Rebecca Sear

Kin and child survival in Malawi: are matrilineal kin always beneficial in a matrilineal society?

Article (Accepted version)
(Refereed)

Original citation:
Sear, Rebecca (2008) Kin and child survival in Malawi: are matrilineal kin always beneficial in a matrilineal society? Human nature, 19 (3). pp. 277-293.
DOI: 10.1007/s12110-008-9042-4

Kin and child survival in rural Malawi: are matrilineal kin always beneficial in a matrilineal society?

Rebecca Sear

Department of Social Policy
London School of Economics
Houghton St, London WC2A 2AE
Tel: +44 (0)20 7955 7348 Fax: +44 (0)20 7955 7415
Email: r.sear@lse.ac.uk

Abstract

Here we investigate the impact of kin on child survival in a matrilineal society in Malawi. Women usually live in close proximity to their matrilineal kin in this agricultural community, allowing opportunities for helping behaviour between matrilineal relatives. However, there is little evidence that matrilineal kin are beneficial to children. On the contrary, child mortality rates appear to be higher in the presence of maternal grandmothers and maternal aunts. These effects are modified by the sex of child and resource ownership: female children and children in households where women, rather than men, own land suffer higher mortality rates in the presence of maternal kin. These modifiers suggests the detrimental effects of matrilineal kin may result from competition between such kin for resources. There are some positive effects of kin on child survival: the presence of elder siblings of both sexes is correlated with higher survival rates, and there is some weak evidence that paternal grandmothers may be beneficial to a child's survival chances. There is little evidence that any male kin, whether matrilineal or patrilineal, and including fathers, affect child mortality rates. This study highlights the importance of taking social and ecological context into account when investigating relationships between kin.

Keywords: kin, child mortality, matriliny, Malawi

List of Figures

Figure 1: odds ratios for the probability of death by survival status of maternal grandmother and sex of child (open bars represent males, grey bars females), adjusted for control variables

Figure 2: odds ratios for the probability of death by number of living maternal aunts and household land ownership (open bars represent households in which women own land, grey bars those in which men own land), adjusted for control variables

Figure 3: odds ratios for the probability of death by number of living elder brothers and household land ownership (open bars represent households in which women own land, grey bars those in which men own land), adjusted for control variables

List of Tables

Table 1: household characteristics by land ownership

Table 2: descriptive data (sample sizes and percentage of children dead in each category) for variables used in the analysis

Table 3: results of logistic regression analysis on the probability of child death

INTRODUCTION

Empirical evidence has been rapidly accumulating over the last few years that kin are important to child well-being and survival (e.g. Beise 2002; Beise 2005; Gibson and Mace 2005; Leonetti et al. 2004; Leonetti et al. 2005; Mace and Sear 2005; Sear et al. 2000; Sear et al. 2002). This research stems from the theoretical expectation that human child-rearing may be subsidised by other family members, since our rapid reproductive rate and the altriciality of human children make the costs of child-raising too great for mothers to bear alone. We have recently reviewed the evidence, from 45 published studies, on whether relatives (including fathers) are beneficial to child survival (Sear and Mace 2008). The results of this review suggest that mothers do receive help from at least one other relative in almost every society where such help has been looked for. Who helps, however, varies between populations. Maternal grandmothers and elder sibling 'helpers-at-the-nest' appear to be reasonably consistent at improving child survival rates (though there are exceptions). The effects of fathers and paternal grandmothers are much more variable: sometimes they are beneficial, sometimes not.

Kin are not always beneficial, however. A few of these studies have shown that the presence of particular kin increases child mortality. In certain populations, the presence of fathers, paternal grandmothers or grandfathers has been found to increase the risk of child death (though sometimes these detrimental effects are seen only in one sex: Campbell and Lee 1996; Derosas 2002; Gibson in preparation; Kemkes-Grottenthaler 2005; Sorenson Jamison et al. 2002). Kin are only expected to help one another out when the benefits of helping outweigh the costs (weighted by relatedness: Hamilton 1964). Availability and distribution of resources may affect this calculation of costs and benefits. Given that kin often share the same resource base, there may be competition between relatives for resources when these resources are scarce (West et al. 2002). Such competition is most comprehensively documented between siblings (e.g. Borgerhoff Mulder 1998; Borgerhoff Mulder 2007; Hadley 2004; Hagen et al. 2001; Lawson and Mace in preparation; Low 1991; Mace 1996; Muhuri and Preston 1991; Wahab et al. 2001), but may also occur between other categories of relative who live and work together.

An additional complication is that ‘kin’ who live together are not all genetically related. Individuals who marry into a household are not genetically related to adult family members in that household (they are affinal kin). Though the reproductive interests of both affinal and genetically related kin within a household will often coincide (since both may benefit from co-operating in the raising of children within the household, who will be related to both affinal and genetically related adults), this may not always be the case. Affinal kin always have the option of deserting a household if it is likely to improve their reproductive success; and genetic kin may be able to replace any affinal kin by bringing in more spouses to the household. Such conflict of interests between non(genetically)-related kin may spill over into adverse effects on the children within a household.

Although the number of studies investigating the impact of kin on child survival has been increasing recently, the conclusions described above are still based on relatively small sample sizes. More data are needed from high fertility, high mortality societies in order to understand why kin help (or hindrance) varies between populations: what aspects of the social and ecological environment cause this variation in kin effects? Here, we add to this literature by presenting an analysis of the impact of kin on child survival in a matrilineal community in Malawi. Matriliny is a relatively unusual inheritance system in which resources are passed along the female line: in the Standard Cross-Cultural Sample only 17% of societies are matrilineal (Murdock 1967). Much of the traditional anthropological literature on matriliny focuses on societies in which men own resources, but pass them on to their matrilineal relatives (i.e. their sisters’ sons) rather than their own sons. In matrilineal societies in the part of the world considered here, however, resources are not only passed along the female line, they are also largely owned by women so that inheritance passes directly from mother to daughter (Davison 1997).

Most previous research on the effects of kin on child mortality has been undertaken in patrilineal societies (since most societies are patrilineal). One study did compare the kin and child mortality relationship in a matrilineal and a patrilineal group in northern India (Leonetti et al. 2005), and found that while maternal grandmothers supported their daughters and improved child survival rates in the matrilineal community, *paternal* grandmothers improved child survival rates in the patrilineal community. Do we find a similar beneficial effect of matrilineal kin in this African matrilineal community?

DATA

Data were collected in 1997 during a single round demographic survey conducted by the author. Two villages were surveyed, situated on Lake Malawi in the Southern region of Malawi. Both women and men of reproductive-age were interviewed and were asked to give complete marriage and birth histories. Information was also collected on household economics, including how households earned their living. For farming households, information on farm size was collected as a measure of wealth. Additional information was collected on who owned the farm, and from whom they had inherited it (strictly speaking, land is owned by the village chief, but once families have been allocated land by the chief they are able to pass it on to their heirs: Takane 2007). Information on the survival and residence status of parents was also collected from both men and women.

One village was largely an agricultural village, though some income was also earned through trade, crewing on fishing boats in neighbouring fishing villages and occasional waged work. The second was originally an agricultural village but has recently expanded with an influx of fishermen from northern Malawi, who established a commercial fishing industry in the village. For this analysis, only members of the matrilineal Chewa ethnic group are included, who are the long-established farmers of this region. The population of the agricultural village was very largely Chewa; the population of the fishing village was of mixed ethnic origin, with

Chewa making up approximately one-third of the residents. Only Chewa who were still primarily agricultural were included in the analysis: the small proportion who had no farms or whose main means of subsistence was other than agriculture were excluded, since households who have moved largely into a monetary economy may have different patterns of kin relationships to those still living a traditional agricultural life.

The Chewa were traditionally matrilineal and matrilocal (Marwick 1952; Phiri 1983; Tew 1950). Women usually remained within their natal villages at marriage and lived close to their mothers and matrilineal kin. Women were allocated land by the matriline when they married, and farmed this land along with their husband and children. The ideal is of equal distribution of farmland among daughters. However, available farmland is scarce in this densely populated African country, and some authors suggest that later-born daughters may lose out in the distribution of farmland, as they are the last to marry and be allocated farmland (Hirschmann and Vaughan 1983; Peters 1997). The extended family rarely farms together, though food may be shared and eaten together with kin living nearby (Hirschmann and Vaughan 1983). Marriages were usually monogamous: polygyny was not prohibited but in practice was rather rare. Though this summary describes the traditional Chewa way of life, there is some evidence in recent years that the Chewa are adopting more patrilineal customs, with men becoming more likely to own their own land and pass it onto sons (Mtika and Doctor 2002), as tends to happen to matrilineal societies during economic development (Holden et al. 2003). However, there is also a degree of flexibility in land transfers, which may be due in part to increasing land scarcity in Malawi, so that individuals must obtain land through non-traditional means. This has led some authors cautioning against the simplistic notion of a shift from a matrilineal to an increasingly patrilineal society (Takane 2007).

In this survey, and for the sample of households used in this analysis, in about 80% of all households gardens were owned by women; men owned land in the majority of the remaining 20%; in only a handful of households did both sexes own land. The vast majority of these gardens were reported to have been inherited matrilineally: 95% of gardens owned by women were reported to have been inherited from matrilineal kin (92% directly from mothers). The majority of the remaining 5% were obtained directly from the village chief: only 5 women reported inheriting from patrilineal kin. Men also reported that the majority of their land had been inherited from matri-kin, but were more likely than women to report having inherited it from patrilineal kin (see Table 1 for descriptive data and statistical tests of how gardens owned by women and men differ). 75% of gardens owned by men came from matrikin (73% directly from mothers) and 19% from patri-kin (most commonly from fathers – 7% – or paternal grandmothers – 7%). There was little evidence for the importance of the mother's brother, at least in terms of land inheritance, as only 2 women and no men in this sample reported inheriting land from their mother's brother. Households in which men owned land tended to be somewhat wealthier than those in which women owned land, suggesting that men may be more likely to inherit in wealthy families: gardens owned by men were significantly larger than those owned by women; households where men owned gardens were also more likely to farm a larger number of crop types (including cash crops such as tobacco or cotton), and to own livestock and fishing gear (all of which are indicators of relatively high wealth).

Demographically, this was a high fertility and high mortality population. There was little access to contraception and limited medical care available in this rural area. The TFR in 1996 for this population was 5.89, and 12% of all children born within the 5 years preceding the survey were reported dead. Mortality is likely to be under-estimated in a retrospective survey such as this, and this figure is lower than that expected from official statistics for the same time period for the national Malawian population. For example, the 1998 Malawian census estimated that 12.1% of all Malawian children died in infancy (the first year of life) in the year preceding the census, and this proportion was slightly higher (14.1%) in the Southern Region, where this study took place (National Statistical Office of Malawi, 1998). However, these is no reason to suppose that mortality under-reporting is biased according to any of the kin variables of interest, so that the statistical analysis should not be biased by under-reporting of deaths. Both sexes married at a relatively young age, the singulate mean age at marriage for women in this population was 20 years, for men 25 years. Polygyny was extremely uncommon: less than 2% of mothers in this sample reported having co-wives. Post-marital residence was largely matri-local: over 90% of women reported residing in their own mother's village after marriage. Most women drew husbands from the same village, however, as about 60% reported that their husbands' mothers were also available in their own villages after marriage.

METHODS

Women's birth histories were used to create the sample of children used in this analysis. Only children born within the 10 years prior to the survey were included, and only Chewa children born into primarily farming families as described above. The total sample size was 1635 children, of whom 187 (11.4%) had died. Logistic regression was used to analyse the probability of child death. There is likely to be some 'clustering' of datapoints (i.e. children) in this sample, in that some women would have contributed more than one child to the analysis. If the mortality risks of children within the same family are correlated (and there is evidence that this is so: Curtis et al. 1993; Sear et al. 2002), such clustering of datapoints can lead to under-estimation of the standard errors in normal regression analyses (Guo 1993). Exploratory multi-level logistic models were run to determine whether there was any evidence that children from the same mother had correlated probabilities of dying. No such evidence was found. However, robust standard errors are reported for this analysis, to control for the clustering of children within families.

The effects of the following categories of kin on child mortality were investigated (data on all kin were current status, i.e. the survival and residential status of each relative at the time of the survey was recorded):

- *Father*: data were available from women's marriage histories on the status of each child's father. Three codes (alive and still married to mother, divorced and dead) were used for the current status of the father, because divorce may have different consequences for children than the father's death. Dummy variables for father dead and divorced were included in statistical models.
- *Maternal and paternal grandmothers*: data on both the survival and place of usual residence of maternal and paternal grandmothers were collected (grandmothers not living in the same village as the child may not be readily available to help mothers out), so three codes were also used for maternal and paternal grandmothers: alive and living in the same village as the child, alive but living in a different village and dead. The latter two dummy variables were included in the models.
- *Maternal and paternal grandfathers*: residential status was not available for grandfathers, so both maternal and paternal grandfathers were simply coded as alive or dead.
- *Maternal and paternal aunts and uncles*: number of maternal and paternal aunts and uncles were coded as continuous variables: number of living older aunts or uncles (where older refers to older than the child's mother for maternal aunts and uncles and older than the child's father for paternal aunts and uncles). Exploratory analysis also included variables for the total number of aunts or uncles and number of younger aunts or uncles, but these models suggested that it was number of *older* relatives that was most important.
- *Older brothers and sisters*: these variables were also coded as continuous variables: number of living older brothers or sisters of the child.

A number of control variables were included to adjust for other factors which are known to affect child mortality: child's year of birth, birth order, maternal age, whether the child was a twin and length of previous inter-birth interval. Measures of both the absolute level of resources available to a household, and who owns those resources, were also included, since both overall wealth, and who owns this wealth (i.e. women or men) may affect child mortality. Wealth was defined by garden size (in hectares). Resource ownership was divided into two categories: households in which only women owned land, and those in which either men only or both men and women owned land (the latter category consists largely of households in which only men owned land, as only 8% of children in this category lived in households where both men and women owned land). Dummy variables for missing data for each variable (both kin and control variables) were included in initial models, but were dropped from the model as all missing dummies were non-significant.

Logistic regression models on the probability of child death were run twice. The first model included all kin and control variables described above, and listed in Table 2 (which shows all the variables included in the analysis, with descriptive data for each category). The second model also included interaction terms between: all kin variables and sex of child; all kin variables and overall wealth; and all kin variables and land ownership. Previous research has indicated that kin effects may depend both on the child's sex (Gibson and Mace 2005; Sorenson Jamison et al. 2002) and on the level of resources available to a household (e.g. Borgerhoff Mulder 2007). Interaction terms were therefore included in the second model to determine whether the sex of the child, access to resources, or how those resources were allocated within the household, affected relationships between kin and child mortality. All non-significant interactions were dropped from the final model.

RESULTS

The results of the logistic regressions on the probability of child death are shown in Table 3. Two models are presented: the first including only main effects; the second including all significant interaction terms between the kin variables and sex of child, kin variables and wealth, and kin variables and land ownership (only 3 interaction terms were significant; all others were dropped from the model). Odds ratios are the most easily interpreted output from a logistic regression analysis. In this case, an odds ratio greater than one means that a child in that particular category had an increased risk of dying compared to the reference category. An odds ratio below 1 means a lower risk of dying compared to the reference category. For example, children whose mothers were divorced from their fathers have a risk of dying which is more than double that for children whose mothers are still married to their fathers (in Model 1 an odds ratio of 2.34 for children of divorced mothers indicates that these children have a risk of dying 2.34 times greater than that of children in the reference category, i.e. those with mothers still married to their fathers). This difference is statistically significant. There is no significant difference, however, in the mortality risks of children whose fathers are dead, compared to those with married parents. This suggests the detrimental effect of father absence may be restricted to divorce, and is not associated with the death of the father.

Maternal grandmothers also have a significant impact on child mortality, but, rather than being protective against mortality, their presence appears to increase mortality rates. If the maternal grandmother is dead, the child has a *lower* risk of death than if its maternal grandmother were alive and living in the same village. This effect, however, is only apparent for female children. In Model 1, including only main effects, the detrimental effect of the maternal grandmother is not statistically significant. It is significant in Model 2, which includes an interaction between the survival status of the maternal grandmother and the sex of the child (this interaction was the only – marginally – significant interaction between sex of child and any kin variable: p=0.076). Figure 1 illustrates this interaction: the mortality risk of boys is similar regardless of whether the maternal grandmother was alive or dead; but the mortality risk of girls is about half that in the absence of the maternal grandmother compared to that when maternal grandmothers are present (odds ratio = 0.47). There was no main effect of sex of child: so overall, there was no difference in the survival rates of boys and girls.

Maternal aunts also appear to have a negative impact on children. In Model 1, there is a marginally significant (p=0.064) effect of maternal aunts on child mortality: the more living older sisters the child's mother has, the higher the child's risk of death. Again, however, this effect is not straightforward, as there was a significant interaction between having living maternal aunts and land ownership. Model 2 in Table 3 and Figure 2 show that the negative effect of maternal aunts was restricted to households in which women owned land: in these households, having more maternal aunts resulted in an increase in child mortality rates. In contrast, where men owned land, maternal aunts had a protective effect against child mortality. Overall, children in households in which women owned land appeared to have somewhat lower mortality than those in which men owned land, though this main effect was not significant in Model 1, which included no interaction terms. No adult male maternal kin – neither maternal grandfathers nor maternal uncles – had any effect on mortality risk.

Turning to paternal relatives, there is some weak evidence that paternal grandmothers may lower child mortality rates. The lowest mortality rates were for children whose paternal grandmothers were still alive and living in the same village. The mortality risk for children whose paternal grandmothers were dead was slightly higher, but not significantly different from this reference category. But the mortality risk of children whose paternal grandmothers were alive but lived in a different village was significantly elevated over that of children whose paternal grandmothers were available in the same village. As with maternal kin, there was no evidence that male paternal kin – grandfathers and uncles – had any effect on child mortality.

Having living older siblings of either sex decreased the risk of dying significantly, and this effect was independent of the sex of the child. There were no significant interactions involving the number of living older sisters, but the effect of brothers was modified by land ownership. Though the presence of older brothers lowered mortality rates in all kinds of household, their effect was much stronger in households in which men, rather than women, owned land (Figure 3).

Finally, as expected, the biodemographic variables included as controls in the model were significantly related to child mortality: twins, children born to older mothers, firstborns and later born children, and children born after short birth intervals all suffered relatively high mortality. Wealth was also significantly correlated with mortality risk: children born into households with large garden sizes had lower mortality rates than poorer families. But no interactions between the level of resources available and any category of kin were significant in this analysis, suggesting that it is not the amount of resources available that affects kin relationships, but who owns those resources.

DISCUSSION

The results suggest that kin have a significant impact on child mortality rates in this Malawian population, as they do in almost every other population where this effect has been investigated. However, unlike most other populations, the evidence that grandmothers protect child against mortality is rather weak. Maternal grandmothers even appear to increase mortality rates (though this effect is restricted to female children). There is some suggestive evidence that paternal grandmothers may be protective, in that significantly higher mortality rates were seen in children whose paternal grandmothers were alive but living apart from the child, compared to those who were resident in the child's village. But children whose paternal grandmothers were dead did not appear to have elevated mortality risks, which leaves open the possibility that it is not care or help from the paternal grandmother that affects child mortality, but perhaps some correlate of having a father from a different village.

This is the first study which has shown a detrimental effect of maternal grandmothers, but other studies have found detrimental effects of paternal grandmothers. In both historical

Germany (Beise 2002) and historical Japan (Sorenson Jamison et al. 2002), paternal grandmothers were found to increase child mortality rates (though the latter effect was seen only for boys). Beise interpreted his finding as the result of conflict between women and their mother-in-laws. While the reproductive interests of women and their own mothers are often closely aligned, those of women and their mothers-in-law are not always in harmony. Mothers-in-law cannot be certain that any children produced by their daughter-in-law are genetically related to them, and, given their lack of genetic relatedness, daughters-in-law are also to some extent expendable to mothers-in-law (sons can always take another wife to continue reproducing her lineage). Such tensions between mothers- and daughters-in-law may result in higher mortality for any children produced, or the woman herself (Skinner 1997), as well as changes in reproductive behaviour or fertility rates in the presence of mothers-in-law (Kadir et al. 2003; Leonetti et al. 2005; Sear et al. 2003; Skinner 2004; Tymicki 2004).

Tensions should not arise between women and their own mothers for the reasons given above, since mothers and daughters are genetically related. But, as stated in the Introduction, relationships between even genetically related individuals may be characterised by competitive, rather than cooperative, interactions. Maternal grandmothers will be striving to maximise their reproductive success by spreading their investment over all their children and children's children. In situations such as this Malawian context, where resources are scarce and where a fixed resource-base will become diluted as it is shared among more offspring, women must allocate their resources carefully in order to maximise their total production of offspring and grandoffspring. This resource allocation may come at the expense of certain grandchildren, in this case apparently female grandchildren, who will create greater competition for resources within the family than male grandchildren. This hypothesis that matrilineal kin are likely to be in conflict with one another over the valuable and restricted resource of land is supported by the maternal aunt effect on child mortality. Mortality rates are elevated in children whose mothers have living older sisters, but only in households where women own land. Where men own resources, maternal aunts have a protective effect on child mortality. Competition between matrilineal kin is likely to be strongest in families still living the traditional matrilineal way of life where women own the resources and allocate them to matrilineal kin.

The exact mechanism by which maternal grandmothers increase the mortality rates of their granddaughters is not clear. Several studies in both sub-Saharan Africa and India have shown that grandmothers can have an important influence on child feeding practices (Aubel et al. 2004; Bezner et al. 2008; Douglass et al. 2007; Sharma and Kanani 2006). For example, in northern Malawi, where the population is predominantly patrilineal, paternal grandmothers are key decision-makers in the decision on when to introduce complementary foods to breast-feeding babies, and may be involved in the decision to stop breast-feeding a child (Bezner et al. 2008). These grandmothers are also frequent care-takers of toddlers, when the mother is away from the household, and so may have some control over how often children are fed. Such influence could potentially be exerted in ways which affect the mortality rates of children, either positively or negatively. Early complementary feeding and early cessation of breast-feeding, for example, may both be associated with higher morbidity and mortality rates of children (Briend et al. 1988; Feacham and Koblinsky 1984; Kalanda et al. 2005).

However, the mortality rates of children whose maternal grandmothers were alive but not resident in the village were no different from those whose maternal grandmothers did reside in the same village as the child (at least in the statistical analysis; the raw data suggest such children have the highest mortality rates of all), which may imply that the detrimental effect of maternal grandmothers is not due to direct influence. Unfortunately, the small sample size of children who fell into the maternal grandmother alive but absent category, as well as collinearity between this variable and female ownership of land, makes any definitive conclusions about relative mortality rates difficult for children in this category. An additional difficulty is that the variable on grandmaternal residence was constructed from a question which asked women ‘where does your mother live?’, likely to be interpreted as requiring information on the usual place of residence of the grandmother, rather than directly obtaining information on the residence of grandmothers when the child of interest was potentially under grandmaternal care. Given that grandmothers may visit their daughters frequently (e.g. Gibson and Mace 2005), particularly when their daughters have recently given birth, this variable may not accurately capture grandmaternal residence patterns.

The mechanism by which maternal aunts increase child mortality rates (or decrease them in patrilineal households) can also only be speculated upon. There is little literature to suggest that maternal aunts are influential in the care or feeding of their nieces and nephews, though adult sisters may live in close proximity within villages, which at least opens up the possibility that maternal aunts may have such an influence. Few other studies have looked at the influence of aunts on child mortality, so there is relatively little comparative evidence to help explain this finding, though Borgerhoff Mulder (2007) did find that paternal uncles improved child survival rates in patrilineal agropastoralists in Kenya, the reverse of the negative effect of maternal aunts in this matrilineal society. This effect, however, was much more noticeable in rich households compared to poor, suggesting such kin may only be inclined towards nepotism when resources are plentiful. A similarly resource-dependent effect of maternal kin networks was found by Hadley (2004) on child health amongst the Pimbwe, patrilineal horticulturalists in Tanzania. Children whose mothers had large kin networks had better anthropometric status than those with small kin networks, and this positive effect appeared to be largely due to the number of mother’s sisters available. In contrast to Borgerhoff Mulder’s findings, however, this effect appeared to be strongest in poorer households. Children in the richest households may even have suffered a health cost in having too many maternal aunts, similar to the negative effect of aunts reported here. In the Tanzanian study, respondents were also asked how they felt about the availability of kin, and reported in roughly equal numbers that kin could either be a help in providing food, money and support or a hindrance because of the ‘conflict’ they caused. Clearly, individuals in such subsistence societies recognise that kin can be costly, as well as beneficial, though further research is needed to determine exactly how such conflict might harm child health or survival prospects.

Here in this Malawian population, there appeared to be no modifying effects of the overall level of wealth: interaction terms between overall garden size and all kin variables were included in exploratory models but were not significant. To explore potential wealth effects more fully, the data was also broken down by wealth category (rich, poor and medium) and separate statistical models run by wealth class. There was no evidence in any of these models that any of the kin effects were influenced by the wealth of a family. Who owns household wealth appeared to be far more important than the level of wealth available, in that land ownership did modify the effects of maternal aunts and elder brothers. There is some collinearity between land ownership and wealth, in that gardens owned by men are significantly larger than those owned by women, though this effect is fairly small (male-owned gardens are 0.3 ha larger on average). But to check for potential distorting effects of collinearity, separate models were also run by wealth class after the data had been divided into women-owned households and men-owned households. There was again no evidence that wealth had any modifying influence on kin effects, so that, for example, the detrimental effect of maternal aunts was seen at all levels of wealth in female-owned households. This analysis provides further evidence that kin effects on child mortality are contingent on resource access, but it also demonstrates that who controls resources within the household should be taken into account, and not only the level of resources.

Older siblings of both sexes were significantly correlated with lower mortality risk. This is consistent with the hypothesis that older children act as ‘helpers-at-the-nest’, and improve the survival rates of their younger siblings by relieving some of the mother’s domestic and subsistence burden. But as with other relatives, demonstrating a correlation between child survival and the presence of older siblings does not mean that we have demonstrated a causal relationship. Such a correlation between the survival of siblings from the same family may be brought about because women differ in their ability to keep children alive (Pennington and Harpending 1993). Exploratory analysis showed no evidence for such correlated mortality risks between children from the same mother in this dataset, but the dataset was restricted to children born within 10 years of the survey, thereby reducing the number of children any one women contributed to the dataset. Perhaps arguing against the possibility that siblings have correlated mortality risks because of the characteristics of the mother is the observation that the effect of older brothers at least is modified by land ownership. Older brothers had a greater protective effect in households where men owned land, compared to those in which women owned land. It is possible boys are more useful in households where men undertake a substantial responsibility for subsistence work. In addition, ethnographic evidence can support the argument for helping-at-the-nest by providing evidence that kin are directly helpful to mothers: for example, research on this population has demonstrated the usefulness of daughters in helping mothers out with the arduous job of collecting firewood (Biran et al. 2004). But more detailed time budget data are required to fully understand the mechanisms by which such correlations between any kind of kin and child mortality rates are brought about (see Gibson and Mace 2005 for a rare example of a correlational study which also collected time budget data on how kin were interacting with one another).

Finally, this study finds rather little evidence that fathers matter for child survival. Divorce does significantly increase child mortality rates, suggesting that the presence of fathers is beneficial to children. However, the death of the father does not affect mortality, which would be expected if children do suffer in the absence of fathers. Other studies have also found limited evidence that fathers make much difference to the survival of children (see Mace and Sear 2005; Sear and Mace 2008 for reviews), though fathers may be beneficial in other ways (Allal et al. 2004; Huber and Breedlove 2007; Reher and González-Quiñones 2003; Winking in press). Other research has also shown that what matters for child outcomes is the reason for the loss of the father, rather than the absence of a father alone, so that children with fathers absent through divorce experience different outcomes to those who lose their fathers through death (e.g. Rende Taylor 2005). Divorce itself may cause more disruption to the child than the death of the father, particularly in traditional societies such as this where other family members can step in to compensate for the death of the father (e.g. Alam et al. 2001). The stress of divorce and a difficult marital relationship between the parents may result in more severe consequences for their child. Alternatively (or in addition), the likelihood of divorce may be correlated with other characteristics of the parents or family, which may affect child mortality rates (Fu and Goldman 2000).

CONCLUSION

This analysis has demonstrated again the importance of taking kin into account when investigating child mortality rates. It has also demonstrated once again the importance of taking socio-ecological context into account when performing such analyses. This study is the first to show a detrimental effect of maternal grandmothers on child survival, and highlights the prediction that the presence of kin will not always be beneficial. Given that kin sharing the same resource base may be in competition for one another for these resources, the presence of certain relatives may do more harm than good to child survival rates. This study also highlights the importance of resources to kin relationships. Other studies have shown that the level of resources matters for kin relationships, but this study found that resource ownership matters too: patterns of kin help or harm are different in households where men own resources compared to those in which women own resources.

ACKNOWLEDGEMENTS

With thanks to the team of fieldworkers in Malawi who collected the data; to the Simon Population Trust, Parkes Foundation and Boise Foundation for funding fieldwork; and to Mhairi Gibson and four anonymous reviewers for helpful comments on the manuscript.

BIOGRAPHICAL INFORMATION

Rebecca Sear is a Lecturer in Population Studies at the London School of Economics. She has degrees in Zoology and Biological Anthropology, and her research interests can broadly be described as evolutionary demography.

REFERENCES

Alam, N., S. K. Saha, A. Razzaque and J. K. Van Ginneken

2001 The effect of divorce on infant mortality in a remote area of Bangladesh. *Journal of Biosocial Science* 33:271-278.

Allal, N., R. Sear, A. M. Prentice and R. Mace

2004 An evolutionary model of stature, age at first birth and reproductive success in Gambian women. *Proceedings of the Royal Society of London, Series B, Biological Sciences* 271:465-470.

Aubel, J., I. Toure and M. Diagne

2004 Senegalese grandmothers promote improved maternal and child nutrition practices: the guardians of tradition are not averse to change. *Social Science & Medicine* 59:945-959.

Beise, J.

2002 A multilevel event history analysis of the effects of grandmothers on child mortality in a historical German population, Krummhörn, Ostfriesland, 1720-1874. *Demographic Research* 7.

Beise, J.

2005 The helping grandmother and the helpful grandmother: the role of maternal and paternal grandmothers in child mortality in the 17th and 18th century population of French settlers in Quebec, Canada. In *Grandmotherhood: the Evolutionary Significance of the Second Half of the Female Life*, E. Voland, A. Chasiotis and W. Schiefenhoevel, ed. Pp. 215-238. New Brunswick: Rutgers University Press.

Bezner Kerr, R., L. Dakishoni, L. Shumba, R. Msachi and M. Chirwa

2008 "We grandmothers know plenty": breastfeeding, complementary feeding and the multifaceted role of grandmothers in Malawi. *Social Science & Medicine* 66:1095-1105.

Biran, A., J. Abbot and R. Mace

2004 Families and firewood: a comparative analysis of the costs and benefits of children in firewood collection and use in two rural communities in sub-Saharan Africa. *Human Ecology* 32**:**1-25.

Borgerhoff Mulder, M.

1998 Brothers and sisters: how sibling interactions affect optimal parental allocations. *Human Nature* 9**:**119-161.

Borgerhoff Mulder, M.

2006 Hamilton's rule and kin competition: the Kipsigis Case. *Evolution and Human Behavior* 28**:**299-312.

Briend, A., B. Wojtyniak and M. G. M. Rowland

1988 Breast feeding, nutritional state, and child survival in rural Bangladesh. *British Medical Journal* 296**:**879–882.

Campbell, C. and J. Z. Lee

1996 A death in the family: household structure and mortality in rural Liaoning: life-event and time-series analysis, 1792-1867. *History of the Family* 1**:**297-328.

Curtis, S. L., I. Diamond and J. W. McDonald

1993 Birth interval and family effects on postneonatal mortality in Brazil. *Demography* 30**:**33-43.

Davison, J.

1997 Gender, Lineage and Ethnicity in Southern Africa. Boulder, Colorado: Westview Press.

Derosas, R.

2002 Fatherless families in 19th century Venice. In *When Dad Died: Individuals and Families Coping with Distress in Past Societies*, R. Derosas and M. Oris, ed. Pp. 421-452. Bern: Peter Lang.

Douglass, R. L., B. F. McGadney-Douglass, P. Antwi and N. A. Apt

2007 Filial factors of Kwashiorkor survival in urban Ghana: rediscovering the roles of the extended family. *African Journal of Food, Agriculture, Nutrition and Development* 7

Feachem, R. G. and M. A. Koblinsky

1984 Interventions for the control of diarrhoeal diseases among young children: promotion of breast-feeding. *Bulletin of the World Health Organization* 62**:**271-291.

Fu, H. S. and N. Goldman

2000 The association between health-related behaviours and the risk of divorce in the USA. *Journal of Biosocial Science* 32**:**63-88.

Gibson, M. A.

in preparation Does investment in the sexes differ when fathers are absent? Sex-biased infant survival and child growth in rural Ethiopia.

Gibson, M. A. and R. Mace

2005 Helpful grandmothers in rural Ethiopia: A study of the effect of kin on child survival and growth. *Evolution and Human Behavior* 26**:**469-482.

Guo, G.

1993 Use of sibling data to estimate family mortality effects in Guatemala. *Demography* 30**:**15-32.

Hadley, C.

2004 The costs and benefits of kin: kin networks and children's health among the Pimbwe of Tanzania. *Human Nature* 15**:** 377-395.

Hagen, E. H., R. B. Hames, N. M. Craig, M. T. Lauer and M. E. Price

2001 Parental investment and child health in a Yanomamo village suffering short-term food stress. *Journal of Biosocial Science* 33**:**503-528.

Hamilton, W. D.

1964 The genetical evolution of social behaviour I. *Journal of Theoretical Biology* 7**:**1-16.

Hirschmann, D. and M. Vaughan

1983 Food production and income generation in a matrilineal society: rural women in Zomba, Malawi. *Journal of Southern African Studies* 10:86-99.

Holden, C. J., R. Sear and R. Mace

2003 Matriliny as daughter-biased investment. *Evolution and Human Behavior* 24:99-112.

Huber, B. R. and W. L. Breedlove

2007 Evolutionary theory, kinship, and childbirth in cross-cultural perspective. *Cross-Cultural Research* 41:196-219.

Kadir, M. M., F. F. Fikree, A. Khan and F. Sajan

2003 Do mothers-in-law matter? Family dynamics and fertility decision-making in urban squatter settlements of Karachi, Pakistan. *Journal of Biosocial Science* 35:545-558.

Kalanda, B. F., F. H. Verhoeff and B. J. Brabin

2005 Breast and complementary feeding practices in relation to morbidity and growth in Malawian infants. *European Journal of Clinical Nutrition* 60:401-407

Kemkes-Grottenthaler, A.

2005 Of grandmothers, grandfathers and wicked step-grandparents: differential impact of paternal grandparents on grandoffspring survival. *Historical Social Research* 30:219-239.

Lawson, D. W. and R. Mace

in preparation Sibling configuration & childhood growth in British families.

Leonetti, D. L., D. C. Nath, N. S. Hemam and D. B. Neill

2004 Do women really need marital partners for support of their reproductive success? The case of the matrilineal Khasi of NE India. *Research in Economic Anthropology* 23:151-174.

Leonetti, D. L., D. C. Nath, N. S. Hemam and D. B. Neill

2005 Kinship organisation and the impact of grandmothers on reproductive success among the matrilineal Khasi and patrilineal Bengali of Northeast India. In

Grandmotherhood: the Evolutionary Significance of the Second Half of Female Life, E. Voland, A. Chasiotis and W. Schiefenhoevel, ed. Pp. 194-214. New Brunswick: Rutgers University Press.

Low, B. S.

1991 Reproductive life in nineteenth century Sweden: an evolutionary perspective on demographic phenomena. *Ethology and Sociobiology* 12**:**411-448.

Mace, R.

1996 Biased parental investment and reproductive success in Gabbra pastoralists. *Behavioural Ecology and Sociobiology* 38**:**75-81.

Mace, R. and R. Sear

2005 Are humans cooperative breeders? In *Grandmotherhood: the Evolutionary Significance of the Second Half of Female Life*, E. Voland, A. Chasiotis and W. Schiefenhoevel, ed. Pp. 143-159. New Brunswick: Rutgers University Press.

Marwick, M. G.

1952 The kinship basis of Cewa social structure. *South African Journal of Science* 48**:**258-62.

Mtika, M. M. and H. V. Doctor

2002 Matriliny, patriliny and wealth flows in rural Malawi. *African Sociological Review* 6**:**71-97.

Muhuri, P. K. and S. H. Preston

1991 Effects of family composition on mortality differentials by sex among children in Matlab, Bangladesh. *Population Development Review* 17**:**415-434.

Murdock, G. P.

1967 Ethnographic Atlas. Pittsburgh: University of Pittsburgh Press.

National Statistical Office of Malawi (1998) 1998 Population and Housing Census: http://www.nso.malawi.net/

Pennington, R. and H. Harpending

1993 The Structure of an African Pastoralist Community: Demography, History and Ecology of the Ngamiland Herero. Oxford: Clarendon Press.

Peters, P. E.

1997 Against the odds: matriliny, land and gender in the Shire Highlands of Malawi. *Critique of Anthropology* 17**:**189-210.

Phiri, K. M.

1983 Some changes in the matrilineal family system among the Chewa of Malawi since the nineteenth century. *Journal of African History* 24**:**257-274.

Reher, D. S. and F. González-Quiñones

2003 Do parents really matter? Child health and development in Spain during the demographic transition. *Population Studies* 57**:**63-75.

Rende Taylor, L.

2005 Patterns of child fosterage in rural northern Thailand. *Journal of Biosocial Science* 37**:**333-350.

Sear, R. and R. Mace

2008 Who keeps children alive? A review of the effects of kin on child survival. *Evolution and Human Behavior* 29:1-18

Sear, R., R. Mace and I. A. McGregor

2000 Maternal grandmothers improve the nutritional status and survival of children in rural Gambia. *Proceedings of the Royal Society of London, Series B, Biological Sciences* 267**:**461-467.

Sear, R., R. Mace and I. A. McGregor

2003 The effects of kin on female fertility in rural Gambia. *Evolution and Human Behavior* 24**:**25-42.

Sear, R., F. Steele, I. A. McGregor and R. Mace

2002 The effects of kin on child mortality in rural Gambia. *Demography* 39**:**43-63.

Sharma, M. and S. Kanani

2006 Grandmothers' influence on child care. *Indian Journal of Pediatrics* 73**:**295-298.

Skinner, G. W.

1997 Family systems and demographic processes. In *Anthropological Demography: Toward a New Synthesis*, D. I. Kertzer and T. Fricke, ed. Pp. 53-95. Chicago: University of Chicago Press.

Skinner, G. W.

2004 Grandparental effects of reproductive strategizing: nôbi villageres in early modern Japan. *Demographic Research* 11**:**111-147.

Sorenson Jamison, C., L. L. Cornell, P. L. Jamison and H. Nakazato

2002 Are all grandmothers equal? A review and a preliminary test of the "Grandmother Hypothesis" in Tokugawa Japan. *American Journal of Physical Anthropology* 119**:**67-76.

Takane, T.

2007 Customary land tenure, inheritance rules, and smallholder farmers in Malawi. *Institute of Developing Economies Discussion Paper No.104* Chiba, Japan.

Tew, M.

1950 Peoples of the Lake Nyasa Region. London: Oxford University Press.

Tymicki, K.

2004 The kin influence on female reproductive behaviour: the evidence from the reconstitution fo Bejsce parish registers, 18th-20th centuries, Poland. *American Journal of Human Biology* 16**:**508-522.

Wahab, A., A. Winkvist, H. Stenlund and S. A. Wilopo

2001 Infant mortality among Indonesian boys and girls: effect of sibling status. *Annals of Tropical Paediatrics* 21**:**66-71.

West, S. A., I. Pen and A. S. Griffin

2002 Cooperation and competition between relatives. *Science* 296**:**72-75.

Winking, J.

in press Are men really that bad as fathers? The role of men's investments. *Social Biology*.

Figure 1: odds ratios for the probability of death by survival status of maternal grandmother and sex of child (open bars represent males, grey bars females), adjusted for control variables

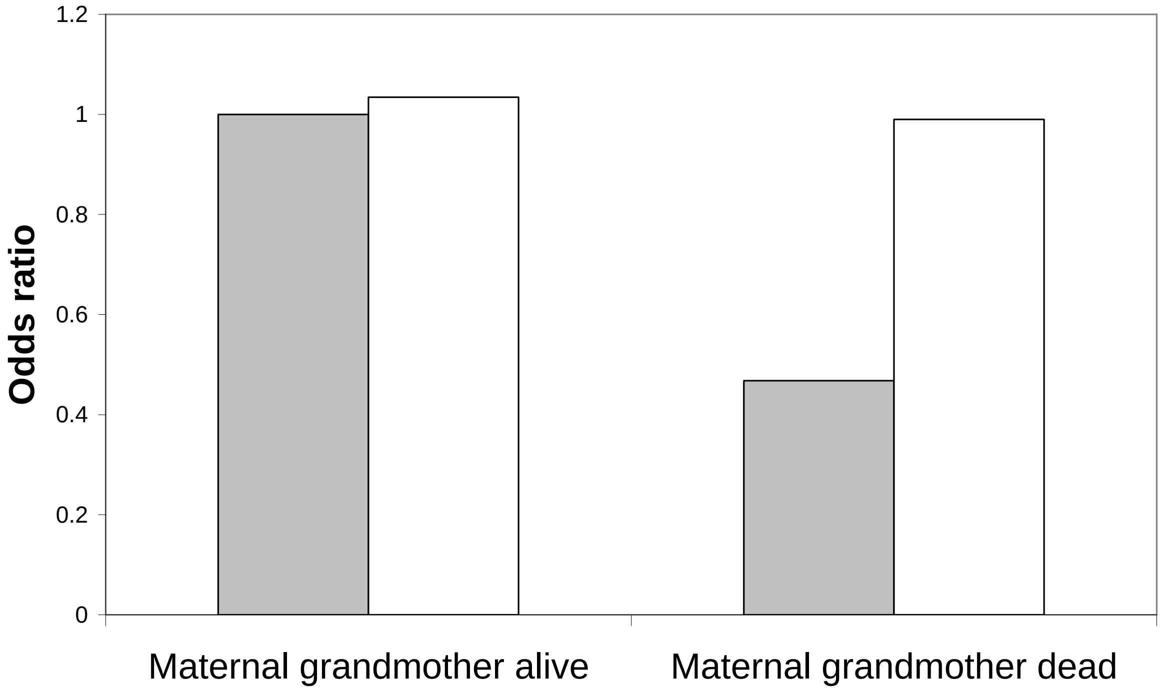

Figure 2: odds ratios for the probability of death by number of living maternal aunts and household land ownership (open bars represent households in which women own land, grey bars those in which men own land), adjusted for control variables

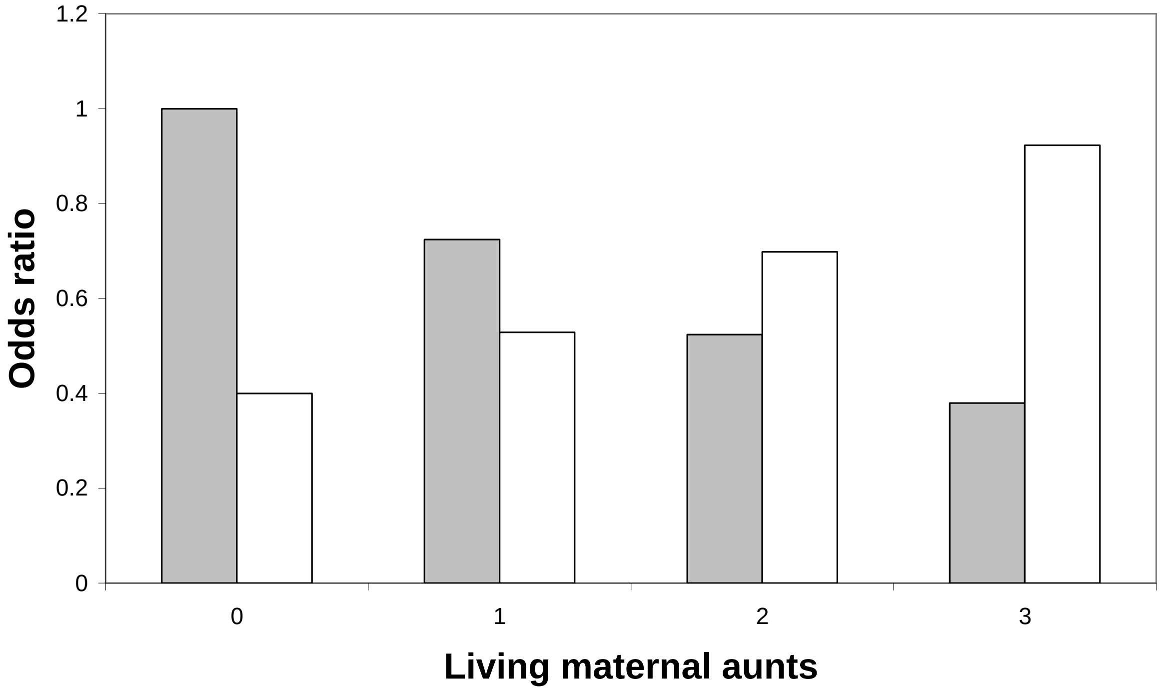

Figure 3: odds ratios for the probability of death by number of living elder brothers and household land ownership (open bars represent households in which women own land, grey bars those in which men own land), adjusted for control variables

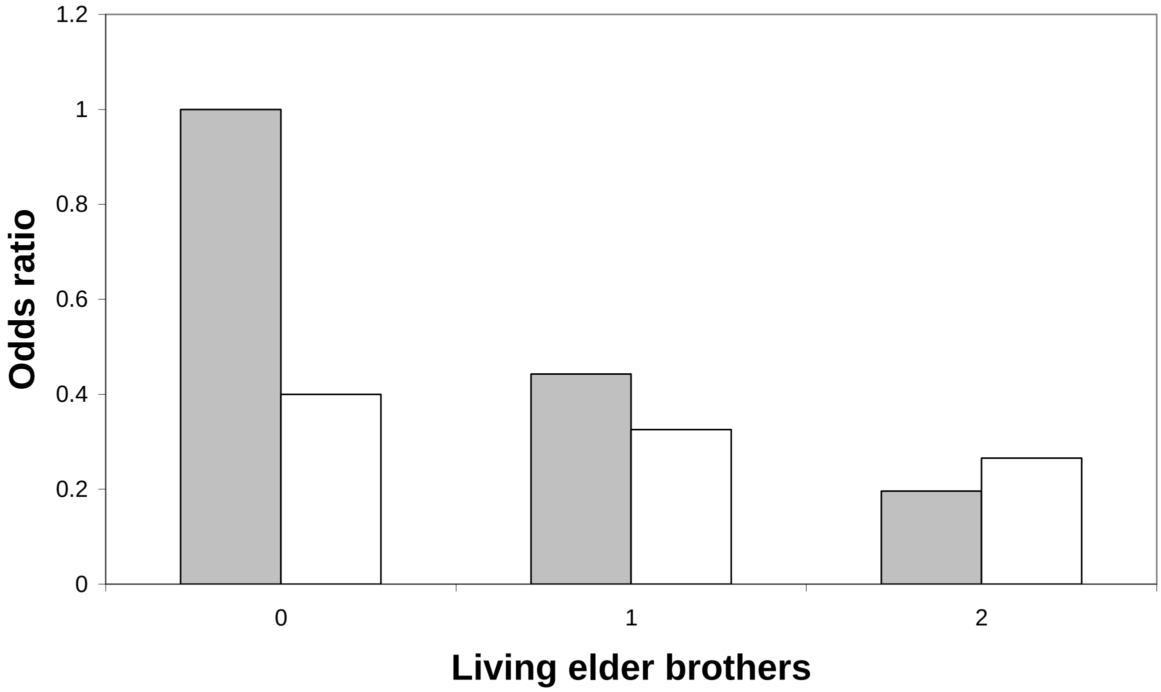

Table 1: household characteristics by land ownership

Household characteristics	Gardens owned by Women	Men	Both sexes	Tests of statistical significance[1]
N (%)	569 (81.1)	123 (17.5)	10 (1.4)	
Mean size of garden (ha)	2.3	2.7	3.5	t=3.78, df=690, p<0.001
Mean number of crop types grown	1.1	1.2	1.4	t=3.33, df=690, p=0.001
Number (%) of households with livestock	63 (11.1)	31 (17.0)	3 (30.0)	χ^2 = 2.80, df=1, p=0.09
Number (%) of households with fishing gear	204 (35.9)	54 (43.9)	6 (60.0)	χ^2 = 17.20, df=1, p<0.001
Gardens inherited from (%):				χ^2 = 107.80, df=2, p<0.001
Matri-kin	95	76		
Patri-kin	<1	19		
Village chief	4	5		

[1] Statistical tests only compared households in which women owned land with those in which men owned land; those in which both sexes owned land were excluded because of the small sample size of this category

Table 2: descriptive data (sample sizes and percentage of children dead in each category) for variables used in the analysis

Variable		N	No. deaths	% dead
Father	Married to mother	1171	116	9.9
	Dead	183	22	12.0
	Divorced	281	49	17.4
Mother's mother	Alive	1087	125	11.5
	Alive but not in village	73	12	16.4
	Dead	473	50	10.6
Father's mother	Alive	526	36	6.8
	Alive but not in village	172	34	19.8
	Dead	430	41	9.5
Mother's father	Alive	919	88	9.6
	Dead	716	99	13.8
Father's father	Alive	621	52	8.4
	Dead	523	60	11.5
No. living older maternal aunts	0	897	91	10.1
	1 or more	717	92	12.8
No. living older maternal uncles	0	763	85	11.1
	1 or more	851	98	11.5
No. living older paternal aunts	0	702	70	10.0
	1 or more	418	38	9.1
No. of living older paternal uncles	0	566	54	9.5
	1 or more	554	54	9.7
No. living older sisters	0	711	81	11.4
	1	424	38	9.0
	2 or more	500	68	13.6
No. living older brothers	0	761	91	12.0
	1	425	43	10.1
	2 or more	449	53	11.8
Land ownership	Women	1319	162	12.3
	Men or both	320	36	11.2
Sex of child	Female	823	87	10.6
	Male	812	100	12.3
Child's year of birth	Before 1992	658	95	14.4
	1992 onwards	790	92	11.6
Birth order	1	400	47	11.8
	2-3	603	50	8.3
	4-6	472	59	12.5
	7+	160	31	19.4
Maternal age (yrs)	<20	331	42	12.7
	20-29	904	100	11.1
	30-39	303	24	7.9
	40+	94	18	19.1
Multiple birth	Twin	60	11	18.3
	Singleton	1575	176	11.2
Previous inter-birth interval (yrs)	1	36	8	22.2
	2-3	978	120	12.3
	4+	220	11	5.0
Garden size (hectares)	<2	455	73	16.0
	2-2.9	693	71	10.2
	3+	487	43	8.8
Total		**1635**	**187**	**11.4**

Table 3: results of logistic regression analysis on the probability of child death

Variable	Categories	Model 1 Odds ratio	Model 2 Odds ratio
Father	Married to mother (ref)	1.00	1.00
	Dead	1.12	1.19
	Divorced	2.34**	2.53**
Mother's mother	Alive (ref)	1.00	1.00
	Alive but not in village	1.16	1.03
	Dead	0.71	0.47*
Father's mother	Alive (ref)	1.00	1.00
	Alive but not in village	2.59**	2.74**
	Dead	1.03	1.06
Mother's father	Alive (ref)	1.00	1.00
	Dead	1.29	1.20
Father's father	Alive (ref)	1.00	1.00
	Dead	1.30	1.36
No. living older maternal aunts		1.20†	0.72
No. living older maternal uncles		0.88	0.89
No. living older paternal aunts		0.96	0.94
No. of living older paternal uncles		0.88	0.88
No. living older sisters		0.68**	0.67**
No. living older brothers		0.74*	0.44**
Land ownership	Women	0.86	0.40**
	Men or both (ref)	1.00	1.00
Sex of child	Female (ref)	1.00	1.00
	Male	1.25	1.03
Sex*mother's mother dead			2.04†
Land ownership*mother's sisters			1.82*
Land ownership*elder brothers			1.84**
Child's year of birth		1.07*	1.07*
Birth order	1	0.07**	0.07**
	2-3 (ref)	1.00	1.00
	4-6	0.25**	0.25**
	7+	3.69**	3.35**
Maternal age (yrs)	<20	1.89	1.87
	20-29	1.44	1.47
	30-39 (ref)	1.00	1.00
	40+	3.06**	3.00**
Multiple birth	Singleton (ref)	1.00	1.00
	Twin	2.18*	2.35*
Previous inter-birth interval (yrs)		0.68**	0.69**
Garden size (hectares)		0.71**	0.70**

† p<0.1; * p<0.05; **p<0.01