Factors Associated with Infant Mortality in a Rural Setting in South Africa

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Abstract

Background: Infant mortality rate is one of the leading indicators of the level of child health and overall development in countries as well as a Millennium Development Goals (**MDG**) indicator. Studies on risk factors and causes of infant mortality **(IM)** present the opportunity to identify intervention programs appropriate in different populations in our attempt to reduce mortality.

Objectives: The aim of the study was to determine factors associated with **(IM)** in a rural setting for children born between 1998 and 2002 in the Agincourt Health and Demographic Surveillance Site (**AHDSS). Methods:** Secondary data extracted from the longitudinal A**HDSS** database were used to study determinants of infant mortality using survival analysis for 10492 children. **Results:** Infant mortality in the site in 1998, 1999, 2000. 2001 and 2002 was 12.41, 29.99, 25.77, 28.18 and 40.52 deaths per 1000 person years respectively, with evidence of an increasing trend. The leading causes of death were HIV/AIDS, Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified and other infectious diseases with 17.02% 16.60% and 14.47%, respectively. Findings from this study suggest that **(IM)** was associated with biological factors for instance breastfeeding duration and birth weight, and health seeking behaviour

of parents such as utilization of under five programs in clinics. Proxies for socio-economic status such as education and refugee status of the mother were also associated with **(IM)**. However, the effects of these factors differed significantly according to whether mothers were either gravida one or more. **Conclusion:** Findings call for future in-depth research to explore the major risk factors associated with infant mortality in order to draw effective public health intervention programs to reduce the burden of most of the preventable childhood diseases like malnutrition and move towards making progress in achieving millennium development goals.

Introduction

South Africa has been deeply influenced by the institutionalized racial discrimination that has prevailed for much of the recent history and led to dramatic disparities in morbidity and mortality. However, the dismantling of the apartheid in 1994 held hopes and potential for reducing racial disparities particularly in child health (Burgard and Treiman 2006; Nannan, Timaeus et al. 2007). Given the history of apartheid in South Africa which may have resulted in wealth disparities within the society, monitoring the infant mortality rate is critical to track inequalities in child health and progress in social development since the re-installment of democracy. Infant mortality is one of the most important indicators of health for any developing country and also plays a role in reflecting a rough picture of health status in general and community development. It is estimated that close to 10 million children under the age of five die every year due to largely preventable causes making an average death rate of 70 per 1000 live births world wide. However, these deaths are unevenly distributed over the 0-5 years period. More than two thirds (69%) of under-five deaths occur in the first year of life, particularly during the first month of life where nearly 37% of all child deaths occur (WHO, 2007). Most of these deaths occurred in developing countries and it was estimated that 50% of them occurred in sub-Saharan Africa. This paper presents the estimates of levels and trends of infant mortality in a rural setting of South Africa and assesses the plausibility of the results by comparing them with national estimates obtained from surveys. It also focuses on socioeconomic factors related to the family and demographic factors related to the mother and infant, because they are both important components of infant survival. In rural

settings the critical factor may be in a mother's ability to address the health needs of her children might be resources that promote the understanding of disease process, the use of health services, infant feeding practices rather than formal schooling. Sub-Saharan Africa has experienced a slow decline in child mortality between 1980's and early 1990's. However, countries affected by HIV/AIDS like South Africa have shown a reversal in the trend (Garenne and Gakusi 2006). The number of child deaths in South Africa remains unacceptably high and most of these deaths are preventable (Bradshaw et al., 2004).

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, 2006). The estimates from WHO for infant mortality in South Africa for 1960(89.0), 1970(80.26), 1980(66.11), 1990(49.0), 1995(49.32), 2000(55.70), 2004(54.0), 2005(49.57) and 2007(46.05) deaths per 1000 live births respectively (WHO, 2007). In contrast estimates within South Africa pitted infant mortality rate at 47.1 deaths per live births in 1994 (Statistics South African, 1994), 45.0 deaths per live births in 1998 (South African demographic Health Survey, 1998) and 59 deaths per 1000 live births in 2000 (Bradshaw et al., 2004). Comparing regional neonatal estimates in 2004 Africa is leading with 40 deaths per 1000 live births while the European region is as low as 10 (WHO, 2007).

Materials and Methods

The aim was then to answer the question "what are the major determinants of infant mortality in a rural setting of South Africa" using secondary data collected by the Agincourt Demographic and Health Surveillance Site (ADHSS). The paper addresses the following objectives; 1) determine factors closely associated with infant mortality; 2) examine major causes of infant mortality and 3) determine if there is evidence of a trend in infant mortality between 1998 and 2002.

Study site

The ADHSS 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).

Study population

The population of interest are all children under one year of age who were born in the site between 1 January 2002 and 31 December 2002. This included a study population of 10 492 children which represents approximately 15 percent of the total population under surveillance in 2002. And in that a total of 271 deaths occurred. No sampling strategy was applied since all individuals who met the inclusion criteria were studied.

Data collection and quality

Data were extracted from the ADHSS database. 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). 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 (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.

Infant mortality

Mortality (death) was defined as the probability (expressed as a rate per 1000) of an infant born in a specified year dying before reaching the age of one 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. The information 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).

Analysis

Data processing, cleaning and analysis were performed using Stata version 10.0 IC software (Stat Corp, 2008). The essence of the statistical analysis was to establish factors that are associated with infant mortality. The analysis was done in two parts. The first part comprised of descriptive summary statistics, t-test for continuous variables to assess differences between groups. 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. Survival analysis (to compute Cox proportional hazard ratios and 95% confidence intervals) was used to fit a model to determine which factors influenced the probability of an infant dying. In the survival analysis two sets of variables were used, those that directly relate to the infant (sex, birth weight, number of siblings and gestational period) and those related to the mother (education and refugee status, antenatal visits, and age). Other factors, like environmental conditions, size of household and social economic status were also considered. The observation time for all children started from time of birth and ended at the occurrence of the event (death) or migrating or at the age of one. Conclusions were based on a two sided p-value of 0.05 considered to be statistically significant. Since the data had enormous amount of information missing a dummy was created for all variables to avoid reducing the statistical power of the analysis. Restricting the analysis to only those with non-missing information reduced the sample size from initially (n=10492 to n=5218).

Ethics

Ethical clearance was sought 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. The data used for this study did not contain identifiers hence there was no way that it could be linked to individuals. Informed consent is obtained verbally each year.

Results

The results of this report focused on comparing the characteristics of infants who died and those who survived. In addition, the analysis also examined the influence of factors that have been associated with infant mortality in previous studies. The study examined 10 492 children who were born between 01 January 1998 and 31 December 2002.

Table 1 shows the summary of socio-demographic characteristics of the overall study population. The marital and educational status shown in this table were for mothers only because close to 50% of the information on fathers was missing.

No significant differences in terms of gender were observed. However, there were significant differences in the gender of household heads. Majority of mothers had 8-12 years of schooling (secondary education). The mean age of the fathers did not significantly differ in the two groups. 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 (results not shown).

Aggregated Infant mortality for the entire period was 26.26 deaths per 1000 person years and mortality at birth was 2.38 deaths per 1000 live births. The infant mortality rate in 1998, 1999, 2000, 2001 and 2002 was 12.41, 29.99, 25.77, 28.18 and 40.52 deaths per 1000 person years respectively. There is some evidence of an increasing trend in infant mortality (figure 2). The leading causes of death were HIV/AIDS, Symptoms, signs and abnormal clinical and laboratory findings not elsewhere classified, other infectious diseases (HIV-related protozoal and bacterial infections), diseases of the respiratory and certain conditions originating in the prenatal period with 17.02%, 16.60%, 14.47%,

13.19% and 13.19%% respectively followed by malnutrition and congenital malformations and deformation (figure 1). However, unknown causes constituted 15.74% of all deaths.

To select which variables to include into the model, a step wise Cox regression method was run with breastfeeding and ownership of road to health card as time dependent covariates. Among infants born to gravida one mothers, a birth weight of ≥2.5kg (HR: 0.38, 95% CI 0.23-0.63), a road to health card (HR: 0.06, 95% CI 0.04-0.09), born to mothers who had secondary education (HR: 0.60, 95% CI 0.39-0.91) were less likely to die. Risk of mortality was also lower in infants born to former Mozambicans refugees who came to the site in 1983 (HR: 0.38, 95% CI 0.26-0.57) and with a gestational period of >=38 weeks (HR: 0.49, 95% CI 0.33-0.73) respectively. In contrast, infants who were not breastfeed (HR: 7.73, 95% CI 4.80-12.45) and delivered in the presence of doctors and nurses were more likely to die (HR: 1.22, 95% CI 1.30-3.79) and (HR: 2.10, 95% CI 1.43-3.09) respectively (Table 2). Former Mozambicans refugees infants whose mothers came to the site after 1983 were more likely to die (HR: 2.99, 95% CI 2.03-4.41). For gravida two or more mothers, those who had a road to health card (HR: 0.23, 95% CI 0.08-0.65) and born to mothers who migrates to the site from Mozambique in 1983 (HR: 0.23, 95% CI 0.08-0.65) were at lower risk of mortality (Table 3).

Discussion

The leading causes of deaths were consistent with previous investigations into infant mortality in the Agincourt HDSS and South Africa (Kahn et al., 1999; Angsong, 2004). The prevalence of HIV infection among antenatal clinic attenders in the health region was 19.1% in 1998 (Department of Health, 1999b). And previous work on the site had

shown that HIV/AIDS had an impact in increasing adult mortality (Tollman, Kahn et al. 1999). Therefore this may help explain the linear trend noticed in infant mortality during the current study period.

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 sub-Saharan Africa (UNICEF, 2006). However, 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. The estimates from South African Demographic Health Survey showed a down trend from mid 1980's to the early 1990's but an increase by the mid 1990's (DOH, 1999a).

The unexpected results of children whose mothers were attended by doctors and nurses during delivery may be due to the fact that, 65.02% and 32.40% of women who had pregnancy complications were attended by doctors and nurses respectively. 55.01% of all births were attended by nurses and 3.19% of them died. Therefore it is most likely that women who had complications realized that they were likely to lose their children and chose to deliver in a health facility. And most probably doctors and burses could do little to help those who presented late with complications. Cases of pregnancy complications were higher 796(8.91%) in gravid one mothers compared to 92(5.91%) in gravid two or more mothers. Moreover, the nurses who attended those mothers may not have been general nurses who are not yet trained midwives. Despite free comprehensive antenatal

care in South Africa, studies have shown that women particularly in rural areas book for these services late in pregnancy (Myer and Harrison 2003; Sibeko and Moodley 2006). A study done in Johannesburg also identified that pregnant women either do not attend or commence antenatal care late in their pregnancies (Dawood and Buchmann, 1996). Frequent visits to a medical doctor before giving birth pregnancy is critical as trained physicians can prevent and or detect complications early (Paul and Rumsey, 2002). Breast fed infants were found to have lower mortality rates and this has also been well documented in several studies (Ssengonzi et al., 2002). Probably the mother's beast milk contains most of the essential nutrients needed by the infants. However, the same study also went on to establish that the duration of feeding also increased infant survival contrary to the results in this study. However, the HIV/AIDS epidemic may be confounding the results since breastfeeding contributes substantially to the overall risk of mother to child transmission of HIV infection but improves survival (Newell, Brahmbhatt et al. 2004; Edmond, Zandoh et al. 2006; Krawinkel and Chavez-Zander 2006; Coovadia and Kindra 2008). Low birth weight is also an established risk factor of infant mortality (Cooper and Sandler 1997; Edmond, Zandoh et al. 2006; de Carvalho, de Brito et al. 2007). In 2003, birth weight was ranked the second leading cause of death among under fives in South Africa (Medical Research Council, 2003). 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). Registration of

infants after birth was also associated with a lower risk of death. Therefore birth registration may also be used as a proxy for health seeking behaviour.

Infants who had road to health card were less likely to die and this could be used as a proxy of health seeking behaviour as well. Mothers who had road to health cards are mostly likely the ones who attended antenatal clinic and had formal education. Educated mothers tend to have better understanding of disease and child health management processes and seek medical attention on time and on regular basis (Uchudi, 2001). The education status of the mother (secondary and tertiary) was important in explaining infant mortality. The results were consistent with findings from previous studies (Madise et al., 1999; Sear et al., 2002). Women with formal education are more aware about the problems that might occur during pregnancy and they are in a better position to take care of such problems (Raj, 2005). The infants born to former Mozambican refugees who migrated to the site in 1983 were less likely to die but those born to those who arrived after 1983 were at an increased risk of mortality contrary to the finding of Hargreaves, Collinson et al. 2004. Former Mozambican refugees who came earlier were more likely to have been integrated into the host population since they had spent relatively more time than those who came on the second migration stream. Thus analysis suggests that some Mozambican households have fared better in South Africa than others (Hargreaves, Collinson et al. 2004).

There were no significant differences in the survival of males compared to females confirming findings of research in the site (Hargreaves, Collinson et al. 2004) and other studies elsewhere (Becher et al., 2004; CDC, 2001). This was contrary to previous studies that have shown significant differences in males and females survival (Argesenau

et al., 2003; Konseiga et al., 2006). The socio-economic status and marital status were also not associated with infant mortality contrary to findings in studies of several African countries (Thomas, 2007). Evidence suggests that, in most societies, infants born to unmarried mothers face higher risks (Johnson-Hanks, 2005).

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 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. 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. However, cases were ascertained by a verbal autopsy conducted by well trained interviewers and further analysed by medical officers.

The findings from this study can not be used to draw generalisations because it is not representative of the South African population. But the results emphasize the importance of demographic surveillance sites as tools for studying populations.

The results also showed that breastfeeding was important in reducing infant mortality and hence, mothers should be encouraged to breastfeed particularly during the first few months of life. However, it could also be stressed that those who are HIV positive or suspect they are should be discouraged to breastfeed. As a result services like clean water

need to be made available to all residents since it vital for those practicing bottle feeding. Mothers need to be educated on best practices for preparing formula feeding to avoid gastro-intestine infections. 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 infant mortality, greater efforts must be directed towards effective coordination of preventive interventions and empowering women.

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. To reduce the number of infants who die from HIV/AIDS and its related infections, programmes like Prevention of Mother to Child Transmission (PMTCT) should be made available to all sero-positive mothers. Further studies are needed to assess the socio-economic status and health care utilization patterns of residents and define ways to improve them if they are found to be low. In future, further analyses that really take advantage of the longitudinal strength of the data are needed to model the survival of the infants over a longer period of time.

There is evidence to suggest the presence of an increasing linear trend in infant mortality between 1998 and 2002. Since under five mortality (U5M) is a function of infant mortality efforts to reduce (U5M) should start with lowering the infant mortality. Findings also call for future in-depth research to explore the major risk factors associated with infant mortality in order to draw effective public health intervention programs to

reduce the burden of most of the preventable childhood diseases like malnutrition and move towards making progress in achieving millennium development goals.

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41. ***Table1: distribution of deaths according to socio-demographic characteristics***

Variable		***Died first year of life***	***Survived first year of life***	***Total***
		Number (%)	***Number (%)***	***Number (%)***
Pregnancy complications	No	225 (3.06)	7128(96.94)	7353 (70.08)
	Yes	34(3.83)	854(96.17)	888(8.46)
	Unknown	12(0.53)	2239(99.47)	2251(21.45)
Attended antenatal clinic	Yes	257(3.13)	7953(96.87)	8210(78.25)
	No	6(4.58)	125 (95.42)	131(1.25)
	Unknown	8(0.37)	2143 (99.63)	2151(20.50)
Pregnancy planned	No	122(3.07)	3854(96.93)	3976(37.90)
	Yes	129(3.24)	3851(96.76)	3980(37.93)
	Unknown	20(0.79)	2516(99.37)	2536(24.17)
Breastfed	Yes	213(2.61)	7953(97.39)	8166(77.83)
	No	42(24.28)	131(75.72)	173(1.65)
	Unknown	16(0.74)	2137(99.26)	2153(20.52)
Refugee	Yes-1983	41(1.15)	3513(98.85)	3838(36.58)
	Yes-After 1983	46(16.20)	238(83.80)	284(2.71)
	No	184(2.77)	6464(97.23)	6648(36.63)
	Unknown	0(0)	6(100)	6(100)
Birth weight	<2.5 kg	23(4.72)	464(95.28)	487(4.64)
	>=2.5 kg	78(1.65)	4663(98.65)	4727(45.05)
	unknown	170(3.22)	5108(49.98)	5278(50.30)
Gender	Female	123(2.32)	5180(97.68)	5303(50.54)
	Male	145(2.80)	5032(97.20)	5177(49.34)
	Unknown	3(25.00)	9(75.00)	12(0.11)
household head	Female	71(2.90)	2375(97.10)	2446(23.31)
	Male	157(2.75)	5545(97.25)	5702(54.35)
	unknown	41(1.83)	2301(98.17)	2344(22.34)
Gravida	One	236(2.64)	8700(97.36)	8936(85.17)
	Two or more	35(2.25)	1521(97.75)	1556(14.83)
Delivery attended	Relative	46 (2.79)	1605 (97.21)	1651(15.74)
	Doctor	30(3.69)	782(96.31)	812(7.74)
	Nurse	184(3.19)	5589(96.81)	5773(55.02)
	Unknown	11(0.49)	2245(99.51)	2256(21.50)

Table1 continued

Variable		*Died first year of life*	*Survived first year of life*	*Total*
		Number (%)	*Number (%)*	*Number (%)*
Health card	No	54(30.86)	121 (69.14)	175(1.67)
	Yes	188(2.31)	7959(97.69)	8147(77.65)
	Unknown	29(1.34)	2141(98.66)	2170(20.68)
breast feeding duration	more than 9 months	1(0.24)	417(99.76)	418(3.98)
	4-9months	36(14.81)	207(85.18)	243(2.32)
	1-3 months	70(35.18)	129(64.82)	199(1.90)
	0 months	160(2.12)	7389(98.77)	7549(71.95)
	unknown	4(0.19)	2079(99.81)	2083(19.85)

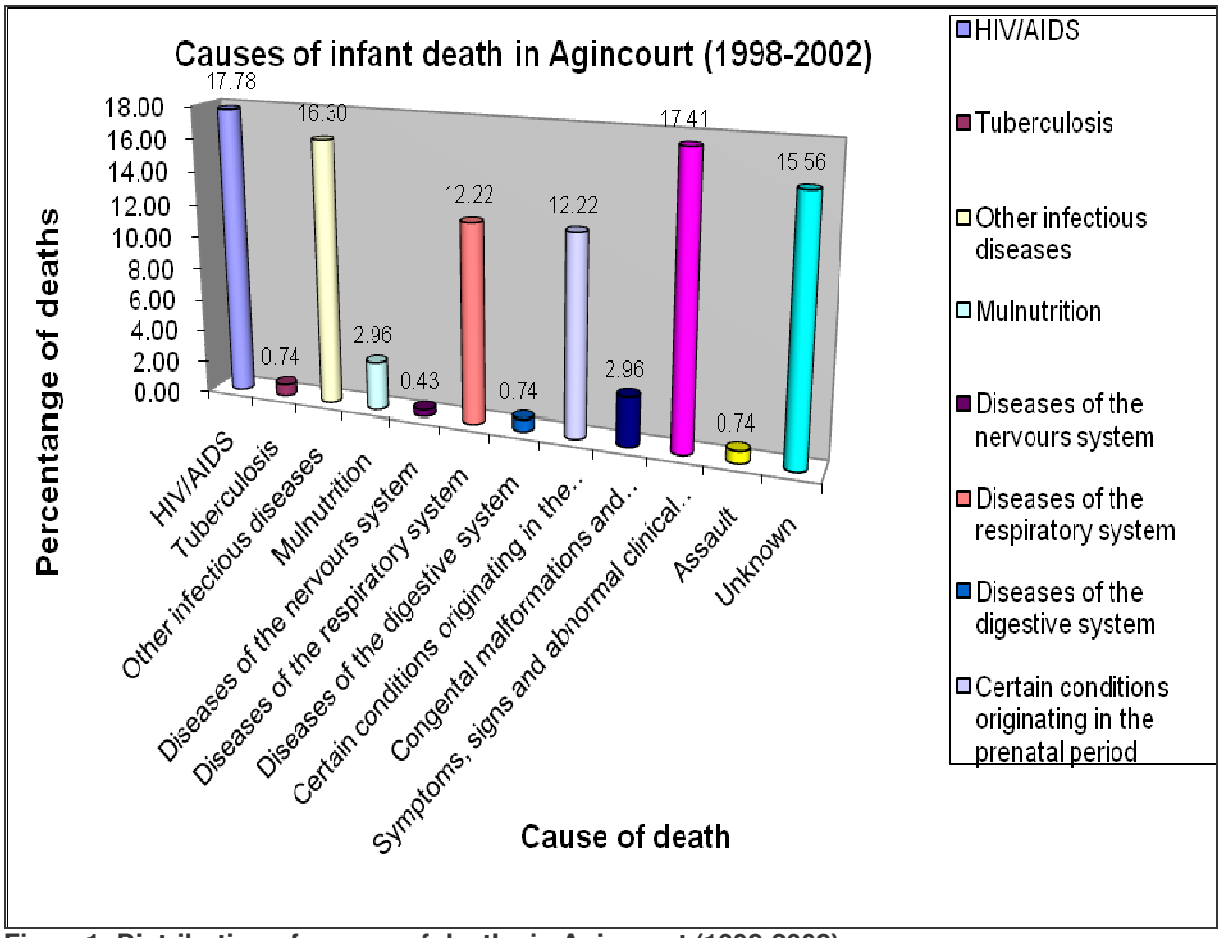

Figure1: Distribution of causes of deaths in Agincourt (1998-2002)

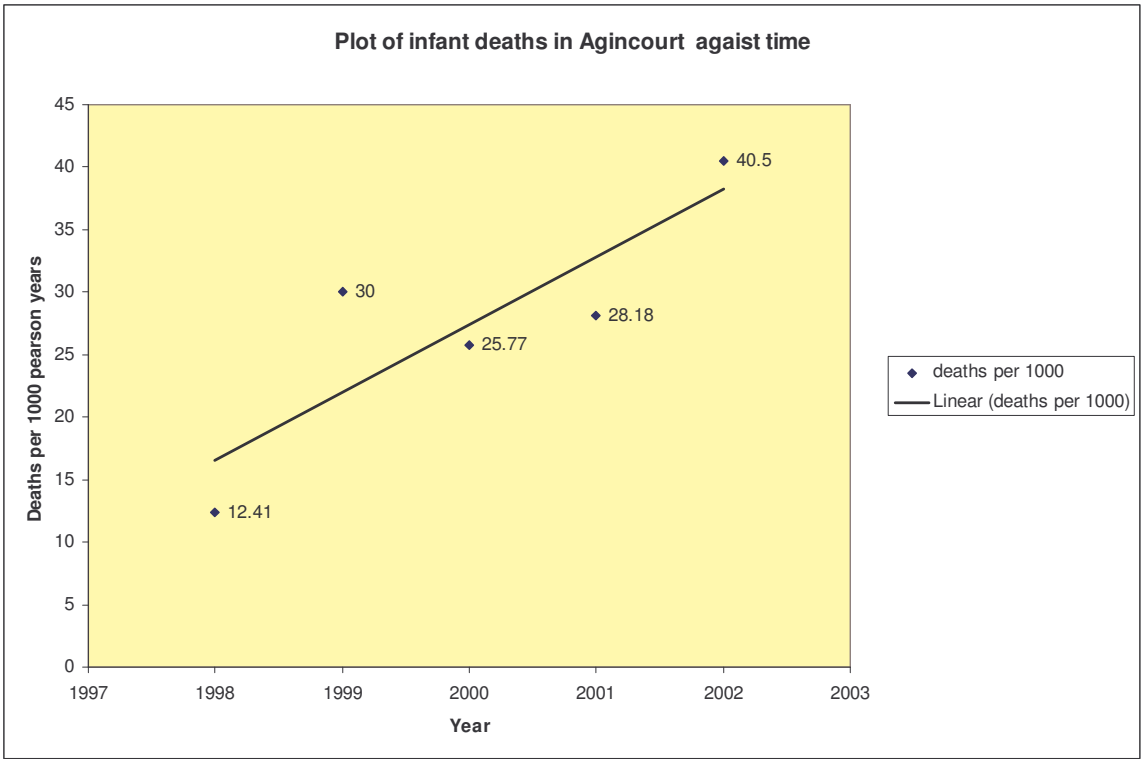

Figure 2: Deaths occurring between 1998-2002 and a fitted linear trend

Table 2: infant mortality risk factors for gravida one mothers

Variable		*Hazard ratio*	*95% CI*	*P-value*
Delivery attended by	Relatives	1		
	Doctor	**1.22**	**1.30-3.79**	**0.003**
	Nurse	**2.10**	**1.43-3.09**	**0.0001**
	Unknown	0.37	0.15-1.45	0.135
Breastfeed	Yes	1		
	No	**7.73**	**4.80-12.45**	**0.0001**
	Unknown	**6.8**	**2.27-20.34**	**0.001**
Birth weight (kilograms)	less than 2.5kg	1		
	more than 2.5kg	**0.38**	**0.23-0.63**	**0.0001**
	Unknown	0.93	0.56-1.53	0.772
Birth registered	Yes	1		
	No	**2.06**	**1.29-3.73**	**0.002**
	Unknown	0.80	0.30-2.19	0.671
Health card	No	1		
	Yes	**0.06**	**0.04-0.09**	**0.0001**
	Unknown	0.55	0.24-1.27	0.164
Education	none	1		
	primary	0.72	0.48-1.08	0.109
	secondary	**0.60**	**0.39-0.91**	**0.016**
	tertiary	0.49	0.23-1.07	0.073
	Unknown	0.32	0.07-1.38	0.125
marriage status	Married	1		
	Widowed	0.47	0.06-3.40	0.455
	Divorced	1.74	0.83-3.66	0.142
	Single	1.11	0.82-1.50	0.516
Refugee	No	1		
	Yes-1983	**0.38**	**0.26-0.57**	**0.0001**
	Yes- After 1983	**2.99**	**2.03-4.41**	**0.0001**
	unknown			
Gestational age	<38 weeks	1		
	>=38 weeks	**0.49**	**0.33-0.73**	**0.0001**
	Unknown	**0.03**	**0.004-0.18**	**0.0001**

Table 3: infant mortality risk factors for gravida two or more mothers

Variable		***Hazard ratio***	***95% CI***	***P-value***
delivery attended by	Relatives	1		
	Doctor	3.66	0.87-15.38	0.076
	Nurse	2.30	0.87-6.10	0.093
	Unknown	**6.77**	**1.21-37.84**	**0.03**
Breastfeed	Yes	1		
	No	0.91	0.08-10.40	0.939
	Unknown	**-**	**-**	**-**
Birth weight (kilograms)	less than 2.5	1		
	more than 2.5	0.48	0.10-2.22	0.345
	Unknown	1.34	0.29-6.08	0.706
Birth registered	Yes	1		
	No	0.85	0.33-2.17	0.738
	Unknown	0.59	0.08-4.37	0.609
Health card	No	1		
	Yes	**0.23**	**0.08-0.65**	**0.006**
	Unknown	1.51	0.16-14.05	0.718
education	none	1		
	primary	1.91	0.47-7.75	0.367
	secondary	0.98	0.24-4.22	0.996
	tertiary	**-**	**-**	**-**
	Unknown	**-**	**-**	**-**
Marriage status	Married	1		
	Widowed	**-**	**-**	**-**
	Divorced	**-**	**-**	**-**
	Single/Unknown	1.47	0.65-3.33	0.355
Refugee	No	1		
	Yes-1983	**0.23**	**0.08-0.65**	**0.006**
	Yes-After 1983	2.89	0.93-8.98	0.066
	unknown			
Gestational age	<38 weeks	1		
	>=38 weeks	0.59	0.22-1.53	0.273
	Unknown	**-**	**-**	**-**

- could not run because observations were too