HOUSEHOLD STRUCTURE AS A DETERMINANT OF INFANT MORTALITY IN SOUTH AFRICA

By
Nompumelelo Nzimande

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Thesis submitted to Graduate School of Social Science at the University of Natal, for partial fulfillment of the requirements for the degree of Master in Sociology.

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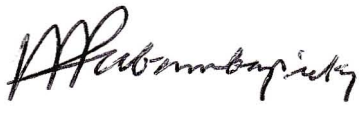
Declaration:

I declare that this thesis was written by myself and was supervised by Dr Peter Ubomba-Jaswa. The thesis contains views of the author, not of the University of Natal.

Graduate Student: 

Date: 25/02/02

Approved by:

Supervisor: 

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Abstract

Infant mortality rates are used as indicators of a group or population's well being. A high rate indicates poor access to social services such as health care provision, and other socioeconomic factors. Sub-Saharan Africa has the highest infant mortality rates in the world. Compared to the region as a whole, South Africa's rates are lower. However, a sudden increase in rates was noted from early 1990s (Department of Health, Medical Research Council, Macro International, 1998).

Since household is the first environment that infants are exposed to, it is thus the environment that strongly influences development and survival chances of this group. The study aims at taking a closer look at several aspects of the structure of the household and how they impact on infant mortality. The study is based on data from the South African Demographic and Health Survey (SADHS) administered by the Department of Health in 1998. Aspects of household structure that are viewed as affecting infant mortality are: sex of the household head, his/her age, number of household members, and number of children under 5 years old in a household. Estimating infant mortality rate and its probability by using ordinary life tables and multiple logistic regression modeling respectively, the study found that sex of the household head does no have an impact as a determinant of infant mortality in South Africa. However, other aspects of the household structure (number of household members and number of younger children under 5 years of age) were found to determine the survival of infants. Larger households are better off in securing infant survival than smaller households.

Introduction

Infants are among the most vulnerable groups in any society. Their survival is not only dependent on their parent's nurturing abilities, but also on the population's well being and its ability to provide adequate public facilities and services. Due to this, infant mortality rates have been used as one of the indicators of wellbeing and development (Hill and Pebley: 1989). Countries with high infant mortality rates depicts inadequate provision of basic health care, low standard of living, and show that provision of services is insufficient.

As with most countries, South Africa's infant and childhood mortality has been gradually declining over the years. Between 1950-1955 the estimated rate was as high as 96 infant deaths per 1000 live births (United Nations, 1997). Since then a steady decline in rates was observed and suggested a plausible improvement in service provision and accessibility of health care. As indicated by United Nations (1997) [1], there was a 50% reduction in infant mortality rates from the period 1950-1955 to the more recent period 1995-2000. However, Udjo (1999), Department of Health et al (1998), and Mencarini (1999) have reported reversal of this positive trend in infant and childhood survival. An upward trend in South Africa's infant and child mortality from 1990 has been noted. This has also been observed in other Sub-Saharan countries African countries where incidences of HIV/AIDS are high (Timaeus, 2001). This increase in infant mortality implies that there is either a deterioration in the availability and accessibility of basic resources and services, or that as suspected by

[1] This is the annual review of the world population which provides aggregate infant mortality rates for regions and countries

the South African Demographic and Health Survey (SADHS), HIV/AIDS has taken its toll not only on population in their reproductive ages, but also on Africa's infants.

Factors affecting infant mortality are numerous and diverse. Their effects need to be independently and collectively examined in order to search for reasons that hinders survival chances of infants in a population. Determinants that have gained popularity both in developed and developing countries are socioeconomic, bio-demographic, household environment, and to a smaller proportion socio-cultural determinants. Due to HIV/AIDS, the effect of the epidemic on mortality of children has also been explored (Timaeus, 2001).

"The family and the household are the most fundamental socioeconomic institutions in human society. The principal social function of the family is to bring children into the world and to care for them until they can support themselves" (Bongaarts, 2001:3). This indicates that the household is the first environment that infants are exposed to. More often than not, it is the only environment they are exposed to and hence the one that is most likely to determine their development, cultural orientation and hence survival chances. This is not to suggest that outside factors such as the community and the society at large does not have an effect in the development of the younger members of the society, however, their effect is latent and indirect in nature. Household structure determines infant mortality in two ways. Firstly the structure of the household determines resource availability and distribution. For infants to survive, there has to be resources in the household to meet immediate needs and provide an environment conducive for development. The issue of who controls these resources then impacts on how those resources will be used and who will likely benefit from

them. Secondly, the number of people benefiting from the pool of resources will further determine the share available for each member, such that if resources are scarce, a large number of beneficiaries limit amount allocated for each member. In particular, children under 5 years old require some similar attention as infants during this stage of development. They still need affection and close care from an adult person. In societies where extended family structure is still prevalent, looking at the number of children under 5 years of age in the household is more appropriate for analysis of resources available for the benefit of the infant, as opposed to looking at siblings.

This study aims to examine the impact of household structure on infant survival chances in South Africa. The household structural factors that are considered as important in determining the survival chances of infants are factors related to household type and household size. Traditionally patriarchal domination has meant that only men headed households. However, with the growing levels of divorce and women who chooses to remain single, female-headed households, which were traditionally rare, have grown in numbers worldwide (Creighton and Omari, 1995).

Household structure

The concept of a household is not self-explanatory. It has diverse interpretations that vary for different cultures and different disciplines (Preston-Whyte, 1976, Buddlender, 1997, Davis 1999). How a household is defined in this study is guided by the definition used by the SADHS. According to them, a household is a unit consisting of individuals who live together and eat from the same pot. In addition, a

household member will be an individual who spends at least four nights a week with the household.

There are three conventional household structures that have been prevalent in most societies. These are: (1) nuclear household consisting of the head, spouse and his/her children. The (2) stem household has the head living with his grandchildren in addition to the nuclear structure, and lastly (3) the extended household structure has other relatives of the head or spouse in the same household with the nuclear family. The stem and extended household structure is still prevalent in African societies. For all these household types the eldest male member of the household is usually selected as the head. This is worth mentioning in all studies that examine the effect of household headship on any aspect of the household functioning. The task of identifying the household head is often used by researches in order to identify the reference person or the person who is responsible for foreseeing the functioning of the household (Buddlender, 1997). Selection of this person is often a debatable and subjective issue. Some people will select as head a person who is the financial provider or often considered a breadwinner. However, the patriarchal system is such that more often that not, males are selected as household heads irrespective of whether they are financial providers or not. Buddlender (1997) notes that if there is an older male present in the household, he will be selected as head of household irrespective of his economic contributions. This she concluded indicates that gender and power of decision-making is an important factor to consider when considering reasons for selection of household heads. For the purposes of this study, the household head is an individual that was selected by the respondent as heading the household. Therefore the criteria used for selection of that person is unknown. Female-headed households

are ones reported by respondents as having a female head. A further investigation of the dynamics that led to selection of that individual as head is beyond the scope of this present study.

Data on mortality

The most basic data used for analysis of mortality for most populations are death registration, substituted by censuses. However, for most of the developing world, vital registration systems are clouded by massive under-registration of deaths and mis-reporting of its causes. In the case of South Africa, high incidences are noted in rural areas and in former Transkei, Bophuthatswana, Venda, and Ciskei States (TBVC) (Dorrington *et al*, 2001). Bah (1998) outlined the history of vital statistics and noted that factors that explain shortage of vital statistics in the country are racial and geographic in nature. South African reports on vital statistics since 1910 were exclusively on the white population. Colored population were included in 1937, and Asians in 1938. During these periods there was no systematic recording of vital statistics on the African population. The processing of information on the African population that began in 1979 was discontinued in 1981 due to under-registration, and late registration of births for this group. Even death reports issued between 1978 and 1990 covering the African population, they excluded former TBVC states that hosted 25% of the African population.

Furthermore, limited empirical studies have been conducted to investigate mortality estimates and determinants. To date, almost all writings on mortality in developing countries commence with an indication of the non-existence of data and poor quality of available data (Bah, 1998, Timaeus, 1997, Udjo, 2000). Unlike most developing

countries, South Africa has unfortunately not benefited from the internationally administered post-independent surveys such as World Fertility Surveys (WFS) and Demographic and Health Surveys (DHS), until the 1998 SADHS. This has made analysis of mortality challenging and for some groups even impossible. Although rigorous methods of analysis of mortality using ill-equipped data have been adopted, estimates and conclusions drawn using these data should be treated with caution.

Past research

Studies worldwide have shown that some bio-demographic, socioeconomic, cultural, and environmental factors affect or even determine various childhood outcomes. A number of factors from these categories have also been associated with infant mortality, with mother's education as one of the most important determinants (Caldwell, 1979, Hobcraft et al, 1984, Cleland, 1988). However, despite that the household and the family are the starting point of human life, not much empirical research has been conducted to examine the effect of these basic forms of social system on childhood survival. Sociological literature acknowledges that rapid social change, particularly in developing countries, has come with various implications for family formation and existence and has altered basic processes that are the fabric of society. Yet very little is said about how this impacts on the youngest members of the family.

One of the factors of great interest in this study is the survival of children in the households headed by women. There is mounting literature that indicates an increase in the number of households headed by women worldwide (Creighton and Omari, 1995, Davis, 1999). These households have received popularity, firstly because their

arrangement deviates from the household type conventionally known (male-headed) and accepted in the society. Secondly, these households have increasingly been labeled as vulnerable and poor. These have been perceived as factors that have a potential to hinder the ability of these households from providing an environment conducive for child development and survival. However, it is important to note that these households do not have a homogenous existence. "Some women-headed households are regarded as poor, vulnerable, and socially isolated, providing inadequate environment for children's growth because tradition or societal norms sanction the independence of widows, divorced, separated and single women. Other women headed households are viewed as social and economic innovators, survivors or pioneers who have broken with tradition and succeeded" (Davis, 1999:5). However, despite the two extreme conditions of existence of female-headed households, emphasis is made on their vulnerable nature. An account on how female-headed households have increasingly been characterized as "vulnerable", and unable to secure satisfactory child development has also been made in South Africa (Buddlender, 1997).

However, some studies have shown that households headed by women can provide better opportunities for children than other household types. "A large body of research now exists demonstrating that female-headed households devote greater proportions of income to food. That the intra-household distribution of resources is more equitable among members; and that the rates of child malnutrition are lower compared to other household types" (Davis, 1999:5). Kennedy and Haddad (1994) also found in their analysis of the nutritional status of pre-scholars from different household structures in Ghana and Kenya, that some poorer female-headed households are able to provide a

better nutritional status for their children than wealthier male and other households types. They concluded that "the degree of authority mother's have in decisions over their children's wellbeing may have an important effect on allocations of income for health care, clothing, or food for children" (Kennedy and Haddad, 1994: 694). It is important not to make an assumption that women who head households have obsolete autonomy on the running of the household. But compared to households headed by men, women heads of households can be said to have better say on decisions made regarding the running of the household, and they utilize that power towards the benefit of children.

Studies conducted in South Africa have concentrated on trends and differentials of mortality rather than its determinants. This is largely because apartheid policies and social system undermined collection and analysis of detailed demographic information for the majority of the population. More recently, Mencarini (1997) conducted a study on socioeconomic determinants of fertility and child mortality in South Africa using Living Standards and Development Survey collected in 1994. As expected, the study shows that race is the most important factor in explaining economic, social and demographic differentials in the country. The white population has infant mortality rates resembling that of developed countries while the African population has very high levels. His analysis also examined differences in fertility patterns and child mortality for women living in different household types. He concluded that, "women from multigenerational households have borne fewer children and have fewer children dead among those born alive, all other factors being equal" (Mencarini, 1997: 7). This is not in line with Kennedy and Haddad's finding that female headed households are more likely to utilize resources towards child care

and have better childhood outcomes than male headed households. Mencarini's study shows that children born in larger families have a better chance of survival compared to children from smaller families. This could be showing the shared responsibility by household members either in child rearing or in allowing the mother enough time to concentrate in the health of the child and development. The study however does not indicate how other household structural factors such as household headship might affect survival chances of South African children.

Studies in other African countries have indicated a relationship between household structure and infant mortality. Bongaarts (2001) conducted an analysis of household size and structures in different countries using the DHS Measure surveys from 43 developing countries. Although he does not make a connection between the structure of the household and childhood outcomes, his study makes contributions that can be linked with the well-being of children. He found that average household size in Sub-Saharan Africa is higher than in the other regions. Household size has both negative and positive effect on child survival. As with Mencarini (1997), larger families may mean that the mother has more time to spend with the child and that the responsibility of raising children is shared amongst household members. On the other hand more members mean more people sharing resources. This may deter or limit resources available for childcare for the benefit of all household members.

Children and siblings of the same age range often require similar resources. In the same household, children less than 5 years old often compete over similar resources and attention. This implies that in households that are not economically well, having more children under 5 years of age at one point in time, may hinder the ability of that

household to secure plausible childhood development for each of the children. "Evidence from economically diverse settings in Asia and Latin America systematically document the negative relationship between family size and children's educational attainment as well as negative relationship between the number of siblings and child's current school enrollment" (Lloyd and Desai, 1992).

Theoretical Framework

In understanding the effect of household structure on infant mortality in South Africa, it is important to understand child bearing and rearing in a traditional African household. These cultural practices influences the manner in which households care for children even in areas that are considered urban. Bringing a child into the world is understood not only as an event celebrated by the parents and the household where the child is born, but the whole family clan is involved. From birth, the child is celebrated through a customary ceremony where it is welcomed into the family and then to the household. This is to introduce the child to the Ancestors and then to ask them to care for the child. After that, the child is guarded by Ancestors, and its health is protected by them. Such that when the child gets an illness, it is believed that it has coincidentally caught bad spirit that was passing through the dwelling (because it is believed that had bad spirit been directed to the child, the ancestors would have seen and prevented it). In this case, a ritual will be performed "ukuhlanzwa" (cleansing), where the child will be rid of the evil spirit (umoya omubi). If the child is not better, elders will be called to pray and advise, after which the child might be taken to inyanga (traditional doctor). This is done after it has been established that nothing within the family has helped. Only after all has been tried, is the child referred to modern medical facilities.

The death of an infant is understood differently from death of a person in other age groups. Infants are considered as reflecting their parents and grandparent's inner spirits. When an infant dies, it could be a reflection of a number of problems. The child could die because the Ancestors did not accept it due to bad relations between its parents or grandparents. The child could also die through being affected by bad spirit that has always been in the household, or that the Ancestors are bitter with the family and are showing their anger though taking the infant. Therefore, the death of a child is not understood as reflecting inadequate resources in the household; poor quality of health care, or neglect. This understanding is crucial when viewing the effect of processes within the household on infant and childhood development and survival in South Africa.

"Decisions by family members may affect the probability of death at various stages in the life course. Quite apart from conscious decision-making, structural features of family systems directly affect demographic processes, often in ways not recognized by family members" (Skinner, 1997:53). This indicates that a relationship exists between household operation and childhood outcomes. It is here acknowledged that practices and behavior of household members are embedded within societal epistemologies, beliefs and norms, which are products of cultural ideologies existing in those societies. Processes that determine household practices which are considered crucial for childhood survival are: production and consumption of resources, fertility and child-care, nuptuality, morbidity and mortality, and lastly migration. In fact, in any given population, these processes determine the child's existence even after

infancy. These factors either directly (proximate) or indirectly determine survival chances of infants and children within households.

Household size is a function of a number of cultural, socioeconomic and demographic behaviors. Firstly, the size of the household is determined by fertility, migration, nuptuality, and mortality (Bongaarts, 2001). Household composition is a reflection of the number of employed members of the household relative to total household members. This determines the number of people who might financially contribute to the pool of household resources required for household consumption. However, the number of beneficiaries from these resources will give a more complete picture of the resources available per household member.

Due to limitations introduced by scope and focus, DHS does not collect information on household income or economic activities of each member of the household. However, from the size of the household and its socioeconomic status inferences can be made regarding expected effect this might have on infant and childhood outcomes. "Larger households with several adult members who are potential wage earners are likely to be relatively well-off, provided the adults can find employment (Sharp and Spiegel, 1985: 142). This is also relevant in the South African context where unemployment levels are estimated at 30% (May, 1998). In this case, I argue that a child in a larger household (where at least one member will be employed) is standing a better chance at survival than in a smaller household that has a higher chance of having no one employed.

From South African point of view, another side of household size that is of great importance due to continued prevalence of the stem and extended family structure. African households tend to have larger members some of these members are not related to the head through kinship linkages. For households headed by males, it is usual to find the head residing with his parents, his wife/wives, his children and grand children. In this case the size of the household increases vertically (his wife/wives and children). In another structure, the head would be an older male residing with his siblings (usually male, and women who have not married) and their wives and his grand children, in which case the household has a horizontal setting. Preston-Whyte (1978) described a type of household structure prevalent in households headed by female siblings (sisters). Some of these households she argues are "female-linked". This constitutes unmarried sisters who have borne children whilst still at home. This household is also large in size even though it has a composition different from the one explained above. Outside of economic activities in these household, cultural practices in larger households allows for the traditional distribution of household duties. The mother of the infant will have time to concentrate on caring for the infant during its tender age and will also receive assistance from other females in the household. In this case, a larger household allows for better time for childcare practices.

Characteristics of the household head[2] are important in providing some indication of resource availability and distribution in the household. "The household head's characteristics are more important than any other household member's in affecting the household's ability to stay out of poverty" (Swanson, 1995). Households headed by women have been reported to be growing and have gained popularity through their

[2] An assumption is made here that there is a positive relationship between household headship and control over resource distribution

doubted ability to secure socioeconomic stability within the household. Despite reports indicating that these households are vulnerable and poor, in some countries such as Ghana they have produced good childhood outcomes (Kennedy and Haddad, 1994). This could be attributed to the manner in which, according to socialization and its emphasis on separating boys and girls. Socialization theory and development of gender roles is organized such that boys are socialized to become more active and aggressive; while girls are prepared for more passive and nurturing roles (Goslin, 1969, Pitcher, 1983, Mensc *et al*, 1998). Such roles are initiated from childhood and are commended though all stages of human development. This has both positive and negative implications for child wellbeing. If women are heading households (which in this case it is assumed has more control over resources), she is more likely to utilize those resources for the benefit of children. Furthermore, South Africa's past Apartheid laws, that perpetuated migration of men from rural to more urban areas in search for employment, has left a number of households headed by women[3]. In this case, the man will visit the household irregularly, but will be sending money home. Often this money is the only source of income in the household and thus the only means for survival. In this case although the man still has control over the running of the household (often for major decisions, the woman has to consult the husband before taking any action) but she is the one that foresees the distribution of resources. In this case, I argue, she is most likely to utilize these resources according to how she has been raised, which is towards nutrition and child care.

Older household heads often have been in the family longer than any member of the household. They have a better understanding of the culture and customs that were

[3] The head in this case must be a de facto member of household

used to raise them. Culturally, in African household in South Africa, the head of household is the one that determines health facilities to be sorted in event when the child is unwell. It is considered disrespectful to go against what an elderly person has suggested, hence their suggestions would always be carried through. They are considered more knowledgeable and have the wisdom to know what the child needs. However, they were socialized at a time when infant and childhood mortality were very low (Infant mortality was very high in South Africa until beginning of 1980s). Older household heads (over 50 years old) are most likely to adhere to old norms and customs that are not conducive for child survival. They are less likely to believe in modern medicine and health care, thus endangering lives of this vulnerable group. Therefore, even though middle-aged household heads have less experience in running of the household, for infant care, they are expected to have better outcomes that older heads. Due to inexperience at raising children and running the household, younger (below 30 years old) household heads may present health threats to infants.

Data source and methods

The South African Demographic and Health Survey (SADHS) conducted by the Department of Health, Medical Research Council and Macro International in 1998 is the data set used in this study. This is a nationally representative survey that was designed to provide information on various demographic and maternal, child, and adult health indicators in South Africa. The SADHS sample design is not self-weighting for a number of reasons, firstly, the survey had as one of its objectives to provide separate survey estimates for each province. Due to this, 1,000 households were targeted for each province irrespective of the disproportionate distribution of the populations of the provinces. Secondly, Eastern Cape received extra financial support

from USAID and was therefore over sampled in the survey (2000 households) to provide separate survey results for each of the five health regions. Thirdly, based on the National Census 1996, only 3% of the South African population classified themselves as Asians in the census (Statistics South Africa: 1996). An equal probability sample would mean that Asians would have a lesser chance of selection into the sample, which would impede upon analysis of this group. To remedy this scenario, urban areas of Gauteng and KwaZulu-Natal (which has greater Indian population) were also over sampled in order to increase the sample of Indian households.

The survey had a satisfactory response rate, where of the 12, 860 households that were targeted by the survey, 97% (12, 247) were interviewed. Although the SADHS is a household survey, the principal respondents are women between ages of 15 to 49. The 11735 women interviewed had given birth to 22,934 children. A considerable proportion of these children (45%) were reported to be from households headed by women, whereas 55 were from male-headed households. The average household size was 4.3, but the average size of the households where these children come from (6) was higher than that of the overall sample. On average, children came from households that only had 1 child less than five years of age, with the highest number being 7 (Department of health *et al*: 1998).

Birth histories were collected from women between ages 15 to 49 who have given birth in their lifetime. This provided information on all children that a woman has ever given birth to, including stillbirths. Date of birth and date of death (if not alive) for these children were collected. This information was used in this study to establish

the age of the child at death in months to identify infant deaths. However, it is worth noting that retrospective data has a number of problems. Women tend to underreport deaths of children when they are still very young, often when these children were not yet named (which is most likely to happen with neonatal deaths). This needs to be noted as a possible shortcoming in any analysis of infant and child mortality.

Table 1 shows the distribution of children borne by women in the data. The amount of household headed by women is substantially large (45%). Close to half of the children are from medium sized households and more than a third (35%) are in larger household, showing that only a small proportion of children are born in smaller households. The respondents are equally distributed between rural and urban areas. More than half of the children in the sample are from households that have smaller number of children under 5 years old. Surprisingly, given the household size distribution, only a few of these households have larger number of younger children (2.3). The Nguni ethnic group has the largest number of children born by women in the survey. This is expected since this ethnic group combines the 2 largest ethnic groups in South Africa (Zulus and Xhosas). As indicated prior that Eastern Cape had additional funds and hence added the sample size, a quarter of the children in the data come from this province.

Table 1 - Some characteristics of children in the sample (N=22,652)

Variable	*%*	*Variable*	*%*
Sex of head		**Area type**	
Male	54.6	Urban	49.06
Female	45.4	Rural	50.94
Age of head		**Province**	
< 30	8.11	Western Cape	6.52
30-49	61.80	Eastern Cape	25.00
50 +	30.09	Northern Cape	8.75
		Free State	7.38
		Kwa-Zulu Natal	15.29
		North West	7.45
		Gauteng	8.27
		Mpumalanga	10.24
		Northern	11.09
Household size		**Year of birth**	
1-3	17.13	< 1980	21.71
4-6	47.54	1980-1989	40.87
6 +	35.33	1990-1998	37.40
No. of children under 5		**Ethnic group**	
No children	37.55	White	21.92
1-3	60.15	Nguni	46.97
3 +	2.30	Tswana	17.64
		Other	13.77
Total	100	**Total**	100

Two levels of analysis were used in the study to examine the effect of the chosen independent variables of infant mortality. The first method is the estimation of infant mortality rates using the ordinary life table approach, and the second are binary logistic regression models for testing the effect of independent variables controlling for other factors. Several life tables were developed to assess the effect of household type, socio-cultural, socioeconomic status and environmental factors on infant mortality. By creating different infant mortality estimates for different characteristics it is possible to compare these and give a descriptive account of mortality rates for different subgroups. The life table probability of dying, estimated as a rate per 1000 live births, was used.

For all logistic regression models in this paper, the dependent variable is infant mortality. This is a dichotomous variable coded as 0 if the child survived thorough infancy, that is, if the child reached age one (12 months). This variable is coded 1, if the reference child died anytime between birth and before reaching age 1. Binary logistic regression modeling is suitable for dichotomous dependent variables and categorical, and numerical independent variables. This model estimates the coefficients in the form of odds using the formula:

$$In\left(\frac{p}{1-p}\right) = b_0 + b_1 x_1 + \cdots b_n x_n$$

Where P is the odds for the dependent variable, X_I is the independent variable (i=1…8), b_0 is the constant, and $b_i \ldots b_n$ are regression coefficients. Binary logistic regression is used in order to establish the effect of each independent variable on infant mortality, controlling for other selected infant mortality determinants.

Results

Table 2 shows that female-headed households have a 32% higher infant mortality rate compared to male-headed households. Smaller households have a higher infant mortality rate compared to both medium sized and larger households. The infant mortality rate of 201 deaths per 1,000 live births for children born in households with no younger children seem too high. As shown, this rate is 169% higher than that in households with 1-3 number of children under 5 and 181% higher than that of households with larger number of children. However, these results could be affected by skewed distribution of observations (reflected in table 1) in these categories.

Table 2-Infant mortality rates calculated for children born from 5 years before the survey

Household structure predictors	*$_1q_0$/1000*
Sex of household head	
Female	54
Male	41
Household size	
1-3	66
4-6	43
7+	44
No. Of living children <5 in age	
None	201
1-3	32
More than 3	20
Age of household head	
< 30	48
30-49	42
50+	54
Overall	47

Results of life table estimates should be treated with caution as they are biased by smaller sample size, which may yield unreliable results (Ubomba-Jaswa, 1989). The results were affected by the small proportion of children (2.3%) reported to be from households with more than 3 children under 5 years old. There is a 50% decrease in infant mortality rate from smaller households to larger households. This could show the importance of extended family structure and its positive impact on infant survival. The data also shows that households with older heads (above 49 years) have a higher infant mortality rate compared to those with middle aged and younger heads, with children from middle aged heads having the least probability of dying (42 infant deaths per 1000 live births). This U shaped curve in the relationship between infant mortality and age of household head could be indicative of the resistance to change and adopting new forms of lifestyle by older household heads. These heads, despite that they head large households, still hold on to traditional practices that may not be conducive for proper childhood development.

Table 3-Logistic regression model of household structural determinants of infant mortality (Odds ratios are reported).

Variables	*Model A*	*Model B*	*Model C*	*Model D*	*Model E*
Sex of household head					
(Male)					
Female	*1.089*				*1.105*
Age of household head					
(< 30)					
30-49		*1.261*			*1.052*
50 +		1.723***			1.556***
Household size					
(1-3)					
4-6			0.743***		0.771***
6 +			0.791***		0.771**
No. Of children under 5					
(No child)					
1-3				0.824***	*0.999*
3 +				0.43***	0.515**
Year of birth					
(Before 1980)					
1980-1989					0.605***
1990-1998					0.482***
Pseudo R^2	**0.00034**	**0.0034**	**0.0016**	**0.0019**	**0.0166**
Log likelihood	**-4624.23**	**-4624.23**	**-4639.46**	**-4638.07**	**-4563.179**

Reference category in parenthesis. *** Significant at p<. 01, **significant at p<. 05, not significant in Italics

Results of the individual models are presented in tables 3. This table shows an independent and group effect of household structural determinants with model E showing the effect of these variables controlling for other factors. As shown, sex of household head is not significant as a determinant of infant mortality on its own and after controlling for other household determinants in the model. Number of household members however is significant and shows that medium and larger households are less likely to experience infant deaths compared to smaller households. However, the difference between the middle household size and large household is very small after controlling for other household structural factors. The effect of the number of children under 5 years is consistent with results obtained from the life table probability of

dying. Where households with more children have an even smaller probability of experiencing infant deaths compared to those with lesser number (1-3) and those with no younger children either than the reference child.

Year of birth has been included in the model to control for differences in periods of exposure to death. Since as has been indicated, mortality of infants and children was high until steady decline in early 70s to 1990s, it is important to control for year of birth in any analysis that include this group.

Pseudo R^2 reported are very week and at face value indicate that the models explain no variation in infant mortality. However, R^2 is not a good measure of fit in a regression that uses Logit to estimate parameters. Since logistic regression uses Maximum Likelihood Estimation (MLE) to estimate parameters, the significance of the log likelihood estimates are important and thus have been provided in all models. The significance of the model is hence indicated by the model likelihood ratio Chi^2. This is the model Chi^2 with degrees of freedom indicated by the number of predictors in the model. All models have a significant LR Chi^2 at their specified degrees of freedom. This indicates that all of the models are significantly different from the null hypothesis that a relationship between the different variables (controlling for other in the model) and infant mortality is 0 (does not exist).

Table 4- Logistic regression model of determinants of infant mortality

Independent Variable	Odds Ratios	Independent Variables	Odds Ratios
Sex of household head		***Age of mother at birth***	
(Male)		(<19)	
Female	1.01	19-30	0.61***
		30 +	0.51***
Age of household head		***Sex of the child***	
(<30)		(Male)	
30-49	1.34	Female	0.74***
50+	2.21***		
Household size		***Preceding birth interval***	
(1-3)		(< 18 months)	
4-6	0.70***	19-30 months	0.52***
6+	0.53***	30+ months	0.34***
No. Of children under 5		***Birth order***	
(No child)		(First birth)	
1-3 children	0.94	2nd birth	0.99
More than 3 children	0.57	3rd birth	1.50***
Ethnic group		***Toilet facility***	
(English/Afrikaner)		(Own flush)	
Nguni	1.68***	Other	0.91
Tswana	2.11***	No facility	1.16
Other	1.51		
Area type		***Floor material***	
(Urban)		(Earth)	
Rural	0.99	Cement/barewood	0.97
		Carpet/ceramic tiles	0.85
Province		***Year of birth***	
(Western Cape)		(Before 1980)	
Eastern Cape	2.32***	1980-1989	0.73***
Northern Cape	2.45***	1990-1998	0.67***
Free State	1.48		
Kwa-Zulu Natal	1.44		
North West	1.23		
Gauteng	1.59		
Mpumalanga	2.511***		
Northern Province	1.50		
Mother's education			
(No education & primary)			
Secondary +higher education	0.78**		
Pseudo R^2 = 0.07			

Log likelihood = 2762.0295

Reference category in parenthesis. *** Significant at p<. 01, **significant at p<. 05

Individual effects of bio-demographic, socioeconomic, socio-cultural and household environmental factors are presented in the appendix. Variables that were not significant in these independent models were excluded in the model represented in table 4. This model aims at looking at the effect of household structural factors in the model controlling for other determinants of infant mortality. As with the household structure model presented in table 3, female-headed households are more likely to experience infant mortality compared to male-headed households. However, given the data and the model, this effect is not significant, and therefore sex of household head is not a determinant of infant mortality in South Africa.

After controlling for other variables in the model, households with older heads are even more likely to experience infant mortality compared to those with middle aged and younger heads. However, the finding that households headed by middle aged people are more likely to have infant mortality than those headed by younger members was not expected. Household size still has a significant effect on infant mortality after controlling for all other factors in the model. The effect of larger households becomes even stronger showing that controlling for all other factors, such households are even less likely to experience infant mortality compared to smaller and medium sized households. Although one of the categories of number of children under 5 years was significant after controlling for other household structural factors, such an effect disappears after controlling for all other groups of determinants.

Number of younger children under 5 years old is not significant in the model. This variable is closely related to household size in the sense that households with fewer household members are less likely to have larger number of younger children

compared with larger households. Therefore after controlling for household size in the model, the effect was expected to be significant. The rationale behind selection of this variable as a determinant of infant survival is that, infants and younger children in one household compete for similar resources. However, a number of factors could be confounding the effect of this variable on infant mortality. The fact that these children are counted twice in the models; i.e. their effect could be incorporated in household size. A simple solution would have been to separate children under 5 from the household size, however this would have defeated the purpose of including them. Household size measures the effect of household's ability to provide adequate resources and services conducive for infant development and survival. On the other hand, number of children under 5 measures persons competing for these resources in the same fashion as infants.

Mother's education is used here as a proxy for socioeconomic status and an indicator of child wellbeing. As expected, the effect of this variable significantly shows that educated mothers are 22% less likely to have an infant death compared to mothers with very low or no education. These results are well in line with findings in other countries, which suggests that maternal education improve survival of infant and children substantially (Caldwell 1979, Hopcraft *et al*, 1984, Cleland 1988).

As expected, all of the bio-demographic determinants in the model significantly affect infant mortality even after controlling for other factors. Maternal age at birth shows that having a child at younger age than after 19 years of age, poses a threat to the survival chances of that child. Duration of breastfeeding is acknowledged as being one of the important determinants of infant survival, however, this variable could not

be tested in the model due to the fact that DHS collects this information only for children born from 5 years before the survey.

Household environment is important for preventing infections that could result in diarrhea and respiratory tract infection that are some of the leading causes infant deaths. However, floor and toilet facilities are not significant in the model. The effect of socio-cultural variables confirms inequalities adopted from Apartheid regime that ensured that (among other things) African population has lower socio-economic standing.

Table 5- Exploratory logistic regression model of determinants of infant mortality after backwards selection

Independent Variable	Odds Ratios	Independent Variables	Odds Ratios
Year of birth		***Toilet facility***	
(Before 1980)		(Own flush)	
1980-1989	0.68***	Other	1.16
1990-1998	0.61***	No facility	1.46***
Age of household head		***Province***	
(<30)		(Western Cape)	
30-49	1.10	Eastern Cape	2.90***
50+	1.70***	Northern Cape	2.29***
		Free State	2.22***
		Kwa-Zulu Natal	1.66**
		North West	1.83**
		Gauteng	2.25***
		Mpumalanga	2.96***
		Northern Province	1.63
Household size		***Mother's education***	
(1-3)		(No education & primary)	
4-6	0.69***	Secondary & higher education	0.73***
6+	0.53***		
Preceding birth interval		***Age of mother at birth***	
(<18 months)		(<19)	
19-30 months	0.55***	19-30	0.59***
30+ months	0.38***	30+	0.52***
Birth order		***Sex of the child***	
(First birth)		(Male)	
2nd birth	0.65***	Female	0.77***
3rd birth	0.66***		
Pseudo R^2 = 0.067			

Log likelihood = -2962.5397

Reference category in parenthesis. ***Significant at p<. 01, **significant at p<. 05.

NOTE - dropped variables: Sex of household head, area type, floor material, ethnicity, and number of children under 5 in the household. Variables selected using backward selection at significance level >0.05

Table 5 is the model developed through backwards selection in Stata at significance level $p \leq 0.05$. This was an exploratory exercise done to allow for creation of a model based on statistical significance rather than theory. Year of birth is entered first in the model. As expected, as the societies moves through stages of demographic transitions, the year in which an infant was born should be a strong determinant of whether that

infant survived or not. Despite recent changes, more recent periods have made improvements in infant and child survival compared to early 1970s. Number of household members, and age of household head are the only variables that remained as household structural indicators that affect infant mortality controlling for the determinants in the model. Larger households are still less likely to have an infant death compared to smaller and medium sized households. The bio-demographic determinants are still indicated as strong determinants. Confirming Caldwell's theory, mother's education also remains as a strong determinant of infant mortality in the model. The province where the mother lives appears to be significant, only with Northern province being insignificant. Eastern Cape offers the lowest chances of infant survival compared to other provinces.

Significant changes appear in the effect of birth order after excluding non-significant variables. Firstly, both categories of birth order become significant. Secondly the direction of odds ratios change such that third births become less likely to die during infancy compared to first births. The odds of dying for second births also becomes stronger compared to first births. The odds of mortality in households with no toilet facility compared to those that have own flush toilet also becomes significant showing that households with no toilet facility are more likely to have infant mortality.

Discussion

Based on the data and the models, the effect of some of the selected household structural variables on infant mortality has been shown to be insignificant in South Africa. The sex of the household head was expected to be a strong determinant of infant mortality especially after controlling for other determinant in the model.

Controlling for differences in socioeconomic status and household size between male and female-headed households was expected to improve the chances of infant survival in households headed by women. A number of inferences can be made from the results. The direction of the odds ratio (although not significant) suggests that households headed by women are doing badly on infant survival even after controlling for differences in socioeconomic status.

Results could be indicating that in South Africa, gender of the household head does not determine who allocate resources in the household and hence who is likely to benefit from them. A number of factors could also be downplaying the effect of household headship on infant mortality. Factors such as composition of the household and the relationship structure need to be examined in order to make more informed conclusions.

The effect of household size is significant, and consistent in all models. Larger households have a lower infant mortality rate, and a lower chance of experiencing such deaths after controlling for other factors in the model. A number of factors could be influencing this effect. As has been indicated elsewhere that due to high unemployment levels, a larger household cannot be directly associated with an increase in number of people contributing financially towards the pool of resources in the household. Despite this, the likelihood of having more people employed is higher in larger households as opposed to smaller ones. However, it should be borne in mind that multigenerational households (which have large household size) tend to also have benefits in distribution of child-care responsibilities. Firstly by taking care of the infant in the absence of the mother, and secondly by ensuring that she has enough

time to care for the new born. So, despite financial resources, large households have a better social environment for child development.

Larger households are still prevalent in most African societies and this seems to have positive implications for child survival. A more recent study has shown that mortality patterns have changed in South Africa. Mortality of individuals between 25-35 years has increased. The report indicates that mortality of women between 25-29 years is 3.5 times higher in the period 1999/2000 compared to 1985. This high mortality is attributed to HIV/AIDS (Dorrington *et al*, 2001). This is the group that is at the pick of their reproductive life and will have born children. This then leaves these children orphaned and vulnerable. Therefore, in this era of high prevalence of HIV/AIDS in South Africa, a high dependence on the extended family to provide care for these AIDS orphans has clearly increasing. This household type will benefit children and increase their ability to enhance their early development.

Since practices that inform how children are raised are embedded in cultural norms of the society, different ethnic groups that have different cultural beliefs are expected to do differently at infant and child mortality. In addition, in the case of South Africa different racial groups also need closer look given their differences in access to resources adopted from the past. The Nguni's are an ethnic group that constitutes of Zulu, Xhosa and Swazi ethnic groups. On the other hand the Tswana group combines those groups that speak Tsonga and related languages. Ethnicity was included as a variable to control for differences in child rearing patterns between different ethnic groups and also to establish which ethnic groups do worse on infant mortality. The

White, Colored and Asian populations were combined and not surprisingly have a lower infant mortality compared to Africans.

Conclusion

This work contributes to the study of infant mortality by conceptually linking household practices and behaviors to early childhood outcomes. It develops a multidimensional set of household-based family structure, socioeconomic, cultural, environmental and bio-demographic variables. Then these predictors and their linkages are tests the sample of 12,247 households from all 9 provinces of South Africa. Larger household size seems to have positive impact on child development outcomes. Two conclusions can be made from these findings. Firstly, larger households prevalent in rural households of Africa have a positive effect on childhood survival. Taking into account the effect of HIV/AIDS and the manner in which the epidemic develops in the continent, more support will be required for younger children living with HIV and those that are victims of the epidemic in other ways. As more children become orphaned as a result of the epidemic, the reliance on other household members or relatives will increase. The findings plausibly show that the role of child-care and development can be absorbed by larger households. Secondly, it is clear that a closer look at the composition of these households and factors that make them do better than smaller households need to be a focus for future research.

Although sex of the household head consistently indicated that this variable is not a significant determinant of infant mortality, a closer look at this relationship still need further investigation. Female-headed households are growing in number. These households are poorer than those headed by men. However, this contradicts with the

childhood outcomes they are showing in some countries (Kennedy and Haddad, 1994). For the individual to be considered as head of household, the DHS requires than that individual be resident in the household. In the South African case, due to high migration from rural to urban areas, some households will have heads that are not residents of the household (usually males). However, these males would be coming home regularly and send money for household consumption and maintenance. Whether the woman who then will be designated as the "head" of the household (in the absence of a male who is working elsewhere), has similar condition as women-headed households with no other assistance remains a serious issue to be resolved.

Improvements have been made on Primary Health Care (PHC) accessibility in South Africa since 1995. All pregnant women; and children under 6 years have access to free health care in all public health centers. This however does not seem to have benefited some infants and children. The effectiveness of PHC and its accessibility to the needy and poorer households and communities could assist in saving infant's lives.

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APPENDIX

Table 6-Logistic regression model of household Environment determinants of infant mortality

Variables	*Odds ratios*
Floor material	
(Earth)	
Cement/bare wood	*0.987*
Carpet/ceramic tiles	0.724**
Wall material	
(Mud/plastic)	
Corrugated	*0.810*
Brick	0.794**
Toilet facility	
(Own flush)	
Other	1.238**
No facility	1.521***
Source of drinking water	
(Piped in house)	
Public tap	*0.850*
Bore hole/river/dam	*1.220*
Year of birth	
(Before 1980)	
1980-1989	0.560***
1990-1998	0.439***
Pseudo R^2	0.0252
Log likelihood	-4206.5136

Reference category in parenthesis. ***Significant at p<. 01, **significant at p<. 05

Table7-Logistic regression model of socioeconomic Determinants of infant mortality

Variable	*Odds ratio*
Mother's education	
(No education & primary)	
Secondary and higher	0.788***
Partner's education	
(No education & primary)	
Secondary and higher	*0.884*
Household possessions index	*1.065*
Household possessions index squared	0.966***
Year of birth	
(Before 1980)	
1980-1989	0.602***
1990-1998	0.487***
Pseudo R^2	0.029
Log likelihood	-3485.7458

Reference category in parenthesis. ***Significant at p<. 01, **significant at p<. 05

Table 8-Logistic regression model of socio-cultural Determinants of infant mortality

Variables	*Odds Ratios*
Ethnic group	
(English/Afrikaner)	
Nguni	1.759***
Tswana	2.505***
Other	1.729***
Area type	
(Urban)	
Rural	1.386***
Province	
(Western Cape)	
Eastern Cape	2.434***
Northern Cape	2.404***
Free State	1.289
Kwa-Zulu Natal	1.878***
North West	1.066
Gauteng	1.557**
Mpumalanga	2.339***
Northern Province	1.308
Year of birth	
(Before 1980)	
1980-1989	0.558***
1990-1998	0.442***
Pseudo R^2	0.0166
Log likelihood	-4498.6187

Reference category in parenthesis. ***Significant at p<. 01, **significant at p<. 05

Table 9-Logistic regression model of bio-demographic Determinants of infant mortality

Variable	*Odds ratio*
Age of mother at birth	
(<19 years)	
19-30	0.564***
30 +	0.490***
Sex of the child	
(Male)	
Female	0.737***
Preceding birth interval	
(<18 months)	
19-30 months	0.483***
30 + months	0.350***
Birth order	
(First birth)	
2nd birth	0.589***
3rd birth	0.613***
Year of birth	
(Before 1980)	
1980-1989	0.648***
1990-1998	0.548***
Pseudo R^2	0.0438
Log likelihood	-2880.6707

Reference category in parenthesis. ***Significant at p<. 01, **significant at p<. 05