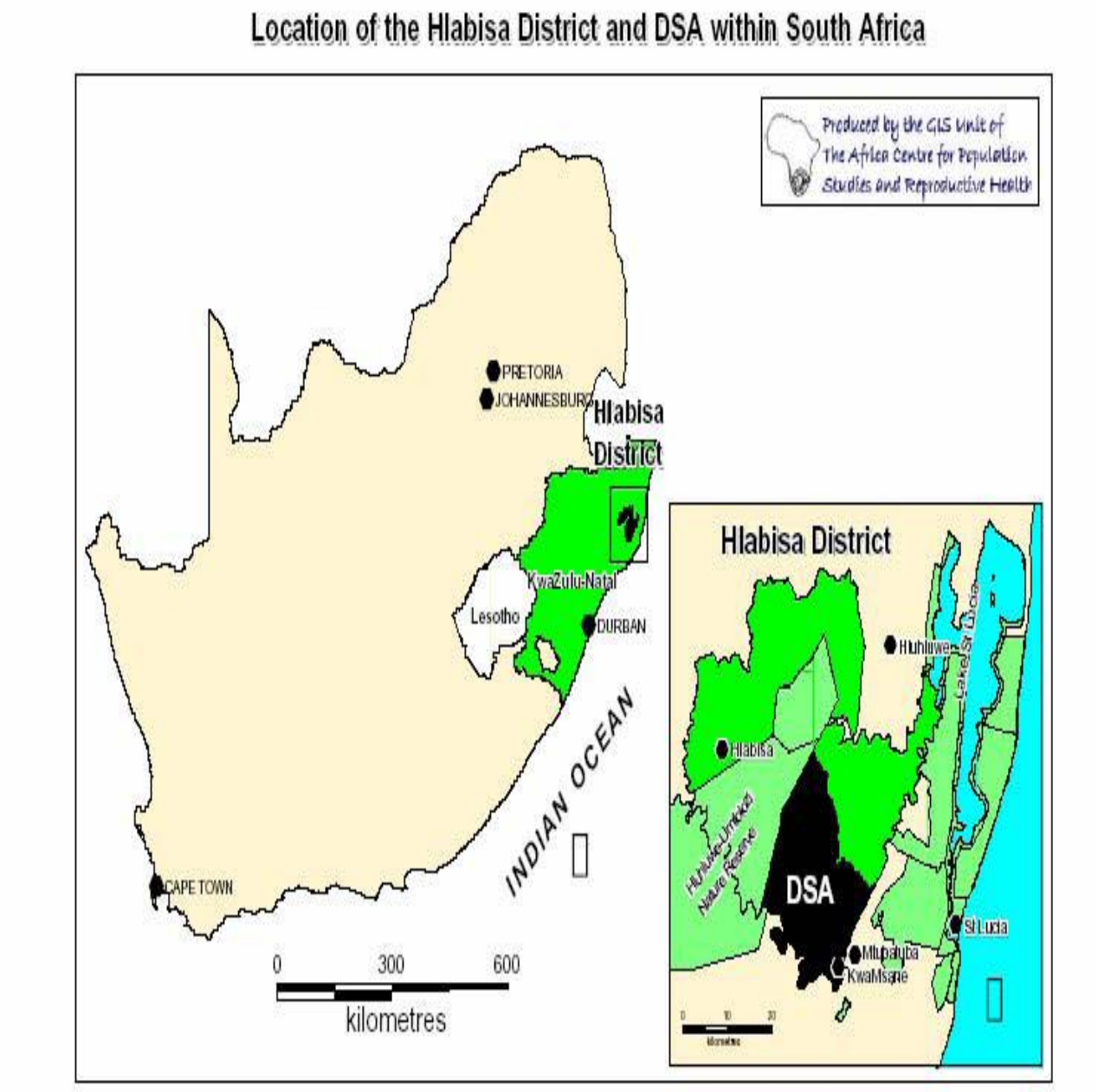
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APPENDIXES

Appendix 1: Map of South Africa showing Africa Centre Demographic Surveillance Area



Appendix 2: Human Research Ethics Clearance Certificate from Wits

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Nikoi

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M080975**
PROJECT	The Association betweenSocio-Economic Status and Adult Mortality
INVESTIGATORS	Mr CA Nikoi
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** .....
pp (Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Prof 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 3: Ethics Clearance Certificate from ACHPS

AFRICA CENTRE FOR HEALTH AND POPULATION STUDIES

Africa Centre Demographic Information System (ACDIS)

Data Use Agreement

It is hereby agreed with : CHRISTIAN ASHONG NIKOI (The "Data User")
of UNIVERSITY OF WITWATERSRAND (Affiliation) on 08/09/2008 (date)
that s/he will have access to the following ACDIS dataset(s) :

1. Demographic characteristics of Adults aged 15-64 between 2004-2006.
2. Household Asset information of Adults aged 15-64 between 2004-2006.
3. Mortality information of Adults aged 15-64 between 2004-2006.
4. .....
5. .....

The following conditions will apply:

1. The Data User will neither release nor permit others to release the files or data therein to any person (including media and subcontractors) except with the written approval of the ACDIS Project Leader;
2. The Data User will neither use nor permit others to use the data in any way other than listed in the original application (Analysis Plan) for access to the dataset;
3. The Data User will ensure that the data are kept in a secured environment and that only authorized users have access to the data.
4. Every publication or report based on the data must carry an acknowledgement of the form:
   This Analysis is based on data collected by the Africa Centre Demographic Information System
5. The Data User will not release or permit others to release any data that identifies persons, directly or indirectly;
6. Once the dataset has served its indicated purpose it must be disposed of;

All datasets remain the property of the Africa Centre and the Africa Centre reserves the right to request the return of any datasets should any of the above conditions be violated;

The following documents must accompany this agreement:

1. A short description of the intended purpose and method of analysis of the data (Analysis Plan)
2. A list of the names and organizational affiliations of all those who will engage in this analysis. In the case of students, a statement by their supervisor that they will ensure that the student abides by these conditions.
3. A description of the means by which the Data User will restrict access to confidential Africa Centre data.

Signed:

..... Date: 08/09/2008
Data User

Marie-Louise Newell Date: 09/09/2008
Prof Marie-Louise Newell (Director)

..... Date: 9/9/2008
Dr A J Herbst (ACDIS Project Leader)

IN COLLABORATION WITH THE UNIVERSITY OF KWAZULU-NATAL AND THE SOUTH AFRICAN MEDICAL RESEARCH COUNCIL

Postal: PO Box 198, Mtubatuba 3935, South Africa **Physical:** Africa Centre, R618 en route to Hlabisa, Somkhele
Tel: +27 (0)35 550 7500 Fax +27 (0)35 550 7565 E-mail: info@africacentre.ac.za
Website: www.africacentre.ac.za

Appendix 4a: Ethics Clearance Certificate for the original study from SA MRC.

UNIVERSITY OF
KWAZULU-NATAL

Research Office
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
Nelson R Mandela School of Medicine
Private Bag 7, Congella 4013
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769
Fax: 27 31 2604609
Email: buccas@ukzn.ac.za
Website: www.ukzn.ac.za

29 November 2007

Dr K Herbst
Africa Centre for Health & Population Studies
Nelson R Mandela School of Medicine
University of KwaZulu-Natal
kherbst@africacentre.ac.za

Dear Dr Herbst

PROTOCOL: A socio-demographic platform for population-based reproductive health research in a rural health district of KwaZulu-Natal. Dr A J Herbst. Ref: E009/00

Your application for recertification received on 21 November 2007 has been noted by a sub-committee of the Biomedical Research Ethics Committee.

As there is verbal consent for analysis you are requested to please submit an amendment in addition to this submission.

Please also note that according to our records, full approval for the above study was given on 06 September 2000, and where the PI was G C Solarsh.

Please indicate whether this has since changed, and if so, a letter from the PI has to be submitted.

Yours sincerely

Suraiya Buccas
Biomedical Research Ethics Administrator

Appendix 4b: Ethics Clearance Certificate for the original study from SA MRC.

AC 015

UNIVERSITY OF
KWAZULU-NATAL

Research Office
BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
Nelson R Mandela School of Medicine
Private Bag 7, Congella 4013
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604769
Fax: 27 31 2604609
Email: buccas@ukzn.ac.za
Website: www.ukzn.ac.za

13 February 2008

Dr K Herbst
Africa Centre for Health & Population Studies
Nelson R Mandela School of Medicine
University of KwaZulu-Natal
kherbst@africacentre.ac.za

PROTOCOL AMENDMENT RATIFICATION

PROTOCOL: A socio-demographic platform for population-based reproductive health research in a rural health district of KwaZulu-Natal. Dr A J Herbst. Ref: E009/00

Dear Dr Herbst

Further to our letter to you dated 20 December 2007, this letter serves to notify you that at a full sitting of the Biomedical Research Ethics Committee Meeting held on **12 February 2008**, the Committee RATIFIED the sub-committee's decision to approve the Protocol Amendment with change in PI and submission of 2003 Progress Report.

Yours sincerely

SURAIYA BUCCAS
Ethics Research Administrator
SB/pn

Appendix 5a: ACHPS Household Socioeconomic form

Household Socio-economic Form

DSRound 20

Section 1. Household Identification

BSID [redacted] Visit Ref.# Weekblock Name Type:A WeekBlock:CD01

HH ID: [redacted] Visit Type

Informant DSID Staff Member

Visit Date: Supervised? Yes No

Section 2. Operational Information

Refused Form? Yes ➤ FORM COMPLETE

Reason for premature completion

Outmigrated outside DSA ➤ FORM COMPLETE

Mentally Disabled ➤ FORM COMPLETE

Not found after 4 attempts ➤ FORM COMPLETE

Other ➤ Specify

Very sick ➤ FORM COMPLETE

Broken down/non-functional BS ➤ FORM COMPLETE

➤ FORM COMPLETE

Section 3. Household Information

1. What is the most often used source of drinking water in the household? (Tick one only)

Piped - internal	Well non-borehole
Piped - Public tap/kiosk (free)	Protected spring
Piped - Public tap/kiosk (paid)	Water carrier or tanker
Borehole	Other
Rainwater	Don't know
Flowing river/stream	Refused
Dam/stagnant water	

2. What kind of toilet does the household use? (Tick one only)

Flush toilet	Other
VIP	None
Other pit latrine	Don't know
Bucket toilet	Refused
Chemical toilet	

3. Is the household connected to an electricity supply? (Tick one only)

Yes	Don't know
No	Refused

4. What is the main fuel used for cooking? (Tick one only)

Wood	Electricity from generator
Gas (LPG)	Other
Coal	Don't know
Electricity from solar energy	Refused
Electricity from grid	

5. Is the owner of this Bounded Structure a member of this household? (Tick one only)

Yes	No	Don't know	Refused

6. Does the household have any of the following items in good working order? (Tick Yes or No for each item)

	Yes	No		Yes	No		Yes	No
Telephone			Video recorder/DVD player			Table and chairs		
Cellphone			Radio/stereo			Sofa or sofa set		
Primus Cooker, Sikeni			Sewing machine			Kitchen sink		
Electric hot plate			Block maker			Car battery for electricity		
Electric stove with oven			Car or bakkie			Wheelbarrow		
Gas cooker			Motorcycle or scooter			Hoe, spade or garden fork		
Frige or freezer			Bicycle			Bed nets		
Electric kettle			Kombi, lorry or tractor			Cattle		
Television			Bed			Other livestock (chickens etc)		

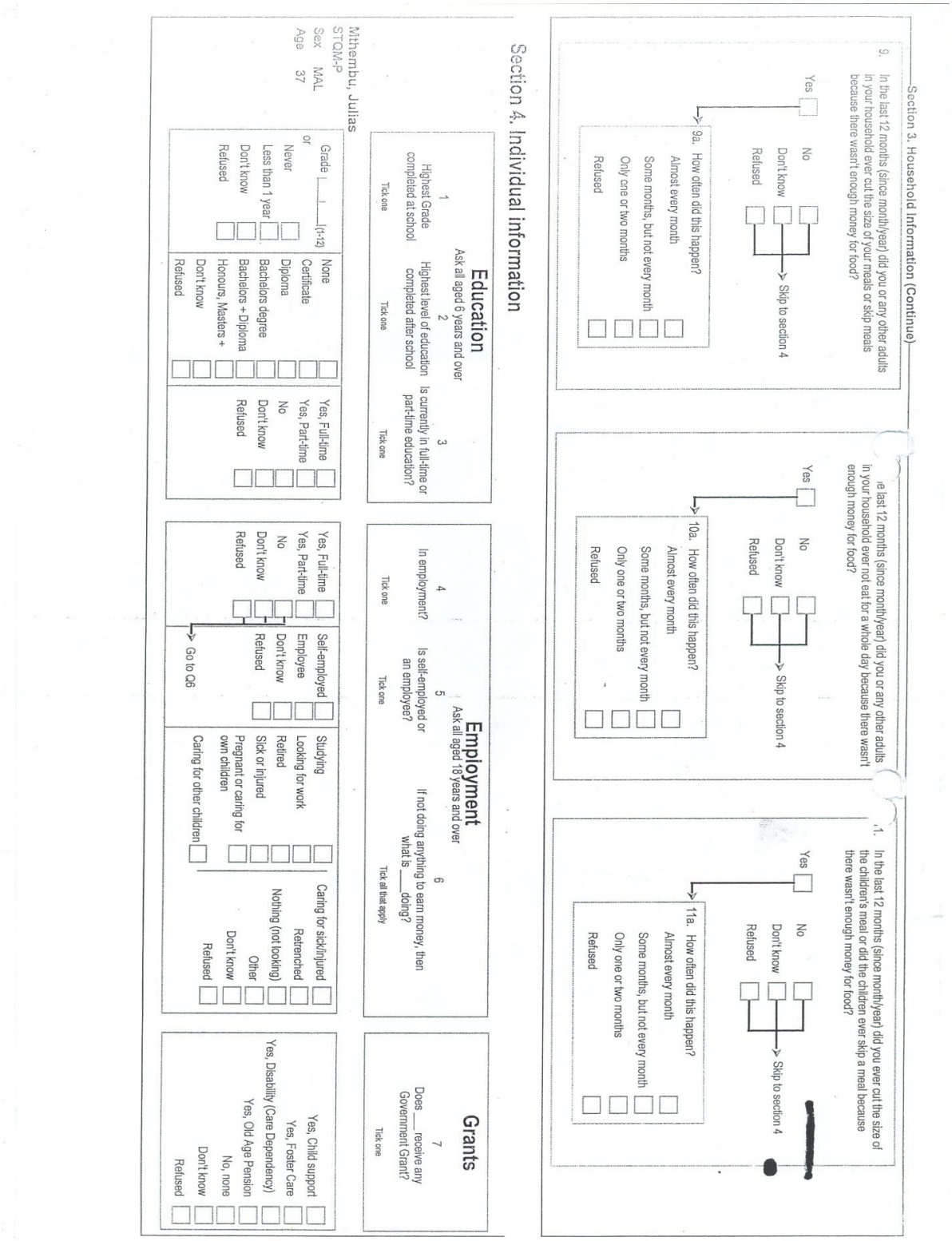
7. Has any resident member of the household been a victim of any of these crimes during the past 12 months? [Tick all that apply]

Theft		Murder	None	
Assault (incl. Sexual assault)		Other crime	Don't know	Refused

8. How would this household classify its financial situation these days? Would you say it is very comfortable, comfortable, just getting by, poor, or extremely poor? [Tick only one]

Very Comfortable		Just getting by	Extremely poor	
Comfortable		Poor	Don't know	Refused

Appendix 5b: ACHPS Household Socioeconomic form



Appendix 6: Principal Component Eigenvectors

Variable	**Eigenvectors**
Drinking water	0.1871
Toilet	0.3213
Electricity	0.3036
Bicycle	0.0141
Block maker	0.0446
Car	0.1915
Electric cooker	0.2254
Electric hot plate	0.2082
Electric kettle	0.3412
Fridge	0.3390
Gas cooker	0.1838
Kombi/lorry/tractor	0.0403
Primus cooker	-0.1910
Radio	-0.0864
Sewing machine	0.1013
Table & Chair	0.0702
Telephone	0.2445
Cell phone	0.2575
TV set	0.3271
Video recorder	0.2763
Wheelbarrow	0.0365

Appendix 7: Multivariate Cox proportional hazard model of death due to other causes other than HIV/AIDs & TB

Variable		HR, (95%CI) p-value 15-64 yrs		
Sex	Male	1		
	Female	0.64	(0.59, 0.70)	0.000
Age		1.04	(1.043, 1.052)	0.000
SES	Lowest	1		
	Low	1.01	(0.87, 1.15)	0.891
	Middle	0.94	(0.82, 1.09)	0.449
	High	**1.20**	**(1.05, 1.37)**	**0.006**
	Highest	**1.21**	**(1.05, 1.39)**	**0.008**
Marital Status				
	Married	1		
	Separated	1.78	(1.36, 2.32)	0.000
	Divorced	1.67	(0.86, 3.24)	0.125
	Single	1.90	(1.69, 2.15)	0.000
	Widowed	1.38	(1.17, 1.64)	0.000
Education				
	None	1		
	Primary	0.98	(0.87, 1.10)	0.759
	Secondary	0.96	(0.84, 1.11)	0.654
	Tertiary	0.76	(0.57, 1.01)	0.063
Employment				
	Employed	1		
	Unemployed	0.98	(0.89, 1.07)	0.700

Test of proportional Hazard Assumption: Global test p-value>0.0000

Appendix 8: Differences in the Characteristics of adults who exited the cohort before the end date of 31 December 2007

Variable	Those who completed the cohort (i.e. end date was 31st Dec. 2007)		Those who exited before the cohort ended. (i.e. end date was before 31st Dec. 2007 excluding the deaths)		Test of difference in proportions
Characteristic	**Freq.**	**%**	**Freq.**	**%**	**p-value**
Age (mean)	22695	30.5	6924	28.5	0.000
Sex					
Male	9,380	41.33	3,104	44.83	0.001
Female	13,315	58.67	3,820	55.17	0.000
Marital Status					
Married	4,619	20.98	905	14.09	0.000
Separated	561	2.55	143	2.23	0.429
Divorced	42	0.19	19	0.30	0.933
Single	15,694	71.29	5,186	80.74	0.000
Widowed	1,097	4.98	170	2.65	0.180
Education					
None	2,834	13.56	636	11.66	0.201
Primary	6,233	29.82	1,535	28.15	0.199
Secondary	11,178	53.48	2,950	54.10	0.548
Tertiary	657	3.14	332	6.09	0.028
Employment					
Employed	5,191	22.87	1,831	26.44	0.002
Unemployed	17,504	77.13	5,093	73.56	0.000
	Mean Follow-up time in years				**Overall**
Mean Follow-up time (years)	22695	**6.995**	6924	**3.140**	**5.766**

Appendix 9: Comparing mean index scores for Household Socioeconomic assert at three time points in the cohort

