Household Structure and Childhood Mortality in Ghana: Monitoring Progress on the Millennium Development Goals

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Abstract

This study examines household structures and the living arrangements of children and its effects on child mortality using data pooled from the 1993, 1998 and 2003 Ghana Demographic and Health Surveys (GDHS). Results from discrete-time hazard models indicate that net of socio-economic, bio-demographic and maternal health utilization factors children in nuclear family arrangements have lower odds of child mortality than those in three generational and laterally extended households. Results from rural and urban areas suggest that while household structure significantly predicts childhood mortality in rural areas, the same significant effect is not found in urban areas, where education and standards of living significantly predict child mortality. This study is situated within the broader framework of biological and behavioral causes of childhood mortality and takes a critical look at new household economic models in predicting childhood mortality in Ghana. Some policy implications as they pertain to galvanizing efforts to meet the needs of the world's poorest as captured in the fourth goal of the millennium development targets are discussed.

Introduction

Reducing infant and child mortality are high priority national public health objectives among sub-Saharan African countries. In the context of the United Nations Millennium Development Goals (MDG), African governments and indeed governments around the world are enjoined to reduce child mortality by the year 2015. However, recent empirical analysis has shown that substantial declines in infant and under-five mortality recorded between 1970 and 1990 in all sub-Saharan African regions have stalled and some countries are beginning to see a rise again (Agbessi 2000; Rustein 2000). Demographic and epidemiological studies conducted thus far, have largely focused on socio-economic and biological correlates of child mortality (DaVanzo 1984; Hobcraft, McDonald and Rutstein 1984; Huffman and Lamphere 1984; Rustein 2000). Of relatively less prominence in this literature is the role of household structures and children's living arrangements on childhood mortality. Although socio-economic and biological studies of child mortality provide invaluable insights on the effects of a variety of biological and behavioral factors on child survival, there is the need to examine specifically, the effects of household formation and living arrangements of children on childhood mortality within the cultural and socio-economic context within which children live.

Using data from the Demographic and Health Surveys (DHS) in Ghana, we examine the influence of household structures on childhood mortality, from the broader framework of behavioral and biological determinants of child mortality. This is with the intent of demonstrating differential effects of household structures on childhood mortality in rural and urban settings in Ghana, and in contributing to the vast literature on socio-economic and biological determinants of child mortality. Ghana is especially ideal for this analysis due to weak conjugal bonds between men and women (Andro 2002) and varying roles of men and women's responsibility for caring for children.

Household Structure and Child Health Outcomes

The importance of household composition and child outcomes in national public health and social policies has been well documented in developed countries (Angel and Tienda 1982; Astone 1991; Glick 2000). Because children depend largely on their parents to meet their basic human needs, information on households is essential for planning for the welfare of children. In developing countries, studies have identified household structure as a prime determinant of children's economic and social well-being (Lloyd 1995; Kelly 2000). However, little is known about the influences of household structure on childhood mortality. This information is important for understanding children's living arrangements in diverse social settings and for testing the validity of classical household models applied uniformly across cultures (Desai 1992; Gage, Sommerfelt and Piani 1997).

Analysis of DHS data in sub-Saharan African countries have shown mixed results on the relationship between household structure and child health outcomes. Some studies suggest that nuclear households are worse off than extended family households and polygynous families in terms of household possessions, amenities and prestige {Gage, 1996; Cronk, 1991 Lloyd 1995). Yet other findings indicate no significant effects of large extended households on child health outcomes {Desai, 1992} . Studies focusing specifically on total household income and nutrient intake have also yielded mixed results with some finding a weak relationship (Desai 1992; Behrman 1987) and others finding a strong (Alderman, 1990) to moderate (Ravallion, 1990) relationship.

Desai (1995) examined the impact of family size on children's physical growth in 16 less developed countries using DHS data and found that the effect of different family structures on children's well-being depends on the extent to which parents rather than the extended family bear the cost of rearing children and on the level of economic development. The study notes that with increasing privatization and reduction in state support for food, health care and education, parents are becoming increasingly responsible for the welfare of their children. This trend coupled with increasing nuclearization of families especially in urban areas is likely to increase the vulnerability of children in large families (Desai 1995). However, with increasing urban poverty, exacerbated by sustained levels of rural-urban migration (APHRC, 2002), it is unclear if nuclear or extended households in urban areas will maintain a health advantage over their rural counterparts.

Theoretical Perspectives on Household Structure and Child Health Outcomes

The underlining theoretical perspective of studies on the household can be traced to the model of "new household economic theory" (Becker 1981; Schultz 1974). This theory was initially adopted to describe resource allocation, decision making and utility maximization processes of households in developed settings. Later, it was applied to developing countries, particularly in the analysis of agricultural households. According to this theory the household is viewed as a small factory or a production unit and combine capital goods, raw materials and labor to clean, feed, procreate and produce useful commodities (Becker, 1965).

The basic premise of this theory is that people allocate their time and other economic resources in response to the value of the time of each family member and on the amount of the family's non-human capital endowments as well as the relative prices of the family's market inputs and outputs (Schultz 1984).

This model makes several simplifying assumptions that have been critically examined particularly in view of the fact that researchers tend to apply it uniformly to several diverse cultural settings (See Desai 1992 for analysis on Africa and Latin America). Three major aspects of this model seem particularly problematic in developing countries: the assumption of the household as a single entity with perfect cohesion, altruism and pooling of resources within the family, and the lack of consideration of flexible boundaries of the household (Desai 1992).

Desai (1992) concludes that although parents care about the welfare of their children; their level of altruism varies across different types of families and seems to depend on culturally acceptable practices.

Drawing on critical perspectives of the model on the family proposed by the new household economics theory, we derive and test hypotheses regarding childhood mortality in various household arrangements in which children live and examine these hypotheses at the national level and for rural and urban areas in Ghana.

Conceptual and Analytical Framework

Our conceptual framework for analyzing the effects of household structure and childhood mortality resembles those proposed by Mosley and Chen (1984). Our main premise is that varying forms of household structures has both a direct and indirect influence on childhood mortality

Although the ultimate cause of death is biological, this factor is determined by a chain of social and behavioral factors. Thus household structure may act through household socio-economic factors and maternal biological and utilization factors to influence child mortality. The motivation for our conceptual model drives from the fact that household living arrangements determine the availability of resources for child services which varies according to the level of economic development, urbanization and education in a country. Parents can affect the survival chances of their children by investing in their health with inputs of their own time and by providing a clean environment and access to medical care etc. However a child's health is dependent on not only its own 'health capital' like weight at birth and birth defects but by its mother's health, such as her nutritional status and utilization of maternal health services such as prenatal and delivery care. However, data limitations prevent a full test of all the concepts briefly outlined in this model (For instance we lack data on the level of economic development; also, we do not include measures of birth weight and birth defects).

Research Hypotheses

Guided by previous literature and our conceptual model, we propose the following specific hypotheses:

First, we expect children in nuclear households in which parents bear full responsibility for the welfare of children to have a better health advantage then children in laterally extended or in three generational families. In this proposition, we not necessarily assume that the income or opportunity given to one family member necessarily implies improvement in the welfare of all household members including children.

Second, we posit that the health advantage of nuclear households will be mediated by mother's education and the living standards of the households as well as mother's biological factors and her utilization of health services.

Lastly, because socio-economic status indicators and health access factors vary between rural and urban areas, we hypothesize that the health advantage of nuclear households will be more important in rural than urban areas.

Data and Methods

The data for this study are cross-sectional and are taken from the Demographic and Health Surveys (GDHS) conducted on Ghana in three separate years (1993, 1998, and 2003). These data are pooled in one dataset for this analysis. GDHS surveys are based on a two-stage stratified design (GDHS 2003). At the first stage, enumeration areas (EAs) with population and household information is used as the sampling frame, EAs are then selected each with probability proportional to size. The second stage involves systematic sampling of households from those selected in the first stage. Each sample is selected in a manner as to allow for separate estimates for the country as a whole and each of the 10 regions of Ghana as well as urban and rural areas. Sample weights are used to compensate for unequal probability of selection between geographical regions and to make the data representative at the national level.

The survey instrument consisted of a household schedule and an individual questionnaire, the household schedule was used to list all usual members and visitors in the selected households. Information was then collected on the characteristics of each person listed, including age, sex and relationship to household head. Questions on the source of drinking water, type of toilet facility, dwelling characteristics and other household possessions and characteristics are also collected. Overall, the DHS provides a snapshot of the structure and composition of a household as well as its human and material resource base. The individual questionnaire also collects information on the background characteristics of women, fertility, family planning and child health. Information on mortality among infants and children are also collected using birth histories obtained from the mothers. Biological and maternal and child health indicators are also collected.

The sample for this analysis focuses on under-five mortality (0-59 months) of all last born children (except twins) within the five years period preceding each survey. The sample was limited to last born children because most information on maternal health and utilization factors in GDHS is limited to the last born child. This was also in an attempt to avoid a likely correlation in mortality risk for children in the same family due to genetic, behavioral, or socio-economic factors that are shared by children of the same mother (Curtis, Diamond and McDonald 1993, Das Gupta 1990; Guo 1993; Sear et al, 2002).

Measures

Dependent Variable: Our dependent variable is under-five mortality measured as the probability of dying between birth and exact age five for only last born children.

Independent Variables: Our main predictor is household structure defined into two broad groups; elementary households and extended households (Gage, Sommerfelt and Piani 1997).

Elementary households are defined as consisting only of parents and their biological children. These includes: (a) nuclear households; made up of a head, one spouse, and their biological children. (b) single-parent households made up of a household head and her biological children. (c) Elementary polygynous households made up of a head, more than one spouse and their biological children with no other relatives present.

Extended households are defined as households consisting of parents, their biological children and other family members or non relatives. These are sub-divided into two groups; (a) Three generational households made up of parents and parent in-law of the household head, these could also include grandchildren of the head of the household with at least one biological child of the head or spouse present. (b) Laterally extended households are made up of siblings, cousins and other relatives of the head. These broad definitions though do not capture the plethora of household forms that exist, provide a starting framework for analyzing the relationship between household structure and mortality. Furthermore, they capture essential cultural patterns of household formation. For instance, three generational households capture settings where different generations share the same housing unit, facilities and food. Laterally extended households depict setting where cooperation in farming and animal husbandry is associated with co-residence of brothers even after they marry and their parents have died (Timaeus and Graham, 1989).

Control Variables: We control for mother's education in accordance with existing literature on child mortality (Desai 1998; Ware 1984; Muhuri 1995). This variable is coded 0 for no education, 1 for primary education and 2 for secondary or higher education. Household socio-economic status is also controlled for. This is measured using principal component analysis to create an index of standard of living from all household possessions and consumer durables. This measure has been proven to be effective in settings that lack income data (Filmer and Pritchett 1999; Bawah 2004; Rutstein, 2004). Scoring coefficients were categorized into quintiles with the lowest 20% for the last quintile through the top most 20% for the first quintile.

These quintiles were further recoded into three levels; low consisting of the last two quintiles, medium consisting of the third quintile and high made up of the first two quintiles. A dummy variable was included to indicate when a child was born; this is to measure cohort effects on mortality and to serve as a proxy for period effects on child mortality. This variable was coded 1 if born in the 1990s and 0 if born later. Birth interval is measured as number of months between current and previous birth (1 if less than 24 months and 2 if greater than 24 months) (Wagstaff 2000; Whitworth 2002). Birth order is measured simply as the order of the child in relation to other siblings at birth. This is a continuous measure from 1-4 or more (Whitworth 2002). Age of mother at birth is measured as respondent's age in years (Hobcraft 1985). Duration of breastfeeding (Huffman and Lamphere 1984) was measured in months ranging from 1-60 months. Sex of the child is a dichotomous indicator of whether the child is male (1) or female (0). Prenatal and delivery care were combined as one variable. The variable was coded 1 if the mother had neither a prenatal check from a doctor or qualified health personnel and was not assisted by these personnel at delivery, 2 if the mother had received either prenatal checks or was assisted in delivery and 3 if the mother received both.

Statistical Model

To estimate the effect of households' structure on child death, we estimate discrete-time hazard models using logistic regression procedures. The use of discrete–time hazard models is appropriate as it allows modeling of censored data and permits the specification of a baseline hazard. We use five age intervals: 0, 1-5, 6-11, 12-23, and 24-59 months to specify the baseline hazard. These chosen age intervals are consistent with established conventions and assure that there are enough cases in each of them. The corresponding hazard is thus specified as a series of five dummy variables; these variables also account for unequal interval lengths. Each child thus contributes a minimum of 1 to a maximum of 5 observations depending on the age of the child at death or censoring. The estimated model can be specified in the following form:

$$\ln (P_{jt}/1 - P_{jt}) = \beta_0 + \beta_1 X_{jt} + \beta_2 z_j + \beta_3 T_{jt}$$

Where P_{jt} is the probability of dying for individual j in year t, β_0 is the intercept, β_1, β_2 , β_3 are vectors of coefficients, X_{jt} is a vector of household structure, z_j is a vector of control variables and T_{jt} is a specification for the baseline hazard of death which is parameterized as a series of dummy variables.

Our analysis was performed in two stages. In stage 1; we fit three models predicting under-five mortality from household structure. We start with a baseline model that includes only household structure and the dummy variables specifying the baseline hazard. We then add household socio-economic status indicators in model two. In the final model, we add bio-demographic and maternal health utilization variables.

The second part of the analysis is performed separately by rural and urban areas but maintain the same structure as in the models presented in the first stage.

Results for all models are presented in the form of odds ratios given by exponential co-efficient ß. An odds ratio greater than 1 means the child with the given characteristics is more likely than those in the reference category to die. Values of less than 1 signify that variables decrease the probability of under-five death relative to the reference category. A value of 1 means that the variable has no effect. For continuous variables, the odds ratios measure the change in under-five mortality per unit change in the variables.

Results

Trends in infant and child mortality

We first examine trends in infant (0-12 months) and under five (0-59 months) mortality for three five year periods of DHS surveys conducted in Ghana. These trends are presented in figure 1. Both indicators of childhood mortality declined between 1988-1993 and 1994-1998. However, these trends seems to have reversed within the period 1999-2003, when infant and under five mortality slightly increased from 57 deaths per 1000 live births to 64 deaths per 1000 live births and from 108 deaths per 1000 live births to 111 deaths per 1000 live births respectively. Further analysis of the component parts of infant mortality rates indicates that the slight increases seen in the 1999-2003 period were due to increases in neonatal and postnatal mortality within this period (GDHS, 2003). However, these increases are small and not statistically significant.

[Figure 1 about here]

Household Structure and Mortality

Next, we analyze survival function estimates by household structure. These are captured in figure 2. The survival function estimates were estimated at 0, 5, 11, 23, and 59 months and done separately for nuclear, single-parent, elementary polygynous, three generational and laterally extended households (Elementary polygynous households were excluded at this stage due to technical difficulties with fitting the survival curve at the latter intervals of survival). A clear difference can be observed in survival chances between children in nuclear households and other households at all ages of children under-five. However, it is only after two and half years of birth that the difference between nuclear households and single-parent households is vivid. The difference between three generational and laterally extended households also widens after two and half years of age (30 months). (The survival curve of elementary polygynous is excluded due to fewer deaths in later age intervals).

[Figure 2 here]

Household Structure and Risk Factors of Under-Five Mortality

Of central importance to our analysis are distributions of the structure of households in Ghana by bio-demographic risk factors and maternal utilization factors that are known to influence under-five mortality. These are presented in table 1. Overall, elementary polygynous households seem to be performing worse than other types of households. For instance, a higher proportion of mothers without an education are drawn from this category. Families with a lower standard of living index are also drawn from this category. Three generational families seem to have higher proportions in primary, secondary or higher education than nuclear families. Same trend can be observed for laterally extended families. Mean age at last birth for three generational and laterally extended families are about the same as those of nuclear and single-parent households. No differences can also be observed for prenatal and delivery care across family types. However, marginal differences can be observed in last born children reported not to be alive. The descriptive table does not show marked differences between household types and socio-economic or biological risk factors. However, marginal differences can be observed in child death. We probe these differences further in multivariate analysis.

[Table 1 here]

Multivariate Results

Table 2 presents the odds ratios for predictors of under-five mortality. Model 1 is a baseline model that includes only household structure and months since birth as covariates. In this model, the odds of mortality for a child living in an elementary polygynous household are more than double the odds of a child in a nuclear family household. Also, the odds of children living in three generational and laterally extended households are 68.6% and 70.3% higher, respectively, than those of nuclear households. These differences are statistically significant.

[Table 2 here]

In model 2, a set of socio-economic characteristics of households are included to examine if the differences in household structure can be explained by these factors. The inclusion of these factors does not noticeably change the differences between three generational and laterally extended households and nuclear households. Both differences remain statistically significant. However the differences observed for elementary polygynous households decreases considerably and are only significant at < .1 level. The results of model 2 demonstrate that household socio-economic factors do not fully explain under-five mortality differentials observed broadly between extended households and elementary households. However, the weakening of the differences and statistical significance observed for elementary polygynous households suggest the household socio-economic status is an effective intervening variable in the relationship between polygynous households and under-five mortality.

In model 3, bio-demographic and maternal health utilization factors are added. Their addition did not change the effect of household structure on under-five mortality. The odds of three generational and laterally extended households as compared to nuclear households are only changed slightly from the previous model. The differences observed for elementary polygynous household and nuclear households as observed in the previous model increased remarkably and was significant at <.05 level. The results of this model suggest that the differences observed between elementary polygynous, three generational and laterally extended households and under-five mortality are not solely a function of the association of these types of households with socio-economic status and bio-demographic factors.

The persistence of the significant effects of household structure on childhood mortality as seen in the three models presented in table 2 lends partial support to our theory that children in elementary households have lower risk of childhood mortality. The hypothesized benefit of extended households pooling resources from several adults in the households for the benefit of the child does not seem to be supported by these results. Instead a nuclear household with parents fully responsible for their own children has a positive effect on child mortality. As to whether these differences hold in rural and urban areas is the subject of discussion in the next section

Household structure and rural and urban mortality differentials

In the analysis presented in table 3, I analyze separately the effect of household structure on rural and urban areas. Similar models as presented for the entire sample are estimated for rural and urban areas.

Generally, the results observed in the rural sample mimic those observed for the entire sample. In model 1, the odds of mortality for a child living in an elementary polygynous household are nearly 2.2 times those of children living in nuclear households. Those of three generational and laterally extended households are 87.3% and 89.6% higher than those of nuclear households. These differences are all statistically significant.

[Table 3 here]

In model 2, where we add household socio-economic status, the effects observed for three generational and laterally extended households are virtually unchanged and are significant. This implies that the effect that these households have on under-five mortality cannot be fully explained by household socio-economic status. However the odds of elementary polygynous households are reduced but remain significant, suggesting that household socio-economic status mediates part of the effect these households have on under-five mortality. Polygynous households often connote a higher socio-economic status for males and this is likely to act in minimizing the effect of these households on childhood mortality.

In model 3, the effects of household structure are assessed with the addition of bio-demographic and maternal health utilization variables. The results of this model demonstrate even stronger and statistically significant effects of household structure on under-five mortality. Children in elementary polygynous, three generational and laterally extended households have higher odds of under-five mortality than those in nuclear households. This effect cannot be solely explained by household socio-economic status and bio-demographic factors. Even though, I do not discuss covariates of child mortality in this analysis to simplify the discussion, I will like to note that mother's primary education rather than household standard of living has a significant influence on childhood mortality in rural areas. Perhaps, living standards differentials among rural people are not large enough to have a significant influence on childhood mortality.

The results of the effects of household structure on childhood mortality in rural areas are informative as they show that in rural areas, where we may be inclined to suggest that adults in extended households pull pool resources for the advantage of children. This may be changing in different circumstances such as in times of low economic performance and sustained levels of rural-urban migration. The mortality advantage of nuclear families in rural areas could be justified in terms of the fact that in times of scarce resources parents are more likely to use their scarce resources to the health advantage of their children rather than for other children in the extended families.

The analysis on the effects of household structure on childhood mortality in urban areas reveals rather interesting findings (see table 4).

[Table 4 here]

Household structure has no effects on childhood mortality in urban areas. No significant differences can be discerned between extended households and elementary households in all three models estimated for urban areas. However, in model 2, living standards and secondary or higher education in urban areas has a strong and significant effect on childhood mortality. The odds of children whose mother has a secondary or higher education are 64.4% less than those whose mother has no education. Similarly, the odds of children who live in households with a higher living standard are 71.89% less than those who are found in a low standard of living in the household. These effects are increased and remain statistically significant in model 3, even if we control for bio-demographic and utilization factors.

The results in urban areas show that for urban areas, what matters for child mortality is not the structure of the household but the effects of individual socio-economic and bio-demographic factors. These factors have a direct effect on childhood mortality independent of household structure.

Discussion and Conclusion

This article examined differences by household structures in childhood mortality in Ghana using data from the demographic and health surveys. We argued from the critical perspective of economic models of the households that ignore cultural and social variations in applying these models to different family systems. We then drew from a conceptual framework similar to that first proposed by Mosley and Chen (1984) to explain the mechanisms through which household structure may influence childhood mortality by acting through socio-economic and bio-demographic and maternal utilization factors.

The results show that extended households have a negative impact on child mortality even if we control for socio-economic and biological risk factors as well as maternal utilization factors. This was clearly demonstrated by the higher odds of three generational and laterally extended households as well as elementary polygynous households as relative to nuclear households. Although the analysis lacked direct measures to test in full the assumptions of the new household model, what we found in this study seem to corroborate earlier findings that new household economic models do not adequately predict child health outcomes because they assume that income or opportunity for one family member translates into improvement for all household members particularly children (Desai 1992). Also, the simple assumption that household members may pool resources and thus improve or invest in children's health does not seem to be supported by the findings of this study. We infer from these findings that in difficult economic situations as pertains in many sub-Saharan African countries, the responsibility for care for children may fall first in the hands of parents than the extended family. .

The results as presented by rural and urban areas not only offer evidence that household types may operate differently from what has been predicted by new household models but that rural and urban socio-economic variations in household structures may be relevant for child survival. Whereas, in rural areas nuclear household structures are relevant and significantly predict lower odds of child mortality, similar significant effects are not shown in urban areas. Instead, standards of living and mother's education play a significant role in predicting the survival chances of children in urban areas. This could imply that in rural areas where resources and health services are more scarce, benefits accruing to nuclear families will be more important than in urban areas where access to these services are more readily available. With increasing urbanization and nuclearization of families as well as rural and urban migration, mother's education and higher standards of living act as formidable buffers to child mortality in urban areas than the living arrangements of children.

With policies of structural adjustment implemented in most sub-Saharan countries urban-rural inequalities have further widened. Similarly, governments' and donors' disproportionate attention to HIV/AIDS has tended to curtail renewed interest in reproductive and child health services therby compromising the quality of these services.

Thus in this era of vigorous efforts to meet the fourth goal of MDGs, community level health interventions must heed the needs of children in different household living arrangements. More research is however needed to clarify children in most vulnerable household arrangements and to target these children for community level health services.

A note on the limitations of this study and the need for further analysis is appropriate here, issues of health selection; that children in nuclear families may be in good health and may not be subject to socio-economic and biodemographic risk factors could also be at play. However the cross sectional nature of this dataset does not permit any analysis in that direction. We also see the findings of this study limited by the definitions and operationalisations of different household structures. For instance, our analysis excludes children in foster families; we also do not have information on children in single father families. Secondly, our data is cross-sectional and only provide a snap shot of households at a particular time. This design does not allow us to measure households as time varies and to take into consideration changing opportunities and constraints in the domestic cycle and in society in general. Thus a problem of temporal ordering could arise if household structure are measured at the time of each survey but child mortality is measured retrospectively.

We propose to deal with the limitations of this study by limiting analysis to infant mortality, this will help address the issue of temporal ordering and improve the strength of the argument promoted by these findings. Similarly, there’s the need for more control variables into the complex array of cultural issues that could be at play in child mortality. For example, are the survival chances of children in matrilineal households different from patrilineal households? How about religion?. Further analysis of this paper will be undertaken to strengthen the conclusions reached by these preliminary results.

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Whitworth, Alison, and Rob Stephenson. 2002. "Birth spacing, sibling rivalry and child mortality in India." *Social Science & Medicine* 55:2107-2119.

Figure 1 Trends in Infant and Under-five Mortality Rates Ghana 1988-2003

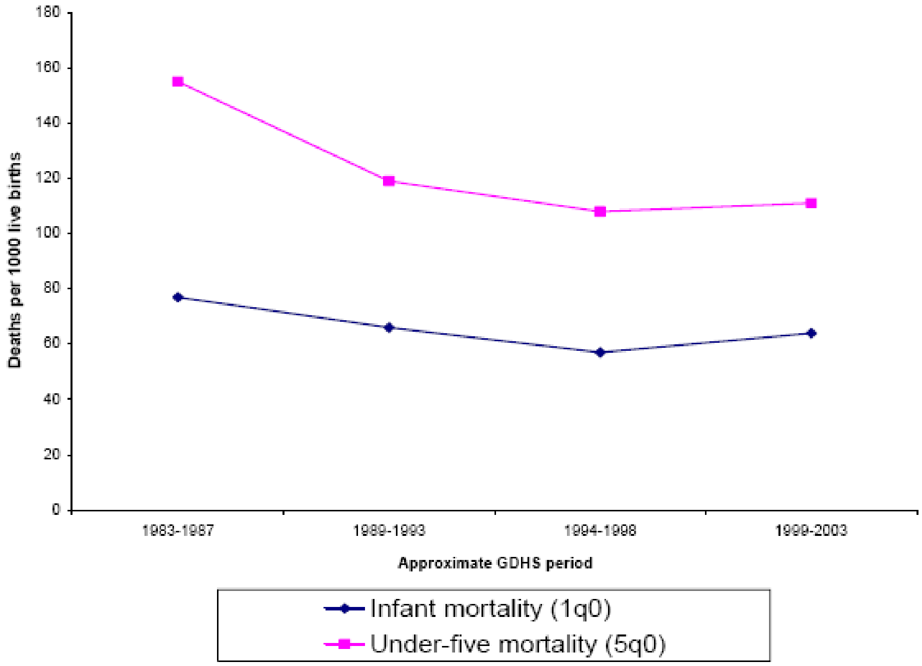

Figure 2: Child survival estimates by household structure

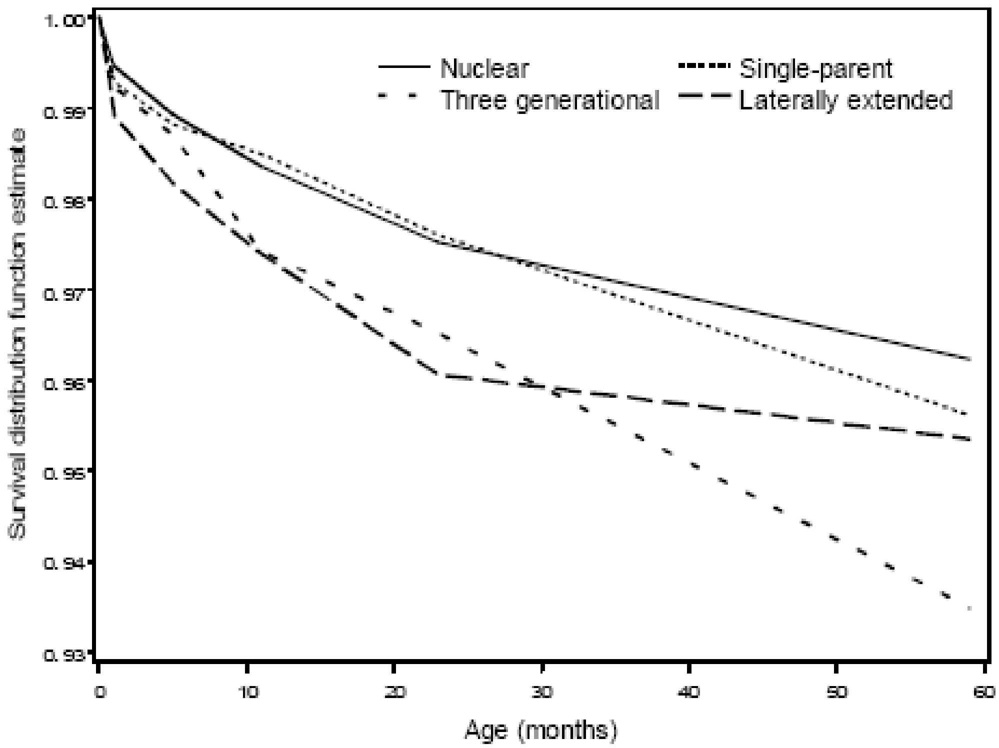

Table 1. Household structure by bio-demographic risk factors and maternal utilization factors of mothers of last born child. Ghana 1993, 1998, and 2003 (percentages unless otherwise indicated)

	Nuclear	Single parent	Elementary polygynous	Three generational	Lateral extended
Mother's education					
Secondary or Higher	24.8	29.7	2.6	33.0	30.0
Primary	24.8	43.5	6.3	33.1	27.4
No education	48.5	26.8	91.1	33.9	42.6
Standard of living index					
High	40.1	43.0	9.1	37.6	43.2
Medium	20.2	24.6	22.0	21.1	20.1
Low	39.8	32.5	69.0	41.4	36.7
Born in the 1990s	66.2	77.7	67.3	60.7	60.7
Mean age of mother at birth (standard deviation)	28.9	28.3	31.5	26.6	27.5
Mean months of breastfeeding (standard deviation)	14.4	14.5	15.5	14.3	14.4
Prenatal care	89.3	92.4	74.6	89.5	91.1
Delivery care	53.9	66.6	24.8	55.8	57.5
Birth interval < 24 months	53.9	51.3	50.8	71.7	63.9
Child not Alive	2.2	2.4	4.2	3.4	3.3
N	2634	1140	496	788.0	1293

Table 2: Odds ratio (with standard errors) of the relationship between family structure and child death

	Model 1	Model 2	Model 3
Family Structure			
Single-parent	1.054	1.13	1.18
	(0.237)	(0.241)	(0.246)
Elementary polygynous	2.13 **	1.66 +	2.05 *
	(0.283)	(0.293)	(0.303)
Three-generational	1.69 *	1.71 *	1.77 *
	(0.234)	(0.236)	(0.245)
Laterally extended	1.703 **	1.709 **	1.689 *
	(0.205)	(0.205)	(0.216)
(Nuclear)	1	1	1
Month			
('0)	1	1	1
'1-5	0.679 *	0.659 *	0.09 **
	(0.273)	(0.274)	(0.313)
'6-11	0.756	0.737	0.27 **
	(0.276)	(0.277)	(0.294)
'12-23	0.7	0.69	0.58
	(0.293)	(0.293)	(0.306)
'24-59	0.89	0.863	0.09
	(0.261)	(0.261)	(0.306)
Place of Residence			
Urban		1.27	1.118
		(0.207)	(0.224)
(Rural)		1	1
Mother's eductaion			
Secondary or Higher		0.66 +	0.65 +
		(0.219)	(0.233)
Primary		0.80	0.74
		(0.197)	(0.207)
(No education)		1	1
Standard of living index			
(Low)		1	1
Medium		0.61 *	0.57 *
		(0.226)	(0.237)
High		1.027	1.006
		(0.199)	(0.205)
Born in the 1990s		0.70 *	0.92
		(0.162)	(0.229)
(Born in the 2000s)		1	1
Prenatal care and delivery assistance			
(Received both)			1
Received either			0.80
			(0.313)
Received neither			0.672
			(0.313)
Months of breast feeding			0.76 *
			(0.017)
Sex of the child			
Male			1.081
			(0.159)
(Female)			1
Mother's age at child brith			0.83 +
			()0.102
Mother's age squared			1.00 +
			(0.002)
Birth interval			
Greater than 24 months			1.95 **
			(0.242)
(Less than 24 months)			1
Birth order			
'1			0.26 **
			(0.384) *
'2			0.50
			(0.295)
'3			0.76
			(0.264)
('4)			1
-2 log likelihood	1988	1969	1574
N	24597	24597	24597

*= <.05, ** = <.01 + = <.1
() Reference category

Table 3: Odds ratio (with standard errors) of the relationship between family structure and child death in rural areas

	Rural		
	Model 1	Model 2	Model 3
Family Structure			
Single-parent	0.977	1.041	1.04
	(0.302)	(0.305)	(0.314)
Elementary polygynous	2.169 *	1.87 *	2.44 **
	(0.300)	(0.310)	(0.322)
Three-generational	1.873 *	1.947 *	2.24 **
	(0.279)	(0.272)	(0.284)
Laterally extended	1.896 **	1.909 **	1.982 **
	(0.243)	(0.244)	(0.253)
(Nuclear)	1	1	1
Month			
('0)	1	1	1
'1-5	0.954	0.949 *	0.07 **
	(0.337)	(0.338)	(0.397)
'6-11	0.89	0.887 *	0.08 **
	(0.342)	(0.343)	(0.394)
'12-23	1.034	1.032	0.30
	(0.343)	(0.343)	(0.368)
'24-59	0.969	0.969	0.77
Mother's eductaion			
Secondary or Higher		0.856	0.87
		(0.253)	(0.274)
Primary		0.657 +	0.64 +
		(0.243)	(0.271)
(No education)		1	1
Standard of living index			
(Low)		1	1
Medium		1.11	1.09
		(0.219)	(0.231)
High		0.837 *	0.85 *
		(0.257)	(0.271)
Born in the 1990s		1.01	1.55
		(0.200)	(0.276)
(Born in the 2000s)		1	1
Prenatal care and delivery assistance			
(Received both)		1	1
Received either			0.78
			(0.216)
Received neither			0.75
			(0.326)
Months of breast feeding			0.75 **
			(0.02)
Sex of the child			
Male			0.86
			(0.188)
(Female)			1
Mother's age at child brith			0.92
			(0.127)
Mother's age squared			1.00
			(0.001)
Birth interval			
Greater than 24 months			0.313
			(0.269)
(Less than 24 months)			1
Birth order			
'1			0.28 *
			(0.459)
'2			0.52 **
			(0.355)
'3			0.80 *
			(0.312)
('4)			1
-2 log likelihood	1426	1422	1108
N	17930	17930	17930

*= <.05, ** = <.01 + = <.1
() Reference category

Table 4: Odds ratio (with standard errors) of the relationship between family structure and child death in Urban areas

	Urban		
	Model 1	Model 2	Model 3
Family Structure			
Single-parent	1.17	1.017	1.26
Elementary polygynous	1.691	1.514	3.35
Three-generational	1.224	1.223	1.14
Laterally extended	1.358	1.266	1.6
(Nuclear)	1	1	1
Month			
('0)	1	1	1
'1-5	0.818 *	0.755 *	0.14 **
'6-11	0.379 *	0.349 *	0.08 **
'12-23	0.361	0.334	0.16
'24-59	0.325	0.312	0.27
Mother's eductaion			
Secondary or Higher		0.356	0.33 **
Primary		1.09	0.79
(No education)		1	1
Standard of living index			
(Low)		1	1
Medium		0.597	0.61
High		0.282 *	0.262 **
Born in the 1990s		0.30	0.33 *
		(0.307) **	(0.487)
(Born in the 2000s)		1	1
Prenatal care and delivery assistance			
(Received both)			1
Received either			1.22
			(0.351)
Received neither			0.001
Months of breast feeding			0.78 *
			(0.98)
Sex of the child			
Male			1.06
			(0.312)
(Female)			1
Mother's age at child brith			0.67
			(0.190)
Mother's age squared			1.01 *
			(0.002)
Birth interval			
Greater than 24 months			1.31
			(0.575)
(Less than 24 months)			1
Birth order			
'1			0.35
			(0.786)
'2			0.68
			(0.577)
'3			1.07 *
			(0.519)
('4)			1
-2 log likelihood	552.8	514.6	419.4
N	6667	6667	6667

*= <.05, ** = <.01 + = <.1
() Reference category