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RESEARCH REPORT

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PROJECT TITLE

Socio-demographic factors associated with morbidity in children under-five years in Agincourt HDSS in 2006.

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Declaration

I, Mosehle Noriah Matabane, declare that this research report is my own work. It is being submitted for the degree of Master of Science (Med) in the field of Epidemiology and Biostatistics in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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Date:

Dedication

I dedicate this degree to the Lord in the Highest who enabled me through His Strength to complete this course.

To my family, Mom and Dad thanks for your unconditional love and support. To my sisters Itumeleng, Motlatjo and Basetsana thanks and you're the best, love you all very much.

Abstract

Introduction: A large proportion of under-5 mortality in the world occurs in the sub- Saharan region and South East Asia and these deaths are mostly due to preventable diseases. Socio-economic status of the household, maternal education, maternal employment status, child's age and gender are said to be determinants of children's morbidity and mortality. An inverse relationship between illness, mortality and socioeconomic status has been observed with morbidity and mortality concentrated in children in the lower socio-economic class and substantial reductions occurring in higher socio-economic class.

Objectives: To determine the prevalence of all-cause morbidity, proportional morbidity from common illnesses and the maternal, household and community socio-demographic risk factors associated with morbidity in children under-5 years of age in the Agincourt health and Socio-Demographic Surveillance System (AHDSS) site, Mpumalanga Province, in 2006.

Methods: Secondary data analysis based on a child morbidity survey for children under-5 years was linked to the Agincourt Health and Socio-demographic Surveillance System site between August and December 2006. Caregivers of 6 404 children were administered a health care utilization questionnaire and 732 children were reported to have had an illness in the preceding 14 days. Stata version 10.0 was used for data handling, cleaning and statistical analysis.

Results: Nine percent of the children in the AHDSS site had had an illness in the 14 days preceding the survey. Illnesses due to other infections contributed to over half of the proportion of morbidity in the children. This was followed by fever, acute respiratory infections, malnutrition, gastro intestinal disease and lastly injuries. The 12-23 months age group had the

highest proportion of morbidity due to malnutrition and gastro intestinal diseases compared to the other age groups, although this relationship was not significant. A significant difference in proportion of morbidity between children living in households headed by Mozambicans and those living in households headed by South Africans was found. A younger age, higher birthweight, living in a household headed by an individual with only (primary) and living in a community without a clinic increased the likelihood of a child being reported ill.

Conclusion: A younger age, higher birthweight, living with a household head with some education (primary and less) and poor access to a community health center in the village of residence increased the risk of a caregiver reporting a illness in a child. Confounding factors could have attributed to the observed association found between morbidity and high birthweight as well as that found between household head education status and morbidity. Further investigations as to why increase in household head education and higher birthweight is associated with morbidity is necessary. More research is needed to find out which factors at all levels (individual, household and community) unique to this region, contribute to making younger children more vulnerable to acquiring an illness.

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Table of Contents

List of tables

List of figures

Abbreviations or Acronyms

AIDS:	Acquired Immunodeficiency Syndrome
ARI:	Acute Respiratory Infections
HDSS:	Health and Socio-Demographic Surveillance System
HIV:	Human Immunodeficiency Virus
LRTI:	Lower Respiratory Tract Infection
MDG:	Millennium Development Goal
NFCS:	National Food Consumption Survey
SADHS:	South African Demographic Health Survey
SAVACG:	South African Vitamin A Consultative Group
SES:	Socio Economic Status
WHO:	World Health Organisation

1.0 Introduction and literature review

1.1 Introduction

A large proportion of under-5 mortality in the world occurs in the sub-Saharan African region and South East Asia and these deaths are mostly due to preventable diseases [1]. According to the World Health Organization (WHO), the leading causes of under-5 mortality in the world, following neonatal causes are diarrhoea and respiratory infections [2]. It is difficult to group major causes of deaths in sub-Saharan Africa as every country's death rates are affected differently by each country's leading cause of under-5 mortality [2].

A review of 27 prospective studies from 20 countries published from 1990 to 2000 estimated the incidence of diarrhoea as 3.8 episodes per child per year for children <11 months of age and 2.1 episodes per child per year for children 1–4 years of age [3]. The presence of rotavirus aggravates the situation as it is not only the most common cause of diarrhoea but also leads to severe type of diarrhoea [4]. More than 150 million episodes of pneumonia occur every year among children under five in developing countries, South Asia and sub-Saharan Africa combined bear the burden of more than half of the total number of pneumonia episodes worldwide among children under five [5]. An estimated 230 million (39%) children, in the developing world, under the age of five are chronically malnourished and about 54% of deaths among children younger than 5 are associated with malnutrition. In Sub-Saharan Africa, the prevalence of malnutrition among the group of under-fives is estimated at 41% [6]. In 2004, according to the World Health Organization, unintentional injuries were responsible for over 3.9 million deaths and over 138 million disability-adjusted life-years, with over 90% of those occurring in low- and middle-income countries (LMIC).The rates for disability-adjusted life-

years are highest in regions with many developing countries: Southeast Asia (3,065 per 100,000), Eastern-Mediterranean (2,825 per 100,000), and Africa (2,743 per 100,000) [7].

Socio-economic status of the household, maternal education, maternal employment status, child's age and gender are said to be determinants of children's morbidity and mortality. An inverse relationship between illness, mortality and socioeconomic status has been observed with morbidity and mortality concentrated in children in the lower socio-economic class and substantial reductions occurring in higher socio-economic class [8]. Maternal education has been reported to decrease both morbidity and mortality in children [9].

1.2 Problem statement

Child morbidity is present both in developing and developed countries but developing countries are the most affected with a large number of these children living in poverty. Poor children live in regions where there is inadequate water supply and sanitation, indoor air pollution, crowding and poor housing conditions [10, 11]. Children living in these circumstances are also more prone to contract infectious diseases particularly if they are malnourished [1]. According to WHO, 31 % of burden of disease in children under 5 is found in low and middle income countries. Africa has the highest disability-adjusted life years due to diarrhoeal disease and lower respiratory infections [12]. Every hour in South Africa, 10 children under the age of five die from a preventable condition [13].

1.3 Justification for study

A number of studies have reported that socio-demographic factors and socio-economic factors affect child survival with a higher percentage of child mortality occurring in the poorest economic quintile [10, 11]. During the period 1992 -1995, diarrhoea, kwashiorkor, unintentional injury and acute respiratory tract infection (ARI) including pneumonia, were the top four causes of death in children under-5 in the Agincourt sub-district [14]. Ten years later (period 2002-2005), the trend changed with HIV/tuberculosis being the top cause of death in the sub-district, followed by diarrhoea, acute respiratory infection and malnutrition [14]. Although an association between high under-5 mortality and socio-economic status of households has been established, a relationship between child morbidity and socio-demographic factors has not been investigated in this rural setting. This study will provide some understanding of the relationship between household socioeconomic status, socio demographic factors and community factors and prevalence of child morbidity in rural South Africa.

1.4 Literature Review

1.4.1 Risk factors of morbidity

Mosley and Chen developed a framework to study factors affecting child mortality and reported that child survival is dependent on proximate determinants such as maternal factors, nutrient deficiency, injury, environmental contamination and personal illness control. They reported that social and economic determinants of child mortality operate through proximate determinants and

these determinates are grouped into individual-level (mother, father), household-level (income/wealth) and community-level (health system) variables. These proximate factors including maternal factors, environmental contamination, nutrient deficiency and injury are said to influence the rate of shift of healthy individuals towards sickness, while personal illness control factors influence both the rate of illness (through prevention) and the rate of recovery (through treatment) [15].

Children living in poverty are more likely to be malnourished as well as diseased as they are living in conditions where there is inadequate water supply and sanitation, indoor air pollution, crowding and also poor housing. Lack of safe water and sanitation contribute to the leading killers of young children, including diarrhoeal diseases, pneumonia, neonatal disorders and undernutrition [1]. Malnutrition and infections are synergistic: the causal relationship between malnutrition and infection is postulated to be two way with each predisposing and exacerbating the other, resulting in a combined effect that is more harmful than either alone. Thus the link between malnutrition and diarrhoea is difficult to resolve. Poor nutrition increases the susceptibility to diarrhoea, whereas diarrhoea, with rapid passage of unabsorbed nutrients through the gastrointestinal tract, leads to or exacerbates malnutrition. In many communities in developing countries, malnutrition is so common that parents do not recognize the depleted state of their child [16]. Evidence suggests that low weight-for-age increases risk of having pneumonia, diarrhoea, or a clinical malaria attack [17].

1.4.2 Risk factors for morbidity in developing and sub-Saharan Africa

The major burden of under-5 morbidity and mortality lies in sub-Saharan Africa and South East Asia regions as most of the children in these regions are living in poverty [10]. In 2003, each

child in the developing world experienced an average of three episodes of diarrhoea per year with a median incidence of 3.2 episodes per child in children under-5 [18, 19]. Diarrhoeal disease affects all people in both developed and developing countries, although a stronger relationship exists between poverty and diarrhoeal diseases [20]. Children living in socioeconomically underdeveloped areas have overall more diarrhoeal episodes, severe episodes with dehydration, and a higher death rate compared with children living in more economically developed areas. These events are a consequence of numerous conditions common to poverty, including deficiencies in infrastructure (decreased accessibility to non-contaminated water and appropriate sewage disposal), crowding, lower standards in food handling and hygiene, decreased accessibility to health care, and low educational level [21, 22].

A study in a Guinea-Bissau, revealed that the risk of acquiring diarrhoea was high in weaned and partially weaned children [23]. In Keneba, Gambia, it was revealed that diarrhoeal diseases were estimated to cause one-half and lower respiratory tract infections (LRTI) one-quarter of weight faltering in children under 3 years of age [24]. The study also demonstrated that diarrhoea was the main cause of weight faltering in children aged 6 months to 3 years [24]. In India, it was reported that children who were malnourished were at a greater risk of becoming diseased and were more likely to come from poorer households [25]. In Ghana, children from poorer households are at a greater risk of becoming malnourished compared to those from well-off households [26]. A study in Tanzania showed that mothers with a secondary education are more likely to have nutritionally normal children than those with only primary education [27]. In Malaysia, one-quarter of children aged 1-2 years were malnourished and also that a low family income increased the risk of a child to be malnourished [28]. Studies in Nigeria and Tanzania

revealed that maternal characteristics such as age at birth, employment status, place of birth, type of feeding, marital status, place of residence and visits to antenatal clinics affect the nutritional status as well as the health of a child [29, 30].

Estimates of clinical pneumonia incidence are highest in South East Asia (0.36 episodes per child year), closely followed by Africa (0.33 episodes per child-year) [31]. Increased incidence of acute respiratory infections has been associated with a number of risk factors (low birthweight, malnutrition, environmental air pollution and poor sanitation) which are mostly directly linked to poverty and low socioeconomic status [32]. Environmental factors such as cigarette smoke, pollution within the house, smoke from indoor fires and crowding are also risk factors in acquiring respiratory infections [33]. In Brazil, children living in crowded households, with more than 3 people per room and those living in houses/apartments were at increased risk of developing acute respiratory infections while those living in huts had greater risk of lower respiratory infections. Living with other children younger than 5 years also increased both the risk of developing acute respiratory infections and lower respiratory infections [34]. In Malawi, Children living in an improved house were at a reduced risk acquiring respiratory infections, gastrointestinal illnesses, or malaria compared to those living in traditional houses [35]. In pakistan, children who were malnourished, younger and not being immunized increased the risk of a child of developing pneumonia [36].

A study in Ethopia, Vietnam, Peru and India showed that factors such as region of residence, father not living in the household, single parent families, age, wealth index, regular care of child by a non-household member, leaving the child alone or with other under-5s, caregiver having no education and main\caregiver not being the biological mother increased the risk of a child of

being injured [37]. The prevalence of cough, fever and gastro intestinal diseases was reported to be higher in children of illiterate mothers than those of literate mothers in India although an association between morbidity and maternal literacy was not found [38].

Maternal education improves health of children [39]. Mothers' educational levels influence child morbidity in general and diarrhoeal incidence in particular, through a stronger and positive attitude towards hygienic handling and cleanliness of the child, expenditure on child care and food as well as an awareness of availability of health resources [40]. Living with an older mother or a younger mother increased a child's risk of acquiring illnesses such as cough and diarrhoea [30, 41]. Risk of diarrhoea and respiratory illnesses was low in children in households in the higher economic quintiles [42]. A younger age, higher birth order, being female and malnutrition have been associated with higher incidence and prevalence of infections among children [43-46].

1.4.3 Risk factors of morbidity in South Africa

Among children under 5, diarrhoeal diseases are the third largest cause of death (11.0% of all deaths), and the third greatest contributor to the burden of disease, constituting 8.8% of all disability-adjusted life years (DALYs) in this age group [47]. In 1998, 13% of under-5s in South Africa had diarrhoea but this reduced to 8% in 2003 with the prevalence being the highest in the 6-11 months age group [48]. Undernutrition is closely linked to diarrhoea and other infectious diseases [49]. In 2000 in South Africa, 11.8 % of children under-5 were underweight and 12.3% of deaths occurring in this age group were attributable to being underweight [50]. The prevalence of stunting doubled from the first to the second year of life, and reached higher

levels in rural areas. Stunting is often associated with poor overall economic conditions [51]. The South African Vitamin A Consultative Group national study among preschool children (SAVACG, 1995), and the National Food Consumption Survey among children aged 1-9 years (NFCS, 1999) showed similar results, with underweight ranging from 6.9 to 10.7 %, stunting from 16.1 to 27 % and wasting from 1.8 to 3.7 %. Malnutrition prevalence was always higher in rural than urban areas [52, 53]. The NFCS reported that prevalence of underweight and stunting decreased with an increase in age [53]. A study in 2007 in the Agincourt HDSS site reported stunting at 18%, underweight at 10% and wasting at 7% among children aged less than five years [54]. A study in South Africa has indicated that the household's economic position is seen to have a highly significant impact on the probability of a child being stunted and underweight. Improved household income levels are associated with a dramatic drop in the probability of stunting of children [51].

According to the South African Demographic and Health Survey 2003 (SADHS), 22% of children in the 6-11 months age group had an acute respiratory infection [48]. In a study in South Africa, a major difference between malnourished and well nourished children was the educational status of the mothers [55]. Only 57% of the mothers of the children with kwashiorkor were literate compared with 93% of mothers of the well nourished children; 25% of mothers of malnourished children as opposed to 47% of mothers of well nourished children were married and lastly 36% of malnourished children as opposed to 72% of well nourished children received support from the father [55]. A study in Soweto showed that a father's level of education and the number of people living in a household were risk factors for developing acute respiratory infections [56]. Acute respiratory infections are also associated with a history of

hospital admission in the preceding 6 months, absence of a clinic card, poor housing and lack of electricity for indoor fuel use [57].

1.5 Research Question

What are the key socio-demographic risk factors associated with morbidity in children under-5 years in the rural Agincourt HDSS site, South Africa, 2006?

1.6 Aim

To determine the key socio-demographic risk factors associated with child morbidity in a rural setting in South Africa in order to better understand the impact these factors have on child morbidity and to guide policy-makers in implementing policies to improve preventive and curative health programmes for child survival in these settings.

1.7 Objectives

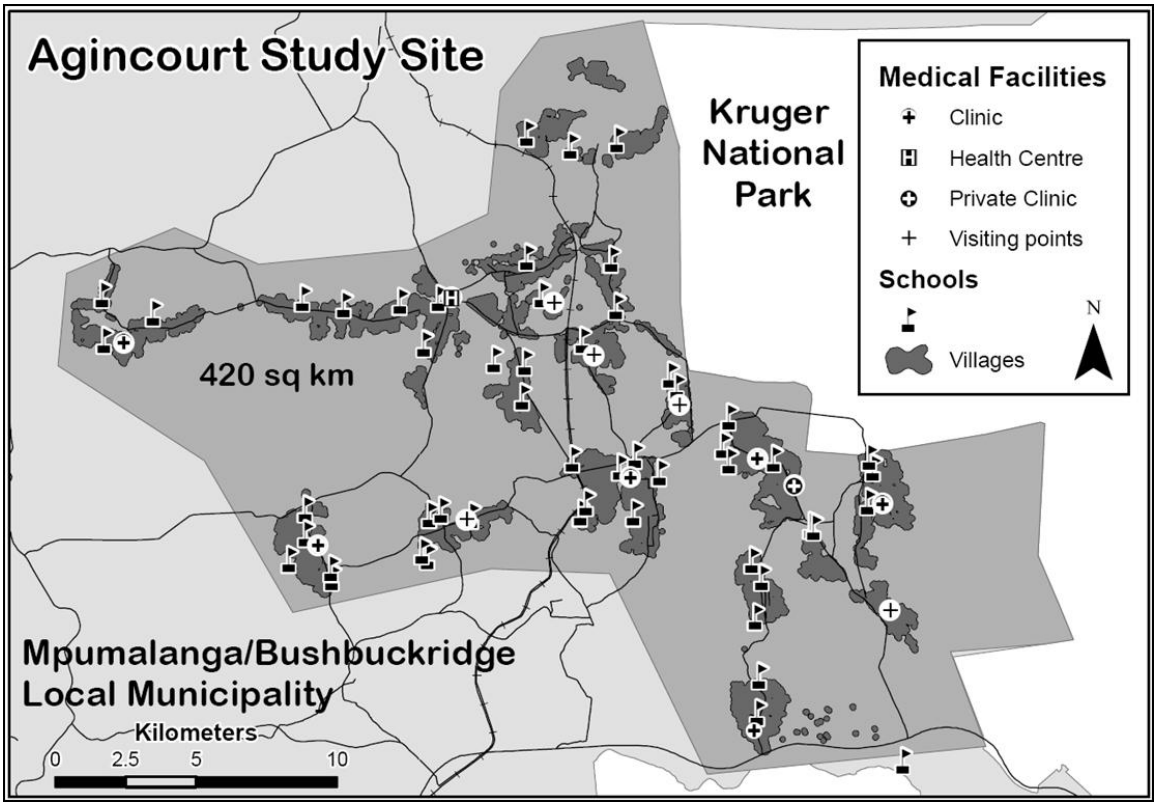
In the Agincourt HDSS site in Mpumalanga province, 2006:

- to determine the prevalence of all-cause morbidity in children under-5 years.
- to determine proportional morbidity from common illnesses (acute respiratory infections, gastrointestinal disease, malnutrition and injuries) in children under- 5 years.
- to determine maternal and household socio-demographic risk factors associated with all-cause morbidity in children under-5 years.

2.0 Methodology

2.1 Study area

The Agincourt sub-district is located in rural northeast in Mpumalanga Province, South Africa, alongside the border with Mozambique. The site extends from 24°50' to 24°56' south latitude and 31°08' to 31°25' east longitude. The altitude above sea level ranges from 400 to 600 metres and covers. In the Agincourt HDSS, there are 21 villages with 70,000 people living in 11,700 households. The original population in 1992 was 57,509 persons in 8,896 households, then it rose to 69 000 in 11 500 households by 2002. In 2002, the site had a population density of 172 persons per square kilometer and the male: female ratio was 0.929 [58]. The population comprises XiTsonga-speaking people, 30% of whom are of recent Mozambican origin, having entered South Africa mainly as refugees in the early to mid-1980s following the civil war in Mozambique [59]. The site has one public and one private health center with five satellite clinic and a district hospital which is 25 km away from the health center. The area is a labour sending area, similar to most rural Southern African areas. Labour migration is widespread involving up to 60% of working age men and growing numbers of women [60]. The area has poor infrastructure despite recent improvement to electricity and water supply [61].



2.2 Study design

The study involves secondary data analysis of data from a cross-sectional survey on health care utilization and morbidity survey among children under-5 years in the Agincourt HDSS site Mpumalanga Province, in 2006. Survey data was supplemented by variables selected from the health and socio-demographic system dataset.

2.3 Study population

The study population consists of all children under-5 years within the Agincourt HDSS site. Children who were in-migrants and had not lived in the HDSS for at least 12 months by 2006 were excluded.

2.4 Data collection

Data was collected in the Agincourt HDSS site through a health care utilization survey and child morbidity survey conducted between August and December 2006. Additional variables such as child's characteristics (gender, age, relationship with household head, birthweight, delivery place), maternal characteristics (mother's age, co-residence with child, nationality, education status, union status), household characteristics (household head gender, age, nationality, education status, Socio Economic Status (SES)) and community characteristics (community clinic and predominant members living in a community) were obtained from the main Agincourt HDSS database. The household SES was generated from a household assets survey, which was conducted as a special module in 2005. In the household assets survey, field workers administered questionnaires in every household which included questions on type of dwelling; water and sanitation facilities; possession of livestock, bicycle, radio among other assets. The Agincourt HDSS site involves an annual census update of all households in 21 contiguous villages in the Agincourt HDSS site. The individual variables such as union status, education status, nationality and relation to household head are updated annually as part of the census round. All vital demographic events (births, deaths and in- and out

migrations) occuring in each household are systematically recorded when the household roster is updated each year [62]. Children who particitipated in the child morbidity survey were under-5 years whose caregiver answered yes to any of the following four questions from a health care utilization questionnaire administered in 2006:

- if the child had been sick or injured in the last 14 days,
- if the child had been chronically ill or requiring chronic treatment in the last year,
- if the child had a disability that required treatment or health care support in the last year
- if the child had been admitted to hospital in the past year.

Caregivers of 6 404 children were administered the health care utilization questionnaire and 732 caregivers answered yes to any of the above four questions. Between August and December 2006, field workers administered the child morbidity questionnaire to caregivers of these 732 children under-5.

2.4.1 Explanatory variables

Explanatory variables include: child's characteristics (gender, age, relationship with household head, birthweight, delivery place), maternal characteristics (mother's age, co-residence with child, nationality, education status, union status), household characteristics (household head gender, age, nationality, education status, Socio Economic Status (SES)) and community characteristics (community clinic and predominant members living in a community).

The household SES was determined by combining household assests using weights and giving an absolute score from 1(lower), 2(middle lower), 3(medium), 4(middle higher) and 5(higher).

The individual variables such as union status, education status, nationality and relation to household head are updated annually as part of the census round. Education status indicates the highest level of education attained by an individual at time of observation. Levels of education were grouped into four categories: none (individuals without any formal education), some education (individuals with basic and some primary education), secondary education (individuals with incomplete as well as complete secondary education) and tertiary education (individuals with complete and incomplete post secondary education). Union status was grouped into two categories: currently in union (individuals who were re-married, married or in an informal union) and not in union (individuals who were single, widowed, divorced or separated). Mothers co-residence with child was grouped into three categories: co-residing (women living with their children in the same household), not co-residing alive (women that are not living with their children but are alive) and not co-residing dead (women not living with their children because they have passed on). Nationality indicates the individual's country of origin: South Africa, Mozambican or Others. Relation to household head indicates the relationship of the children to the household head and this was categorised into grandparents (individuals who were the child's biological grandparents as well as step grandparents), parents (the child's biological parents as well as step parents) and others (individuals who were not immediate family members). Child's age in months was categorized into five groups: 0-11, 12-23, 24-35, 36-47 and 48-59 months. Mothers age in years was categorised into three groups:<20, 20-34 and 35 years and above. Household head

age group was categorised into three groups:<30, 30-49 and 50 years and older. Gender of child and household head was male and female.

Children born with birthweight less than 2.5 kg were categorized into the low birthweight and those with birthweight higher than or equal to 2.5 kg were categorised in the normal/high group. Community clinic was generated by grouping villages with a clinic as "Yes" and villages without a clinic as "No".

2.4.2 Outcome variables

All-cause morbidity was measured by the caregiver's reporting the presence, in a child under 5 years, following in the 14 days preceding interview injuries, eye infections, ear infections, skin rash, fever, malnutrition, gastro intestinal diseases, acute respiratory infections, swelling of parotid glands and white rash in the mouth. All cause morbidity was defined as "Yes" if presence of any of the conditions, or signs or symptoms were reported and "No" if none of the symptoms were reported. Proportional morbidity from either acute respiratory infections, gastro-intestinal diseases, malnutrition, injuries or other illnesses in the last 14 days was determined. Acute respiratory infections was measured by caregiver's reporting the presence of one of the following symptoms: runny nose, cough, difficulty breathing, wheezing and fast breathing. Gastro-intestinal diseases was measured by caregiver's reporting of presence of diarrhea and bloodystool. Malnutrition was measured by caregiver's reporting malnutrition and lose of weight. Injuries were measured by caregiver's reporting any injuries. Injury was measured as by the caregiver's reporting of incident of injuries due to accident or violence. Other illnesses was measured by caregiver's reporting the presence of eye infections, ear

infections, ear pain, skin rash, swelling of parotid glands, swelling lymphs and white rash in the mouth.

2.5 Data Management

2.5.1 Data processing methods and data analysis

Data quality control in the Agincourt HDSS occurs at five levels. The first three checks are at field level: by fieldworkers on a daily basis, cross-checks by fellow team members on a weekly basis, and random checks by team supervisors. The remaining two quality control measures are done by specialised quality checkers and programmed computer checks which identify invalid codes, missing values, and inconsistent or duplicate entries done in the data room [62]. Stata version 10.0 was used for data handling, cleaning and statistical analysis. Data cleaning involved checking the quality of the data for missing and erroneous values. Erroneous values in the data were assigned as missing values.

2.5.2 Descriptive Analysis

A frequency table with number and percentage of all participants, diseased and non-diseased children, in each demographic variable was drawn (Table 1). Graphs showing proportions of morbidity due to illness (acute respiratory infections, gastrointestinal diseases, malnutrition, fever and injuries), proportional morbidity according to household head nationality and proportional morbidity according to age in months were drawn (Figure 1,2).

2.5.3 Analytic statistics

A chi-square test was used to compare differences between all-cause morbidity by the different variable groups (e.g mother's age group, education levels, and household SES). All-cause morbidity as well as proportional morbidity was then associated with these variables. P values were calculated to test for statistical significance at the 5% level. Association between socio-demographic factors and morbidity was determined using univariate and multivariate logistic regression (Table 2). Only factors that were statistically significant at 10% level were included in the final multivariate model. Factors included in the multivariate model were child's age-group, delivery place, birthweight category, mother's co-residence with the child, mother's education status, household head age-group, household head education status and presence of community clinic.

2.6 Ethical consideration

Ethical clearance for the Agincourt HDSS (**Protocol No: 960720)** was obtained from the Wits University Ethics Committee for Research on Human Subjects (Medical). Ethical clearance for secondary analysis in the current study (**Protocol No: M090947**) from the same committee was also obtained before the data was analyzed.

3.0 Results

3.1 Socio-demographic characteristics of participants, their mothers, household and communities.

Of the 6 404 children, 50.5% were males and 49.6% were females. Most children (22.39%) were aged between 12-23 months and 9.63% of children were born with a low birth weight. Over seventy percent (71.79%) were born in hospital. Nearly two-thirds of mothers (65.98%) were aged between 20-34 years. Majority of children (92.55%) where co-residing with their mothers, two-thirds (66.01%) of the mothers were of South Africa nationality and nearly half (48.61%) of the children's mothers had a secondary education. Over half (51.74%) of children lived in households headed by their grandparents and 41.98% lived in households headed by their parents. Over half (57.12) of the children lived in communities with a clinic (Table 1).

A higher proportion of sick children were in the younger age categories 0 - 11 (27.3%) and

12 - 23 (26.2%) months. The majority of sick children (92.6%) were born with a normal weight, and over seventy percent (73.5%) were born in hospital. Over half (62.4%) of the household heads were male and 50.4% of children were living in households headed by their grandparents. Two-thirds (68%) of the children's mothers were in the 20-34 year age group. Ninety percent of the children were co-residing with their mothers while only 4.1% of the mothers had died. Nearly two-thirds of mothers were South African (66%), nearly half (48.6%) had secondary education and 40.4% had primary or adult basic education. Nearly half of sick children (48%)

lived in communities with a clinic. The majority of children (92.3%) lived in communities which predominantly had South Africans as residents (Table 1).

There was an inverse relationship between age group and morbidity prevalence with younger children having higher morbidity ($p < 0.001$). There was a marginal significant difference in morbidity prevalence between household heads with no education, basic or primary, secondary and tertiary education ($p = 0.049$). A statistical difference in morbidity between communities with clinics and those without clinics was found ($p <0.001$) (Table 1).

Table 1: Characteristics of study participants 0-59 months, their mothers, household and community, Agincourt HDSS 2006.

Characteristics	All (n = 6 404)	Illness present (n = 732)	Illness not present (n = 5 672)	% p-value *
Child characteristics				
Sex (n = 6 402)				
Male (n = 3 169)	49.50	50.49	49.38	
Female (n = 3 233)	50.50	49.59	50.62	0.60
Age in Months continuous (n = 6 404)	1.88 (1.41)	1.63 (1.41)	1.88 (1.40)	**0.00**
Age group (n = 6 404)				
0-11 (n = 1 362)	21.27	27.32	20.49	
12-23 (n = 1 434)	22.39	26.23	21.90	
24-35 (n = 1 294)	18.43	14.21	18.97	
36-47 (n = 1 218)	19.33	16.53	19.69	
48-59 (n = 1 096)	18.58	15.71	18.95	**0.00**
Birthweight continuous (n = 3 623)	3.05 (0.49)	3.06 (0.46)	3.04 (0.49)	0.56
Birthweight Category (n = 3 623)**				
Low (n = 349)	9.63	7.37	9.95	
Normal/High (n =3 274)	90.37	92.63	90.05	0.08
Delivery place (n = 5 288)				
Hospital (n = 3 796)	71.79	73.46	71.56	
Clinic (n = 385)	7.28	7.44	7.26	
Home (n = 717)	13.56	13.59	13.55	
Health center (n = 313)	5.92	4.37	6.12	
Other (n = 77)	1.46	1.13	1.50	0.46
Child's Household Head Relation (n = 6 224)				
Parent (n = 2 613)	41.98	43.18	41.83	
Grand Parent (n = 3 220)	51.74	50.42	51.91	
Other (n = 391)	6.28	6.41	6.27	0.75

Characteristics	All n = 6404	Illness present n = 732	Illness not present n = 5762	% pvalue*
Mother's characteristics				
Mother's Age group (n = 6 056)				
<20 (n = 774)	12.78	12.55	12.81	
20-34 (n = 3 996)	65.98	67.97	65.73	
35+ (n = 1 286)	21.24	19.48	21.46	0.44
Mother's Co-residence (n = 6 387)				
Co-residing (n = 5 911)	92.55	90.95	92.75	
Not co-residing (Dead) (n = 197)	3.08	4.12	2.95	
Not co-residing (Alive) (n = 279)	4.37	4.94	4.29	0.15
Mother's Nationality (n = 6 061)				
Mozambican/Other (n = 2 170)	33.99	33.62	34.04	
South African (n = 4 279)	66.01	66.38	65.96	0.82
Mother's Education status (n = 5 758)				
None (n = 595)	10.33	9.06	10.33	
Some education (n = 2 324)	40.36	44.56	39.82	
Secondary school (n = 2 799)	48.61	45.77	48.98	
Tertiary (n = 40)	0.69	0.60	0.71	0.12
Mother's Union Status (n = 3 528)				
Currently in Union (n = 2 629)	74.52	74.75	74.49	
Not in union (n = 899)	25.48	25.25	25.51	0.90
Household Head characteristics				
Household Head Sex (n = 6 313)				
Male (n = 3 950)	62.57	64.23	62.35	
Female (n = 2 363)	37.43	35.77	37.65	0.32

Characteristics	All n = 6404	Illness present n = 732	Illness not present n = 5 672	% p value*
Household Head Age-group (n = 6 313)	6.70	8.15	6.51	
<30 (n = 423)	48.11	48.90	48.01	
30-49 (n = 3 037)	45.19	42.96	45.48	0.16
50+ (n = 2 853)				
Household Head Nationality (n = 6 313)				
Mozambican/Other (n = 2 320)	36.75	37.98	36.59	
South African (n = 3 993)	63.25	62.02	63.41	0.46
Household Head Education				
(n = 5 693)				
None (n = 2 343)	41.16	36.81	41.74	
Some education (n = 2 070)	36.36	39.64	35.92	
Secondary school (n = 1 212)	21.29	22.80	21.09	
Tertiary (n = 68)	1.19	0.75	1.25	**0.04**
Household SES (n = 5 923)				
Most poor (n = 1 976)	33.36	32.50	33.47	
Middle (n = 1 973)	33.31	34.12	33.31	
Least poor (n = 1 974)	33.33	33.38	33.32	0.85
Community characteristics				
Community Clinic (n = 6 404)				
Clinic present (n = 3 685)	57.12	48.36	58.25	
No Clinic (n = 2 746)	42.88	51.64	41.75	**<0.001**
Nationality (n = 5 577)				
Mozambican (n = 427)	7.66	6.34	7.83	
South African (n = 5 150)	92.34	93.66	92.17	0.17

***comparing % in Illness present and illness not present**

****low (<2.5kg) and normal/high (>=2.5kg)**

3.2 Types of morbidity

Fever constituted about 20% of the morbidity reported, acute respiratory infections about 14%, gastro intestinal diseases 4%, malnutrition 5%, injuries 2% and other illnesses 56% , with frequent diseases such as ear and eye infections, of morbidity reported (Figure 1).

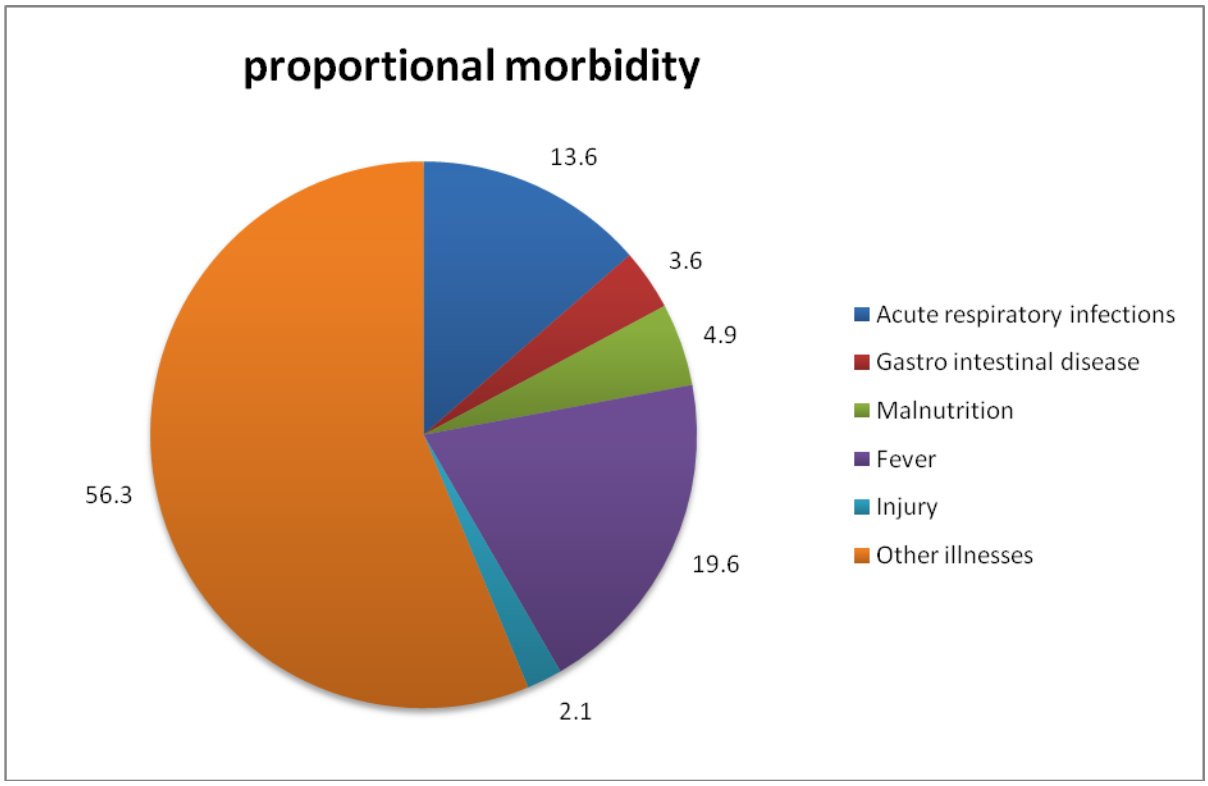


Figure 1: Proportional morbidity in children 0-59 months, Agincourt HDSS 2006.

The proportional morbidity due to malnutrition (7.2%) and gastro intestinal diseases (7.2%) was highest in the 12-23 months age group, morbidity due to fever and acute respiratory infections, was higher in the age group 24-35 months. The age group 36-47 months had the highest proportion of morbidity due to injuries (3.5%) and the 48-59 month age group had the highest proportion of morbidity due to other illnesses (66.4%) (Figure 2).

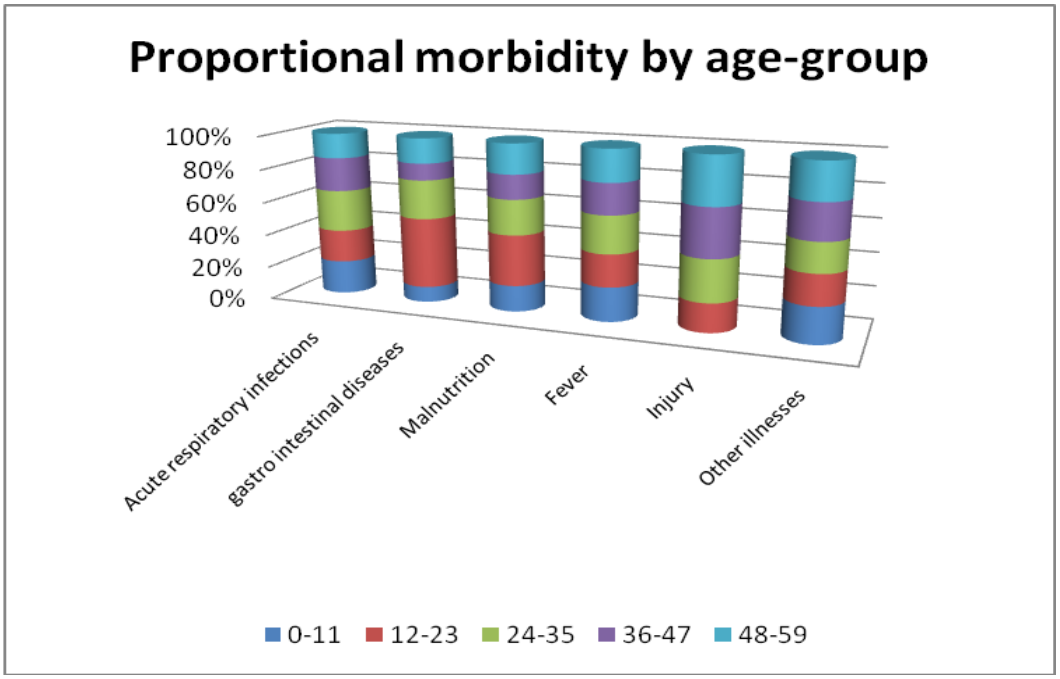


Figure 2: Proportional morbidity by age-group in children 0-59 months, Agincourt HDSS 2006.

Children from South African-headed households had a higher proportional morbidity due to other illnesses, injuries and malnutrition while children from households with Mozambican heads had a higher proportional morbidity due to acute respiratory infections, fever and gastro intestinal diseases. This relationship was statistically significant (p = 0.011) (Figures 3).

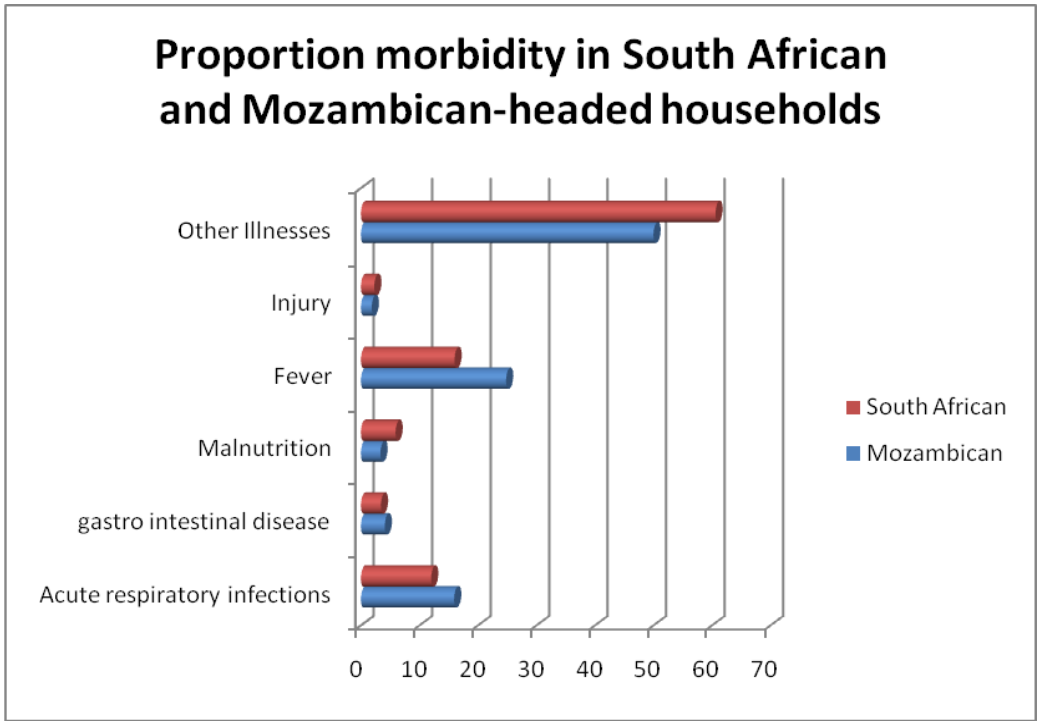


Figure 3: Proportional morbidity in children 0-59 months living in South African or Mozambican headed households, Agincourt HDSS 2006

3.3 Socio-demographic characteristics of participants, their mothers, household and communities associated with child morbidity

Univariate analysis was done on all socio-demographic factors, associating them with morbidity. Only factors that were statistically significant at 10% level were included in the final multivariate model. Factors included in the multivariate model were child's age-group, delivery place, birthweight category, mother's co-residence with the child, mother's education status, household head age-group, household head education status and presence of community clinic.

Older children were less likely to have had an illness episode in the past 14 days. Children in the 24-35 months age group were 0.5 times less likely to be sick compared to those in the 0–11 months age group and the association was statistically significant at 5% level (95 % CI 0.37-0.75, p-value <0.001). Compared to the 0 - 11 months age group, those in the 36 – 47 month age group were 0.6 times less likely to be sick (95% CI 0.39-0.79, p = 0.001); while those in the 48–59 months age group were 0.6 times less likely to be sick (95 % CI 0.42-0.86, p = 0.005). Children born with a normal/high birthweight were 1.7 times more likely to be sick compared to those born with a low birthweight (95% CI 1.24-2.29, p = 0.001). Compared to children living in households headed by individuals with no education, children in households headed by those with a primary education and less (some education) were 1.3 times more likely to be sick (95 % CI 1.01-1.69, p = 0.04). Communities without clinics were 1.6 times more likely to have sick children compared to communities with clinics (95 % CI 1.33-2.02, p <0.001) (Table 2).

Table 2: Child's, maternal, household and community socio-demographic factors associated with child morbidity, Agincourt HDSS, 2006.

Characteristics	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95 % CI)	P value
Child Characteristics				
Childs Sex				
Female (ref)				
Male	1.04 (0.89 - 1.2)	0.601		
Age group (months)				
0-11 (ref)				
12-23	0.89 (0.73 - 1.11)	0.32	0.91 (0.70 - 1.20)	0.51
24-35	0.56 (0.44 - 0.72)	0.00	0.53 (0.37 – 0.75)	**0.00**
36-47	0.63 (0.50 - 0.80)	0.00	0.55 (0.39 – 0.79)	**0.00**
48-59	0.62 (0.49 – 0.79)	0.00	0.58 (0.42 – 0.86)	**0.01**
Birthweight category				
Low (ref)				
Normal/High	1.39 (0.96 – 2.02)	0.08	1.68 (1.24 -2.29)	**0.00**
Delivery place				
Hospital (ref)				
Clinic	0.99 (0.72 – 1.38)	0.99	1.13 (0.77 – 1.67)	0.52
Home	0.97 (0.76 – 1.25)	0.85	1.33 (0.84 - 2.09)	0.22
Health center	0.69 (0.46 – 1.04)	0.07	0.78 (0.50 – 1.21)	0.26
Other	0.73 (0.33 -1.61)	0.44	1.12 (0.43 – 2.91)	0.82
Childs Household Head Relation				
Parent (ref)				
Grand Parent	0.94 (0.80 - 1.11)	0.46		
Other	0.99 (0.71 – 1.37)	0.95		

Characteristics	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95 % CI)	P value
Mother's Nationality				
Mozambican/Other (ref)				
South African	1.02 (0.86 - 1.20)	0.83		
Mother Co-residence				
Co-residing (ref)				
Not co-residing (Dead)	1.17 (0.82 - 1.68)	0.39	1.55 (0.45 - 5.35)	0.49
Not co-residing (Alive)	1.42(0.96 - 2.11)	0.08	0.73 (0.28 – 1.91)	0.52
Mother Union Status				
Not in Union (ref)				
Currently in Union	1.01 (0.80 -1.29)	0.91		
Mother's Education Status				
None (ref)				
Some education	1.29 (0.96 – 1.74)	0.08	1.32 (0.86 -2.02)	0.20
Secondary school	1.08 (0.80 - 1.45)	0.60	1.15 (0.74 – 1.78)	0.54
Tertiary	0.99 (0.34 – 2.88)	0.99	1.25 (0.23 – 6.77)	0.80
Household Characteristics				
Household Head Sex				
Female (ref)				
Male	1.08 (0.92 – 1.27)	0.33		
Household Head age group (years)				
<30 (ref)				
30-49	0.81 (0.61 – 1.09)	0.17	0.84 (0.55 – 1.28)	0.43
50+	0.75 (0.56 – 1.02)	0.06	0.79 (0.50 – 1.25)	0.31

Characteristics	Univariate analysis		Multivariate analysis	
	OR (95 % CI)	P value	OR (95 % CI)	P value
Household Head Education				
None(ref)				
Some education	1.25 (1.04 -1.50)	0.02	1.30 (1.01 - 1.69)	**0.04**
Secondary school	1.23 (0.99 -1.52)	0.06	1.39 (0.94 – 1.90)	0.06
Tertiary	0.67 (0.27 -1.69)	0.40	0.64 (0.17 – 2.45)	0.51
Household Head Nationality				
Mozambican/Other (ref)				
South African	0.94 (0.80 - 1.10)	0.43		
Household SES				
Most poor (ref)				
Middle	1.06 (0.87 - 1.29)	0.57		
Least poor	1.03 (0.85 – 1.26)	0.75		
Community Characteristics				
Community clinic				
Present(ref)				
Not present	1.50 (1.28 – 1.74)	0.00	1.63 (1.33 – 2.02)	**0.00**
Nationality				
Mozambican				
South African	1.26 (0.90 – 1.75)	0.18		

4.0 Discussion and conclusion

4.1 Discussion

Only eleven percent of the children were sick 14 days preceding the survey. Illnesses due to other infections contributed to over half of the proportion of morbidity in the children, followed by fever, acute respiratory infections (ARI), malnutrition, gastrointestinal disease (GID) and finally injuries. The other infections group is made up of diseases such as ear infections, eye infections and rashes but their numbers were too small to be represented individually. A significant difference in the proportion of morbidity between children living in households headed by Mozambicans and those living in households headed by South Africans was found. A younger age, higher birthweight, living in a household headed by an individual with some education (basic or primary) and living in a community without a clinic increased the risk of a child being reported ill.

Other studies have indicated that acute respiratory infections, diarrhoea and malnutrition are the principal diseases among under-5s in developing countries [63, 64, 65]. The 12-23 month age group had the highest proportion of morbidity due to gastrointestinal diseases as well as malnutrition. Our findings are consistent with other studies such as a study in Sudan where frequency of gastrointestinal morbidity was highest in the 12-23 month age group [66]. The high frequency in this age group has been suggested to be due to exposure to contaminated and harder to digest food from the household diet as the second year of life is generally the weaning period [67]. The present study found that malnutrition in children was 5% of ill children and the frequency was highest in the 12-23 month age group. The high proportional morbidity of

malnutrition and gastrointestinal illness in this same age category is consistent with studies in Gambia and Guinea-Bissau demonstrates high risk of infectious diseases such as diarrhea during the weaning period. These infectious are then responsible for weight loss and growth retardation in these children [23, 24].

The risk of illness increased if the child lived in a household headed by an individual with some education (primary or less). This is contradictory to other studies that report on the importance of maternal education status of the mother in improving the health of children [30, 68]. The household heads in this education category (some education) are predominantly male South Africans in the 30-49year age group, who may not play a role in child care. We therefore have to look at the education status of the caregiver, however the dataset did not have this information. Further investigation is necessary as a previous study revealed that children under-5 years living in a male South African-headed household have a decreased risk of mortality in this region [69].

The significant relationship between prevalence of morbidity and age group found in this study is consistent with other findings where younger children had a higher prevalence of morbidity and infections compared to older children. We found that being of a younger age group and higher birthweight also increases the risk of acquiring an illness [44, 45, 46, 70]. Our findings contradict other studies where children with a low birthweight have an increased risk of morbidity, malnutrition and acute respiratory infections [71, 72]. The dataset had small numbers of children with high, so children with normal and high birthweight had to be grouped together. Our findings, suggesting an increased risk in children with a high birthweight, needs to be confirmed and investigated further. Increased risk of morbidity in children living in communities

without a clinic was consistent with findings from a study in Senegal showed that a significant positive correlation between presence of health center and risk of malnutrition [73].

The unexpected positive association between morbidity and normal/high birthweight and education of household head could be attributed to confounding as the crude odds ratios of these variables in the univariate models changed by more than 10% when compared to the adjusted odds ratios in multivariate model (Table 2). HIV could be a confounding factor in the association between normal birthweight and morbidity, it is probable that HIV infected children born with a low birthweight had already died by the time of the study; hence HIV infected survivors are more likely to be those born with normal birthweight, and these HIV infected survivors may be more prone to illnesses leading to the positive association between normal birthweight and morbidity. The dataset did not have information on whether or not the child was born prematurely and the child's HIV status, which are potential confounders. Data on household SES was only available for 2005 and not for 2006 which is a limitation of the study. The dataset was also not large enough to allow us to check for risk factors specific for each proportional illness. The strength of the dataset is that recall bias was minimised since reports on symptoms of illness were limited to the past 14 days.

4.2 Conclusion

The present study found that younger age, higher birthweight, living with a household head with some education (primary and less) or with secondary education and lack of a community health center increased the risk of acquiring an illness. Further research is needed to specify risk factors at a individual, household and community levels unique to this region, that contribute to making younger children more vulnerable to acquiring an illness. These findings would help government to not just implement policies that assume similar conditions in rural settings in South Africa but implementing child health care policies looking at the differences of rural settings in the country. It would also inform health education messages and health promotion strategies in child care, child nutrition, clean water and sanitation, oral rehydration therapy and also prevention of unintentional injuries that are tailored to the local context. More clinics are needed in rural areas in order to improve the health of children living in impoverished conditions.

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Appendix

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Moseble N Matabane

CLEARANCE CERTIFICATE	**M090947**
PROJECT	Socio-Demographic Factors Associated with Morbidity in Children Under-Five in Agincourt Health and Socio-Demographic Surveillance Site in 2006
INVESTIGATORS	Miss Moseble N Matabane.
DEPARTMENT	School of Public Health
DATE CONSIDERED	2009/10/02
DECISION OF THE COMMITTEE*	Approved unconditionally

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

DATE 2009/10/02 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr K Kahn

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...

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717 2119
Tel: (011) 717-2745

Reference: Ms Tania Van Leeve
E-mail: tania.vanleeve@wits.ac.za
22 September 2009
Person No: 0505275F
PAG

Miss MN Matabane
Po Box 1926
Chuenespoort
0745
South Africa

Dear Miss Matabane

Master of Science in Medicine (Epidemiology & Biostatistics): Approval of Title

We have pleasure in advising that your proposal entitled "*socio-demographic factors associated with morbidity in children under-five in Agincourt HDSS in 2006*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences