CHILDHOOD MORTALITY AND SOCIOECONOMIC STATUS IN THE AGINCOURT HEALTH AND DEMOGRAPHIC SURVEILLANCE SITE IN 2003, SOUTH AFRICA

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A RESEARCH REPORT SUBMITTED TO THE FACULTY OF HEALTH SCIENCES, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF
MSc (MED) BY [COURSEWORK AND RESEARCH REPORT]
IN THE FIELD OF EPIDEMIOLOGY AND BIOSTATISTICS

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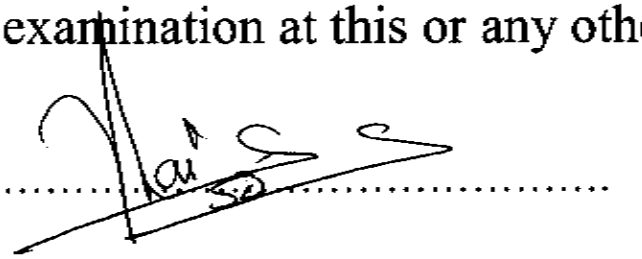
DECLARATION

I, Didier BAKAJIKA KAPUKU, declare that this research report is my own original work. It is being submitted for the degree of Master of Science (Medicine) in Epidemiology and Biostatistics of the University of the Witwatersrand, Johannesburg. To the best of my knowledge, it has not been submitted before in part or in full for any degree or examination at this or any other University.



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27-03-2008

DEDICATION

To God be the Glory

ABSTRACT

TITLE: CHILDHOOD MORTALITY AND SOCIOECONOMIC STATUS IN THE AGINCOURT HEALTH AND DEMOGRAPHIC SURVEILLANCE SITE IN 2003, SOUTH AFRICA.

OBJECTIVE: Aspects of socioeconomic status (SES) have been shown to correlate with childhood mortality in a variety of settings. The objective of the current analysis was to construct a SES index from individual household asset survey questions and to assess its association with the childhood mortality in children under age five in 2003 in the Agincourt Health and Demographic Surveillance Site.

DESIGN: Secondary data analysis utilizing previously collected data during the 2003 census within the framework of the Agincourt Health and Demographic Surveillance Site.

SETTING: The Agincourt Health and Demographic Surveillance Site.

METHODS: To assess the socioeconomic status in the Agincourt Health and Demographic Surveillance site. A questionnaire on the ownership of appliances, transport, and livestock, access to water and electricity, building materials and structure of the main dwelling was administered during the census in 2003. A wealth index as a proxy of SES was constructed by use of principal component analysis. Study participants were assigned a wealth index value and were categorized into three different wealth index categories (lowest (40%), medium (40%) and highest (20%)). Subsequently, the association of wealth index categories with childhood mortality in children under age five was assessed by logistic regression taking into account potential confounders.

RESULTS: The study population comprised 7521 children under age five of whom 117 died in 2003. In univariate logistic regression analysis children in the highest wealth index category were least likely to die in 2003(OR: 0.56, 95% CI 0.32-0.99, p=0.047) compared to those in the lowest wealth index category. Multivariate adjustment (age, birth weight, union status of the parents) deattenuated the observed association (highest versus lowest wealth index category OR=0.69, 95% CI 0.37-1.28, p=0.240). Stratification by children's age (< 1 year versus 1-4 years) showed no association of wealth index with mortality for infants, but reduced mortality for children aged 1-4 years in the highest compared to the lowest wealth index category(OR=0.31, 95% CI 0.09-1.04, p=0.058)

CONCLUSION: The results of this secondary data analysis suggest an inverse association of socioeconomic status with childhood mortality and are in line with previous results obtained in the Agincourt Health and Demographic Surveillance Site indicating a persisting effect of low socioeconomic status on childhood mortality in rural South Africa.

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NOMENCLATURE

AHDSS	Agincourt Health and Demographic Surveillance Site
AIDS	Acquired Immunodeficiency Syndrome
AHPP	Agincourt Health and Population Programme
CI	Confidence Interval
CSG	Child Support Grant
DHS	Demographic and Health Survey
DoH	Department of Health
GNP	Gross National Product
HDI	Human Development Index
HDSS	Health and Demographic Surveillance site
HIV	Human Immunodeficiency Virus
IMR	Infant Mortality rate
OR	Odds Ratio
PCA	Principal Component Analysis
RDP	Reconstruction Development Programme
SADHS	South African Demographic and Health Surveys
SD	Standard Deviation
SES	Socioeconomic status
U5MR	Under five mortality rate
UNDP	United Nations Development Programme
VA	Verbal autopsy

CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW, AIMS AND OBJECTIVES

1.1. Introduction

Traditionally at the national level, the socioeconomic status (SES) was measured by the level of income indexed crudely by either the gross domestic product or gross national product (Bawah A and Zuberi T, 2004). Nevertheless, these measures have been found to be problematic in measuring economic status at the micro-level because of their inability to capture adequately at the individual and household level the notion of well-being (Todaro 1978). In 1960, it was discovered that the per capita gross national product (GNP) used, as the indicator of human well being was inadequate (Bawah A and Zuberi T, 2004). Sen argued repeatedly that the measure of standard of living must capture happiness, utility, and choice; the ultimate objective beyond this was to enhance the well-being of people. In addition, he has been very critical of the undue emphasis on income as a measure of well being and advocated a basic needs approach using social indicators such as freedom of choice, the quality of the physical environment (Sen 1985, 1987 and 1992).

During the same year the United Nations suggested the use of human development index (HDI) which in principle also, emphasis the basic needs approach (Bawah A and Zuberi T, 2004). The HDI places emphasis on human longevity as reflected in life expectancy, acquisition of knowledge in terms of level of literacy and access to resource for a decent standard of living (UNDP) (Bawah A and Zuberi T, 2004).

In line with the principle of basic needs or human well-being approach, various questions on household characteristics or possessions conceptualized to reflect the socioeconomic status were included in the 1970 round of census and subsentquently, with the hope that

these will help measure differences in the level of socioeconomic status among household in different countries (Bawah A and Zuberi T, 2004).

The basic idea beyond this is that households with pipe-borne water; Water closet (WC) toilet; electricity for cooking or lighting energy; such durable items as radio, TV, animals (goats, pigs etc) and constructed with modern materials are likely to be "richer" than those without these facilities or those that rely on public toilet or use water from public sources (Bawah A and Zuberi T, 2004). These variables can be used either individually or as an aggregate, to differentiate households on their level of economic well-being (Bawah A and Zuberi T, 2004).

Many demographic literatures are full of studies demonstrating the significance of household characteristics and possessions on different demographic outcomes.

In numerous of these studies, household characteristics such as type of housing materials construction, type of toilet facilities, source of water used and household assets like stove, fridge, television , video, and livestock like cattle, goats, poultry and pigs, are either considered as economic status or are thought to have direct effect on mortality (Bawah A and Zuberi T, 2004). Various approaches are used by different researchers in their use of these variables for demographic analysis. These different approaches depend on relation between the particular variable and the outcome of interest. However, other researchers examine the effect of each variable separately or treat them together as socioeconomic status by creating a composite index of socio economic status (Bawah A and Zuberi T, 2004).

1.2. Background information

South Africa is a southern African country marred by its history of extreme racial inequalities from the apartheid system. Apartheid literally "apartness" in Afrikaans and Dutch was a form of segregation introduced in South Africa from 1948 to 1994(History of South Africa during the apartheid era). This system created a society of inequalities between different racial groups. Under this system, the population was legally classified into four racial groups: Black, Coloured, Asian and White (History of South Africa during the apartheid era). At the beginning of the century during the apartheid system, the country was divided into number of separate states. Eighty seven percent of land was reserved for whites, coloured and Indians while thirteen percent - mainly the least productive land in the country was reserved to blacks and divided into ten homelands called Bantustan (History of South Africa during the apartheid era).

During the 1960's and 1970's 3 ½ million of blacks were removed from the cities to their nominal homelands where neither they nor their ancestors have lived before (History of South Africa during the apartheid era).Within this system, occupational opportunities were segregated and unequal with wide disparities in income between different racial groups (Treiman et al., 1996). The education was segregated with Bantu education aimed to teach black basic skills to use when working for whites. Existing and reputable universities were reserved for whites. Health services were administered separately between different racial groups. White hospitals were of very good standard with well educated and trained staff and ample funds while black's hospitals were generally unstaffed and under equipped with many black areas without a hospital at all (History of south Africa during the apartheid era).

These specific aspects of apartheid have been shown to affect children's health and survival in South Africa. The institutionalization of racial inequalities in life chances resulted in the coexistence of distinct child mortality profiles with black and coloured children dying from less preventable causes, such as congenital and other non communicable diseases. Using different study populations and methodologies, studies across South Africa showed in the 1970s and 1980s significantly higher risk for nonwhites infants and children, particularly blacks than for whites. One study found that Infant Mortality rate (IMR) for coloured declined from the 135 deaths per 1,000 live births to 51 over the period from the 1970 to 1983, while for whites the infant mortality rate (IMR) dropped from 22 to 13 over the same period(Herman AA and Wyndham CH, 1985). Among blacks in some urban areas, the infant mortality rate fell from 124 deaths per 1, 000 live births to 86 from 1970 to 1980, while the IMR was still 130 in the Transkei area in 1980 (Herman AA and Wyndham CH, 1985). Child mortality in rural black areas was concentrated among children under one year of age, with diarrhea identified as an important, and largely preventable, cause of death.

At the end of that system in 1994, 53% of South Africans lived in poor households, the majority of whom were blacks in rural areas (National Institute for Economic Policy, 1996). Since 1994, the Democratic Government of South Africa has developed a framework for socioeconomic development in a special programme called Reconstruction and Development Programme (RDP).

In addition to his major thrust to build the economy that will address the poverty issue in general, the government addressed effectively various problems facing the majority of the population in South African by setting up broad principles and strategies for development in all key areas and sectors. It proposed also health services reconstruction in order to enable all South Africa citizens to achieve the optimal level of health and well-being through the Primary Health Care (PHC) principles, decentralization (District Health System) and community.

Infant mortality rate (IMR) and under five mortality rate (U5MR) are key indicators for assessing the health status of communities, districts and countries (Bradshaw, 1996). Internationally these indicators are used as a sensitive and although not-specific way of comparing health status and development within (districts, provinces) and between countries (Sarah B and Treiman DJ, 2004). Socioeconomic status of families, level of community development and education, access and quality of health services are factors contributing to the deaths of infants. In a specific area the U5MR is a good reflection of the general well being of children (Koumans, 1992).

1.3. Motivation of the study:

According to the 1995's October Household Survey (OHS) poor people in South Africa are concentrated in homelands (Bophuthatswana *(North West province),* Ciskei & Transkei *(Eastern Cape), Kwazulu,* Lebowa and Venda *(Limpopo Province),* the peri urban areas and the townships); 74% of them live in rural areas, 15% live in small towns, 4% live in secondary cities (Pietermaritzberg) and 7% live in major metropolitan centers (Durban, Cape Town, Port Elizabeth and Pretoria/Johannesburg);

62% of the rural population is poor compared to 32% of those in small towns, 21% in the small cities and 13% in Metropolitan areas. Also Eastern Cape and Limpopo are according to the 1999's October household surveys the poorest provinces in South Africa (Woolard Ingrid, 2002).

The Agincourt sub-district of South Africa's largely rural Limpopo province was part of the former Bantustan homeland that today scores high in poverty with an unemployment rate estimated at 40 to 50% (Collinson MA et al., 2002). As in other South African rural areas, poverty conditions are in that site exacerbated by the growing epidemic of HIV/AIDS and lack of basic facilities (including water, food, electricity, education, health care and shelter). Also children as in the whole South Africa are particularly vulnerable to socio-economic stresses that affect their standards of living and well-being. In an attempt to reduce the scale of poverty and meet the needs of the poorest, the South African government introduced the child support grant (CSG) in April 1997 to target those in lower income households in an attempt to support child growth and development (Twine R et al., 2007). The Agincourt Health and Demographic Surveillance Site (AHDSS) as rural area benefited from the CSG grant and others types of government grants. Previous studies showed a relationship between childhood mortality and socioeconomic status in South Africa in general. The efforts of the South African government to increase the socioeconomic status of poorest families should have improved the socioeconomic status of families and possible consistency towards decreased childhood mortality.

1.4. Literature review

U5MR and IMR respectively the probability of dying between birth and age five and the probability of dying before age one both expressed per 1000 live births are used as measures of well being. Data indicate that some eleven million children under the age of five die annually in the world as a whole, of whom over ten million are in the developing countries (Hill, 1994).The most affected region around the developing world is Sub Saharan Africa and accounting for more than one-third of deaths of children under the age of five (Hill, 1994).

Most previous studies around the world have shown a close relationship between socio-economic status and child mortality (Hobcraft et al., 1984; Caldwell, 1979). Most indicators of socioeconomic status used are education, the place of residence (urban/rural); parents work status and household assets. Using twenty Demographic and Health Survey (DHS) from developing countries, Bicego and colleagues (Bicego et al., 1989) found that mortality risks of under five born to uneducated mothers were more than twice as high as to those born to mothers with education/educational attained.

Similarly, focusing on twenty-eight developing countries mostly in Asia and Latin America, Hobcraft (Hobcraft et al., 1984) found that mothers and husband's education; their work status and their type of residence were more or less associated with child survival. Increased socioeconomic status, mother's level of education was found to be closely associated with improved child survival in Nigeria (Caldwell, 1979), in Nicaragua (Sandiford.P et al., 1995) and Costa Rica (Haine et al., 1982).

Bawah and Zuberi (Bawah and Zuberi, 2004) showed in three Southern African countries that the chances of childhood mortality decreased consistently with higher levels of the socioeconomic status index. Gwatkin (Gwatkin, 1999) using data from Tanzania found differentials between poor and the least poor in mortality, nutrition and treatment of illness. In Zimbabwe Woelk and Chikuse (Woelk and Chikuse, 2000) showed that stunting, underweight and occurrence of diarrhea varied according to socioeconomic status. According to their study they noted that lowest socioeconomic status increased the risk of being underweight for children by three times compared to those in the highest socioeconomic status. In South Africa so far studies found a close relationship between socioeconomic status and child mortality. The 1998 South African Demographic and Health Surveys (SADHS) showed that U5MR was consistently higher in non-urban than urban areas. This survey showed low U5MR if the mother attained secondary education and higher U5MR for families where the source of drinking water was other than piped water. Where poor sanitation existed child mortality rates were considerably higher. Where flush toilets were in use the child mortality rate was 7.7 per 1000 compared to 34.9 per 1000 where other sanitation practices were in use (DoH, 2003). In addition, the SADHS generally showed that where poor environmental conditions exist infant mortality rates are significantly higher.

1.5. Keywords and variables of interest

- Infant mortality rate (IMR): the probability of dying before age one expressed by 1000 live births.
- Under five mortality rate (U5MR): the probability of dying between birth and age 5 expressed by 1000 live births.
- Child support grants (CSG): a type of grant introduced by the National government to assist poor families.
- Socio-economic status (SES): Characteristics of economic, social and physical environments in which individuals live and work, as well as demographic characteristics.

1.6. Study Objectives

1.6.1. Main Objective

To understand the association between socioeconomic status and childhood mortality under age five in the Agincourt Health and Demographic Surveillance Site in 2003.

Hypothesis: Socioeconomic status is not associated with childhood mortality in the Agincourt Health and Demographic Surveillance Site in 2003.

1.6.2. Specific objectives

- To construct a wealth index for the Agincourt Health and Demographic Surveillance Site
- To describe the wealth index status in the Agincourt Health and Demographic Surveillance Site in 2003 in families with children under the age of five
- To investigate whether there is an association between the childhood mortality state and wealth index.

CHAPTER TWO: MATERIALS AND METHODS

2.1. Study design

We conducted a secondary data analysis utilizing previously collected data during the 2003 census within the framework of the Agincourt Health and Demographic Surveillance Site.

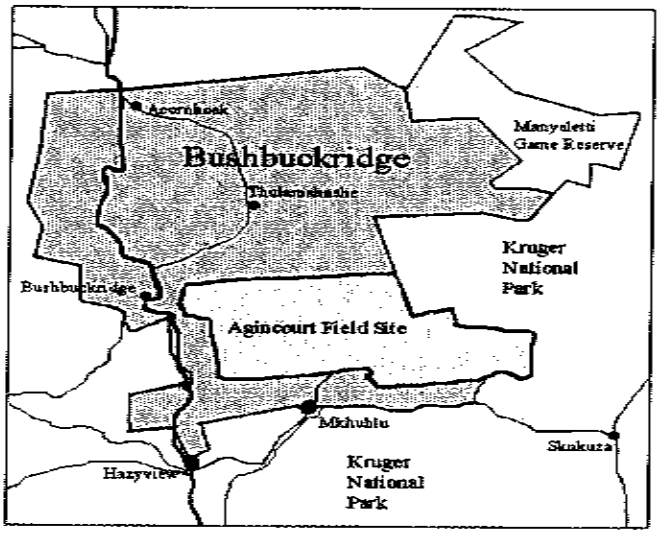
2.2. Study area

The Agincourt Health and Demographic Surveillance Site, the foundation of the Agincourt Health and Population Unit (AHPU), is a research initiative of the University of the Witwatersrand housed within the Medical Research Council/Wits Rural Public Health and Health Transitions Research Unit, School of Public Health (Khan K et al., 2007).

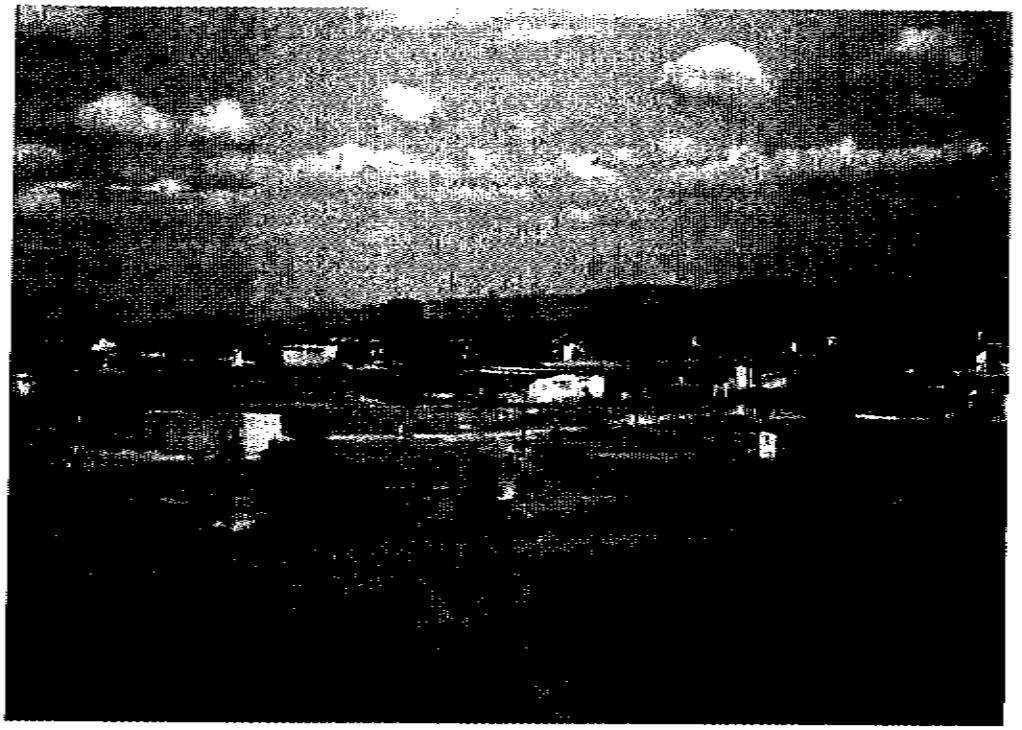
Located about 500 km northeast of Johannesburg in the Agincourt sub district of the Buschbuckridge region, this place was until the end of the apartheid system in 1994 a homeland. It extends between latitudes $24^0$50'and $24^0$56'south and the longitudes $31^0$08' and $31^0$25' east. Ecologically this zone is a semi arid savanna, better suited to game farming and low-density cattle farming than crop cultivation (Collinson MA et al., 2002) .The altitude is 400-600 meters above sea level. It covers 390 kilometer and measures 38 Km x 16Km at its widest points (Khan K et al., 2007).

The total population is 70,000 with 11 700 households and a population density of 174 persons/ km^2 (Khan K et al, 2007). The main ethnic group is the Shangaan, although Mozambicans, originally refugees, constitute more than a quarter (29%) of the total population. Both groups are tsongan-speaking, and the Mozambicans are culturally affiliated with the South African host population.

The area has mainstream Christian churches and independent African churches, and many people hold a mixture of indigenous and Christian beliefs (Tollman SM et al., 1999).



Map 1: The localization of the Agincourt field site (Collinson MA., 2000)



Map 2: A view of the Agincourt HDSS: Field site Area. (Karl .Schatz, 2003)

The unemployment is estimated at 40-50%. The formal sector employment involves migrant men work in the mines, in the manufacturing and service industries of larger towns, and on nearby game and commercial farms and timber plantations. Pensions are an important source of income for many families (Tollman SM et al., 1999). Each village has at least one primary school. About the education in this area, more than 40% of adults 25-59 years old received formal schooling. Of those 15-24 years old, almost all have attended primary school, but only 46% have made the transition to secondary school. The female adult literacy (56%) is lower compared to male adult literacy, which is estimated to be 62% (Tollman SM et al., 1999).

There are different types of housing ranging from the traditional mud huts to brick dwellings with tin or tiled roofs. Women and children collect water manually on the head or by wheelbarrow. Roads are unpaved and the public transport is limited to private

minibus taxis. Electricity and telephone services benefit from the recent development initiatives (Tollman SM et al., 1999).

The site has five satellite clinics and a health centre all staffed by nurses. Services include family planning, child health, antenatal care, delivery and postpartum care, minor ailments and chronic disease treatment. The main health problems are kwashiorkor, diarrhea, Acquired Immunodeficiency syndrome (AIDS) in less than 5 years old; accidents, violence and AIDS in the age group of 15 to 49 and finally chronic disease such us cardiac, cerebrovascular, liver and malignant diseases (Tollman SM et al.,1999; Collinson MA et al., 2002; Kahn K et al., 2007.).

The main health, demographic and socioeconomic variables measured routinely by the Agincourt Health and Demographic Surveillance Site include births, deaths, in- and out-migrations, household relationships, resident status, refugee status, education, asset status and antenatal and delivery health-seeking practices.

2.3. Study population and sample size

Our study population comprises all children under the age of five years residing in the Agincourt Health and Demographic Surveillance Site and born between 01.01.1999 to 31.12.2003 (n=9733). Information on wealth status was available in 7521 children of whom 117 died during 2003.

2.4. Data source.

2.4.1. Data collection

Several census rounds have been completed to date with a baseline one in 1992. Rounds are generally conducted from July to November. During the visit, a trained lay fieldworker interviewed the most knowledgeable respondent available at the time of the visit and checked individual information for every household member. All events that have occurred since the previous census recorded, and any status observations updated. If appropriate respondents were unavailable, the fieldworker undertook revisits, usually during evenings and on weekends, with a limit placed at two revisits per household.

2.4.2. Assessment of data quality

Supervised and random duplicate visits are conducted to ensure the quality of the data collected in the field. During theses visits, the supervisor goes into the field with the lay fieldworker and observes a number of interviews done by the fieldworker.

The supervisor on 2% of the population conducts random duplicate visits.

After each interview, a constructive feedback was given to the fieldworker in order to improve his interview skills. After a given explanation, the entire interview was conducted again, differences between the first and the second interviews were identified, and possible reasons determined. From these data, quality could be assessed, and error rates computed.

Furthermore, form checking occurred in a structured system at four levels of the field organization. The checks become more detailed as the form progresses through the system. An error was returned to the fieldworker for correction, and, where necessary, a

revisit was done. Supervisors kept track of forms, using printed checklists (Collinson MA et al., 2002).

2.4.3. The Verbal autopsy

The verbal autopsy (VA) was used to determine the probable cause of death in Agincourt. This technique relies on clinical assessment of signs and symptoms during the terminal illness, reported retrospectively by a close caregiver of the deceased (Khan K et al., 2000). The verbal autopsy is based on the assumption that the signs and symptoms can distinguish most causes of death, and that these can be accurately recognized, recalled and reported by lay respondent (Khan K.et al., 2000)

Findings were determined in two different parts. In the first part, they were determined by the cause of death in the community, and in the second part by the questionnaire, field procedures, and the analytic process used (Khan K et al., 2000; Chadramohan., 1994; Lulu., 2005).

In each household where death had been recorded, trained fieldworkers conducted a verbal autopsy selecting the person most closely associated with the deceased during the terminal illness as respondent (Khan K et al.; 2007).

To ensure common cultural background with the local community fieldworkers were recruited locally. All of them had completed secondary education, were experienced in conducting surveys, and had demonstrated the ability to conduct a verbal autopsy interview with insight and empathy (Tollman SM et al., 2007).

The interview schedule was divided into two main parts (Khan K et al., 2000): an open section where the informant describes signs and symptoms preceding deaths and their sequences followed by a closed section in which a basic filtering question (such as presence of a fewer or diarrhea), when answered positively leads to a more detailed enquiry of the particular symptoms (Khan K et al., 2000). Further sections address use of modern and traditional treatments, and lifestyle practice.

Clinician assessment was the method used to determine verbal autopsy diagnosis. Each completed questionnaire was reviewed independently by two medical practitioners. If the same diagnosis is reached, this was accepted as the probable cause of death, where not, a third medical practitioner made a further blind and independent assessment.

If two out of three diagnoses corresponded, the three medical reviewers discussed the case. Where consensus was achieved, the diagnosis was accepted. Where not the cause of death was described "undetermined" (Khan K et al., 2000).

2.4.4. The assessment of the socioeconomic status in the Agincourt Health and Demographic Surveillance Site

To assess the socioeconomic status in the Agincourt Health and Demographic Surveillance Site the questionnaire designed in 2003 round was used. This questionnaire developed through a process of discussion and refinement with local filed staff and community members of the Agincourt contained 34 questionnaires on the ownership of appliances (television, fridge, radio, stove, satellite dish, fixphone, cellphone), transport (bicycle, Motorbike, car) and livestock (cattle, goats, poultry, pigs), access to water (tap in the house, in the yard, etc) and electricity; building materials(materials of the walls, roof, floor etc) and structure of the main dwelling(number of rooms, bedrooms etc)

2.5. Data analysis

2.5.1. Methods of analysis

The individual household asset survey question was used to construct the wealth index by use of principal component analysis technique (PCA).

The PCA is a statistical technique that involves breaking down household assets (television, radio, cellphone etc) or household service access (water, electricity) into categorical or an even-based interval variable (Eleuther M et al., 2002, Howe LD et al., 2008). Variables were then processed in order to obtain weights and principal components. The results obtained from the first principal component (explaining the most variability, with the largest eigenvalue) were used to develop an index based on the formula:

$A_j = f_1 x\ (a_{ji}\text{-}a1)/\ (S_1) + \ldots + f_N x\ (fa_{jN}\text{-}a_N)/\ (SN)$ (Filmer and Pritchett, 2001)

Where f_i is the scoring factor or weight for the first asset (or service), x is the variable (asset or service), aj is the value for the assets (or service), and a_1 and s_1 were respectively the mean and the standard deviation of assets or service (Eleuther M et al., 2002).

Based on this equation the wealth index of household were assigned to the residents of those households, and the resulting population was divided into quintiles that then represent proxies for socioeconomic status (Eleuther M et al., 2002).

In this study, we decided to categorize the wealth index into three different classes respectively the lower (comprising poorest and very poor children), middle (comprising the poor and the less poor children) and the higher class (comprising the least poor children).

The wealth index constructed using the principal component analysis technique as indicated above will be use as a proxy of the socioeconomic status to describe the socioeconomic status in the Agincourt Health and Demographic Surveillance Site.

We used logistic regression analysis to test whether the socioeconomic status was associated with childhood mortality and to control for potentials confounders identified such us child age, child sex, refuge status, parent union status, breastfeeding , mother alive, the total number of sibling in the household and parent education status.

2.5.2. Statistics tools

Stata software version 9.0 will be used for data cleaning, the construction of a socioeconomic index and the statistical analysis.

2.6. Ethical Considerations

Ethical clearance for the Agincourt Health and Demographic Surveillance Site was previously obtained from the Ethics Committee for research on human subjects (Protocol **n^{o} 960720**). In addition ethical clearance for the current secondary data analysis was obtained (Protocol n^{o} **M060908**) from the Wits Human Research Ethics Committee (Medical)

CHAPTER THREE: RESULTS

3.1. Description of the wealth index obtained

A wealth index for the children's families was constructed by use of principal component analysis technique (PCA) (Eleuther M et al., 2002). Variables considered in the PCA were the building materials used (type of walls, roof, floor), the structure of the main dwelling (number of rooms and bedrooms in the house, the status of the toilet facility, the toilet type, whether the kitchen or living room is separated from the sleeping room), the access to water and to the electricity (water supply, water availability, powerlight, powercook), the ownership of appliances and transport facilities in the household (stove, fridge, television, video, satellite dish, radio, fixphone, cellphone, bicycle, motorbike and car) and the livestock of the households (cattle, goat, poultry and pigs).

Twenty nine factors were identified by the PCA and the first factor contributing 18% to the overall variance with an eigenvalue of 5.2 was selected (appendices 1 & 2). Each child got a wealth index value assigned and subsequently the study population was categorized into three different wealth status categories respectively lowest, medium and highest (40%/40%/20%).

Appendices 3, 4, 5 , 6 and 7 show the distribution of building materials used (type of walls, roof, floor), the structure of the main dwelling (number of rooms and bedrooms in the house, type of toilet, kitchen or living room separate from the sleeping room), the access to water and to electricity (water supply, water availability, powerlight, powercook), the ownership of appliances and transport facilities in the household (stove, fridge, television, video, satellite dish, radio, fixphone, cellphone, bicycle, motorbike and car)

and the livestock of the households (cattle, goat, poultry and pigs) over the three wealth index categories.

Children living in households categorized in wealth index I were more likely to live in small thatched houses (appendix 3) with no toilet facilities (appendix 4), with water access predominantly from a tap in the street, less access to electricity and using mainly wood as cooking source (appendix 5) compared to children living in households classified in wealth index category III. Households classified in wealth index category I were furthermore characterized by owing less appliances (appendix 6) and less livestock (appendix 7).

3.2. Description of the study population

Table 1 describes selected characteristics of the study population for all children, infants and children aged 1 to 4 years. Thousand four hundred ninety eight children were aged less than one year (737 males and 761 females) while 6,023 children were aged from one to four years (2967 males and 3056 females). The mean age of children was 30.4 (SD 0.49) months. Among those who died in 2003, 71 were aged less than one year (40 males and 31 females) while 46 were aged one to four years (26 males and 20 females).

Six percent of children had a birth weight less than 2.5 kg while 94% had a birth weight greater than 2.5 kg. Sixty five percent of children were South African while thirty five percent were Mozambican. Mothers were on average 26.1 (SD 7.5, range 12.5-49.9) years old at birth.

Fifteen percent of mothers did not attend the school, twenty-five a primary school, fifty-four the secondary and five percent had reached a higher education.

Fathers were on average 37.2 (SD 9.7, range 13.6-85.9) years old at birth.

Twenty nine percent of fathers did not attend school, thirty-nine percent had a primary education, twenty-six a secondary and two percent reached a higher education.

With regard to marital status of parents, sixty-nine percent of parents were married (married or remarried), nine percent were not (divorce not remarried, separate not remarried and widowed not remarried) and twenty- two percent live in union.

A male and thirty-one by a female headed Sixty eight percent of households.

Table 1: Characteristics of 7,521 children residing in the Agincourt HDSS in 2003 (N (%))

Variables	N	All children N (%)	< 1 Year N (%)	1- 4 Years N (%)
Children status	7521			
Alive		7,404(98.4)	1,427(95.3)	5,977(99.2)
Dead		117(1.6)	71(4.7)	46(0.8)
Sex	7521			
Male		3.704(49.2)	737(49.2)	2,967(49.3)
Female		3.817(50.8)	761(50.8)	3,056(50.8)
Refugee status of children	7521			
South African		4,851(64.5)	978(65.3)	3,873(64.3)
Mozambican		2,668(35.5)	520(34.7)	2,150(35.7)
Birth weight	7521			
<2.5kg		470(6.2)	117 (7.8)	353 (5.9)
>=2.5Kg		7,051(93.8)	1.381 (92.2)	5,670 (94.1)
Father education status	2960			
No education		849(28.6)	145(23.2)	704(30.2)
Primary education		1,166(39.4)	245(39.2)	921(39.4)
Secondary education		780(26.4)	200 (32.0)	580(24.8)
High education		165(5.6)	35(5.6)	130(5.6)
Mother education status	5889			
No education		895 (15.2)	169(13.0)	726(15.8)
Primary education		1,487(25.2)	243(18.7)	1,244(27.1)
Secondary education		3,196(54.3)	818(62.8)	2,378(51.9)
High education		311(5.3)	72(5.5)	239(5.2)
Parent marital status	3110			
Formal married/Remarried		2,146 (69.0)	389 (59.9)	1,757 (71.4)
Not married (widowed, separated, divorced)		272 (8.8)	71 (10.9)	201 (8.2)
In Union		692(22.2)	189(29.2)	503(20.4)
Head of household	7315			
Male		5,017(68.6)	995(67.1)	4,022(69.0)
Female		2.298(31.4)	488(32.9)	1,810(31.0)
Breastfeeding	7521			
Yes		7,259(98.2)	1,429(96.6)	5,830(98.5)
No		137(1.8)	50(3.38)	87(1.5)
Total number of siblings	7521			
No		6.007(79.9)	1.263(84.3)	4,744(78.8)
>=1		1,514(20.1)	235(15.7)	1.279(21.2)
Mother's age at birth	7521			
<=19		1,488(19.8)	303(20.2)	1,185(19.7)
>19 - <= 29		3,488(46.4)	707(47.20)	2.781(46.2)
>29 - <= 39		2,017(26.8)	380(25.4)	1,637(27.2)
>39 - <= 49		481(6.4)	106(7.1)	375(6.2)
> 49		47(0.6)	2(0.13)	45(0.7)
Mother alive	7,431			
No		7.324(98.6)	1,418(95.5)	5,906(99.3)
Yes		107(1.4)	66(4.5)	41(0.7)

3.3. Childhood mortality in the Agincourt HDSS in 2003

3.3.1. Overall and cause specific mortality

Among the 117 children who died in 2003, 72 children were aged less than one year while 45 were aged from one to four years.

The overall mortality rate, calculated by person-year-analysis, with person years in the denominator and number of death in the numerator was 17.45 per 1000 Person-Years. Mortality rate for infants and children aged 1 to 4 years were respectively 90.22 and 7.61 per 1000 Person-Years (Table 2).

Table 2: Mortality rate of children aged less than one and one to four years in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

Child age (Number of children)	Person-years	Death	Mortality rate
Less than 1 year (1,498)	798	72	90.22
From 1- 4 Years (6,023)	5906	45	7.61
Total	6704	117	17.45

The main cause of death in children was the human immunodeficiency virus (Figure 2). Figures 3 and 4 depict the main causes of death for infants and children aged 1 to 4 years with HIV the predominant cause of death in 23% of the infants and 48% in the 1 to 4 years old.

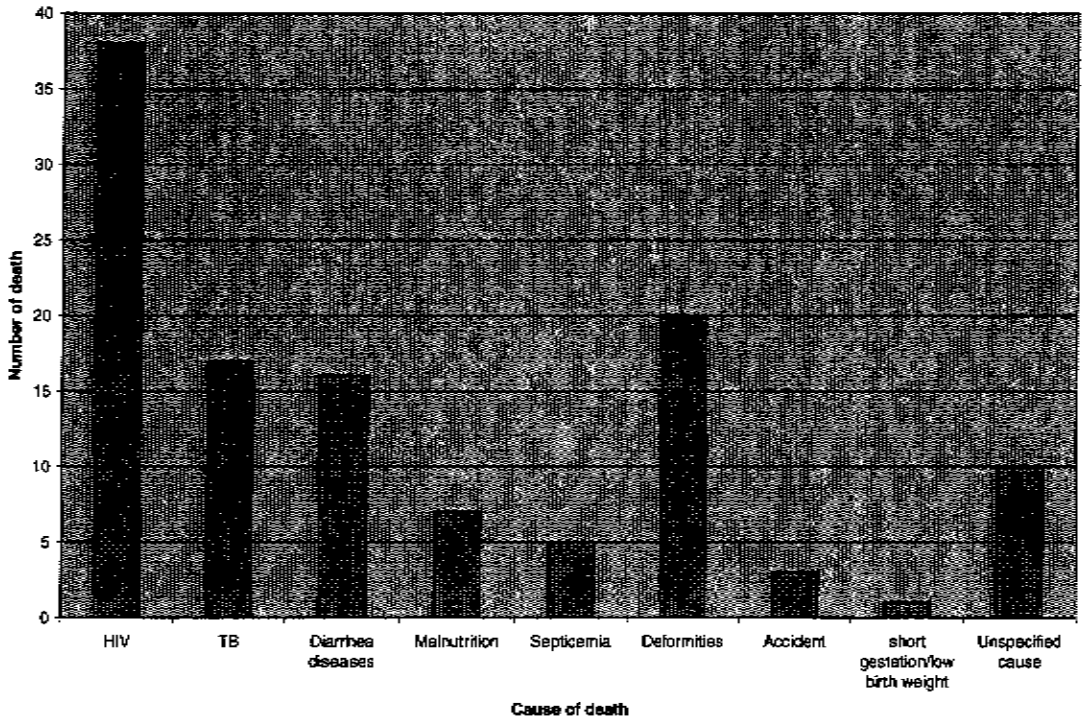


Figure 2: Distribution of main cause of death of 117 children in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

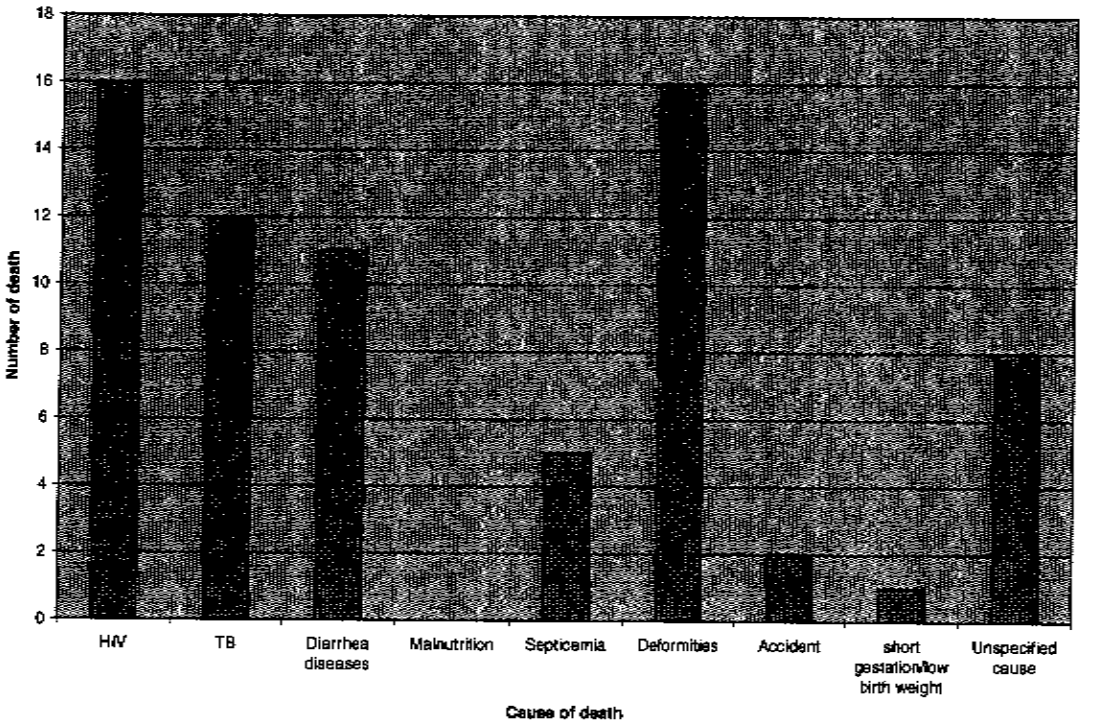


Figure 3: Main cause of death of 71 children aged less than one year in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

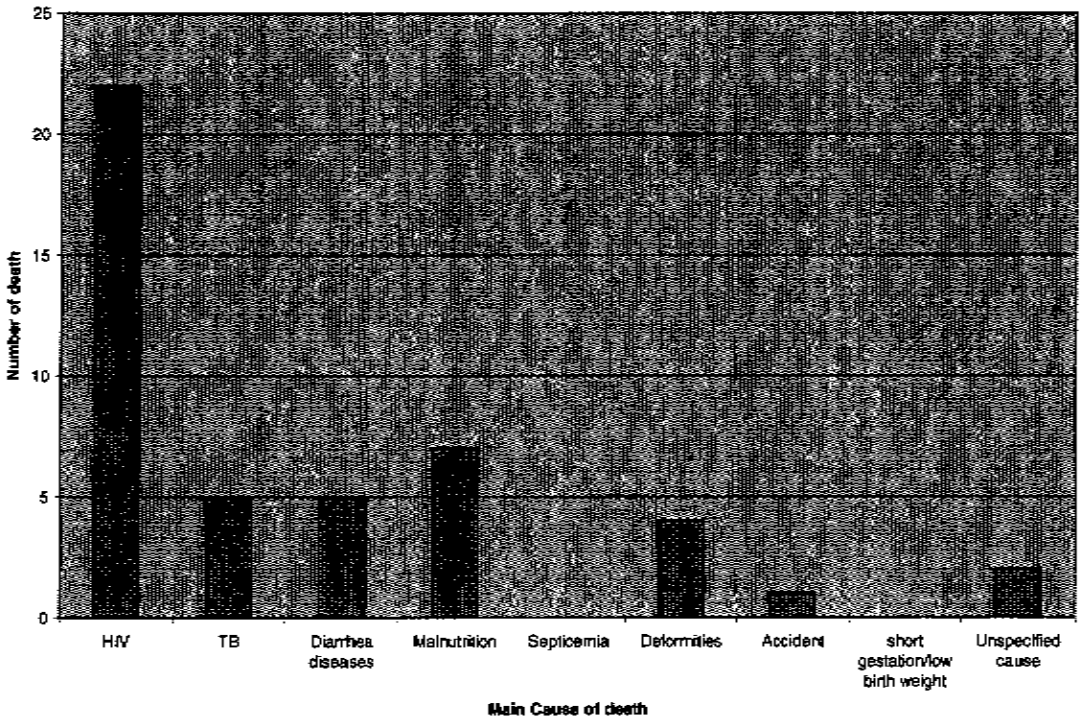


Figure 4: Main cause of 46 children aged from one to four years in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

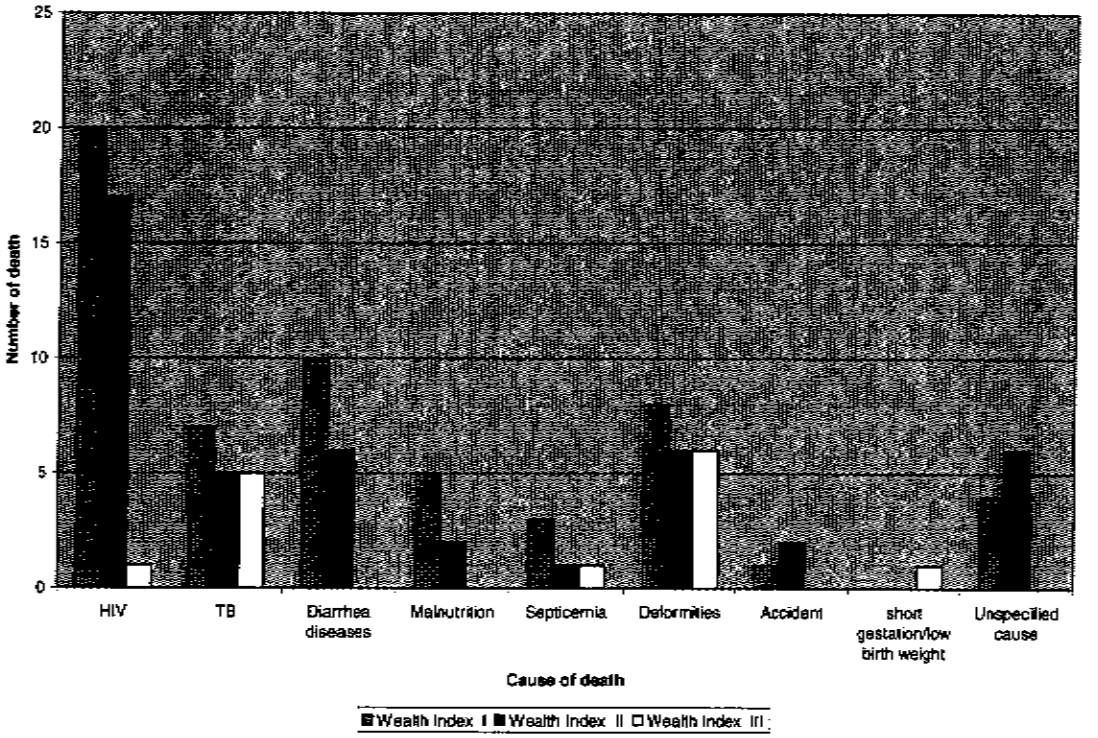


Figure 5: Presentation of cause of death per wealth index categories in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa.

3.3.2. Overall mortality by wealth index categories.

Mortality rates were observed to decrease with increasing wealth index (tables 3).

For infants the mortality rates for those classified in the lowest wealth index category were considerably higher than for those classified in wealth index II and III.

For children aged 1 to 4 years mortality rates for wealth index category III was considerably lower for wealth index category I and II.

Table 3: Mortality rates by socioeconomic status in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

Wealth index (Number of children)	Person-years	Death	Mortality rate
Lowest wealth index(3,008)	2654	56	21.09
Medium wealth index(3,009)	2701	45	16.66
Highest wealth index(1,504)	1349	16	11.85
Total	6704	117	17.45

Table 4: Mortality rates by socioeconomic status and child age in the Agincourt Health and Demographic Surveillance Site in 2003, South Africa

SES/Child age	Person-Years	Death	Mortality rate
Lowest wealth index			
< 1 Year	579	37	63.87
1-4 Years	2074	19	9.15
Medium wealth index			
< 1 Year	562	21	37.37
1-4 Years	2139	24	11.22
Highest wealth index			
< 1 Year	293	13	44.32
1-4 Years	1056	3	2.84

3.4. Association between wealth index status and mortality of children aged under five years in the Agincourt Health and Demographic Surveillance Site.

We subsequently conducted a logistic regression analysis to asses whether wealth index was associated with childhood mortality using the wealth index both as a continuous and as a categorical variable in a univariate and multivariate analysis.

3.4.1 Univariate analysis

In a Univariate logistic regression, using the wealth index as a continuous variable, we found an association between wealth index and child mortality (OR 0.88; 95% CI 0.81-0.95; p= 0.003). Using wealth index as categorical variable we observed children in the highest wealth index category to be significantly less likely to have died in 2003 compared to those classified in the lowest wealth index (OR 0.56; 95% CI 0.32-0.99; p=0.047; p trend=0.001). Further factors associated with childhood mortality were marital status of parent, the mother status (alive or died), the total number of siblings in the household, the age, birth weight and breastfeeding status of the child (table 5)

Table 5:

Childhood mortality for 7,521 children in the Agincourt HDSS in 2003

	Univariate analysis			Multivariate analysis adjusted*		
Variables	**OR**	**CI (95%)**	**p-Value**	**OR**	**CI (95%)**	**P-Value**
Wealth Index						
Wealth Index I(Reference)	1.00			1.00		
Wealth Index II	0.80	0.54 - 1.19	0.270	0.76	0.49-1.16	0.205
Wealth Index III	0.56	0.32 - 0.99	0.047	0.43	0.28-0.82	0.010
Sex						
Male(Reference)	1.00			1.00		
Female	0.75	0.52-1.08	0.120	0.68	0.46- 1.03	0.070
Child age						
< 1 Year(Reference)	1.00			1.00		
1-4 Years	0.15	0.11-0.22	0.001	0.18	0.12- 0.28	0.001
Refugee status						
South African(Reference)	1.00					
Mozambican	0.98	0.67-1.44	0.920			
Mother Education Status						
No education(Reference)	1.00					
Primary education	0.97	0.48-1.95	0.936			
Secondary education	1.18	0.65-2.18	0.579			
High education	0.66	0.19-2.33	0.520			
Birth Weight						
< 2.5 kg(Reference)	1.00			1.00		
>=2.5	0.44	0.26-0.77	0.004	0.49	0.27- 0.91	0.025
Parent Union Status						
Married/Remarried(Reference)	1.00					
Not married(divorced, widowed, separated)	3.22	1.41- 7.39	0.006			
In Union	2.03	1.00- 4.11	0.048			
Gender of the Household Head						
Male(Reference)	1.00					
Female	1.75	0.51 -1.10	0.145			
Breastfeeding						
Yes(Reference)	1.00			1.00		
No	6.80	3.64-12.69	0.001	6.00	3.04-11.95	0.001
Total number of siblings						
No	1.00					
>=1	0.33	0.16-0.65	0.001	0.43	0.20- 0.89	0.024
Mother's age at birth						
<=19	1.00					
>19 - <= 29	0.85	0.53- 1.37	0.505			
>29 - <= 39	0.90	0.54- 1.53	0.712			
>39 - <= 49	0.71	0.29- 1.74	0.453			
> 49	1.22	0.16- 9.20	0.845			
Mother alive						
No	1.00			1.00		
Yes	14.18	4.76-42.22	0.001	13.54	3.91-46.90	0.001

***Adjusted for all other variables in the model.**

3.4.2. Multivariate analysis

Those variables with a p-value less than 0.15 were selected for inclusion in the multivariate analysis. In a multivariate analysis taking into account variables included in the univariate analysis, wealth index was significantly associated with childhood mortality. Categorization of wealth index status showed children in the wealth index III category to be 0.43(OR 0.43; 95% CI 0.28 - 0.82; p=0.010) less likely to die in 2003 compared to these in the wealth index category I.

Further factors significantly associated with childhood mortality in a fully adjusted model were mother status (alive or died), total number of siblings in the household, gender, age, birth weight and breastfeeding status of child (Table 5).

We subsequently stratified children in those under one year and those aged one to four years to evaluate whether the association between wealth index and mortality differed for infants and children aged 1-4 years. We observed the wealth index for children less than one year in a multivariate logistic regression analysis to be associated with child mortality in Agincourt in 2003 if wealth index status was considered as a continuous variable (OR 0.87; 95%CI 0.78- 0.97; p=0.017). Multivariate adjustment deattenuated the observed association (Table 6).

Table 6

Multivariate analysis for children under one and one to four years residing in the Agincourt HDSS in 2003

	< 1 Year			1- 4 Years		
Variables	**OR**	**CI (95%)**	**P-Value**	**OR**	**CI (95%)**	**P-Value**
Wealth index I(Reference)	1.00			1.00		
Wealth index II	0.55	0.30-1.00	0.052	1.11	0.67-2.25	0.734
Wealth index III	0.62	0.31-1.27	0.194	0.10	0.01-0.76	0.027
Sex						
Male(Reference)	1.00			1.00		
Female	0.66	3.08 -14.61	0.132	3.94	0.87-17.80	0.165
Birth Weight						
< 2.5 kg(Reference)	1.00			1.00		
>=2.5	0.82	0.33- 1.98	0.658	2.24	0.11-0.52	0.001
Breastfeeding						
Yes(Reference)	1.00			1.00		
No	0.67	3.08- 14.61	0.001	3.94	0.87- 17.81	0.074
Total number of siblings						
No(Reference)	1.00			1.00		
>=1	0.63	0.26-1.48	0.291	0.21	0.05 -0.89	0.034
Mother alive						
No(Reference)	1.00			1.00		
Yes	5.55	0.50-61.58	0.163	21.74	5.76- 81.98	0.001

Overall, we observed that the association between wealth index and childhood mortality remained statistically significant after multivariate adjustment.

CHAPTER FOUR: DISCUSSION

4.1. Introduction

Childhood mortality rates are basic indicators of country's socioeconomic level and quality of life. In the current study, we explored the relationship between socio-economic status and childhood mortality in the Agincourt Health and Demographic Surveillance Site, focusing on the most vulnerable members of the community-young children. Our main objective was to understand the association between socioeconomic status and mortality rate in the Agincourt Health and Demographic Surveillance Site in 2003. We examined using logistic regression analysis methods, the association between socioeconomic status and childhood mortality in the Agincourt Health and Demographic Surveillance Site for children born from 1.01.1999 to 31.12.2003.

4.2. Socioeconomic status and risk factors of childhood mortality in the Agincourt Health and Demographic Surveillance site

The findings suggest that socioeconomic status was associated with childhood mortality.

In a univariate analysis using wealth index as a continuous variable we found socioeconomic status to be associated with child mortality (OR 0.88; 95% CI 0.81-0.95). Using wealth index as categorical variable we observed children in the highest wealth index category to be significantly less likely to have died in 2003 compared to those classified in the lowest wealth index (OR 0.56; 95% CI 0.32-0.99).

In a multivariate analysis taking into account variables included in the univariate analysis, wealth index was also significantly associated with childhood mortality.

Categorization of wealth index status showed children in the wealth index III category to be 0.43 less likely to die in 2003 compared to these in the wealth index category I(OR 0.43; 95% CI 0.28 - 0.82).

Further factors associated with childhood mortality in the current study were the mother status (alive or died), the total number of siblings in the household, the age, birth weight and breastfeeding status of the child.

Compared to previous studies that focused on the association between socio-economic status with the childhood mortality, current findings appeared to be consistent (Schellenberg J.A., 2003; Khan K et al., 2000; Eleuther M et al., 2002).

Tollman and colleagues in 2001 found the socioeconomic status to be correlated with under five mortality in the Agincourt setting, with the highest socioeconomic status showing the lowest under five mortality and the two lowest classes highest under five mortality. Children who had deceased mothers had lower chance of survival compared to those with their mother alive (OR: 13.54, 95 % CI 3.91-46.90). The number of siblings in the household appeared to be significantly associated with lower mortality (OR 0.43; 95% CI 0.20 - 0.89) especially for infants. Older children had a better survival chance compared to infants (OR: 0.18 95%CI 0.12-0.28). Children who had a birth weight of less than 2.50 kg had lower chance of survival compared to those with more than 2,50 Kg (OR: 0,49, 95% CI 0.27-0.91). Results also showed that breastfed children had lower mortality than those not breastfeed (OR: 6.00, 95% CI 3.04-11.95).

The high mortality of children who had deceased mothers compared to those whose mother were still alive as reported above is consistent with results obtained in other studies (Brokerhoof and Hewett, 2000; Sear et al., 2000) and can be attributed to

improper bottle feeding, no breastfeeding, the reduction in care and the HIV/AIDS pandemic that cause a lot of death among mothers of children impacting on childhood mortality (Konseiga et al., 2006).

The number of siblings was also associated with child mortality. Previous studies by Brokerhoof and Hewett revealed that children without elder sisters (at least 10 years) had higher mortality than those with at least one. Makepeace and colleagues argue that matrilineal kin were assisting mothers of young children (Makepeace and Pal, 2006).

Brokerhoof and Hewett (2000), Konseiga et al (2006) in their studies revealed that mortality in the first year of life was higher compared to subsequent years and this is consistent with our finding and can be explained by the HIV/AIDS pandemic.

Breastfed children were found to have lower child mortality rates and this was consistent with results from Ssengonzi et al., 2002.

4.3. Number of deaths and cause of deaths

The mortality rate in the whole population of 7521 children was 17.45 deaths per 1000 person years and the majority of deaths (64.96%) were for children less than one year. The mortality rate for infants and children aged from one to four years old were respectively 90.18 % and 7.61 %.

HIV/AIDS was the leading cause of death for infants and children aged from one to four years. This cause was consistent with previous investigations into child mortality in the Agincourt Health and Demographic Surveillance Site (Tollman SM et al., 2000; Collinson et al., 2002; Hargreaves JR et al. 2004; Khan K et al. 2007).

However, these results should be interpreted with caution. Differentiation between AIDS and TB is difficult by verbal autopsy method used and could have caused misclassification in the determination of cause of death due to the association of AIDS with many diseases. (Samuel JC et al., 2007).

4.4. Limitations of the study

The current study presents some limitations. We could not establish a temporal relationship due to the assessment of exposure and outcome of interest simultaneously.

The dataset used contained a considerable amount of missings values. Some variables such as father education, parent work status, the place of residence contained a lot of missing values that did not allow constructing a "real" SES status. These missing values were due to residence issue, as many biological fathers do not live in the same household as their children. The father data could therefore be biased because it represents co-resident fathers and linked temporary migrants' fathers, and not absent fathers, which is the majority case. These variables listed above were not included in the SES variable. Therefore, we used the "wealth index" as a proxy of SES instead of using a "real" SES status. The cause of death collected retrospectively from close relatives using verbal autopsy technique could have introduced recall bias and subsequently lead to misclassification.

Finally, data used represent former homeland settlements in South Africa where about 40 % of the whole population are based, including the sub- population with the highest levels of poverty and can therefore not be generalized to the whole population of South Africa.

4.5. Strengths of the study

The data used in the current study were extracted from a large comprehensive database from a demographic system that is relatively representative for the local population. Death cases were ascertained by a verbal autopsy conducted by well-trained field interviewers and analysed by qualified medical officers. The technique used (PCA) has the advantage of capturing the latent essence of socioeconomic status that is assumed present in each one of the multiple indicators.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The main aim of this study was to understand the association between childhood mortality and socio-economic status in the Agincourt HDSS in 2003. Many studies around the world and in African setting have shown a close relationship between childhood mortality and socio-economic status. Tollman and colleagues in 2001 found that socioeconomic status was associated with childhood mortality in Agincourt in 2001 with the highest economic class showing the lowest under five mortality and the two lowest classes showing the highest under five mortality. Eleuther M and colleagues in 2002 found in rural Tanzania a closed association between socioeconomic status and childhood mortality (Eleuther M et al., 2002). However, Brokerhoof and Hewett in 2000 suggested that child mortality in Africa should be conducted within a social and epidemiological framework. This means that this new area of research have to be addressed in detail in order to understand in depth health equity disparities such between ethic groups living in Agincourt, the use of health services. The major findings suggested that mortality was higher in infant(less than one year) than older children (1-4 years). This means that the health of youngest need to be prioritized. The results also showed breastfeeding to be associated with mortality and hence, policy directed to encourage mothers to breastfeed their baby during the infancy should be reinforced. Results showed children with at least one sibling to be at lower risk of death. Therefore, families need to be educated on family planning and child spacing.

5.2. Recommendations

HIV/AIDS remains a major cause of death in South Africa and sub-Saharan Africa therefore Public health interventions program have to be reinforced such roll out antiretroviral therapy in order to reduce the mother to child transmission(MTCT). This major cause of death is followed by Tuberculosis and diarrhea between both infants less than one year and those aged from one to four years old. Therefore, poverty reduction policy needs to be prioritized by empowering black communities and creating employment opportunities in order to reduce poverty. The Agincourt Health and Demographic Surveillance Site is one of the poorest sites in South Africa to benefit from the government different social grants such child support grant (CSG). Therefore, there is a need of improving the socio-economic status, which has a beneficial effect on the survival of under five years old in rural South Africa (Twine R et al., 2007).

Due to the fact that fathers living elsewhere are an important residence category that may affect both child mortality and SES, we recommend a future study that will control the resident status of father and mother and which can be done despite the current data limitation.

Finally, the data used for this research report were cross sectional and this provided an ideal study design for this research report. However, we recommend also further studies in the future using longitudinal data in order to address this question as the Agincourt' data are prospective and longitudinal.

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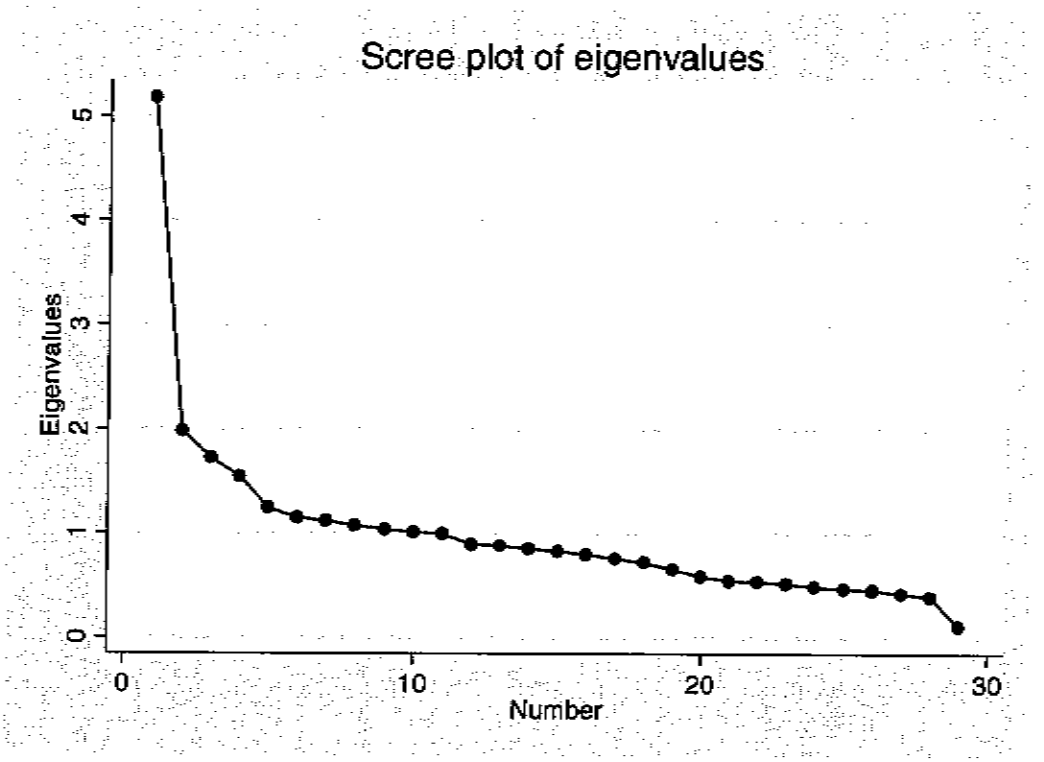
APPENDICES:



Appendix 1:
Figure 1: **Screen plot of principal components and Eigen values**

Appendix 2:
Eigenvalue, difference, Proportion and cumulative of principal components (Factors) in Agincourt in 2003, South Africa

Component	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	5.1841	3.2020	0.1788	0.1788
Factor 2	1.9820	0.2591	0.0683	0.2471
Factor 3	1.7229	0.1783	0.0594	0.3065
Factor 4	1.5445	0.3002	0.0533	0.3598
Factor 5	1.2442	0.0936	0.0429	0.4027
Factor 6	1.1506	0.0320	0.0397	0.4424
Factor 7	1.1186	0.0460	0.0386	0.4809
Factor 8	1.0726	0.0345	0.0370	0.5179
Factor 9	1.0380	0.0263	0.0358	0.5537
Factor 10	1.0116	0.0156	0.0349	0.5886
Factor 11	0.9960	0.1036	0.0343	0.6230
Factor 12	0.8923	0.0122	0.0308	0.6537
Factor 13	0.8801	0.0275	0.0303	0.6841
Factor 14	0.8526	0.0210	0.0294	0.7135
Factor 15	0.8315	0.0322	0.0287	0.7422
Factor 16	0.7993	0.0425	0.0276	0.7697
Factor 17	0.7567	0.0352	0.0261	0.7958
Factor 18	0.7215	0.0676	0.0249	0.8207
Factor 19	0.6538	0.0639	0.0225	0.8432
Factor 20	0.5899	0.0410	0.0203	0.8636
Factor 21	0.5488	0.0112	0.0189	0.8825
Factor 22	0.5376	0.0177	0.0185	0.9010
Factor 23	0.5199	0.0304	0.0179	0.9190
Factor 24	0.4894	0.0177	0.0169	0.9359
Factor 25	0.4717	0.0136	0.0163	0.9521
Factor 26	0.4581	0.0350	0.0158	0.9679
Factor 27	0.4231	0.0303	0.0146	0.9825
Factor 28	0.3927	0.2781	0.0135	0.9960
Factor 29	0.1146	0.0001	0.0040	1.0000

Appendix 3:
Building materials used for construction of houses according to wealth index status for households in Agincourt with children less than 5 years in 2003, South Africa.

Item	Wealth Index Category			Total
	Category I (n=3,008)	Category II (n=3,009)	Category III (n=1,504)	(N=7521)
Walls				
Brick	559 (18.6)	59 (1.9)	0(0.0)	618 (8.2)
Cement	557 (18.5)	92 (3.0)	6 (0.4)	655 (8.7)
Other modern	8 (0.3)	0(0.0)	0(0.0)	8(0.1)
Stabilized mud	22 (0.7)	3 (0.1)	0(0.0)	25 (0.3)
Traditional mud	4(0.1)	2(0.1)	3(0.1)	8(0.1)
Wood	1,848 (61.4)	2,820 (93.5)	1,412 (93.9)	6,080 (80.8)
Other informal	10 (0.3)	33 (1.1)	84 (5.6)	127 (1.7)
Roof				
Tiles	271 (9.0)	22 (0.7)	1(0.1)	294 (3.9)
Corrugated iron	7 (0.2)	0(0.0)	1(0.1)	7(0.1)
Other modern	1(0.0)	0(0.0)	2(0.1)	3(0.0)
Thatch	2,713 (90.2)	2,924 (97.2)	1,260 (83.8)	6,897 (91.7)
Other informal	16 (0.5)	63 (2.1)	241 (16.0)	320(4.3)
Floor				
Other traditional	152(5.1)	0(0.0)	0(0.0)	156(2.0)
Mat	1(0.0)	0(0.0)	0(0.0)	1(0.0)
Dirt	290(9.6)	10 (0.3)	2(0.1)	302(4.0)
Other modern	5 (0.2)	2(0.1)	0(0.)	7(0.1)
Cement	2,554 (84.9)	2,991 (99.4)	1,451 (96.5)	6,996 (93.0)
Modern Carpet	5(0.2)	5(0.2)	46(3.1)	56(0.7)
Tiles	1(0.0)	1(0.0)	5(0.3)	7(0.1)

Appendix 4: Structure of main dwelling according to wealth index status for households in Agincourt with children less than 5 years in 2003, South Africa

Item	Wealth Index Category			Total
	Category I (n=3,008)	Category II (n=3,009)	Category III (n=1,504)	(N=7521)
Rooms				
One	635 (21.1)	155 (5.2)	8(0.5)	798 (10.6)
Two	1,223 (40.7)	665 (21.1)	97 (6.4)	1,985 (26.3)
Three	711 (23.6)	1,072 (35.6)	437 (29.1)	2,220 (29.5)
Four	262 (8.7)	688 (22.9)	460 (30.6)	1,410 (18.8)
Five	113 (3.8)	277 (9.2)	255 (16.9)	645 (8.6)
six	32 (1.1)	102 (3.3)	124 (8.2)	258 (3.4)
Seven	11(0.4)	34(1.1)	42(2.8)	87(1.1)
Eight	5(0.2)	7(0.2)	43(2.9)	55(0.7)
Nine	5(0.2)	4(0.2)	31 (2.0)	40 (0.5)
>=Ten	11(0.4)	5(0.2)	7(0.4)	23(0.3)
Bedrooms				
One	1(0.0)	6(0.2)	1(0.1)	8(0.1)
Two	1,667 (55.9)	415 (13.8)	31(2.1)	2,113(28.1)
Three	1,077(35.8)	1,126(37.4)	219(14.5)	2,422 (32.2)
Four	231 (7.7)	993(32)	616(40.9)	1,840 (24.2)
Five	28(0.9)	395(13.1)	461 (30.6)	884 (11.7)
six	4(0.1)	61 (2.0)	123(8.1)	188 (2.5)
>=Seven	0(0)	13(0.4)	53(3.5)	66 (0.9)
Kitchen separate from the sleeping function				
No	1,197 (39.8)	589 (19.7)	46 (3.1)	1,832 (24.4)
Yes	1,811 (60.2)	2,420 (80.3)	1,458 (96.9)	5,689 (75.6)
living room separate from the sleeping function				
No	2,409 (80.1)	1,092 (36.3)	94 (6.3)	3,595 (48.0)
Yes	599 (19.9)	1,917 (63.7)	1,410 (93.7)	3,926 (52.0)
Toilet facility(status of the type of the toilet)				
Bush	1,123 (37.3)	121(4.0)	0(0.0)	1,244 (16.6)
Other house	863 (28.7)	333 (11.1)	22 (1.5)	1,383 (18.4)
In yard	857 (28.6)	2,555 (84.9)	1,473 (97.9)	4,885 (64.9)
In House	0(0.0)	0(0.0)	9(0.6)	9(0.1)
Toilet Type				
None	2,142 (71.2)	450 (14.9)	17 (1.1)	2,609 (34.7)
Pit toilet	863 (28.7)	2,544 (84.6)	1,468 (97.6)	4,875 (64.8)
VIP	0(0)	0(0)	8(0.5)	8(0.2)
Modern	3(0.1)	15(0.5)	11(0.7)	29(0.4)

Appendix 5

Water and electricity accessibility according to wealth index status for households in Agincourt with children less than 5 years in 2003, South Africa.

Item	Wealth Index Category			Total
	Category I (n=3,008)	Category II (n=3,009)	Category III (n=1,504)	(N=7521)
Water supply(Main status of the main water supply)				
Other	2(0.1)	8(0.3)	5(0.3)	15(0.2)
Traditional well	167(5.5)	216 (7.2)	61 (4.1)	444 (5.9)
Cement well	259 8.6)	231 (7.7)	101 (6.7)	591 (7.9)
Truck	1(0.0)	3(0.1)	0(0.0)	4(0.1)
Tap in street	2,488 (82.7)	2,179 (72.4)	1,007 (67)	5,674 (75.4)
Tap in yard	89 (2.9)	357 (11.9)	307 (20.4)	753 (10)
Tap in House	2(0.1)	15(0.5)	233(1.5)	40 (0.5)
Water availability(Gives the availability of the water supply)				
Very irregular	42 (1.4)	21 (0.7)	7 (0.5)	70 (0.9)
Irregular, not everyday	1,989 (66.1)	1,918 (63.7)	939 (62.4)	4,846 (64.4)
Few hours a day	92 (3.1)	87 (2.9)	71 (4.7)	250 (3.3)
Most of the time	551 (18.3)	675 (22.4)	326 (21.7)	1,552 (20.6)
always	334 (11.1)	308 (10.2)	161 (10.7)	803 (10.7)
Power light				
Other	3(0.1)	0(0)	0(0)	3 (0.1)
Candles	1,037 (34.5)	195 (6.5)	18 (1.2)	1,250 (16.6)
Paraffin	403 (13.4)	133 (4.4)	5 (0.3)	541 (7.2)
Solar Power	3 (0.1)	0(0)	0(0.0)	3(0.1)
Battery/Generator	2(0.1)	2(0.1)	0(0)	4 (0.1)
Electricity	1,560 (51.9)	2,679 (89)	1,481 (98.5)	5,720 (76.1)
Power cook				
Other	8(0.3)	2(0.1)	0(0.0)	10(0.1)
Wood	2,815 (93.6)	2,435 (80.9)	761 (51.1)	6,011 (80)
Paraffin	83(2.6)	89(2.8)	44(2.8)	207 (2.8)
Gas bottle	4(0.1)	55 (1.8)	62 (4.1)	121(1.6)
Electricity	99 (3.3)	435(14.5)	638(42.4)	1,172(15.6)

Appendix 6

Ownership of appliances and transport facilities according to wealth index status for households in Agincourt with children less than 5 years in 2003, South Africa.

Item	Wealth Index Category			Total
	Category I (n=3,008)	Category II (n=3,009)	Category III (n=1,504)	(N=7521)
Stove				
No	2,635 (87.6)	1,604 (53.3)	215 (14.30)	4,454 (59.22)
Yes	373 (12.4)	1,405 (46.7)	1,289 (85.70)	3,067 (40.78)
Fridge				
No	2,629 (87.4)	894 (29.7)	48(3)	3,568 (47.4)
Yes	379 (12.6)	2,115 (70.3)	1,459 (97)	3,953 (52.6)
TV				
No	2,033 (67.6)	745 (24.8)	58(3.9)	2,836 (37.7)
Yes	975 (32.4)	2,264 (75.2)	1,446 (96.1)	4,685 (62.3)
Video				
No	2,993 (99.5)	2,862 (95.1)	1,015 (67.5)	6,870 (91.3)
Yes	15(0.5)	147(4.9)	489 (32.5)	651 (8.7)
Satellite dish				
No	3,008 (100)	3,000 (99.7)	1,487 (98.9)	7,495 (99.7)
Broken, no plan to fix	0(0.)	2(0.1)	0(0)	2 (0.0)
Yes	0(0)	7(0.2)	17(1.1)	24(0.3)
Radio				
No	2,195 (73)	2,242 (74.5)	1,078 (71.7)	5,515 (73.3)
Broken, no plan to fix	1(0.1)	0(0)	0(0)	1(0.0)
Broken, plan to fix	0(0	3(0.1)	0(0)	3(0.1)
Yes	812 (26.9)	764(25.4)	426 (28.3)	2,002(26.6)
Fix phone				
No	3,004 (99.9)	2,977 (98.9)	1,369 (91)	7,350 (97.8)
Yes	4(0.1)	32(1.1)	135(9)	171(2.2)
Cellphone				
No	1,955 (65)	934 (31)	93(6.2)	2,982(39.7)
Yes	1,053 (35)	2,075 (69)	1,411(93.8)	4,539 (60.3)
Car				
No	2,901 (96.4)	2,578 (85.7)	799 (53.1)	6,278 (83.5)
Yes	107 (3.6)	431 (14.3)	705(46.9)	1,243 (16.5)
Motor Bike				
No	6(0.2)	9(0.3)	22(1.5)	37(0.5)
Broken, no plan to fix	3,002(99.8)	2,998(99.6)	1,482(98.5)	7,482(99.5)
Yes	0(0)	2(0.1)	0(0)	2(0.1)
Bicycle				
No	228 (7.6)	388(12.9)	386(25.7)	1,002(13.3)
Broken, no plan to fix	2,7801(92.4)	2,619(87)	1,118(74.3)	6,517(86.7)
Yes	0(0)	2(0.1)	0(0)	2(0.1)

Appendix 7

Possession of livestock according to wealth index status for households in Agincourt with children less than 5 years in 2003, South Africa.

Item	Wealth Index Category			Total
	Category I (n=3,008)	Category II (n=3,009)	Category III (n=1,504)	(N=7521)
Cart				
No	2,994 (99.5)	2,935 (97.54)	1,370 (91.09)	7,299 (97.05)
Broken, to be fix soon	0(0)	2(0.07)	5(0.33)	7(0.09)
Yes	14(0.5)	72(2.39)	129(8.58)	215(2.86)
Cattle				
No	2,893 (96.1)	2,529 (83.9)	921(61.2)	6,343 (84.2)
1-10	80(2.7)	225 (7.4)	174 (11.6)	479 (6.4)
11-40	29(1)	202 (6.7)	263 (17.3)	494 (6.6)
> 40	6 (0.2)	42 (1.4)	107 (7.1)	155 (2.1)
Unknown number	0(0)	11(0.3)	39(2.6)	50(0.7)
Goat				
No	2,705 (89.9)	2,537 (84.3)	1,159 (77.1)	6,401 (85.1)
1-10	124 (4.1)	216 (7.2)	111 (7.3)	451 (6)
11-40	147 (4.9)	223 (7.4)	175 (11.6)	545 (7.2)
> 40	32 (1.1)	29(1)	46(3.1)	107 (1.4)
Unknown number	0(0)	4(0.1)	13(0.9)	17(0.2)
Poultry				
No	1,371 (45.6)	1,038 (34.5)	342 (22.7)	2,751 (36.6)
1-10	1,164 (38.7)	1,278 (42.4)	519 (34.5)	2,961 (39.4)
11-40	373 (12.4)	493 (16.4)	467 (31.1)	1,333 (17.7)
> 40	14 (0.4)	14(0.5)	19(1.2)	47(0.6)
Unknown number	86(2.9)	186(6.1)	157(10.4)	429(5.7)
Pigs				
No	2,985 (99.2)	2,915 (96.9)	1,401 (93.1)	7,301(97.1)
1-10	21(0.7)	84(2.8)	83 (5.5)	188(2.5)
11-40	2(0.1)	9(0.3)	18(1.2)	29(0.3)
Unknown number	0(0)	1(0.1)	2(0.1)	3(0.1)