

Kin and Child Survival in Rural Malawi

Are Matrilineal Kin Always Beneficial in a Matrilineal Society?

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Abstract This paper investigates 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 behavior 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 suggest 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 Child mortality · Kin · Malawi · Matrilineality

Empirical evidence that kin are important to child well-being and survival has been rapidly accumulating over the past few years (e.g., Beise 2002, 2005; Gibson and Mace 2005; Leonetti et al. 2004, 2005; Mace and Sear 2005; Sear et al. 2000, 2002). This research stems from the theoretical expectation that human child-rearing may be subsidized by other family members (Hrdy 1999), since our rapid reproductive rate and the altriciality of human children make the costs of child-raising too great for mothers to bear alone. A recent article has reviewed the evidence, from 45

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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 and paternal grandmothers 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 2008; 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 2008; Low 1991; Mace 1996; Muhuri and Preston 1991; Wahab et al. 2001) but may also occur between other categories of relatives 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 cooperating in the raising of children within the household, who will be related to both affinally 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 more spouses into 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 recently been increasing, the conclusions described above are still based on a relatively small sample of studies. 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? This paper adds to this literature by presenting an analysis of the impact of kin on child survival in a matrilineal community in Malawi. Matriliney 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 matriliney 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 situated on Lake Malawi in the southern region of Malawi were surveyed. 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 agricultural, though some income was also earned through trade, crewing on fishing boats in neighboring villages, and occasional wage labor. 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. For this analysis, only members of the matrilineal Chewa ethnic group are included, 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 than 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 because 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 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 on to 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 to caution 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, about 80% of all household gardens were owned by women. Men owned the 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 five women reported inheriting from patrilineal kin. Men also reported that the majority of their land had been inherited from matrilineal kin, but they 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 matrilineal kin (73% directly from mothers) and 19% from patrilineal 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 two 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

Table 1 Household characteristics by land ownership

Household characteristics	Gardens owned by:			Tests of statistical significance ^a
	Women	Men	Both sexes	
<i>N</i> (%)	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)	$\chi^2=2.80$, $df=1$, $p=0.09$
Number (%) of households with fishing gear	204 (35.9)	54 (43.9)	6 (60.0)	$\chi^2=17.20$, $df=1$, $p<0.001$
Gardens inherited from (%)				$\chi^2=107.80$, $df=2$, $p<0.001$
Matrilineal kin	95	76		
Patrilineal kin	<1	19		
Village chief	4	5		

^a 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

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).

This high fertility and high mortality population has little access to contraception, and limited medical care is available in this rural area. The total fertility rate (TFR) in 1996 was 5.89, and 12% of all children born within the 5 years preceding the survey had died. Mortality is likely to be underestimated in a retrospective survey such as this, and this figure is lower than expected based on official statistics for the same period for the national population. For example, the 1998 Malawian census estimated that 12.1% of all 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, there is no reason to suppose that mortality under-reporting is biased according to any of the kin variables of interest, so 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: fewer than 2% of mothers in this sample reported having co-wives. Postmarital residence was largely matrilineal: more than 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.

Materials and 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 1,635 children, of whom 187 (11.4%) had died. Logistic regression was used to analyze 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 underestimation of the standard errors in normal regression analyses (Guo 1993). Exploratory multilevel logistic models were run to determine whether there was any evidence that siblings' probabilities of dying were correlated. No such evidence was found in this population. 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 based on the survival and residential status of each relative at the time of the survey):

- *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 either alive or dead.
- *Maternal and paternal aunts and uncles*: numbers 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 that 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 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 when all missing dummies were found not to be 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.

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

Variable		Number	Number of deaths	Percent dead
Father	Married to mother	1,171	116	9.9
	Dead	183	22	12.0
	Divorced	281	49	17.4
Mother's mother	Alive	1,087	125	11.5
	Alive but not in village	73	12	16.4
Father's mother	Dead	473	50	10.6
	Alive	526	36	6.8
	Alive but not in village	172	34	19.8
Mother's father	Dead	430	41	9.5
	Alive	919	88	9.6
Father's father	Dead	716	99	13.8
	Alive	621	52	8.4
No. of living older maternal aunts	Dead	523	60	11.5
	0	897	91	10.1
No. of living older maternal uncles	1 or more	717	92	12.8
	0	763	85	11.1
No. of living older paternal aunts	1 or more	851	98	11.5
	0	702	70	10.0
No. of living older paternal uncles	1 or more	418	38	9.1
	0	566	54	9.5
No. of living older sisters	1 or more	554	54	9.7
	0	711	81	11.4
No. of living older brothers	1	424	38	9.0
	2 or more	500	68	13.6
	0	761	91	12.0
Land ownership	1	425	43	10.1
	2 or more	449	53	11.8
	Women	1,319	162	12.3
Sex of child	Men or both	320	36	11.2
	Female	823	87	10.6
Child's year of birth	Male	812	100	12.3
	Before 1992	658	95	14.4
Birth order	1992 onwards	790	92	11.6
	1	400	47	11.8
Maternal age (years)	2–3	603	50	8.3
	4–6	472	59	12.5
	7+	160	31	19.4
	<20	331	42	12.7
	20–29	904	100	11.1
Multiple birth	30–39	303	24	7.9
	40+	94	18	19.1
	Twin	60	11	18.3
Previous inter-birth interval (years)	Singleton	1,575	176	11.2
	1	36	8	22.2
	2–3	978	120	12.3
	4+	220	11	5.0
Garden size (ha)	<2	455	73	16.0
	2–2.9	693	71	10.2
	3+	487	43	8.8
Total		1,635	187	11.4

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, wealth, and land ownership (only three 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 1 means that a child in that particular category had an increased risk of dying compared with

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
Mother's mother	Divorced	2.34***	2.53***
	Alive (ref)	1.00	1.00
	Alive but not in village	1.16	1.03
Father's mother	Dead	0.71	0.47**
	Alive (ref)	1.00	1.00
	Alive but not in village	2.59***	2.74***
Mother's father	Dead	1.03	1.06
	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. of living older maternal aunts		1.20*	0.72
No. of living older maternal uncles		0.88	0.89
No. of living older paternal aunts		0.96	0.94
No. of living older paternal uncles		0.88	0.88
No. of living older sisters		0.68***	0.67***
No. of 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 (years)	<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 (years)		0.68***	0.69***
Garden size (ha)		0.71***	0.70***

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the reference category. An odds ratio below 1 means a lower risk of dying compared with 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 with 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 relative 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. Model 1 shows 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 Fig. 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

Fig. 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

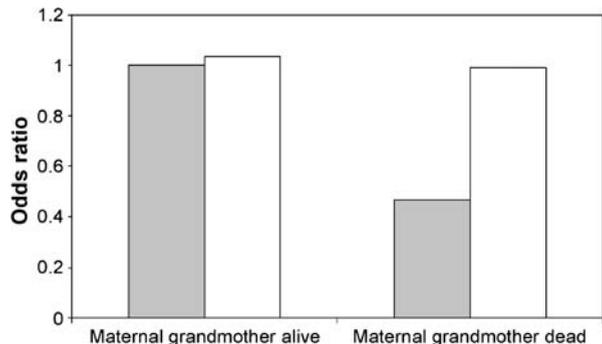
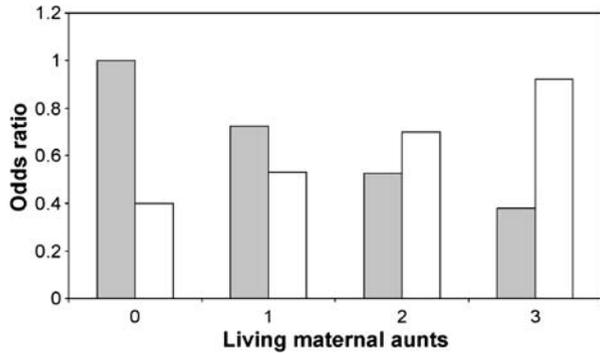


Fig. 2 Odds ratios for the probability of death by number of living maternal aunts and household land ownership (*open bars* represent households in which women own land; *grey bars*, those in which men own land), adjusted for control variables



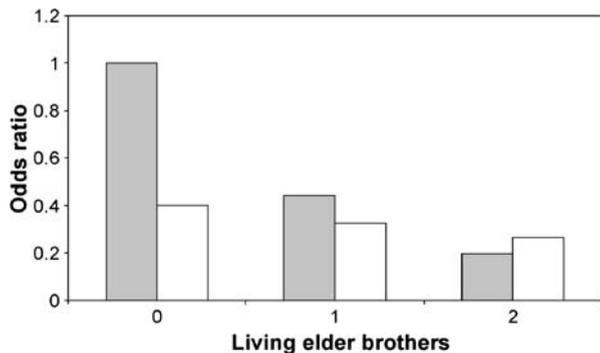
in households in which women owned land appeared to have somewhat lower mortality than those in which men owned land, though this main effect was not significant in Model 1, which included no interaction terms. No adult male maternal kin—neither maternal grandfathers nor maternal uncles—had any effect 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 types of households, their effect was much stronger in households in which men, rather than women, owned land (Fig. 3).

Finally, as expected, the biodemographic variables included as controls in the model were significantly related to child mortality: twins, children born to older

Fig. 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



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 in most other populations, the evidence that grandmothers protect children 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 with 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 this finding as the result of conflict between women and their mothers-in-law. 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 daughters-in-law are genetically related to them, and, given their lack of genetic relatedness, daughters-in-law are also to some extent expendable (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 for the woman herself (Skinner 1997), as well as changes in reproductive behavior 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 introductory paragraphs of this paper, even relationships between genetically related individuals may be characterized by competitive, rather than cooperative, interactions. Maternal grandmothers will be striving to maximize 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 maximize their total production of offspring and grand-offspring. 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 they may also be involved in the decision to stop breast-feeding a child (Bezner et al. 2008). These grandmothers are also frequent caretakers of toddlers when the mother is away from the household, and thus may have some control over how often children are fed. Such influence could potentially be exerted in ways that 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; Feachem and Koblinsky 1984; Kalanda et al. 2005).

The mortality rates of children whose maternal grandmothers were alive but not resident in the village, however, 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 colinearity between this variable and female ownership of land, makes any definitive conclusions about relative mortality rates for children in this category difficult. An additional difficulty is that the variable on grandmaternal residence was constructed from the question "Where does your mother live?," likely to be interpreted as requiring information on the usual place of residence of the grandmother rather than 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 in the 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 with poor ones, suggesting such kin may only be inclined toward nepotism when resources are plentiful. A similarly resource-dependent effect of maternal kin networks was found by Hadley (2004) on child health among 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 they reported in roughly equal numbers that kin could be either a help in providing food, money, and support, or a hindrance because of the "conflict" they caused. Clearly, individuals in such subsistence societies recognize 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.

In this Malawian population there appeared to be no modifying effects of the overall level of wealth: interaction terms between garden size and all kin variables were included in exploratory models but were not significant. To explore potential wealth effects more fully, the data were also broken down by wealth category (rich, poor, and medium) and separate statistical models were 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 colinearity between land ownership and wealth because 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 colinearity, separate models were also run by wealth class after the data had been divided into women-owned households and men-owned households. Again there was 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 woman 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 with 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 Sear and Mace 2008 for a review), though fathers may be beneficial in other ways (Allal et al. 2004; Huber and Breedlove 2007; Reher and González-Quiñones 2003; Winking 2006). Other research has also shown that what matters for child outcomes is the reason for the loss of the father, rather than simply the absence of a father, so that children with fathers absent through divorce experience different outcomes than 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 socioecological context into account when performing such analyses. This study is the first to show a detrimental effect of maternal grandmothers on child survival, and it highlights the prediction that the presence

of kin will not always be beneficial. Given that kin who share the same resource base may be in competition 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 help or harm from kin are different in households where men own resources compared with those in which women own resources.

Acknowledgments 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.

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