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UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

RESEARCH REPORT

PROJECT TITLE

DOES MIGRATION IMPROVE CHILD SURVIVAL: AGINCOURT SOUTH AFRICA 2002?

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RESEARCH REPORT SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF MASTER OF SCIENCE IN MEDICINE IN THE FIELD OF EPIDEMIOLOGY AND BIOSTATISTICS
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG.

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2006 to 2007

Declaration:

I, Mr. Akeem Tshepo Ketlogetswe, 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.

…….. [Signature of candidate]

…… day of ……., 2007

Dedication

I dedicate this degree to the Lord God who has made it possible for me to complete this course. I also dedicate it to my late dad (*Mr. Lucas Ketlogetswe Gori)* and sister (*Onalenna Lizzy Ketlogetswe).*

Abstract

***Background**:* Studies into risk factors and causes of childhood mortality present the opportunity to identify intervention programs appropriate in different populations in our attempt to reach the WHO Millennium Development Goals.

***Objectives**:* To determine whether there is an association between parental labour migration and child mortality in the Agincourt Health and Demographic Surveillance Site (HDSS) in 2002.

***Methods**:* Secondary data extracted from the longitudinal database from the Agincourt Health and Demographic Surveillance System were used to study the association between father's migration and child mortality in 2002 using logistic regression and survival analysis. The analysis included 10050 children born between 01 January 1998 and 31 December 2002.

***Results**:* The child mortality in 2002 was 12.9 deaths per 1000 person years. There was a statistically significant difference in death rate in infants (50.9 deaths per 1000 person years), and in children aged 1-4 years (9.6 deaths per 1000 person years). There was no association observed between migration and child mortality (OR: 0.97, 95% CI 0.59-1.60). The factors associated with mortality were the age of the child, the number of siblings that a child had, the refugee status of the mother, age of the mother at birth, breast feeding and whether the mother was deceased or not. The chances of dying were lower in older children compared to younger ones (OR: 0.58, 95% CI 0.50-0.68). Children who had one or more siblings were less likely to die (OR: 0.62, 95% CI 0.51-0.93) compared to those with none. Child mortality risk was higher in children born to refugees than to local residents (OR: 1.56, 95% CI 1.05-2.33). Those children who were not breast fed had increased chances of dying than those breast fed (OR: 5.33, 95% CI 2.60-10.95). The death of a mother increased the risk of the child dying (OR: 9.35, 95% CI 5.02-17.40). About 84.3% of migrants were sending remittances to members of the households remaining

behind but there was no significant difference in child mortality among remitters and non-remitters. The leading causes of death among households with migrant father and those with a non-migrant father were infectious diseases (mainly HIV/AIDS related illness) with 47% and 50% respectively.

***Conclusion**:*

The results from this study suggest that on average children of migrants in a rural area in South Africa do not experience increased mortality compared to children of non-migrants. The findings from this study where no association between fathers' migration and child mortality was observed were rather inconclusive. So far, this area of research has not been adequately addressed and much remains to be learned about the lives of children left behind by fathers migrating to seek employment elsewhere. For future studies it would be advisable to study in great depth the long term effects of migration on child mortality particularly in Africa.

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TABLE OF CONTENTS

Declaration: i
Dedication ii
Abstract iii
Acknowledgements v
TABLE OF CONTENTS vi
List of figures viii
List of tables ix
Acronyms and Abbreviations x
1.0 CHAPTER ONE: INTRODUCTION 1
1.1 Background information 1
1.1.1 Migration and mortality 2
1.1.2 Remittances 2
1.2 Statement of the problem 4
1.4 Literature review 6
1.5 Study objective 8
1.5.1 Specific objectives 8
1.5.2 Research question 9
1.5.3 Hypothesis 9
2.0 CHAPTER TWO: METHODOLOGY 10
2.1 Introduction 10
2.2 Study site 11
2.3 Study population 11
2.4 Data collection and quality 12
2.5 Assessment of exposure and outcome 13
2.5.1 Migration 13
2.5.2 Mortality 14
2.6 Data analysis and management 14
2.7 Ethics 15
3.0 CHAPTER THREE: RESULTS 16
3.1 Introduction 16
3.2 Descriptive analysis 16
3.3 Logistic regression analysis 24
3.4 Survival analysis 30
4.0 CHAPTER FOUR: DISCUSSION 34
4.1 Introduction 34
4.2 Migration and other risk factors of childhood mortality 34
4.3 Number of deaths and causes of death 39
4.4 Demographic characteristics 40
4.5 Limitations of the study 41
4.6 Strengths of the study 42
5.1 Conclusion 43
5.2 Recommendations from the study 45
References 47

APPENDICES 57
A.1 Migration Questionnaire 57
A.2 Ethics Approval Letter 59
A.3 Agincourt Health and Demographic Surveillance System Ethics Clearance Certificate... 60
A.4 Maps of Agincourt Health and Demographic Surveillance System and South Africa 61

List of figures

Figure 3.1: Causes of mortality among migrant households in Agincourt in 2002.

Figure 3.2: Causes of mortality among non-migrant households in Agincourt in 2002.

Figure 3.3: Causes of mortality among infants and children aged 1-4 years in migrant households in Agincourt in 2002.

Figure 3.4: Causes of mortality among infants and children aged 1-4 years in non-migrant households in Agincourt in 2002.

Figure 3.5: Distribution of migrants from Agincourt in South African provinces in 2002.

Figure 3.6: Child survival of children less than 5 years in Agincourt in 2002.

Figure 3.7: Survival of children of migrant fathers and non-migrant fathers in Agincourt in 2002.

Figure 3.8: Survival of children breastfed and not breastfed in Agincourt in 2002.

Figure 3.9: Survival of children with mothers alive and mothers dead in Agincourt in 2002

List of tables

Table 3.1: Socio-demographic characteristics for households in Agincourt in 2002.

Table 3.2: Comparison of demographic features of migrants and non-migrants households in Agincourt in 2002.

Table 3.3: Distribution of deaths according to demographic characteristics in Agincourt in 2002.

Table 3.4: Remittances of migrants in Agincourt in 2002.

Table 3.5: Univariate analysis: logistic regression for factors associated with child mortality in Agincourt in 2002.

Table 3.6: Multivariate analysis: logistic regression for factors associated with child mortality in Agincourt in 2002.

Table 3.7: Multivariate analysis: logistic regression for factors associated with mortality of infants and children aged 1-4 years in Agincourt in 2002.

Table 3.8: Multivariate analysis: logistic regression for factors associated with mortality in migrant and non-migrant households in Agincourt in 2002.

Acronyms and Abbreviations

AIDS: Acquired Immunodeficiency Syndrome

DSS: Demographic Surveillance System

HDSS: Health and Demographic Surveillance System

HIV: Human Immunodeficiency Virus

ICD: International Classification of Diseases

UNAIDS: United Nations Joint Programme on HIV/AIDS

USA: United States of America

USAID: United States Agency for International Development

UNICEF: United Nation Children's Fund

UNPF: United Nations Population Fund

U5MR: Under Five Mortality Rate

WHO: World Health Organization

1.0 CHAPTER ONE: INTRODUCTION

1.1 Background information

Migration has always been a part of human experience undertaken as a means of preserving or improving life and valued ways of life. The United Nations Population Fund estimated that in 2005 191 million people (3%) of the world's population lived outside their country of origin. Internal migration was also on the rise as some people moved in response to inequitable distribution of resources, services, and opportunities particularly in less developed countries. Thus, living in a family with at least one parent away for a long period of time is part of the normal experience of childhood for many children in the developing world. In South Africa 25% of all households had members who were migrant workers but the proportion rose to over 40% of households in the deep rural areas (SAMP, 2004). Between 18% and 40% of households in Bangladesh had at least one migrant member living and working elsewhere (Afsar, 2003). In Tanzania 50-60% of people living in rural households had at least one member away, while in Mali the figure was 80% (Tacoli, 2002). In addition, rapid social, economic, and political changes in developing countries have led to greater rural/urban and rural/rural migration and widespread movement back and forth between current and or usual place of residence (Djamba et al., 1999).

In the past, research tended to view migration as a rupture of the relationship between migrants and donor communities, cause of environmental degradation (Lohnert, 1998), health problems (such as spread of diseases), "brain drain", political or social instability, declining law and order. Therefore most governments wanted to implement policies to slow down or reverse rural-urban migration because it increased congestions in urban areas despite the fact that migration is often central to household's livelihoods (De Haan et al., 2003; Collinson et al., 2006a).

1.1.1 Migration and mortality

The literature on migration and mortality often compared the pattern of migrant groups to the patterns of the host population and in addition to their counterparts in the place of origin. The results of these studies had shown both a positive and negative relationship between migration and mortality suggesting that migration takes different forms under various settings. The mortality patterns of migrants can be influenced by both their place of origin and their destination and by the migration process itself. For example Chinese culture helped migrant mothers in the United States avoid risky behavior that resulted in low birth weight, however, life in the United States produced higher age specific adult mortality for migrant Chinese (Evans, 1987). There was also an elevated suicide rate for the Chinese relative to United States residents. In South Africa, mortality rates for migrants, members never resident and members always resident were 21, 33 and 42 per 1000 respectively. Migrants had a lower risk of mortality than members never resident but higher risk of HIV/AIDS relative to members always resident (Gofas and Hosegood, 2004).

The effect of migration on health and mortality may be mixed, since migration may bring with it an improvement in socioeconomic status, yet at the same time expose migrants to a new set of health risks (Rosenwaike and Hempstead, 1990). Evans (1987) argued that the migration process itself was stressful and affected the health of a migrant adversely. It also compelled the migrant to adjust to a new lifestyle which often brings with it a new set of health risks.

1.1.2 Remittances

Migration may be a form of livelihood diversification and remittances generated by migration may be critical in promoting access to essential treatment and drugs. Subsequently this may promote health seeking behavior and the spread of knowledge of health and technology (Development Research Centre on Migration, Globalization and Poverty, 2005). Migration can improve the welfare of the migrant as well as the family at large. High out-migration remittances sent back by migrants have increasingly

become a source of income for those left behind. There is also exchange of knowledge and information in the process which can consequentially be transferred to families and communities of origin.

Remittances may encourage families to invest in education and health especially for children. Hence, remittances may reduce infant mortality by improving housing conditions, or by improving access to public services such as clean drinking water (Cordova, 2005). The author also found that mortality fell and birth weight among Mexican children improved with increase in remittances. Evidence from El Salvador, Philippines, and Mexico indicated that children from recipients households stay in school longer (Cordova, 2005). Furthermore, Zamora (2005) stated that the households receiving remittances tended to have better nutrition and access to health and educational services compared to households that did not. Lipton (1980) found that family wealth increased with an increase in remittances and larger proportions of these resources were devoted to family needs. Likewise, several investigators (Gustfasson and Makonnen, 1993; Oberai and Singh, 1980; Roberts, 1997; Bourchachen, 2000; Gamburd, 2003), found a similar pattern in China, India, Lesotho, Morocco and Sri Lanka respectively. De Haan (2000) and Posel (2001) have also found that remittances are considered an important source of livelihood in South Africa.

1.1.3 Effects of migration on those remaining behind

However, migration involves considerable dislocation and disruption and hence there is a possibility that it has negative effects on health and subsequently on infant and child survival. Therefore, despite the economic benefits that migration may be seen to provide, the psychological effects are massive and may consolidate a child's right to development, survival and education (Eelens et al., 1992). During the migration process, there are also likely to be some social disruptive effects both for the migrant and their families. Silver (2006) argued that migration of close family members, especially spouses and children significantly increased the depressive symptoms and feelings of loneliness in remaining family members in Mexico. Argeseanu (2004) found a positive association between spending time away from home and child mortality. Researchers have stated that children leaving with both parents exhibited

advantage on a number of outcomes, including education, health and cognitive development (Amanto and Gilberth, 1999; Seltzer 1994; Strohschein, 2005; Teachman et al., 1998). Hence, children left behind may be marginally less healthy than other children. In contrast, the Philippines study revealed that children of migrants fell ill less frequently when compared with those of non-migrants (Save the children, 2006). The absence of men in the family adds to material and psychological insecurity and the health of household members also suffered (Rafique and Rogaly, 2003).

1.2 Statement of the problem

Child mortality is a meaningful health indicator of the health status of a population. It gives a rough picture of the current and future quality of life in a population. Child health and survival are shaped by the intersection of the biological, demographic, and socioeconomic factors (Argeseanu, 2004). According to the United Nations Children's Fund (UNICEF) Statistics (2006), close to 10.5 million children died every year before reaching fives years of age due to largely preventable causes making an average death rate of 70 per 1000 live births world wide. It was reported that most of these deaths occurred in developing countries and it was estimated that 50% of them occurred in sub-Saharan Africa. The report stated that child mortality rates among developing countries were high in Western and Central Africa and lower in Latin America and Caribbean (190 and 25 per 1000 live births respectively).

The World Health Report (2005) showed that child mortality in South Africa was 66 deaths per 1000 live births in 2003 and with the emergence of HIV/AIDS these figures were likely to go up. Between 2004 and 2005 the overall number of infants deaths increased by 11% (Statistics South Africa, 2006) Agincourt has experienced a rise in the under five mortality from 39 per 1000 to 77 per 1000 since the mid 1990's (Collinson, 2005). Posel and Casele (2003) reported that 32.6% of the rural African households contained a labour migrant in 1993 and this figure rose to 35.8% in 1999 and was expected to continue rising as a result of free movement. During the same period the authors noted that migrant

labour figures rose from 92% to 96.1% and 2.9% to 3.2% for the Africans and Coloured respectively. There had also been a noticeable rise in the migration of women from 30% in 1993 to 34% in 1999. Evidence from the Agincourt study showed remarkably high levels of temporary migration among rural African men and an increasing trend among rural African women (Collinson et al., 2006b). Father's absence due to migration increased the probability of illness among children less than six years by 7% (Frank and Hummer, 2002). Studies on health and mortality differentials by migration status have pointed to the fact that migrants perform better on health indicators than non-migrants. A study in South Africa showed that among migrants, child mortality decrease faster as socio-economic status increased than among non-migrants (Thomas, 2007). With migration figures rising, leading to a number of households in rural areas being composed of elderly grand parents and the young children of migrants parents it raised concerns about the well being of both grand children and grand parents. However, the internal migration in South Africa seems to be different from that in most other African countries because close to 65% of the population lived in urban areas (Djamba et al., 1999).

1.3 Justification of the study

South Africa's migration has been substantially influenced by international migration as a result of civil strife (for example, Mozambicans who are currently settled in Agincourt). The country also hosted a number of labour migrants from countries in the sub-continent (such as Lesotho, Malawi, and Zambia) who came to improve their well being in the relatively strong South African economy. Post apartheid South Africa has also attracted highly skilled professionals from Nigeria, Ghana, tradesmen from Senegal and Mali and street vendors and small traders from Sierra-Leone (Posel and Casele, 2003). However, migration into and within South Africa historically occurred under specific institutional conditions imposed by the apartheid regime. South Africa's segregation laws date back as far as 1913 but a major change took place after 1948 when the then government enacted laws to re-define and re-enforce segregation. Policies such as the native Law Amendment Act of 1937, Group Areas Act, act No 41 of 27 April 1950, Influx Control and Mines and Work Act of 1956 were some of the many laws

that prevented Black Africans from migrating to urban areas resulting in exacerbation of inequities as a result of exclusion from economically productive areas (Kok et al., 2006). In the apartheid era, there was strict control of those searching for employment by migrant labour laws and most often the migration stream was dominated by men who lived in social isolation working in mines. These laws led to densely populated areas (restructured settlement patterns) with some of the lowest levels of service delivery, infrastructure, and employment in the country (Kok et al., 2000). The formation of a democratic government in South Africa, abolition of the homelands and pass system and dismantling of apartheid have led to changes in internal migration (high prevalent temporary migration) especially for black Africans and Indians in particular. A marginal increase in migration rates was evident for black South Africans (from 9% in 1980 to 10% in 1996, excluding figures for former Bophuthatswana and Venda) and Indians (from 9% in 1980 to 12% in 1996) populations (Kok et al., 2006). These major changes that have taken place in South Africa have relaxed migration policies. It can be presumed that this has increased migration and it becomes important to investigate the effects of this massive migration.

1.4 Literature review

Several studies have assessed the risk of childhood mortality and associated risk factors (Ouba, 1998; Gyimah, 2002; Mboup, 2001). However, these studies have rarely assessed migration as a risk factor. The few studies on migration and child survival have most often concentrated on how child mortality differed when a family moved from one area to another particularly from rural areas to urban areas or vice versa, for instance, Brockerhoff (1990, 1994); Silver, 2006; Ssengonzi et al., 2002; Tam, 1994 to mention but a few. Brockerhoff (1994) reported that in developing countries children born after migrants have settled in urban areas experienced much better survival chances than those born to women who remained in the rural areas or were born before relocating; for instance risk of death (odds

ratio) for migrants compared to non-migrants in North Africa and Latin America was 0.73 and 0.77 respectively (p-value <0.001).

Tam (1994) also found that the mortality of children born to rural migrants in Peru and Bolivia was lower than that of children born to non-migrants but higher relative to natives. In contrast, a weak association was found between rural-urban migration and child mortality by Ssengonzi and colleagues (Ssengonzi et al., 2002). However, the association was stronger for children born to urban-urban migrants. A study in Ghana found that among children of urban natives, rural-urban migrants, the hazards were lowered by 50%, 46% and 44% respectively relative to rural natives (Amankwa et al., 2003). Therefore it can be argued that migration and health have a complex relationship which operates both ways and can either be positive or negative from deleterious effects on health (Garenne, 2003).

To date little work has focused on the effect of migration on health and survival of members of migrants' families such as infants and children remaining behind to examine the nature of these pathways. But so far all these studies were conducted in the Asian and South American continent but not in Africa yet.

Razzaque and colleagues (Razzaque et al., 2005) carried out a prospective cohort study in Bangladesh to examine the effect of father's out-migration on children's nutritional level and infant mortality. They hypothesized that migration was likely to affect health and survival of non-migrants through specific socioeconomic pathways. By use of logistic regression they investigated the complicated relationship and concluded that the father's absence could have particular negative consequences if the mother's mobility was limited. Moreover, children were less likely to be malnourished if the father out-migrated because that increased household income. Neonatal mortality was similar if the father was present or absent but post-neonatal mortality was lower in families where fathers had migrated compared to them always present. The education and economic activity of mothers also improved child nutrition. These relationships still hold after controlling for a number of socio-demographic factors.

Hildebrandt and Mc Kenzie (2004) expanded the study carried out by Donato and Kanaiaupuni on the effect of migration on child health in Mexico. Their objective was to assess whether or not migration from Mexico to the USA improves the health of children in migrant households and the mechanisms through which it did so. The paper has applied some economic and econometric issues by Grossman (1972) which describes the demand of health via the theory of human capital. They argued that migration improved health outcomes by increasing both the efficiency of health production and the demand for health. In this context, efficiency of health was increased when migrants acquired knowledge about health which in turn affected certain behaviors. Hildebrandt and Mc Kenzie observed that 0% to 50% household migration prevalence reduced the probability of child mortality by 9%. There was also evidence that migration improves health through income and health knowledge effects. The study however, failed to eliminate bias by omitting variables such as basic infrastructure. The use of income as a measure of household assets also posed a threat because it fluctuates over time.

Donato and Kanaiaupuni (1999) retrospectively studied the effects of migration on infant survival in Mexico and suggested that the benefits of migration were cumulative processes accruing over time and were not limited to infants with household migrants. They hypothesized and observed that risk of mortality was highest for children in households disrupted by frequent absence of household head. However, infants in household heads with greater experience in the USA were less likely to die.

1.5 Study objective

Aim: To determine whether there is an association between father's labour migration and child mortality in the Agincourt Health and Demographic Surveillance System (HDSS) in 2002.

1.5.1 Specific objectives

1. Describe the father's labour migration patterns and characteristics of families with children aged less than 5 years in the Agincourt HDSS in 2002.

2. Investigate if there were differences in cause specific mortality for children of migrant and non-migrant fathers in the Agincourt HDSS in 2002.
3. Investigate if father's labour migration had a positive or negative effect on child mortality in the Agincourt HDSS in 2002.

1.5.2 Research question

Does the absence of migrant fathers improve child survival in Agincourt South Africa in 2002?

1.5.3 Hypothesis

The risk of child mortality is higher in households disrupted by the absence of fathers as a result of migration.

Children are the most vulnerable group of the population and the effects of migration on mortality if there are any are more likely to be seen on children as compared to adults. A major concern is whether migration will be an option and or even a better solution for disadvantaged households. Thus research on migration and infant mortality is an important area and yet much neglected topic in Africa. Therefore the aim of this study is to determine whether there is an association between fathers' labour migration and child mortality in the Agincourt Health and Demographic Surveillance System in 2002.

2.0 CHAPTER TWO: METHODOLOGY

2.1 Introduction

The study attempted to answer one empirical question; how fathers' absence due to migration affected child mortality. Collinson (2005) concluded that children of migrant mothers did not experience higher mortality than children of non-migrant mothers. The author reported a small protective effect albeit non-significant (OR 0.8, 95% CI 0.7-1.0). Thus the migration of mothers' migration on overall child survival did not appear detrimental. Between 1992 and 2003 the percentage of female temporary migrants increased 5% to 17% while male migrants also rose from 21% to 31% during the same period (Collinson et al., 2006b). It can be presumed that there was a low likelihood of mothers migrating when the children are still young. Therefore, the current study focuses specifically on father's migration as opposed to parental migration given evidence that fathers were more likely to migrate than mothers. The aim was then to answer the question stated in the previous chapter using secondary data collected by the Agincourt Demographic and Health Surveillance Site in 2002 (on fathers' migration) by addressing the following objectives; 1) to describe the fathers' labour migration patterns and characteristics of families with children aged less than 5 years. 2) investigate if there were differences in cause specific mortality for children of labour migrant and non-migrant fathers. 3) investigate if fathers' migration had a positive or negative effect on child mortality.

The Agincourt Demographic Health Surveillance Site offered an ideal setting to answer the research question. The households are visited every year and as such a DSS framework is likely to have better coverage of deaths and causes of deaths. The DSS is also able to measure and track temporary migrants over time and link them to their respective households. Furthermore, there is likely to be a better reporting of age. Data collected elsewhere for instance, Census and Demographic Health Surveys could not be used since it's not as detailed and comprehensive as one collected by demographic surveillance

sites. Therefore any other sites with a similar data system could have been chosen to answer the research question.

2.2 Study site

The Agincourt Demographic and Health Surveillance System was set up by the Agincourt Health and Population Programme (AHPP) a research initiative of the University of Witwatersrand in 1992. It covers an area of 390 square kilometres about 500 kilometres northeast of Johannesburg, South Africa. The site covers 21 communities in the sub-district of Bushbuck ridge region (now called Bohlabela district), close to the Mozambican border. The site is 400-600 metres above sea level and extends between latitude 24°50' and 24°56' S and longitude 31°08' and 31°25' E. The temperature varies throughout the year, between 12°–40°C in summer and 5°–27°C in winter. The area has a moderate semi-arid savannah climate with low average rainfall ranging from 700mm in the western to 550mm in the eastern part of the site. The area is better suited to game farming and low density cattle farming than to crop cultivation (Collinson et al., 2002).

2.3 Study population

The population of interest are all children under five years of age who resided in the site from the period of 1 January 2002 to 31 December 2002. This included a study population of 10 050 children which represents approximately 15 percent of the total population under surveillance in 2002. The total number of deaths in 2002 was 119. The study population excluded children who died before 1 January 2002 and after 31 December 2002. All the children included in the study were born between the period 1 January 1998 and 31 December 2002. No sampling strategy was applied since all individuals who met the inclusion criteria were studied.

2.4 Data collection and quality

Data were extracted from the Agincourt demographic surveillance system. The demographic surveillance system involves continuous recording of vital events in the population, health and socio-economic variables namely births, deaths, in and out migrations, household relationships, residential and refuge status, education, antenatal and delivery health seeking patterns. These procedures include visits to all households in the site once every year (from August to November) to update information on vital events, health and socio-economic variables using a standardised questionnaire (not attached as appendix). Additional data is collected in the form of special census modules nested within each census update. These provide limited information relevant to particular lines of investigation. A module on temporary migration was included in 2002.

The trained field workers are allocated an enumeration area and their work is closely monitored by team leaders responsible for ensuring quality of the data collected. The field workers also carry maps to be able to locate all the households in their enumeration area or return to a particular household without risk of confusion (Collinson et al., 2002).

The supervisor goes into the field with the fieldworker and observes a number of interviews. Random duplicate visits are conducted by the supervisor on two percent of the population. A field supervisor reviews all completed questionnaires and return those with inconsistencies to the enumerator for correction(s). Questionnaire checking occurs in a structured system at four levels of the field organization. 1) The supervisor uses a check list to keep track of the completed questionnaires. When questionnaires have left the field and passed through all quality checks the information is entered into a software system. 2) The data are entered simultaneously on three computers connected to a network writing to a database on a server. 3) The system incorporates built in validation checks for invalid codes, missing values, inconsistencies, duplicate entries and incorrect names of places. 4) Those with errors are reviewed by the data manager and if necessary returned to the supervisor for resolution. The

site also compares the village of origin "internal" in-migrants with destination migrants for quality monitoring (Collinson et al., 2002).

Data are stored in a password protected computer programme Microsoft Structured Query Language (SQL) server, and is exported into Microsoft access format for routine data analysis. The data is captured in a relational database model and contains longitudinal information of the population in the sub-district. This provides a powerful and efficient means to handle complex and related data sets.

2.5 Assessment of exposure and outcome

2.5.1 Migration

The exposure and outcome of interest for the current analysis were migration of fathers and mortality of under five year old children respectively. In addition to the information collected in routine census several questions on migration were asked in 2002. Migration status of study participants was either recorded as 'temporary migrant' (resident in the study area for less than six months, but nevertheless regarding the Agincourt area as "home") or 'permanent resident' (resident in the study site for six months or more in the preceding year). Information collected about temporary migrants included; the migrant's name, reasons for migration, place of destination, frequency of coming home, and mode of communication while away (Kahn et al*.,* 2007). In this study the same definition by the site is adopted (questionnaire attached as appendix A.1).

The migration status of the fathers was derived using the question that was asked to describe the type of work that the father was engaged in. The answer to the question included all types of employment ranging from self employment to professional employment. All the fathers who were listed as employed had their place (province) of employment also recorded. The analysis assumed that all the fathers without the above information (unless if the type of job was unknown or missing) were unemployed and hence were non-migrants. Fathers who were dead were excluded from the analysis.

2.5.2 Mortality

Mortality (death) was defined as the probability (expressed as a rate per 1000) of a child born in a specified year dying before reaching the age of five if subject to current age specific death rates. The information on mortality was obtained from the next of kin or a close relative of the deceased during the census taking. Subsequently, a verbal autopsy was conducted on all deaths by trained lay fieldworkers in the local language. Information collected during the verbal autopsy included particulars of the deceased such as name, date of death, place of death and symptoms before death. Information collected was then independently assessed by two medical practitioners. In case of agreement, their diagnosis was accepted as the cause of death. However, if they differ they discuss and reached a consensus. The causes of death were validated among children using medical records over the 3-year period, 1992-1995 and recorded a sensitivity and specificity of 69% and 96% respectively (Kahn et al., 2000).

2.6 Data analysis and management

Data processing, cleaning and analysis were performed using Stata version 9. The essence of the statistical analysis was to compare child mortality among households with fathers migrating and those without migrant fathers. The analysis was done in two parts. The first part comprised of descriptive summary statistics, t-test for continuous variables to assess differences between households with a migrant and without a migrant father. Categorical variables were analyzed using frequency tables, graphs and chi-square statistics to test for associations.

To control for multiple confounders in the statistical analysis multivariate analysis was conducted. Logistic regression (to compute odds ratios and 95% confidence intervals) was used to fit a model to determine how migration influenced the probability of a child dying. In the logistic regression two sets of variables were used, those that directly relate to the child (age, sex, birth weight, number of siblings and gestational period) and those related to the mother (mother's education and age, refugee status of

mother, antenatal visits), and father's migration status. Other factors, like environmental conditions, size of household and social economic status were also considered. The other interest was to compare the survival of under five year old children in migrant and non-migrant households. Therefore a Cox proportional hazards model was used to assess the relative effect of father's migration on childhood survival rates. The observation time for all under five children started from 1 January 2002 and ended at the occurrence of the event (death) or 31 December 2002. Conclusions were based on a two sided p-value of 0.05 considered to be statistically significant.

2.7 Ethics

Ethical clearance was asked from the University of the Witwatersrand Ethics committee for conducting this secondary data analysis (Ref: R14/49). The Agincourt HDSS previously received an ethical clearance (Ref: R14/49) from the committee for research on human subjects (medical) from the University of the Witwatersrand and a copy of this certificate was attached to the research report (clearance attached as appendix A.3). The data will not be passed to unauthorized persons and will be used for the purpose of the study only. If the researcher wish to conduct further analysis on the data which were not part of this report permission will be sought from the site before any investigations are carried out. The data used for this study did not contain identifiers hence there was no way that it could be linked to individuals. The researcher will erase the data from the CD-ROM after completion of the study to protect the confidentiality of the participants.

3.0 CHAPTER THREE: RESULTS

3.1 Introduction

As mentioned in the previous chapter, the main objective of this study was to determine if there was an association between the migration of fathers and child mortality. Therefore, results of this report focused on comparing the characteristics of children from households with a migrant father to those with a non-migrant father to establish if there were any differences. In addition, to assess the impact of father's migration on child health the analysis also examined the influence of factors that have been associated with child mortality in previous studies. The study examined 10050 children who were born between 01 January 1998 and 31 December 2002.

3.2 Descriptive analysis

Table 3.1 shows the summary of socio-demographic characteristics of the overall study population. The continuous variables were summarised in terms of averages and standard deviations and percentages were given for categorical variables. The marital and educational status shown in this table were for mothers only because close to 50% of the information on fathers was missing. The weight of children was used though 56% of the observations were missing. Identifying children born with low birth weight is important since birth weight constitutes a good indicator of the current health status of the child as well as the mother and a good predictor of health problems later in the child's life. Low birth weight is a major cause of child mortality in low income countries (Alderman and Behrman, 2006). In 2003, birth weight was ranked the second leading cause of death among under fives in South Africa (Medical Research Council, 2003).

Out of the total 10050 children there was no significant difference in terms of gender (Table 3.1). Still on Table 3.1, the majority of children were aged above 1 year. However, there were significant differences in the gender of household heads. Table 3.1 also shows that the majority of mothers had 8-12 years of schooling (secondary education). There was a mean age difference between fathers and

mothers of about 10 years. A summary of the birth weight for only children born in 2002 yielded a mean of 3.03 kilograms and a standard deviation of 0.50 (results not shown in Table 3.1). 35.9% of the information on birth weight of infants was missing.

Table 3.1 Socio-demographic characteristics for households in Agincourt in 2002

Variable	Total	Mean	Std	Number (%)
Mother age (years)	9517	28.57	7.55	
Father age (years)	4234	38.9	9.67	
Child Age (years)	9931	2.73	1.4	
Birth weight (kilograms)	5042	3.07	0.01	
Age at death (years)	119	1.24	1.02	
Migration status	10050			
Migrants				2087 (20.77%)
Non-migrants				7963 (79.23%)
Household head	7791			
Female				2,322 (29.80%)
Male				5,469 (70.20%)
Gender of study child	10048			
Male				4946 (49.22%)
Female				5,102 (50.78 %)
Father alive	4542			
Yes				4234 (93.22%)
No				308 (6.78%)
Mother alive	10050			
Yes				9867 (98.18%)
No				183 (1.82%)
Refugee	10048			
Yes				3678 (36.60%)
No				6370 (63.40%)
Grant (care dependency, foster care, child support)	9232			
Yes				783 (8.48%)
No				8449 (91.52%)
Marital status	3701			
Living together				810 (21.97%)
Widowed				90 (2.44 %)
Divorced				123 (3.34 %)
Separated				123 (3.34 %)
Married				2555 (69.30%)
Education status (number of years in school)	7909			
None				1254 (15.86%)
1-7				2,216 (28.02%)
8-12				3,964 (50.12%)
>12				475 (6.01%)

Table 3.2 gives a summary of characteristics of households with migrant fathers and non-migrant fathers. The summary compared the mean differences (using confidence intervals and p-values) for all continuous variables of interest and tables for categorical variables.

Table 3.2 Comparison of socio-demographic features of migrants and non-migrants households in Agincourt 2002

		Migration status of the father		
Variable	**Total**	**Migrants**	**Non-Migrants**	**P-Value**
	10,050	2087 (20.77%)	7963 (79.23%)	
Breast feeding				
Yes		1741 (98.25%)	6118 (98.27%)	
No		31 (1.75%)	108 (1.73%)	
Mother age (years)				
N	9699	2071 (21.35%)	7628 (78.65%)	
Mean		32.17 (31.87,32.47)	27.66 (27.49,27.82)	<0.00001
Std		7	7.41	
Mother age at birth (years)				
N	9699	2071 (21.35%)	7628 (78.65%)	
Mean		29.43 (29.13,29.73)	24.99 (24.83,25.15)	<0.00001
Std		6.91	7.25	
Father age (years)				
N	4542	2087 (45.95%)	2455 (54.05%)	
Mean		39.35 (38.98,39.73)	39.4 (38.96,39.83)	0.8881
Std		8.75	11.06	
Child age (years)				
N	10048	2087 (20.77%)	7961 (79.23%)	
Mean		2.74 (2.67,2.74)	2.7 (2.68,2.80)	0.2589
Std		1.39	1.41	
Age at death (years)				
N	119	22 (18.49%)	97 (81.51%)	
Mean		1.08 (0.68,1.49)	1.28 (1.07,1.49)	0.4102
Std		0.91	1.04	
Antenatal visits (days)				
N	7992	1771 (22.16%)	6221 (77.84%)	
Mean		4.21(4.10,4.32)	4.05 (3.99,4.11)	0.0126
Std		2.39	2.4	
Gestation (weeks)				
N	7998	1772 (21.15%)	6226 (77.84%)	
Mean		39.72 (39.64,39.79)	39.7 (39.66,39.74)	0.7398
Std		1.66	1.51	
Dependency ratio[1]				
N	8134	1799 (22.12%)	6335 (77.88%)	
Mean		1.28 (1.25,1.32)	1.16(1.14,1.18)	<0.00001
Std		0.72	0.8	
Socio-economic status[2]				
Poor	3,463	738 (21.31%)	2,725 (78.69%)	
Middle	3,464	721 (20.81%)	2,743 (79.19 %)	
Rich	1,733	356 (20.54%)	1,377 (79.46 %)	

[1]Dependency ratio-is the ratio of the dependent population (aged under 15 years and over 65) to the "active" population (aged 15-64 years). It gives the number of dependent people per 1000 people of economically active ages.

[2]The socio-economic status was constructed using durable household assets (e.g. domestic animals), access to utilities and infrastructure (e.g. sanitation facility and source of water), and housing characteristics (e.g. number of rooms for sleeping and building material). Then principal component analysis was used to create a socio-economic status to classify households into three classes.

There was no significant difference in father's age (p-value 0.8881), children's age (p-value 0.2589), gestation period (p-value 0.7398), and children's age at death (p-value 0.4102) between households of migrant fathers and non-migrant fathers. The mean age of the mother and dependency ratio were higher in households with migrant fathers (32.17 years and 1.28 respectively). In all the socio-economic classes there were few migrant households compared to non-migrant households. The mortality rates of children according to their father's migration status and other variables of interest are given in Table 3.3. The objective was to determine if child mortality differed according to other characteristics apart from migration status.

Table 3.3: Distribution of deaths according to demographic characteristics in Agincourt in 2002

		Died	Person –years	Total	Mortality rate (per 1000)[3]
Variable		Yes Number (%)			
Father migrant	Yes	22 (1.05%)	1923.18	2,087	11.44
	No	97 (1.22%)	7277.86	7,963	13.33
Age	<1(year)	38 (2.50%)	745.37	1,517	50.98
	1-4(years)	81 (0.95%)	8455.68	8,533	9.58
Gender	Female	57 (1.12%)	4668.59	5,102	12.21
	Male	62 (1.25%)	4532.46	4946	13.68
Breastfeeding	Yes	98 (1.25 %)	7075.98	7,859	13.85
	No	10 (7.19%)	112.33	139	89.02
Gestation period	<38 weeks	17 (3.20%)	346.34	532	49.08
	≥38 weeks	91 (1.22%)	6841.97	7,459	13.30
Birth weight					
	<2.5 kilograms	13 (1.11%)	392.54	449	33.12
	≥2.5 kilograms	43 (0.94%)	4111.62	4593	10.46
	Missing	63 (1.26%)	4696.89	5008	13.41

[3]Person-years were calculated for all the categories. Mortality was calculated using person –years as the denominator and total number of deaths in each category as the numerator (actuarial method) and the rates are expressed per 1000 person-years.

The mortality of children in 2002 was 12.9 deaths per 1000 person years. Infant mortality was high (50.98 deaths per 1000 person years), but there was no significant difference in terms of gender. One other significant result was that breastfeeding had a protective effect against mortality while lower birth weight was a risk factor. Table 3.3 also shows that children born before 38 weeks had higher mortality (49.08 compared to 13.30 deaths per 1000 person years). All mortality rates in Table 3.3 are only relevant to the year 2002 and can not be used to describe under five child mortality in Agincourt.

In figure 3.1 and 3.2 the values given on the right are actual numbers of deaths attributed to these causes while the percentages are given on the left. The values are separated by a comma.

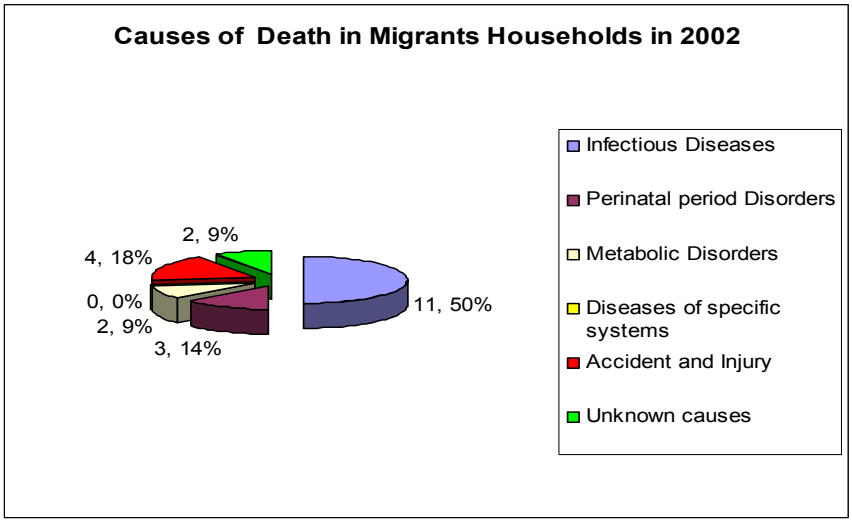


Figure 3.1 Causes of mortality among migrant households in Agincourt in 2002

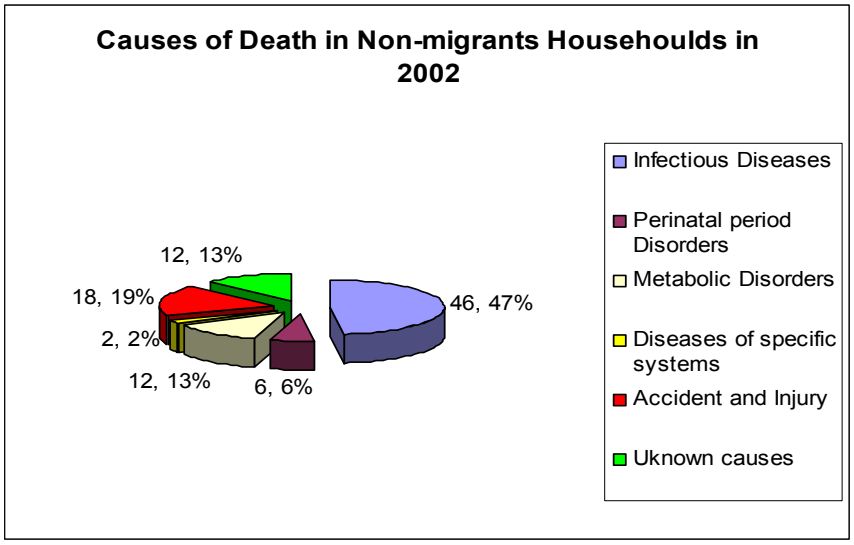


Figure 3.2 Causes of mortality among non-migrant households in Agincourt in 2002

Leading causes of death among households of migrant fathers were infectious diseases (mainly HIV/AIDS related illness) followed by accident and injury and the third leading cause was perinatal period disorders. In households where the father was a non-migrant the leading cause of death was still infectious diseases followed by accident and injury and the third leading causes were metabolic disorders and unknown causes.

In figure 3.3 and 3.4 the causes of deaths have been expressed as a percentage of the total deaths in each category and the values given inside the bars are the actual numbers of the deaths attributed to these causes.

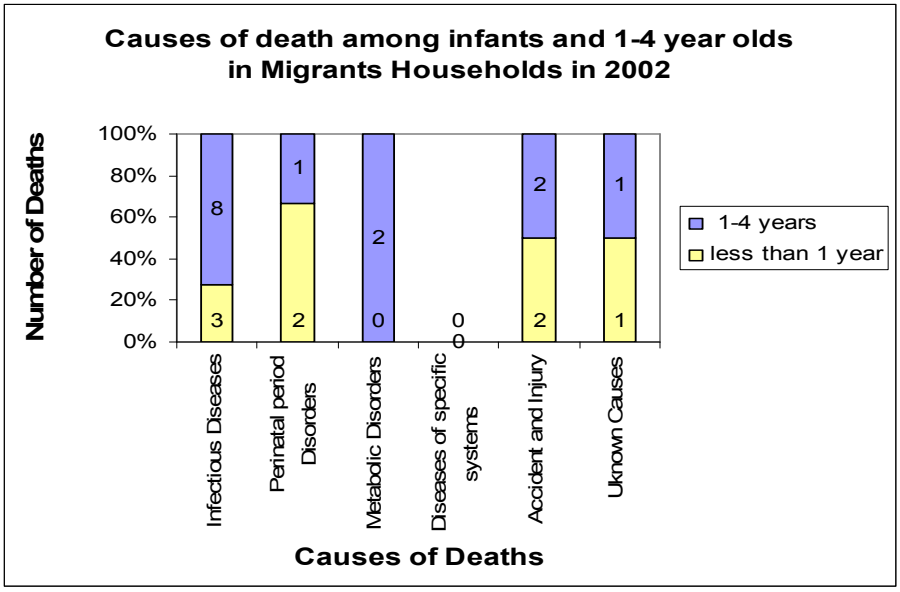


Figure 3.3 Causes of mortality among infants and children aged 1-4 years in migrant households in Agincourt in 2002

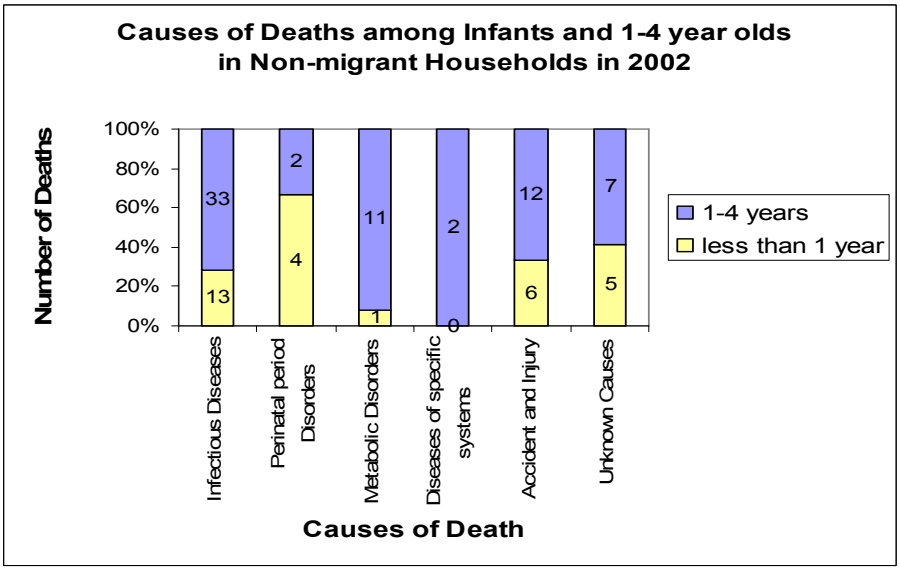


Figure 3.4 Causes of mortality among infants and children aged 1-4 years in non-migrant households in Agincourt in 2002

Metabolic disorders and infectious diseases accounted for the majority of deaths among 1-4 year old children in households of migrating fathers and infants mostly died from perinatal period disorders. Similarly, in households with non-migrant fathers the leading causes of death for 1-4 years olds were diseases of specific systems, metabolic disorders and infectious diseases. But perinatal period disorders remained the leading cause of deaths among infants with fewer cases of accident and injury.

Table 3.4: Remittances of migrants in Agincourt in 2002

	Food	Clothes	Money	Other	Total
Remit					
Yes	172 (8.24%)	7 (0.34 %)	1669 (79.97%)	4 (0.19 %)	1759 (84.28%)
No	1915 (91.76%)	2080 (99.66%)	418 (20.03%)	2083 (99.81%)	328 (15.72 %)

The majority of migrants appeared to be remitting, food and money; money, however, dominated the remittances.

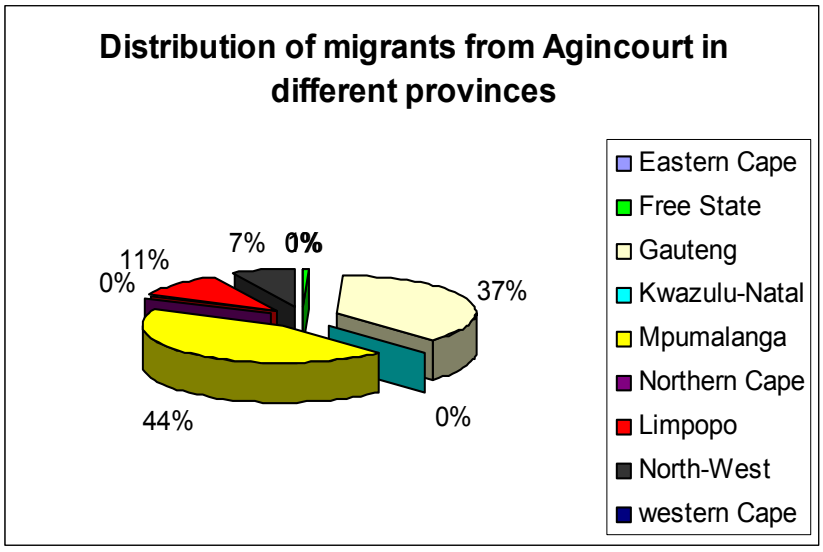


Figure 3.5 Distribution of migrants from Agincourt in South African provinces in 2002

The migration stream seemed to be towards Mpumalanga and Gauteng provinces respectively. About nine percent of migrants visited home (Agincourt) during holidays, 45.25% on week ends or end of the month and 45.69% had irregular visits to their families.

3.3 Logistic regression analysis

The outcome of interest (mortality) is a binary variable and logistic regression was fitted to determine variables that can be used to explain child mortality. The significance level adopted for both univariate and multivariate analysis was 0.05. Stepwise regression (forward selection method) was used to choose explanatory variables for the multivariate analysis and was also verified using the backward selection

method. The model with the maximum likelihood ratio was adopted as the best fit for the data. The section first focused on univariate analysis then multivariate analysis. Then analyses were run for all the variables found to be important in explaining child mortality by stratifying age into infants and 1-4 year olds and by migration status of the father to examine if the underlying variables were consistent for all groups.

Table 3.5 Univariate analysis: logistic regression for factors associated with child mortality in Agincourt in 2002

Variables		Odds Ratio	95% Confidence Interval	P-value
Father's migration				
	No	0.86	(0.54,1.38)	0.538
	Yes	1		
Breastfeeding				
	No	6.14*	(3.13,12.04)	<0.0001
	Yes	1		
Total number of siblings		0.76*	(0.60, 0.97)	0.025
Age				
	1-4 years	0.38*	(0.26, 0.57)	0.0001
	<1 year	1		
Mother's age at birth				
	>30 years	0.82	(0.53,1.25)	0.357
	≤30 years	1		
Birth weight		0.22*	(0.07,0.67)	0.008
Mother alive	No	9.08*	(5.25,15.72)	<0.0001
	Yes	1		
Refugee	Yes	1.26	(0.87,1.82)	0.219
	No	1		
Duration of breast feeding (months)		1.01	(0.97, 1.05)	0.695
Gender				
	Male	1.12	(0.78,1.61)	0.528
	Female	1		
Dependency ratio		1.01	(0.99,1.01)	0.194
Grant				
	No	5.39*	(1.33, 21.85)	0.018
	Yes	1		

* Statistically different from 1, $p<0.05$

The univariate analysis showed that infants were at increased risk of death compared to older children. The families receiving grants (i.e. child support, foster care and care dependency) had a lower ratio of child mortality. Children having more siblings were less likely to die compared to those with none. The mortality was lower in children having a living mother as opposed to a deceased mother (Table 3.5). However, a conclusion can not be based on these results since they may be affected by confounding thus all the variables in the table were examined again in a multivariate analysis.

To select which variables to include into the model, a forward selection method was run with a conservative p-value of 0.15. Then all the eliminated variables were put back into the model of the variables picked by step wise regression one at a time and if not significant they were dropped. Birth weight was important in explaining child mortality, those who were born weighing more than 2.5 kilograms were at reduced risk (OR: 0.33, 95% CI 0.18-0.63) compared to those born weighing less than 2.5 kilograms. But for those with missing information there was no significant difference compared to those with a birth weight less than 2.5 kilograms (OR: 0.62, 95% CI 0.33-1.18). The conclusions remain the same except for refuge status of the mother which is no longer significant (results not shown). However, birth weight was excluded because restricting the analysis to only those with recorded weights reduced the sample size from initially (n=7937 to n=4995) due to too many missing values.

Table 3.6 Multivariate analysis: logistic regression for factors associated with child mortality in Agincourt in 2002

Variable		Odds Ratio	95% Confidence Interval	P-value
Father's migration				
	No	0.97	(0.59,1.60)	0.91
	Yes	1		
Breastfeeding				
	No	5.33*	(2.60,10.95)	<0.0001
	Yes	1		
Total number of siblings		0.62*	(0.51,0.93)	0.016
Age (years)		0.58*	(0.50,0.68)	<0.0001
Mother's age at birth				
	>30 years	0.62*	(0.39,0.99)	0.041
	≤30 years	1		
Mother alive				
	No	9.35*	(5.02,17.40)	<0.0001
	Yes	1		
Refugee	Yes	1.56*	(1.05,2.33)	0.028
	No	1		

* Statistically different from 1, $p<0.05$

Pseudo-R –squared 0.1014

The number of cases for the model in Table 3.6 was 108

Migration was not an important predictor in explaining child mortality (OR: 0.97, 95% CI 0.59-1.60). However, children that were not breastfed were more likely to die compared to those breastfed (OR: 5.33, 95% CI 2.60-10.95). To have siblings appeared to have a protective effect. Compared to locally born residents refugee children were more likely to die (OR: 1.56, 95% CI 1.105-2.33). Having a living mother was protective.

Since there was evidence that age of the child was significant in explaining mortality the investigations were carried further to determine if the effect of the factors above were consistent for both less than one year olds (infants) and children aged one to four years. Therefore, table 3.7 shows stratified multivariate analysis for infants and children age 1-4 years.

Table 3.7 Multivariate analysis: logistic regression for factors associated with mortality of infants and children aged 1-4 years in Agincourt in 2002

		Infants (n=1436)			1-4 year olds (n=6489)		
Variable		**Odds Ratio**	**95% Confidence Interval**	**P-value**	**Odds Ratio**	**95% Confidence Interval**	**P-value**
Father's migration							
	No	1.51	(0.64, 3.56)	0.345	0.75	(0.40,1.40)	0.372
	Yes	1			1		
Breastfeeding							
	No	**13.80***	(5.83, 32.66)	**<0.0001**	0.83	(0.11, 6.16)	0.850
	Yes	1			1		
Total number of siblings		0.82	(0.54,1.25)	0.360	**0.60***	(0.39, 0.92)	**0.019**
Mother's age at birth							
	>30 years	**0.36***	(0.14, 0.94)	**0.036**	0.72*	(0.42,1.25)	0.244
	≤30 years	1			1		
Mother alive							
	No	**7.39***	(1.76, 30.93)	**0.006**	**10.35***	(5.24, 20.44)	**<0.0001**
	Yes	1			1		
Refugee	Yes	0.96	(0.46, 2.01)	0.684	**1.86***	(1.15, 3.01)	**0.011**
	No	1			1		

* Statistically different from 1, $p<0.05$

In Table 3.7 there were 35 cases in the model for infants and 73 cases in the model for older children (1-4years)

The results showed that infants who were not breastfed and had a deceased mother had a significantly increased risk of death but the risk of death was reduced if they were born to mothers aged older than 30 years. The migration status of the father however remained insignificant. Children aged 1-4 years also had a significant increased risk of death, when the mother was deceased and when they and their families were refugees. The risk of death was reduced in 1-4 year olds when they had siblings. There were however some differences, the number of siblings were insignificant for infants while being born to an older mother was protective for infants. Breastfeeding and the age of the mother were insignificant for 1-4 year olds. The migration of the father also remained insignificant for older children after adjusting for all other factors.

Furthermore, we investigated whether risk factors were consistent for both migrants and non-migrants. Table 3.8 that follows shows stratified multivariate analysis for migrants and non-migrants respectively.

Table 3.8 Multivariate analysis: logistic regression for factors associated with mortality in migrant and non-migrant households in Agincourt in 2002

		Migrants (n=1739)			Non-migrants (n=6160)		
Variable		**Odds Ratio**	**95% Confidence Interval**	**P-value**	**Odds Ratio**	**95% Confidence Interval**	**P-value**
Breastfeeding							
	No	**10.77***	(2.83, 40.99)	**<0.0001**	**4.10***	(1.75, 9.62)	**0.001**
	Yes	1			1		
Total number of siblings		0.66	(0.35,1.23)	0.188	**0.68***	(0.48, 0.96)	**0.029**
Age							
	1-4 years	**0.32***	(0.13, 0.79)	**0.014**	**0.43***	(0.27, 0.69)	**<0.0001**
	<1 year	1					
Mother's age at birth							
	>30 years	**0.36***	(0.13, 0.96)	**0.042**	0.70	(0.41,1.18)	0.182
	≤30 years	1			1		
Mother alive							
	No	-	-	-	**11.11***	(5.90, 20.94)	**<0.0001**
	Yes	1			1		
Refugee	Yes	1.21	(0.50, 2.94)	0.675	**1.66***	(1.07, 2.58)	**0.024**
	No	1			1		

* Statistically different from 1, $p<0.05$

- Few cases to run the analysis.

In Table 3.8 there were 20 cases in the model for households of migrant fathers and 88 cases in the model for households of non-migrant fathers

The total number of siblings and refugee status were not significant for migrants. However, the mother's age at birth was significant for migrants. Therefore, there was evidence of inconsistency. The numbers on the mothers deceased in migrants households were few to analyze. Furthermore, investigations were carried out to assess if among migrant households remittances were important in explaining child mortality. But no significant differences were detected (results not shown).

3.4 Survival analysis

Survival analysis was used to measure the influence of any explanatory variable that could have been a time dependent factor (during the 12 months of follow-up). The method also helped to control for the effect of censoring which could have occurred if a child did not die before the end of the study period or lost to follow-up during the study. Survival analysis was also used to check for consistency of results obtained from the logistic regression analysis.

The last section of the results shows several graphical presentations of Kaplan-Meir Survival functions that compared the survival experience of children by variables of interest such as age of the child, migration status of the father, breastfeeding and mortality status of the mother. The entry age was calculated in months and the follow-up time was 12 months.

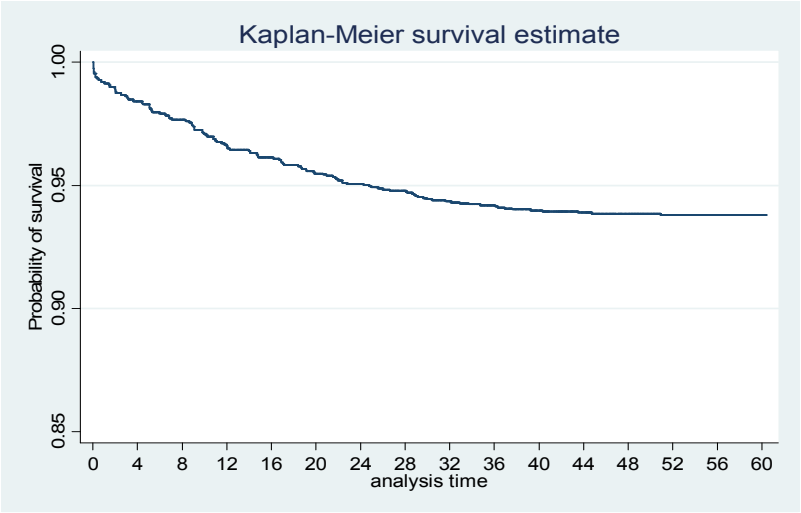


Figure 3.6 child survival of children less than 5 years in Agincourt DSS in 2002

The figure 3.6 shows that the overall survival of all children dropped over time in 2002. The age at entry was calculated in months as well as the follow-up time. The entry age was calculated with reference to 01 January 2002 and those children born in 2002 their entry age was 0. However, this may not be adopted as a true reflection of the child survival of under five year old children because the follow-up period was short (made when other children were already 4 years), and information prior to 2002 was not taken into consideration. The graph does not differentiate between infants and older

children and therefore can not be used to estimate neither U5MR nor infant mortality. Therefore, interpretations are limited to the time of follow-up only and give the cumulative probability of survival during that period (1 January to 31 December 2002). The short follow-up time did not allow stratifying children into infants and 1-4 year olds to detect any meaningful differences.

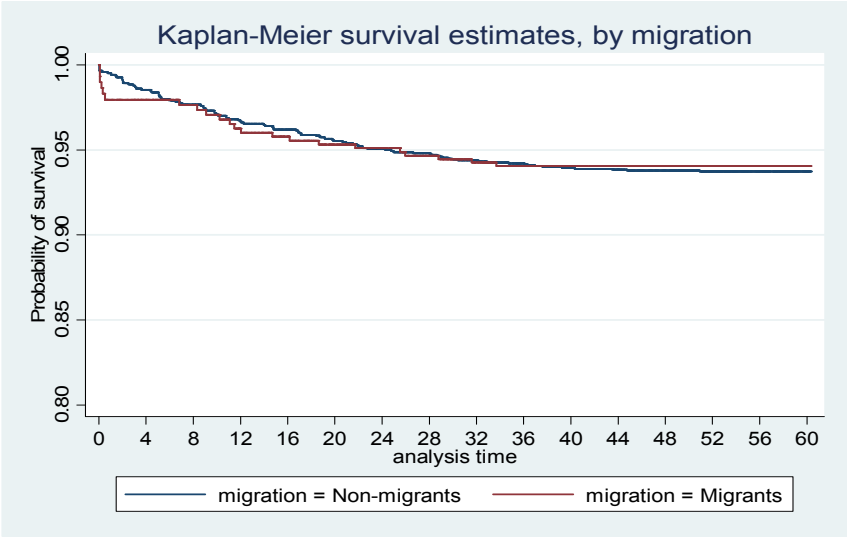


Figure 3.7 Survival of children of migrant fathers and non-migrants fathers in Agincourt in 2002

Figure 3.7 shows that at the beginning of the follow-up time the survival of children from migrant households was slightly higher but overall there were no significant differences.

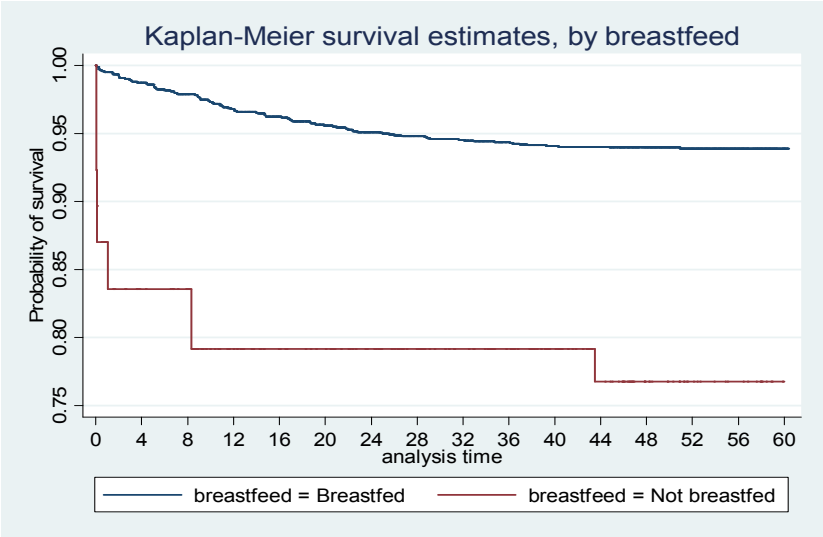


Figure 3.8 Survival of children breastfed and not breastfed in Agincourt in 2002

Figure 3.8 suggest that children who were not breastfed had a lower survival chance compared to those who were breastfed but fewer events were recorded here.

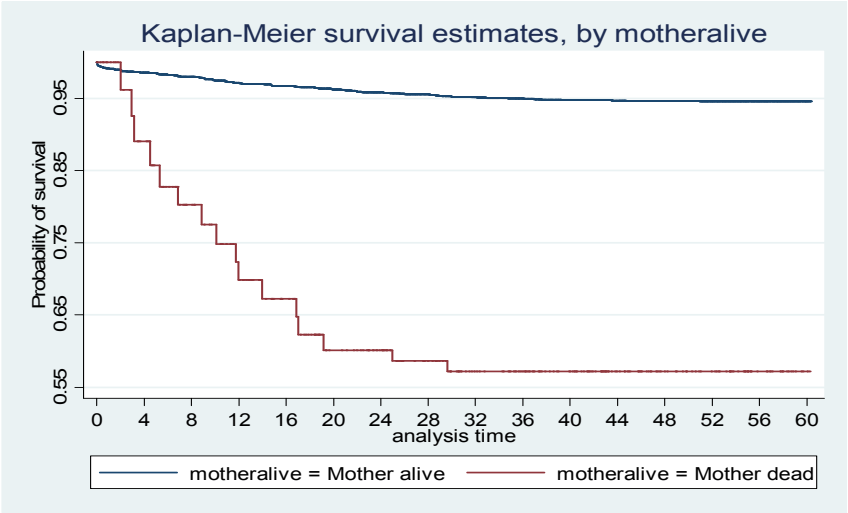


Figure 3.9 Survival of children with mothers alive and mothers dead in Agincourt in 2002

Children whose mothers were deceased had a decreased chance of survival compared to those who had their mother still alive. Further analyses were conducted to determine variables that described the survival experience of all children in 2002. This was done by fitting a Cox proportional hazard model. The age at entry was calculated in months for all children and the follow up time was 12 months. The results were similar to those obtained from logistic regression (results not shown). When the analyses were also stratified according to the age of the children, the results remained unchanged from the ones obtain in logistic regression.

The most important assumption of the Cox proportional hazard model is that the hazard ratio is proportional over time. The global test showed that there was evidence that the proportional hazard assumption had not been violated (results not shown).

4.0 CHAPTER FOUR: DISCUSSION

4.1 Introduction

The objective of this study was to determine if there was an association between fathers' labour migration and child mortality. There are few studies that so far assessed migration as a risk factor of childhood mortality (Frank and Hummer, 2002; Hildebrandt and Mackenzie, 2004; Razzaque et al., 2005, Kanaiaupuni and Donato, 1999). The current study used logistic regression and survival analysis methods to assess the risk of childhood mortality among a population living in a rural setting in South Africa using data extracted from a rich longitudinal demographic surveillance system database.

4.2 Migration and other risk factors of childhood mortality

The findings suggest that migration was not associated with childhood mortality despite the fact that close to 21% of the fathers were migrating (OR: 0.97, 95% CI 0.59-1.60). However, factors associated with child mortality in the current study were; age of the child, breast feeding, number of siblings, refugee status of the mother and whether the mother was deceased or not. It was evident that older children had a better survival chance compared to infants (OR: 0.58, 95% CI 0.50-0.93). The child's age was entered as a continuous variable in the model and therefore the effect observed is for an increase of one unit of age in years assuming that the relationship is linear. Breastfed children had a lower mortality than those not breastfed (OR: 5.33, 95% CI 2.60-10.95). The high number of siblings in the households appeared to be significantly associated with lower mortality (OR: 0.62, 95% CI 0.51-0.93) especially for infants. The results also showed

that relative to local residents, children born to refugees were at increased risk of mortality (OR: 1.56, 95% CI 1.05-2.33). Mother's age at birth was also important in explaining child mortality (OR: 0.62, 95% CI 0.39-0.99). Children who had deceased mothers had a lower chance of survival compared to those with their mother alive (OR: 9.35, 95% CI 5.02-17.40).

The current finding regarding the effect of migration on child mortality appeared to be inconsistent with previous studies (Kanaiaupuni and Donato, 1999; Hildebrandt and Mackenzie, 2004) that studied migration history over a longer period of time, five and seven years respectively. In the current study the use of temporary migration over a short period of time may fall short to detect differences.

Kanaiaupuni and Donato (1999) reported that in the short run households with migrants to the USA experienced higher rates of mortality but in the long run, where remittances were high and migration became increasingly salient mortality rates fell. Child mortality among migrant households was examined but there were no differences among remitting and non-remitting migrants. In order to assess the impact of migration on income of migrant households a comparison had to be made between the pre and post migration state. The actual measure of household income would have improved estimation of the separate remittance effect of migration on child survival.

Though previous studies noted the significance of remittances, it may be that in the current study migrants may not be earning sufficient income to remit enough to care for the family. Schiff (2006) stated that a migrant's income was first used for living expenses and only then was the remainder remitted to the migrant's household. The author also noted that international migrants remitted more than internal migrants and this may have

accounted for the insignificance of remittances in this study. The amount of earnings depends on the type of job which in turn also is dependent on the education status of the migrant. The available data on education status of fathers showed that only 2.71% of migrants had a higher education (tertiary education) attainment and as a result most migrants were likely to be employed in low paying jobs.

Temporary migrants may not be able to settle in a short period of time and adapt to the destination area and thus may struggle to raise enough income to be able to send more resources to the family members remaining behind. Furthermore, child mortality was linked positively to the process of migration, if sufficient time had elapsed (Kanaiaupuni and Donato, 1999). It yielded health benefits over time; therefore a longitudinal analysis may have depicted a different scenario. The length of absence and family structure may have also influenced the effect of migration. Kanaiaupuni and Donato (1999) reported that with experience equivalent to one year the probability of infant mortality actually started to fall.

These inconclusive findings may be a result of potential endogeneity of migration which was adequately addressed by Hildebrandt and Mackenzie (2004) but not in this study. It was also possible that other unobserved variables affecting both migration and child mortality may exist and alter the relationship if not instrumented. Therefore, methodological differences between the current study and the one mentioned above also contributed to the results obtained. The study design in this study was also less superior compared to the retrospective analysis by Kanaiaupuni and Donato (1999). Thus, with the evidence that migration benefits accrue over time the current study may not be the most suitable approach to examine this relationship. Hildebrandt and Mackenzie (2004) have

used data from a nationally representative demographic survey. In the current analysis, the use of data from one setting may comprise communities without a wider range of migration experiences and most likely these may have affected the results. It was also possible that migration may have been underestimated compared to the figure in 2001 (60%) as indicated by Collinsons at el., 2006b and thus not representative of migrating fathers in the Agincourt HDSS. Most importantly, the results have also been affected by information on other variables missing though the population of study was large. The majority of migrants went to Mpumalanga and Gauteng provinces. Mpumalanga province may be a suitable place for work because it's closer to the Agincourt HDSS. Migrants may be attracted to Gauteng province because it offers many employment opportunities. The pattern of returning home is dominated by irregular visits. This may be a result of work commitments and costs of travelling between place of origin and destination.

Previous studies by Brokerhoff and Hewett (2000), Konseiga et al., 2006 revealed that mortality in the first year of life was higher compared to subsequent years and this was consistent with results from this study. Children who had a deceased mother have been reported to be experiencing higher mortality compared to those whose mother were still alive in several studies (Brokerhoff and Hewett, 2000; Sear et al., 2000; Argesenau et al., 2003, Ssengonzi et al.,2002, Becher et al., 2004). This could be attributed to reduction in care, no breastfeeding as well as improper bottle feeding. Moreover, due to the HIV/AIDS epidemic a higher number of children loose their mother and so the impact on childhood mortality will be substantial (Konseiga et al., 2006).

Ethnic differences in child mortality have also been reported in other studies (Konseiga et al., 2006; Becher et al., 2004). It can be argued that refugees were always seen as

strangers and therefore never get fully integrated into the society and hence they experience higher child mortality rates. The disparities in child mortality among local residents and refugees could also be explained by genetic, cultural, educational, socio-economic and environmental differences (Blacker, 1991). Breastfed children (particularly infants) were found to have lower child mortality rates and this was consistent with results from Ssengonzi et al., 2002. Therefore this demonstrated that the effect of breast feeding was confounded by the age of the child. However, the same study also went on to establish that the duration of breastfeeding also increased child survival contrary to the results in this study.

The age of the mother at birth was reported to play a significant role in a handful of studies (Ssengonzi et al., 2002; Konseiga et al., 2006). These studies concluded that children born to older mothers had better survival chances compared to those from young mothers. This can be attributed to older mothers already having experience in child care than younger ones. This study also found that the age of the mother at birth was significantly associated with mortality. The number of siblings was also associated with child mortality but the sex and age of one's siblings was also an important factor in this scenario (Brokerhoff and Hewett, 2000). Brokerhoff and Hewett (2000) stated that children without elder sisters (at least 10 years older) had higher mortality than those with at least one. This leads to argue that matrilineal kin were providing assistance to mothers of young children. Many elder siblings may actually lead to more resources available through the contribution of household members and hence improve child mortality (Makepeace and Pal, 2006). But the authors argued that an increase in child spacing

lowered the chance of the child dying. However, in this study information on the age of the siblings was not available to investigate if the age of the sibling had any influence.

4.3 Number of deaths and causes of death

The mortality rate in the total population of 10050 children is 12.9 deaths per 1000 person years and the majority of the deaths (68.91%) were for children aged 1 year and above. Despite that, mortality rates remained high among infants (50.9 deaths per 1000 person years compared to 9.6 deaths per 1000 person years for 1-4 year olds). However, there was a positive bias because children who were older than one year at 1 January 2002 had already survived through the age group of high mortality so the survival rates are biased upwards. The leading causes of death in both households with migrant fathers and non-migrant fathers were infectious diseases with 47% and 50% respectively followed by accident and injury. Differences were observed for the third leading cause, with children migrant fathers mostly dying from perinatal period disorders while their counterparts mostly died from metabolic disorders and unknown causes. Perinatal period disorders also appeared to be the leading cause of death among infants in both sets of households. Statistics South Africa (2006) reported that in 2005 the leading cause of death (accounting for one third of all deaths) for infants was respiratory and cardiovascular disorders specific to the perinatal period. However, for older children (1 year and above) those with migrant fathers were mostly dying due to metabolic disorders and for children with non-migrant fathers that cause was partnered by diseases of specific systems in non-migrant households.

The leading causes of deaths were consistent with previous investigations into child mortality in the Agincourt HDSS and South Africa (Kahn et al., 1999; Angsong, 2004).

Studies on causes of deaths according to the Medical Research Council (2003) showed that infectious diseases, particularly HIV/AIDS were the leading causes of death accounting for 40.3% of all deaths. HIV/AIDS has eroded hard won gains in improving child health and it has become one of the leading major causes of increasing mortality particularly in Africa south of the Sahara (UNICEF, 2006).

4.4 Demographic characteristics

Examination of other socio-demographic variables showed that breast feeding habits of mothers from migrant households did not significantly differ from their counterparts. The mean of the mother's age was higher in migrants than non-migrants. The mean age of the fathers did not significantly differ in the two groups as well as children's age. There was a mean age difference between fathers and mothers of about 10 years, indicative of such a population that women were married to much older males though marital status was not available for all mothers.

In conclusion, there were no significant differences in the survival of males compared to females. However, this was in agreement with other studies who also found no difference (Becher et al., 2004; CDC, 2001). This was contrary to previous studies that have shown significant differences (Argesenau et al., 2003; Konseiga et al., 2006). The education status of the mother was not important in explaining child mortality. The results were consistent with findings from Konseiga et al., (2006). But they did not support previous findings (Sear et al., 2002; Madise et al., 1999). The socio-economic status and marital status were also not associated with mortality contrary to findings in studies of several African countries. However, the amount of missing information may have affected the results.

4.5 Limitations of the study

The current study cannot establish a temporal relationship due to the simultaneous assessment of exposure and outcome of interest. The data from the Agincourt Health and Demographic Surveillance System have been systematically collected since 1992. However, the amount of missing information could have significantly lowered the sample size and the statistical power of the study results. These consequently led to limitations in analysis and interpretation of data. For example 56.31% of information on fathers' age, education status and children's birth weight were missing. This occurred because the social norms in this setting, which are partly a result of high levels of labour migration, a legacy of apartheid, are such that many biological fathers do not reside in the same household as their children. These distant fathers are the fathers most likely missing from the study and hence their information can not be easily linked to their respective children. This could introduce bias because the children of these fathers may have a higher level of mortality due to neglect of the family by him. Failure to link all children to their fathers may also introduce misclassification bias which may result in under estimation of migrant fathers. Information on birth weight may not have been captured because the children were born at home (not the hospital) or during the interview the mother was not available to provide it. Using a variable with a large amount of missing cases could introduce bias because there was no information to suggest that missing cases had the same characteristics as those used for the analysis. A larger sample size would be needed to investigate this. Failure to control for the duration of migration is a further limitation since fathers who stay away longer are more likely to send more remittances compared to recent migrants. Hence, the findings in this study should be interpreted with caution.

Verbal autopsy was essentially the use of retrospective information from close relatives and therefore had the potential of recall bias which may subsequently lead to misclassification bias in the causes of death. The increasing prevalence of HIV/AIDS in the site could lead to misclassification bias in the determination of causes of death due to its association with many diseases. The migrant may stop any social contact with the rural household but by definition continue to be recorded as a temporary migrant instead of permanent migrant as long as the family still considered that individual as part of the family.

4.6 Strengths of the study

The data were extracted from a large comprehensive database from a demographic surveillance system. The cases were ascertained by a verbal autopsy conducted by well trained interviewers and further analysed by medical officers. Despite the missing information the sample size of 7937 gave a power as high as 0.75.

5.0 CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The goal of this paper was to assess whether or not father's migration improved child mortality. So far, the topic has not been examined in detail and to date only two papers published by Hildebrandt and Mackenzie (2005) and Kanaiaupuni and Donato (1999) have specifically looked at the association between father's migration and child mortality although none in an African setting. Thus this area of research has not been adequately addressed and much remains to be learned about the lives of children left behind by fathers migrating to seek employment elsewhere. The evidence from this study suggested that on average children of migrant fathers did not experience increased mortality compared to children of non-migrant fathers. This may be that apart from migration alleviating household poverty, mothers left behind took all the burden of child caring in the absence of the father. From the analysis, it was evident that few mothers died in migrant households and these may help in raising of children while the fathers are away.

The findings from this study where no association between father's migration and child mortality was observed were different from those proposed by the authors of the papers mentioned above. There was however, evidence that migrants maintain ties with their origin communities through sending remittances to those who were left behind contrary to the view that migration was a rapture of relationships. However, remittances sent did not seem to make an impact in the current study because child mortality did not significantly differ among remitting migrants and non-remitting migrants. Although there

was some evidence that temporary migration was pronounced and patterns changing in Agincourt, this study appeared to have under estimated migration figures. The under estimation may be a result of not being able to link all the migrant fathers with their households. The availability of information on migration of mothers would have provided an opportunity to assess whether results differed according to whom of the parents migrated. Further research should be devoted to how households change their health seeking behaviours after one parent migrates. However, the findings from this study can not be used to draw generalisations because it is not representative of the South African population.

The other major findings suggest that mortality was higher in infants (less than 1 year) than older children (1-4 years) and that the health of these children needs to be prioritised. The results also showed that breastfeeding was important in reducing child mortality and hence, mothers should be encouraged to breastfeed particularly during the infancy stage. Children born to refugees were more likely to die than those born to local residents and these variations between populations also need to be addressed. Having a deceased mother increased the chance of dying. This suggests that orphan-hood is a risk factor for child mortality and hence measures such as empowering women need to be put in place to also reduce maternal mortality. Those children with one or more siblings were at lower risk of death and these were likely to be older siblings. Therefore, families need to be educated on family planning measures and child spacing (in order to have fewer children) because studies have shown that infants with many siblings under five years were at increased risk of death. It also comes out clear that the leading causes of death in under fives were infectious diseases. The emergence of HIV/AIDS has turned around the

downward trend that occurred during the early 1990's and child mortality is now rising again dramatically (Khan et al., 1999; MRC, 2003; UNICEF, 2006). Therefore, to reduce childhood mortality, greater efforts must be directed towards effective coordination of preventive interventions.

Part of the differences to the previous studies may be attributed to the limitations of the current study. Thus for future studies it would be advisable to study in great depth the long term effects of migration on child mortality particularly in Africa. This study builds the foundation for further exploration into substantive differences for child mortality in migrant and non-migrant households.

5.2 Recommendations from the study

The role of communicable and infectious diseases as an important cause of death remains a major health issue in South Africa and sub-Saharan Africa as a whole. Although the HIV/AIDS epidemic appears to be on the increase, other classic infectious and non-infectious diseases such as diarrhoea, respiratory infections and malnutrition are also important causes of mortality in children that need not to be ignored in improving the primary health care system. Therefore, there is the need to intensify effective public health intervention programs to reduce the burden of most of the preventable diseases. For instance, increased roll out of antiretroviral therapy will not only reduce mother to child transmission but also reduce the number of orphans.

Further studies are needed to assess the socio-economic status and health care utilization patterns of refugees and define ways to improve them if they are found to be low. Findings also call for future research to explore the risk factors associated with mortality among children who have deceased mothers.

In future, further analysis that really take advantage of the longitudinal strength of the data are needed to model the survival of the children over a five year period. Thus, further comparative research is necessary to address the complexity underlying migration and child mortality in order to specify the mechanisms through which migration is likely to affect or not affect child survival because the full effect of migration may not be felt in one year alone especially for the older children (1-4 years). Studying migration and understanding its hidden costs and benefits will then help guide migration policies.

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APPENDICES

A.1 Migration Questionnaire

Village: Household: Fieldworker: Date of visit:

If individual migration

Surname:	Name:	ID:

If entire household migration

H/Head name:	H/Head ID:
Name of individual causing household move:	

Both individual and household migration

IN/OUT:	I – moved into this household; O – moved out of this household	
If IN, moved from:	A – Agincourt area; B – BBR area; P – PWV; U – other urban/industrial; M – Mozambique; O – other	
If OUT, moved to:	A – Agincourt area; B – BBR area; P – PWV; U – other urban/industrial; M – Mozambique; O – other	
Move date:		
Move date estimated:	Y – Yes; N – No	
Village (if in study site):	Name of H/Head:	
Place name (if not in study site):		Province:

Main reason:	JF – Job found JL – Job lost LW – Looking for work OW – Other work related reason	NM – New marriage DI – Divorce WI – Widowed SE – Separated OM – other marriage reason	RR – Returning Mozam/refugee NR – New Mozam/refugee SS – School/study

	MS – Missed individual ND – Never resident	PD – Pregnancy/delivery CF- Child returning to parent	NH – New house AF – accompanying family member HH – Household move OT – Other reason
	DR – Duplicate resident NF – No census form	Name:	ID number:

If job related (JF or JL), sector of work:	M – mining I – industry A – agriculture	G – game reserve S – shop/store personnel B – business person	P – public service (specify)_____ E – self employed (informal sector) O – other

Comments:

A.2 Ethics Approval Letter

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ketlogetswe

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER M060911**
PROJECT	Does Migration Improve Child Survival: Agincourt South Africa 2002?
INVESTIGATORS	Mr AT Ketlogetswe
DEPARTMENT	School of Public Health
DATE CONSIDERED	06.09.29
DECISION OF THE COMMITTEE*	APPROVED subject toclarifying how confidentiality will be maintained, completing the ethicsform in full and re-submitting

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

DATE **CHAIRPERSON** .....
(Professors PE Cleaton-Jones, A Dhai, M Vorster, C Feldman, A Woodiwiss)

*Guidelines for written 'informed consent' attached where applicable

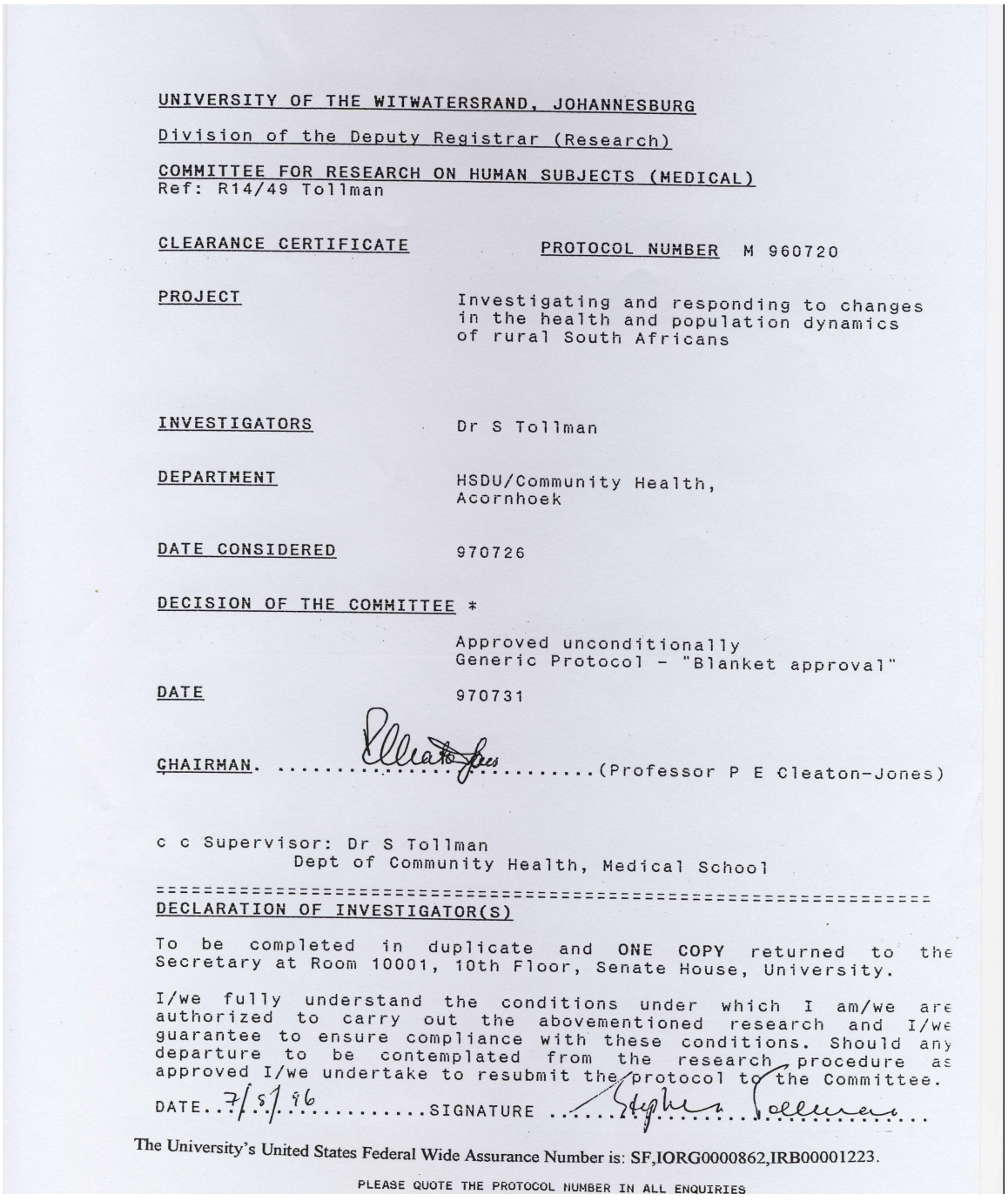
cc: Supervisor : Prof K K-Grobusch

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 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

A.3 Agincourt Health and Demographic Surveillance System Ethics Clearance Certificate



UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

COMMITTEE FOR RESEARCH ON HUMAN SUBJECTS (MEDICAL)
Ref: R14/49 Tollman

CLEARANCE CERTIFICATE — PROTOCOL NUMBER M 960720

PROJECT	Investigating and responding to changes in the health and population dynamics of rural South Africans
INVESTIGATORS	Dr S Tollman
DEPARTMENT	HSDU/Community Health, Acornhoek
DATE CONSIDERED	970726

DECISION OF THE COMMITTEE *

Approved unconditionally
Generic Protocol - "Blanket approval"

DATE 970731

CHAIRMAN. .....(Professor P E Cleaton-Jones)

c c Supervisor: Dr S Tollman
Dept of Community Health, Medical School

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DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and ONE COPY returned to the Secretary at Room 10001, 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.

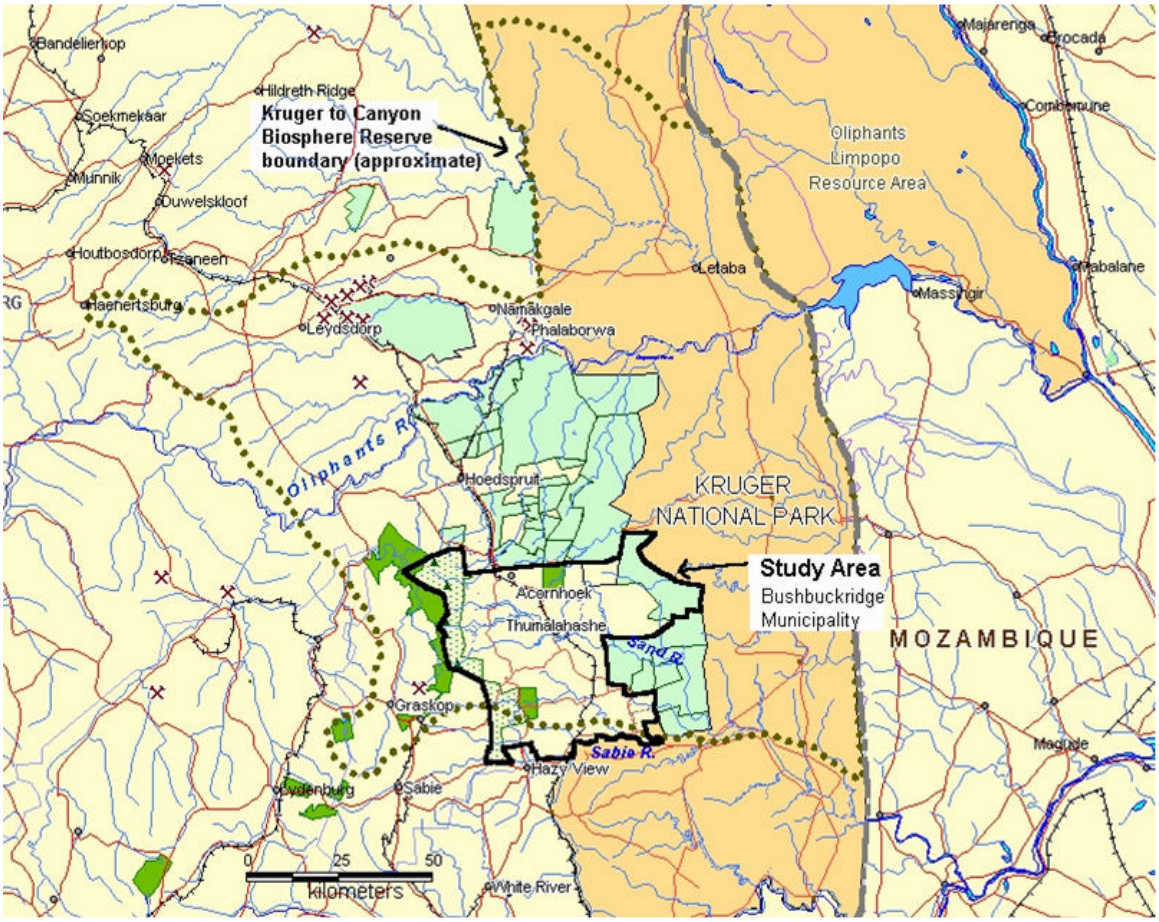
DATE..7/5/96.....SIGNATURE .....

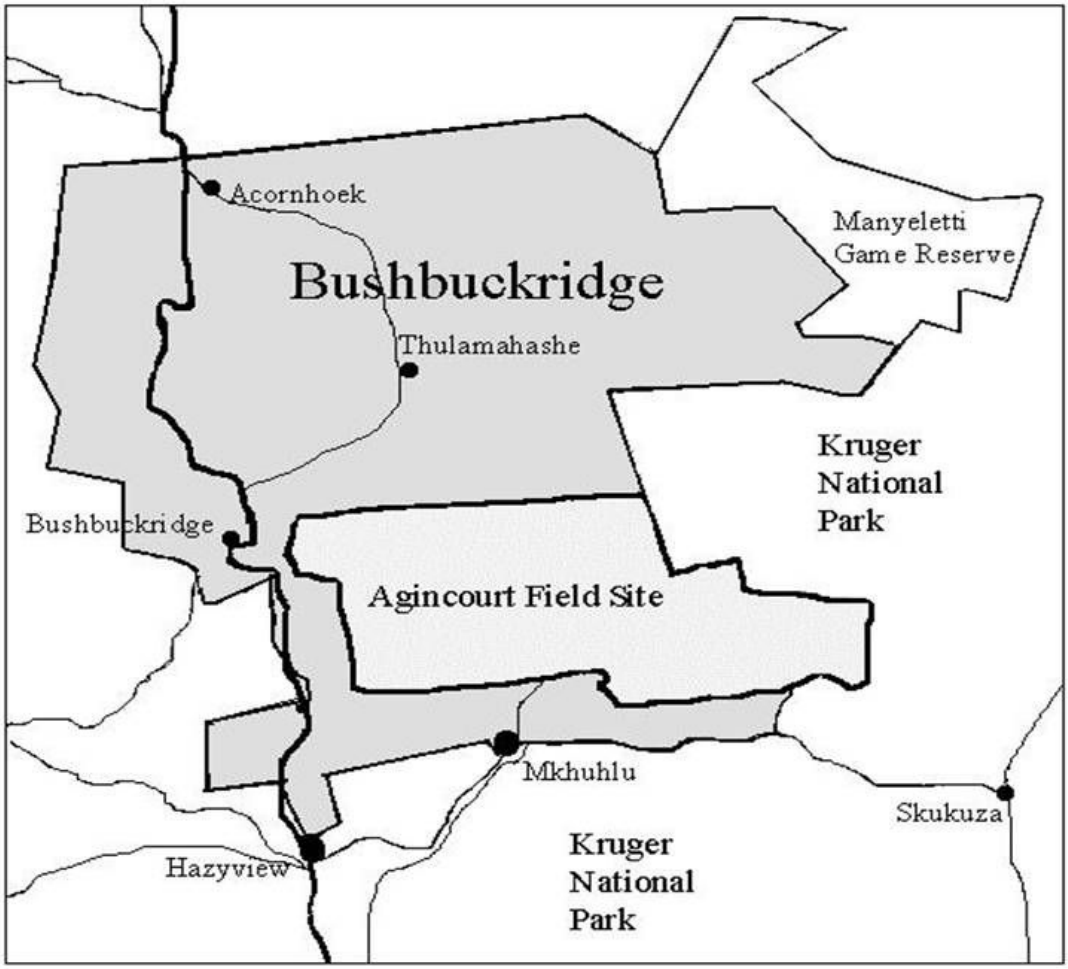
The University's United States Federal Wide Assurance Number is: SF,IORG0000862,IRB00001223.

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

A.4 Maps of Agincourt Health and Demographic Surveillance System and South Africa




Bandelierkop
Hildreth Ridge
Kruger to Canyon
Biosphere Reserve
boundary (approximate)
Soekmekaar
Moekets
Munnik
Duvwelskloof
Houtbosdorp
Haenertsburg
Leydsdorp
Namakgale
Phalaborwa
Majareniga
Brocada
Oliphants
Limpopo
Resource Area
Letaba
Mabalane
Massingir
Oliphants R.
Hoedspruit
KRUGER
NATIONAL PARK
Study Area
Bushbuckridge
Municipality
MOZAMBIQUE
Acornhoek
Thulamahashe
Sand R.
Graskop
Sabie R.
Hazy View
Sabie
Magude
0
25
50
kilometers
White River


Acornhoek
Manyeletti
Game Reserve
Bushbuckridge
Thulamahashe
Kruger
National
Park
Bushbuckridge
Agincourt Field Site
Mkhuhlu
Skukuza
Hazyview
Kruger
National
Park