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THE IMPACT OF CO-RESIDENT SPOUSES AND SONS ON ELDERLY MORTALITY IN RURAL BANGLADESH

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Summary. This paper uses prospective data from the Matlab surveillance system in rural Bangladesh to demonstrate that initially co-resident spouses and sons have a major impact on the subsequent mortality of old people, with significant differences by the sex of the elderly person, and the age of the son. Spouses significantly reduce mortality by similar magnitudes for both elderly men and women. On the other hand, co-resident adult sons reduce mortality for elderly women much more than for elderly men, with younger sons being more beneficial than older sons. Furthermore, both married and unmarried females appear to benefit equally from co-resident adult sons. Finally, this analysis suggests that the impact of spouses and sons on mortality in old age is not substantially mediated through changes in elderly economic status.

Introduction

There is a growing literature from the developed world which suggests that strong social/kin networks have a significant impact on reducing mortality in old age with differing effects for men and women (Kaplan *et al*., 1988; Seeman *et al*., 1987; Schoenbach *et al*., 1986; Berkman & Syme, 1979). Relatively little is known, however, about how such networks affect elderly peoples' well-being in rural developing societies such as South Asia, and the relative importance of specific network members. One might expect that, due to the lack of institutional sources of social support (pensions, insurance, credit markets), kin networks may be an especially important determinant of the welfare of elderly people in that setting. Traditionally in South Asia spouses and sons have been viewed as the primary source of kin support, particularly for elderly women. This is primarily due to the lack of income earning opportunities for women in this society, which makes them dependent economically on husbands and sons. This dependence is further accentuated by the fact that typically married women live far away from their natal families and cannot rely on natal kin as sources of support. Finally, the strong cultural norms about filial obligations of sons towards their parents make them the obvious choice of sources of support in old age (Aziz, 1979; Cain, 1984, 1985; Nugent, 1985; Ellickson, 1988; Martin, 1990). There is some suggestive but

indirect evidence from small cross-sectional studies of living arrangements in Bangladesh and India, that elderly people without co-resident spouses and sons are at higher risk for mortality, with women being especially vulnerable (Cain, 1985, 1986; Chaudhury, 1982; Vlassoff, 1990). In this paper high-quality prospective data are used with a large sample size from rural Bangladesh to examine directly the mortality consequences for elderly men and women of differences in the presence of co-resident spouses and sons.

Research questions

The main research question is: How do initially co-resident spouses and sons affect subsequent mortality in old age in rural Bangladesh, and are there important differences by the sex of the elderly person? In particular, the questions examined are:

(I) Does the presence of a spouse substantially reduce mortality for both elderly men and women, and is this effect different for men than women?

(II) Do co-resident adult sons (aged 15 years or more) reduce parental mortality, and does this effect vary by the sex of the parent and/or the age of the son? Specifically:
   (a) Do co-resident adult sons reduce mortality more for mothers than fathers?
   (b) Are co-resident younger adult sons (aged 15–24 years) more beneficial to the survival of elderly parents than older sons (aged 25–44 years and 45 years and above)?
   (c) Do non-currently married mothers benefit more in terms of survival from co-resident adult sons than currently married mothers do?

(III) Finally, to what extent can the impact of co-resident spouses and sons on the mortality of older people be attributed to associated changes in household economic resources, and does this differ by the sex of the elderly person?

Data, method and variables

The data used in this study come from the Matlab Surveillance System in rural Bangladesh, operated under the aegis of the International Centre for Diarrhoeal Disease Research, Bangladesh. This surveillance system has maintained a continuous register of all vital events (births, marriages, migrations and deaths) on a defined population of 40,000 households and approximately 200,000 individuals in the Matlab sub-province, about 40 miles south-east of the capital city of Dhaka, for the last two decades. In addition to the continuous register (which is based on households being visited twice a month to record vital events), censuses were held in 1974 and 1982 to assess a variety of sociodemographic variables, including household assets and living arrangements. The surveillance population is considered to be typical of rural Bangladesh. A more detailed description of the surveillance system can be found in Shah & Koenig (1988).

For this analysis, a data file (sub-setted from the regular surveillance and census data) consisting of information on the 8-year mortality experience (March 1974 to June 1982) of all individuals aged 60 years or more in the Matlab study population as of March 1974 was set up. There were a total of 9365 such individuals (5128 males and

4237 females). In addition to information on deaths and out-migrations, this file contained sociodemographic data on the elderly collected at the beginning of the follow-up period from the census of 1974. These data included age, sex, marital status, disability status, ages of co-resident sons and elderly household economic status (a mixture of household assets and physical infrastructure).

Statistical methods

The main focus is on multivariate analysis given the strong possibility of confounding from simultaneous effects of various predictors. Cox proportional hazard models have been used to investigate the impact of initially co-resident spouses and sons on subsequent mortality of old people over an 8-year follow-up period, controlling for various predictors. Of the 9365 individuals in the initial sample, 594 (6·3%) out-migrated from the surveillance area during the 8-year follow-up period (March 1974 to June 1982). Using standard practice for Cox proportional hazard models, exposure was assigned to each individual until the time of out-migration, death or end of study, whichever came first.

Variables used in analysis

A detailed description of the dependent and independent variables is given in Table 1. A few salient points are noted here. The dependent variable in this analysis was the hazard of dying in the period March 1974 to June 1982. There were somewhat more women than men in the study sample (55% versus 45%), and the initial age distribution of the male population was slightly older than that of the female population (37% of the men were over age 70 compared with 31% of the women). However, there was no significant difference in the death rates between men and women. Overall, the vast majority of men in this study population had a co-resident spouse at the beginning of follow-up: 88·7% of men as opposed to only 20·5% of women. Of those who did not have spouses at the beginning of follow-up, the overwhelming majority fell into the widowed category. Due to the very small number of observations in the never-married and divorced sub-groups, the three non-married sub-groups (widowed, divorced and never married) were combined into one overall unmarried category. The only initial health status measure available was disability status at the beginning of follow-up in March 1974. People were classified as disabled if they had apparent physical and/or mental handicaps. Finally, a composite indicator of household economic status that dichotomizes households into two groups, those having at least one of the following household assets at the beginning of the follow-up (watch, quilt, cows, boat), and those having none of these assets, was used. These household indicators have been used in earlier studies to predict child mortality successfully (D'Souza & Bhuiya, 1982).

Results

Multivariate analysis

Table 2 presents results from a set of two Cox regressions where the hazard of dying for an elderly individual in the period March 1974–June 1982 is modelled as a function of various predictors (measured at the beginning of follow-up), added successively. In

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Table 1. Description of study population

	Total	Married	Non-married
Sample sizes at beginning of follow-up			
Male	5128	4548	580
Female	4327	870	3367
Proportion dead (March 1974–June 1982)			
Male	43·56%	41·60%	58·97%
Female	44·11%	29·31%	47·90%
Proportion disabled at the beginning of follow-up			
Male	6·01%	3·54%	25·34%
Female	15·44%	7·59%	17·46%
Proportion with ⩾1 son aged 15 and over			
Male	74·92%	75·44%	70·86%
Female	69·98%	68·79%	74·60%
Proportion with ⩾1 sone aged 15–24			
Male	46·72%	49·82%	22·14%
Female	9·91%	24·37%	6·18%
Proportion with ⩾1 son aged 25–44			
Male	46·04%	45·51%	50·17%
Female	48·93%	60·34%	45·98%
Proportion with ⩾1 son aged 45 and over			
Male	3·59%	2·62%	11·21%
Female	19·45%	11·38%	21·53%
Proportion having at least one of the following household assets: watch, quilt, cow, boat			
Male	87·07%	87·49%	82·79%
Female	76·59%	89·54%	73·24%

order to directly test for sex differences in the impact of various household members, the models used are fully interacted with sex.

Model I controls for age of the elderly individual, initial disability status, the presence of a spouse and the presence of co-resident sons of different ages. Model II introduces additional controls for household economic status, allowing one to test: (a) the impact of household economic status on elderly mortality; and (b) the extent to which the impact of spouses and sons on elderly mortality is due to their co-variation with household economic status.

Summary of results

Table 2 shows that the presence of a spouse substantially reduces the hazard of mortality for both elderly men and women. While spouses appear to be somewhat more beneficial for elderly women than men (hazard ratio of 0·74 for females versus 0·87 for males), no statistically significant sex difference can be demonstrated (model II).

Exploratory stepwise analysis (results not presented) shows that controlling for initial disability status significantly reduces the beneficial effect of spouses on elderly men's mortality. This suggests that part of this beneficial impact of wives on the

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Table 2. Cox proportionate hazard models of mortality for the elderly

Predictors	Model I	Model II	95% CI
Male: age	1·05	1·05	(1·05–1·06)
Female: age	1·05	1·05	(1·04–1·05)
Male: spouse	0·87	0·88	(0·78–0·99)
Female: spouse	0·74	0·79	(0·68–0·80)
Male: ⩾1 son 15–24	0·79	0·83	(0·76–0·91)
Female: ⩾1 son 15–24	0·40	0·40	(0·32–0·52)
Male: ⩾1 son 25–44	0·99ns	1·06ns	(0·97–1·15)
Female: ⩾1 son 25–44	0·80	0·83	(0·75–0·92)
Male: ⩾1 son 45+	0·91ns	0·97ns	(0·80–1·18)
Female: ⩾1 son 45+	1·04ns	1·11ns	(0·98–1·25)
Male: disabled	1·90	1·87	(1·60–2·18)
Female: disabled	1·82	1·85	(1·66–2·07)
Male: ⩾1 household asset		0·57	(0·50–0·63)
Female: ⩾1 household asset		0·78	(0·70–0·87)

All coefficients represent instantaneous hazard ratios which are statistically significant at the 5% level, except when designated by ns. All 95% confidence intervals are for model II.

For model II:

Sex differences were statistically significant for: ⩾1 son 15–24; ⩾1 son 25–44.

For both males and females, there were statistically significant differences between the coefficients of ⩾1 son 15–24 and ⩾1 son 25–44.

mortality of their husbands is due to the higher likelihood of healthier (less disabled) men having a spouse. For women there is no such effect.

Table 2 also shows that in addition to the presence of a spouse, co-residing adult sons have a significant impact on mortality in old age. This effect varies both by the sex of the elderly person and by the age of the son. Co-residing adult sons significantly reduce the mortality of elderly people in this study population, with women benefiting more than men. Furthermore, young adult sons (aged 15–24 years) appear to be considerably more beneficial than older sons for their parents' survival (particularly for women).

In the case of elderly women, controlling for age, disability status, the presence of a spouse, the presence of older sons and household assets, the presence of one or more 15–24-year-old co-resident sons dramatically reduces the instantaneous hazard of dying to 40% of what it might have been otherwise. One or more 25–44-year-old sons reduces the instantaneous hazard of dying for elderly women to a more modest 83% of what it might have been otherwise. Sons aged 45 and older appear to have no significant impact on the survival of their mothers.

For elderly men, only 15–24-year-old sons appear to have a significant impact on mortality, with one or more 15–24-year-old co-resident sons reducing the instantaneous hazard of dying for fathers to 83% of what it might have been otherwise, controlling for other predictors.

With regard to the impact of sons on mortality in old age, one of the corollary

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Table 3. Cox proportionate hazard models of mortality for elderly women comparing married and non-married women

Model predictors	Hazard	95% CI
Married: age	1·04	(1·03–1·05)
Non-married: ∼age	1·05	(1·04–1·05)
Married: ⩾1 son 15–24	0·38	(0·25–0·57)
Non-married: ⩾1 son 15–24	0·41	(0·30–0·56)
Married: ⩾1 son 25–44	0·94ns	(0·73–1·22)
Non-married: ⩾1 son 25–44	0·81	(0·75–0·90)
Married: ⩾1 son 45+	1·22ns	(0·86–1·73)
Non-married: ⩾1 son 45+	1·08ns	(0·95–1·23)
Married: disabled	1·99	(1·39–2·84)
Non-married: disabled	1·84	(1·64–2·07)
Married: ⩾1 household asset	0·95ns	(0·64–1·41)
Non-married: ⩾1 household asset	0·77	(0·69–0·87)

All coefficients represent instantaneous hazard ratios which are statistically significant at the 5% level, except when designated by ns.
Differences in the impact of sons of different ages on elderly female mortality were not statistically significant for any category of son.

questions posed was whether co-resident adult sons would help to reduce the mortality of non-currently married mothers more than that of currently married mothers. The results presented in Table 3 show that co-resident sons appear to be equally important for reducing mortality for both married and unmarried elderly women.

Finally, improvements in household economic status as measured by the indicators used in this study account for relatively little of the impact of sons or spouses on elderly people's mortality, despite having a strong independent effect on mortality in old age (model II in Table 2). There is a small attenuation of the effect for spouses of elderly women, suggesting that some of the beneficial impact of husbands in reducing mortality for elderly women is due to the higher economic status of married elderly women compared with their unmarried peers. Interactions between household economic status and spouses and sons were also tested and found to be statistically insignificant (results not shown). This suggests that the impact of spouses and sons on mortality in old age does not vary by the economic status of the elderly person. Thus, rich elderly people need spouses and sons just as much as their poorer peers.

Discussion

This study describes a social setting where co-resident sons and spouses reduce mortality in old age greatly, with significant differences by the sex of the elderly person and the age of the son. Furthermore, the impact of these household members on elderly mortality appears not to be mediated substantially through economic status as measured by household assets. Possible explanations for these strong effects on mortality in old age are reviewed below for each type of household member.

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The impact of spouses on elderly mortality

Elderly women. The impact of the presence of a spouse on reducing elderly women's mortality may be mediated through a number of different mechanisms:

(i) First, for elderly women in the setting of rural Bangladesh, having a husband is a marker of higher social status (Ellickson, 1988). This may lead to decreased social isolation, increased stress buffering, better information networks, better access to health care and healthier habits resulting in improved survival (Berkman & Syme, 1979; Cassel, 1976; Pearlin & Johnson, 1977; Umberson, 1987).

(ii) Second, although this analysis suggests that economic status as measured by household assets does not substantially explain the mortality advantage of currently married elderly women, changes in economic status may still play some role in this difference in risk, as has been found in studies in Canada and the US (Trovato & Lauris, 1989; Korenman, Hu & Goldman, 1990; Lillard & Waite, 1993). It is important to note that the measures used in this study (boats, cows, watch, quilt) represent relatively long-term cumulative assets/investments which may be related only weakly to changes in marital status. Measures that reflect short-term household resource variation, such as the value of weekly household consumption, may be more strongly correlated with mortality risks. In addition, the key economic factor may be differential intra-household allocation, with unmarried women receiving a lower individual share of household resources than their married peers with the same total level of household resources (Chen, Haq & D'Souza, 1981; Evans, 1990).

(iii) Finally, the improved survival of elderly married women may represent selection into the married state on the basis of good health (Goldman, 1993). Thus, intrinsically healthier women may be more likely to get married and/or less likely to become widowed or divorced. Given the norm of universal marriage in this society, the latter is probably a more important mechanism if selection is operative. This possibility has been examined by controlling for initial disability status. As discussed earlier, exploratory analysis suggests that this is unlikely to be a major contributory factor.

Elderly men. This analysis shows that in keeping with the developed world, the substantial beneficial impact of wives on elderly male mortality in this study population is most likely not due to improved economic status of married men versus their unmarried peers. A more plausible explanation is that married men enjoy lower mortality risks than their unmarried peers due to decreased social isolation and/or improved home management, as has been shown in studies in Western societies (Berkman & Syme, 1979; Bowling, 1987; Umberson, Wortman & Kessler, 1992). This is consistent with the findings of small descriptive studies and of anecdotal evidence (personal communication) which have shown that wives are the primary caretakers of elderly husbands in rural Bangladesh.

Another possibility that cannot be discounted is that elderly married men may be selected into the married state because of better health (Goldman, 1993). This hypothesis is consistent with the low proportions of elderly men who are unmarried, and evidence from other studies in the Matlab study population which show that remarriage is associated with significant lower levels of disability (Rahman, 1990). Exploratory results from Table 2 (not shown) confirm that a portion of the beneficial impact of wives on the mortality of their husbands is due to the higher likelihood of less-disabled men having co-resident spouses, compared with their disabled peers.

The impact of co-residing adult sons on elderly mortality

An important contribution of this paper is that it demonstrates quite conclusively that adult co-resident sons greatly reduce the mortality of elderly people, with mothers benefiting more than fathers, and younger sons being more beneficial than older sons. Furthermore, both married and unmarried women appear to benefit equally from co-resident sons.

In rural Bangladesh, elderly women derive a large part of their social standing from having adult co-residing sons, compliant daughters-in-law to do their bidding and grandchildren who they can indulge (Ellickson, 1988). Social integration theory would suggest that this increased status leads to higher survival (Kobrin & Hendershot, 1977) due to decreased social isolation, increased stress buffering, better information networks, better access to health care and healthier habits.

This analysis found little evidence to indicate that improvements in household economic status are a major mechanism explaining the beneficial impact of sons on the mortality of mothers. This may reflect to some extent, however, the lack of more refined measures of economic support, as discussed already.

Finally, for both elderly men and women, one cannot completely rule out the selection argument that suggests that co-residence with an adult son may be related to the underlying health of the elderly person. Thus, it is possible that frail elderly men and women may move in with their adult sons shortly before death (Wolf & Soldo, 1988). If present, this behaviour would have the effect of attenuating the true beneficial impact of sons on parental mortality. This is consistent with exploratory analysis (not presented) that shows that in the absence of controls for elderly disability status, older sons (45 years and over) appear to slightly increase parental mortality, although this impact is not statistically significant. Once controls for initial disability status of the elderly are added, older sons appear to lose some of their adverse impact on parental mortality. However, this effect appears to be rather modest. Furthermore, research in other parts of Asia suggest that co-residence with children is only loosely connected with health status of elderly women (DaVanzo & Chan, 1994).

The more beneficial impact of younger versus older sons raises a number of intriguing possibilities. Younger sons may improve parental survival either because they are more likely to accommodate the wishes of their elderly parents or because they bring in greater income (which is not reflected in the measures of household assets) than older sons. This greater income may be due to their higher education levels/better health status. Finally, perhaps having younger sons is a proxy for late fertility, and consequently better health for their parents.

The powerful impact of young sons aged 15–24 and the lack of impact of sons aged 45 or more suggests that sons are not homogeneously advantageous, even for elderly women for whom sons appear to matter much more than for elderly men. In fact, in terms of the results from this analysis, elderly women with just old sons (45 years or more) are no better off in terms of survival potential than their peers with no available sons. Thus it would seem to be optimal to have sons as late as possible in one's reproductive life.

If one were to use the results of the Cox models to construct a typology of mortality risk for elderly women by initial household composition controlling for age, disability and economic status, the following salient points would emerge. (a) There is a more

than three-fold difference between the highest and lowest risk women. The highest risk group includes older women living alone, those living with sons aged 45 years and over and/or those living with daughters. The lowest risk group includes older women living with a spouse along with young sons (aged 15–24 years) and middle-aged sons (aged 25–44 years). (b) Twenty-nine per cent of elderly women fall into the highest risk group of women with no co-resident spouse or young or middle-aged sons, as compared with only 2% of elderly men.

In conclusion, it is clear that in the study population, the presence of co-resident sons and spouses acts in a complex way to affect mortality in old age, with elderly women being particularly vulnerable to these effects. No single mechanism can fully explain the varying impact of spouses and sons. Not only may different mechanisms (protection through increased social integration/enhanced stress buffering/improved information networks, protection through improved economic status, and selection into co-residences on the basis of health status) be operative in the case of spouses versus sons, but more than one mechanism may be responsible in each case.

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