POLYGYNY AND CHILD SURVIVAL IN NIGERIA: AGE-DEPENDENT EFFECTS

Festus A. Ukwuani,[†] *University of North Carolina at Chapel Hill*
Gretchen T. Cornwell, *Pennsylvania State University*
Chirayath M. Suchindran, *University of North Carolina at Chapel Hill*

Mortality risks under age five are estimated using data from the 1990 Nigerian Demographic and Health Survey for children in monogamous and polygynous families. Integrating existing theories on polygyny's relationship with infant and child mortality and some demographic concepts, the study shows that polygyny has different effects on infant and child mortality at different ages. The results indicate that polygyny does not have a significant effect on neonatal mortality (age less than one month). In contrast to the results of previous research, polygyny is significantly associated with lower child mortality during the post-neonatal period (1–11 months), but not during childhood (12–59 months). The study found socio-economic factors to be important confounders of the relationship between polygyny and mortality during the neonatal and post-neonatal periods. The protective effect of polygyny during the post-neonatal period suggests the need to further investigate circumstances that may favour post-neonatal child survival in polygynous families including availability of childcare.

Polygyny[1] was the predominant form of marriage in pre-industrial societies (Murdock 1967; Strassmann 1997), and evidence from sub-Saharan Africa suggests that polygyny remains an important sociocultural institution in this region. In spite of the influences of modernization, the prevalence rate for polygyny is still very high in sub-Saharan Africa, and there is evidence that many monogamous men have a strong desire for more wives (Aryee 1978; Speizer 1995; Stokes 1995; Ezeh 1997). However, recent national surveys in sub-Saharan Africa suggest the level of polygyny is declining (Timaeus and Reynar 1998).

Research on the implications of polygyny for demographic outcomes has been biased toward the relationship of polygyny with reproductive behaviour. The lack of emphasis on the relationship between polygyny and mortality is rather surprising, given the high mortality rates in sub-Saharan Africa (United Nations 1988; Population Reference Bureau 1996), and the relationship between reproductive behaviour and mortality (Alam 1995; Hobcraft, McDonald and Rutstein 1985; Rutstein 2000). The limited research that previously examined polygyny and child mor-

[†] Address for correspondence: Carolina Population Center, University of North Carolina at Chapel Hill, 123 West Franklin Street, Chapel Hill, NC 27516, USA. E-mail: Ukwuani@unc.edu.

tality relationships did not exploit the possibility of the age-dependent effect, nor control for the effect of some possible confounding variables.

To further explore the effect of polygyny on child mortality, this study focuses on the situation in Nigeria. Polygyny is widely practised in Nigeria and the proportion of currently married women in polygynous families was 41 per cent in 1990 (Federal Office of Statistics 1992) with a slight decline to 36 per cent in 1999 (National Population Commission 2000). Infant mortality levels in Nigeria are also very high, but have declined from 124 deaths per 1,000 live births between 1975 and 1980 to 87 deaths per 1,000 between 1985 and 1990 (United Nations 1988; FOS 1992) and to 75 per 1,000 live births between 1994 and 1999 (NPC 2000). Both the high levels of polygyny and the infant and child mortality rates make Nigeria an excellent locality to examine the implications of polygyny for child mortality.

The aim of this paper is to examine whether the effect of polygyny on infant and child mortality varies by the age of the child: a methodological approach seriously lacking in previous studies. The next section integrates demographic perspectives with some theories about the relationship of polygyny to infant and child health to suggest how the importance of polygyny could depend on the age of the child.

Polygyny effects on child health

Theoretical perspectives on the relationships between polygyny and child mortality

Two theoretical models have been used to explain the prevalence of polygyny, namely, the male-coercion and the female-choice models (Verner and Wilson 1966; Orians 1969; Spencer 1980; Becker 1981; White and Burton 1988; Davies 1989; Borgerhoff 1990). The male-coercion model is more predominant in West African countries (Strassmann 1997) and evidence of female choice has been found in some East African countries such as Tanzania and Kenya (Borgerhoff 1990; Sellen, Mulder and Sieff 2000). Women's health is predicted to be most affected under the coercion model. The female-choice model is similar to the polygyny-threshold model (Verner and Wilson 1966), which predicts no differences in the health (fitness) of monogamous and polygynous women, as women will rationally choose wealthy polygynous men. However, the two models may even co-exist in some societies, and irrespective of which model predominates, polygynous relationships are said to favour men, but constitute a cost to women (Becker 1981; Davies 1989; Chisholm and Burbank 1991; Josephson 1993; Sellen *et al.* 2000). This cost may be in the form of poorer average health for each woman and her children, resulting from competition for limited resources and unfair treatment of the women.

Strassmann (1997) suggests exploring the idea of nepotistic investment as an explanation for the polygyny–child mortality relationship. With a surplus of women and children, particularly sons, in polygynous families, men may be less likely to care about and invest in the health of their wives and children. This implies that monogamous women and their children may be healthier than those in polygynous marriages. Strassmann noted that it is important to understand the spending patterns of men in polygynous families to understand the relationship between polygyny and child mortality.

The fact that polygyny encourages both early marriage and remarriage of older women whose husbands have died (Stokes 1995) relates to the question of the females' health. Older women who marry into polygynous families may still try to give birth in order to inherit part of their current husband's wealth (Oni 1996). Giving birth at very early or later ages could cause birth complications and result in an early child or maternal death.

Other sociocultural perspectives suggest a negative relationship between polygyny and child survival for various reasons. Polygynous women are more traditional than those in monogamous families and are slower to adopt modern health care practices related to prenatal care and child delivery (United Nations 1985). Living in a polygynous marriage reflects adherence to traditional values, and traditionalism is usually associated with low female autonomy (United Nations 1985). Polygynous women are less likely than monogamous women to be educated or to participate in the paid, or formal, labour force (Ware 1984; Stokes 1995). Polygynous families are more likely to be dependent on farming than monogamous households (Chojnacka 1980). Finally, polygynous families are more likely to experience dilution of family resources and income due to the need to support a greater number of women and children compared to monogamous families (Desai 1992; Oni 1996; Strassmann 1997). The associated lack of economic resources can limit access to modern health care facilities (Celik and Hotchkiss 2000).

In contrast, polygyny also has been posited to have a positive effect on infant and child health through its relationship with child spacing and breastfeeding (Hobcraft *et al.* 1985; Nath, Land and Singh 1994; Ahonsi 1995). According to the environmental scientists, the presence of other wives helps to delay the resumption of intercourse after childbirth and reduces the frequency of intercourse (Whiting 1964; Amankwa 1996).[2] Therefore, women in polygynous families space births more widely and breastfeed their children longer than those in monogamous families.

Another perspective deals with the issue of co-wife co-operation (Chisholm and Burbank 1991). Isaac and Feinberg (1982) suggested that one way polygyny could enhance infant and child health and survival is through childcare. With multiple mothers, children in polygynous families have the advantage of more often being cared for and supervised by adults than those in monogamous families. On the other hand, competition among co-wives has been advocated to increase child mortality. However, some form of co-operation may exist among women in polygynous families, and this can depend on how fairly the husband treats the women (Oni 1996). It is important to understand childcare arrangements in polygynous families in order to understand how the institution of polygyny affects child mortality in any particular family.

Past demographic research has shown that factors related to birth circumstances, including the health of the mother, influence child mortality during the neonatal period (Bengoa 1974; Katcha 1978: 52–53; Rutstein 1983; Rathgeber and Vlassoff 1992; Adetunji 1994; United Nations 1994; Martin 1996; Thapa 1996). Furthermore, the use of modern health care facilities for prenatal care and child delivery are important for avoiding child death immediately after birth (Shakya and McMurray 2001). Therefore, if women in polygynous relationships have poorer health conditions and are less likely to use modern health care facilities than those in monogamous families, higher levels of neonatal mortality among polygynous women would be expected.

Infant deaths at age 1–11 months (post-neonatal period) tend to be influenced by other factors such as infections from the environment and personal hygiene (Alam 1995). The absence of the mother could have serious implications for child health at this age. Infants become more active as they grow older and need greater supervision to reduce the risk of infection and accidents that may lead to sudden death. The longer breastfeeding periods and birth intervals expected with polygyny could help to reduce the risk of infection and child deaths (Huffman and Lamphere 1984; Alam 1995; Basu 1996; Population Reference Bureau 1999).[3] The advantage of cooperation among co-wives in polygynous families for childcare also points to lower mortality levels in polygynous families during the post-neonatal period.

However, during childhood (12 months and older) children's deaths are more affected by levels of household resources (Ahonsi 1995). Lower income and greater competition for available resources are expected to increase children's deaths in polygynous families. Other studies have found that favourable socio-economic conditions reduce childhood mortality (DaVanzo, Butz and Habicht 1983; Martin *et al.* 1983; Hobcraft, McDonald and Rutstein 1984).

Empirical findings

To date, findings from empirical analysis have favoured the view that polygyny has a negative effect on child survival, with no analysis showing a positive effect. A comparative study by the United Nations (1985) found consistently higher child mortality in polygynous families, in countries where data were available : Ghana, Kenya, Lesotho, and Nigeria. The results from an earlier study in Nigeria (Chojnacka 1980) and a later study in Ghana (Amankwa 1996) were consistent with the results of the United Nations study. Amankwa (1996) noted that the effect of polygyny on infant mortality in Ghana was indirect and operated through the proximate determinants of child mortality (Mosley and Chen 1984). In a study of Kipsigis women in Kenya, Borgerhoff (1990) found that the presence of many co-wives had a negative effect on the surviving offspring in polygynous families. Strassmann (1997) investigated the experiences of Dogon children who lived in the Malian Sahel and found that polygyny was the strongest predictor of child mortality, and the odds of death were seven times higher than in monogamous families. Furthermore, Sellen *et al.* (2000) found that mortality was high and significant in poor polygynous families with only one co-wife among Datoga women in Tanzania. On the contrary, in Sierra Leone, the United Nations study found no differences between the child mortality of polygynous and monogamous families, which was consistent with the findings of an earlier study by Isaac and Feinberg (1982). The Sierra Leone study found that the mortality rates of infants between birth and 18 months born to women in polygynous households did not differ from the rates of their counterparts in monogamous households.

Conceptual clarity as to how the age of the child might influence the effect of polygyny on child mortality, and controls for the effect of potential confounders of the relationship, are significantly absent from the majority of the above studies. Many combined children of different age groups in their analysis. Furthermore, the control variables differed significantly from one study to another.

In summary, it is important to consider the age of the child. Other factors relevant for child health must also be considered including mother's education, father's education, father's occupation, household wealth, and religion. Consideration should also be given to the proximate determinants of child health including maternal age at childbirth, sex of the child, birth interval, birth order, breastfeeding, prenatal care, place of delivery, tetanus injection, child immunization, birth weight, food supplements, and type of toilet facility in the home. This study, then, improves on earlier studies by examining the effect of polygyny on infant and child mortality at different ages and controlling for these potential confounders.

Data and methodology

Data source

The data source for this study is the 1990 Nigerian Demographic and Health Survey (NDHS), conducted between April and October 1990, which gathered information regarding the health of children born during the five years (1985–1990) preceding the survey. The sampling scheme for the NDHS established 299 enumeration areas (EAs). Thirty-four households were selected from each EA, and 8,781 eligible women (those aged 15–49 years) were selected from these households. A twofold oversampling of the urban stratum yielded 132 urban EAs and 167 rural EAs. Because the urban stratum was oversampled, the NDHS provided sampling weights for the data, which are used in this analysis to obtain samples representative of the population in Nigeria.

Data were collected from the eligible respondents on the health and health-related experiences of their 8,205 children born in the five-year period 1985–1990, including the age at death of those who died which provides the indicator of child mortality for this study. Time (duration) was measured in months. The analysis is limited to children of currently married women who were born within the five years preceding the survey; the survey collected information on marriage type only for women who were currently married. Therefore, the sample unit of analysis for this study is children, and children whose mothers were not currently married are excluded. We further excluded children who had not reached the age of one month, as they might not have been fully exposed to the risk of neonatal mortality, and thus might bias the result. The final sample, therefore, for the study is 7,818 children.

This study has some potential limitations. Age misreporting is still a source of concern in most developing countries. However, the age heaping observed in the 1990 NDHS would not invalidate the results obtained. Another concern relates to the issue of unobserved heterogeneity. Since this problem was controlled at the family level by controlling for the effect of clustering of children, and since some community level variables like place of residence and region of residence were introduced, the impact of this problem is expected to be minimal. Most importantly, this study examined infant and child mortality for births in the previous five years, while using the current polygyny status of the family; some children may have died before the family turned polygynous. This could inflate the mortality level for families that are currently polygynous. However, since the mortality levels are not consistently higher in polygynous than monogamous families during the neonatal, post-neonatal and childhood periods, this bias may be limited.

Data analysis

The dependent variable is child mortality, indicated by occurrence during the neonatal, post-neonatal, and childhood periods. Neonatal mortality is defined as deaths occurring between birth and one month of life, post-neonatal mortality as deaths at age 1–11 months, and childhood mortality as deaths at age 12–59 months.

To begin, we use life table techniques to compare the probabilities of dying within different age intervals corresponding to neonatal, post-neonatal and childhood mortality. An evaluation of the data on age at death showed some heaping at age 12 months. However, the heaping is not severe, and according to the 1990 NDHS report, the type of heaping at this age may not result in biases greater than five per cent (Sullivan, Bicego and Rotstein 1990).[4]

Subsequent work uses logistic regression and a proportional hazards model approach developed by Cox (1972) to predict the effect of marriage type on child mortality while controlling for the effects of potential confounders. The general forms of the logistic and hazards models are respectively,

$$\log [P/(1 - P)] = b_0 + BX \tag{1}$$

$$\log h(t/x) = \alpha(t) + \beta X \tag{2}$$

In equation (1), P is the probability of dying, b_0 and B (a vector) are regression coefficients to be estimated, and X is a set of fixed covariates. Similarly, in equation (2), h(t/x), the dependent variable, is the conditional probability that an event occurs within the time interval t, given the covariates x, and that the event had not occurred before the beginning of the interval. The baseline hazard, $\alpha(t)$, is assumed to be independent of the covariates, β is the vector of unknown regression coefficients to be estimated, and X is the set of fixed covariates.

STATA software was used to estimate the log odds of dying for the neonatal age group and to estimate log conditional hazards of dying for the post-neonatal and childhood age groups. As proportional hazards models can accommodate censored observations and time-dependent covariates, breastfeeding duration, BD(t), and food supplement, FS(t), were modelled as time-dependent covariates as follows:

$$\log h(t/x) = \log \alpha(t) + \beta X + \lambda BD(t) + \gamma FS(t) \tag{3}$$

where the regression coefficients, λ and γ, are estimated for the effects of breastfeeding and food supplements on child survival. BD(t) is the minimum breastfeeding duration at time t: if a child had stopped breastfeeding before time t, BD(t) is the duration of breastfeeding; for children still breastfeeding, BD(t) is equal to t. For food supplements, the age at which each child started receiving supplements was recorded. FS(t) is an indicator variable that is coded zero if the age at which the child started receiving supplements is greater than t, and coded one, if less than or equal to t. In this study, censored children are those who were alive at the time of the survey, but were not old enough to be exposed to mortality at the next age group (they were censored at the time of the survey).

The STATA software has the capability of adjusting for non-independence of observations (clustering). Our analysis adjusted for correlation between responses arising from the fact that some women contributed more than one child to the study sample. When the coefficients estimated from the logistic and hazard models are exponentiated, the results give the odds ratio and relative risks of dying, respectively, for the categories of a covariate compared to the reference category (Allison 1990; Liao 1994).

Measurement of variables used in the analysis

The variables used in the analysis are shown in Table 1. The major independent variable is marriage type: children are grouped according to whether they belonged to monogamous or polygynous families. It has been recognized that using this dichotomy to define marriage may introduce some bias in the measurement of marriage because of the fluidity of marriage and the inability of women to correctly report the number of their husbands' wives (Speizer 1995; Ezeh 1997). Although the percentage of children whose mothers reported incorrect knowledge of the number of their husbands' wives was small (less than 1 per cent) in NDHS 1990 (FOS 1992), we excluded them from the analysis to minimize this problem.

All of the control variables are dummy coded except for breastfeeding, food supplement and maternal age at birth of the child, which are included in the analysis as continuous variables. The index of household possessions is a measure of household economic status based on the possession of such amenities as television, refrigerator, radio, car or electricity. Because first births do not have preceding birth intervals, we created a dummy comparing first births with all other births. For child immunization, children who received partial or full immunization are coded 1 while those who received no immunization were coded 0. We did not include immunization in the analysis of neonatal mortality because of reverse causality: some children may not have received any immunization because they died immediately after birth.

The study includes proxy measures for birth weight (baby size at birth) and food supplements (formula or animal milk). As noted, food supplement is used as a time-dependent variable and measured as the time, in months, for starting supplementation. Breastfeeding is also time-dependent and is not used in the analysis of neonatal mortality, as almost all children in Nigeria are breastfed during the first month of life. The region and place of residence are included as community-level variables (Orubuloye and Caldwell 1975; Rosenzweig and Schultz 1982; Sastry 1996). Evidence exists for important regional differences in the level and practice of polygyny (with the practice of polygyny higher in the north than the south), distribution of health facilities, and levels of infant and child mortality in Nigeria (Olusanya 1979; Adetunji 1994).

Results

This section discusses the results of the study starting with the characteristics of the children in the study sample, comparing children from monogamous and polygynous families. Results of the life table and multivariate analyses for the effects of marriage type on child mortality at the neonatal, post-neonatal, and childhood ages are discussed.

Characteristics of children in the study sample

The socio-economic characteristics of the children in the study sample are shown in Table 1, illustrating that children in polygynous families are more likely than those in monogamous families to have parents who are socio-economically disadvan-

Table 1 Measurement and descriptive statistics for control variables used in the analysis by marriage type, Nigeria, 1990

	Marriage type		Test of association
Variable	Monogamous %/median	Polygynous %/median	χ^2-statistic
Socio-economic and cultural variables			
Mother's economic activity			
Not active (Ref)	32.5	29.7	
Active	67.5	70.3	6.65*
Mother's education			
No education (Ref)	55.8	74.9	
Primary	28.7	18.8	
Secondary plus	15.5	6.3	303.51***
Father's education			
No education (Ref)	47.4	63.9	
Primary	31.0	23.4	
Secondary plus	21.6	12.7	206.76 ***
Father's occupation			
Agriculture (Ref)	55.5	64.2	
Professional	14.9	9.7	
Non-professional	29.6	26.1	67.89***
Index of household possessions			
Low (0–1) (Ref)	73.6	78.7	
Medium (2–3)	16.4	13.4	
High (4–5)	10.0	7.9	25.61***
Religion			
Non-Christians (Ref)	49.4	69.1	
Christians	50.6	30.9	282.15***
Reproductive variables			
Median breastfeeding duration[a] (months)	22.0	23.0	0.25[b]
Preceding birth interval			
1st order births(Ref)	20.4	13.5	
Less than 24 months	23.2	21.8	
24–36 months	33.3	34.0	
37 months plus	23.1	30.7	89.52***
Maternal age at child's birth[c]			
Less than 25 years	45.2	32.8	
25–35 years	44.7	51.7	
36 years plus	10.1	15.5	131.10***
Birth order			
1 birth order	20.3	13.4	
2–3 birth order	32.6	30.0	
4–6 birth order	31.9	34.8	
7+ birth order	15.2	21.8	100.31***

* = p <.10; *** = p < .01

a This is breastfeeding duration in months and not proportion of children breastfed.

b Chi-squared from life table log-rank statistics.

Table 1 (continued)

Variable	Marriage type: Monogamous %/median	Marriage type: Polygynous %/median	Test of association χ^2-statistic
Sex			
Female (Ref)	50.4	50.8	
Male	49.6	49.2	0.09
Health care variables			
Prenatal care			
Others (Ref)	45.1	49.9	
Used modern care	54.9	50.1	16.89***
Place of delivery			
Other (Ref)	65.0	76.1	
Modern facility	35.0	23.9	104.41***
Tetanus injection			
No (Ref)	46.2	50.2	
Yes	53.8	49.8	11.62*
Immunization			
No (Ref)	48.2	52.0	
Yes	51.8	48.0	10.18*
Nutritional variables			
Baby size at birth			
Small (Ref)	16.8	19.4	
Average/large	83.2	80.6	8.63*
Food supplement			
No (Ref)	53.9	63.3	
Yes	46.1	36.7	63.98***
Household environment			
Types of toilet			
No facility/bucket (Ref)	28.1	31.9	
Pit	63.4	64.5	
Flush	8.5	3.6	74.60***
Community-level variables			
Place of residence			
Rural (Ref)	76.7	82.4	
Urban	23.3	17.6	33.97***
Region of residence			
North (Ref)	46.3	62.5	
South	53.7	37.5	190.38***
Weighted sample size	4745	3073	

c Used as continuous variable in the multivariate analysis.

Source: Calculated from Nigerian Demographic and Health Survey 1990 (Federal Office of Statistics 1992).

taged. For example, children in polygynous families are more likely to have uneducated parents. Similarly, children in polygynous families are less likely to have fathers in professional occupations (9.7 versus 14.9 per cent), and more likely to have fathers in an agricultural occupation (64.2 versus 55.5 per cent). They are also less likely to belong to families with a medium or high index of household possessions. On the other hand, children in polygynous families have mothers who are slightly more economically active (70.3 per cent) than those in monogamous families (67.5 per cent). Table 1 further shows that children in monogamous families are more likely to have Christian mothers (52 per cent) than those in polygynous families (31 per cent).

The results in Table 1 are only partly consistent with the findings from previous research about the positive effects of polygyny on breastfeeding and birth spacing. Contrary to expectations, there is no significant difference between the median breastfeeding duration for children in polygynous and monogamous families (log-rank statistics: chi-squared = 0.25, p = 0.6430). On the other hand, children in polygynous families are spaced more widely than those in monogamous families. The results for other reproductive variables show that a greater proportion of children in polygynous families are born to mothers who are older, in their late 30s or 40s. Furthermore, more of the children in polygynous families are high birth order, while no significant difference appears in the numbers of males and females in monogamous and polygynous families.

The results for health care variables in Table 1 reveal that children in monogamous families are more likely to have mothers who used modern health care facilities for prenatal care and child delivery. There is little difference in the proportions of children immunized and whose mothers received tetanus injections. The proportions of children who were of average or larger size at birth are slightly higher in monogamous than polygynous families (83 per cent versus 81 per cent). Children in monogamous families were also more likely to be fed with formula or animal milk than those in polygynous families (46 and 37 per cent, respectively). Children in monogamous families are more likely to belong to families with flush toilet facilities, and to reside in urban areas and the southern part of Nigeria.

Polygyny and child survival: life table estimates

Table 2 shows the life table estimates of the conditional probabilities of dying in the neonatal, post-neonatal, and childhood periods according to marriage type. The table also shows the number of children at risk of dying within each age interval, the number of deaths, and the number censored. In this analysis, children censored in each age interval are those who survived the age interval but were not old enough to be exposed to mortality during the next age interval at the time of the survey. According to the results, the probability of dying during the neonatal period is lower in monogamous families than in polygynous families (0.0354 versus 0.0485). The mortality levels during childhood are also slightly higher in polygynous families. There is higher mortality in monogamous families when only the post-neonatal period (1–11 months) is considered. Therefore, failure to separately consider neonatal and post-neonatal mortality masks the protective effect of polygyny on survival during the post-neonatal period. Analysis distinguishing these ages is important. The log-rank statistic, which stresses the differences in survival toward the end of a process (childhood period), shows no statistically significant

Table 2 Life table estimates of conditional probabilities of dying for children in the sample by age of child and marriage type, Nigeria, 1990

Marriage type	Number of children at risk	Deaths	Censored cases	Conditional probability of dying
		Neonatal (0 month)		
Monogamous	4745	168	0	0.0354
Polygynous	3073	149	0	0.0485
		Post-neonatal (1–11 months)		
Monogamous	4577	197	912	0.0478
Polygynous	2924	103	598	0.0392
		Childhood (12–59 months)		
Monogamous	3468	243	3225	0.1310
Polygynous	2223	176	2047	0.1467

Source: As for Table 1.

differences in the survival between the two family types (chi-squared = 2.16; $p > .10$). However, the Wilcoxon statistics which stress the differences toward the beginning of a process (neonatal and post-neonatal periods) show that survival between the two family types is different but with a marginal statistical significance (chi-squared = 2.67; $p < .10$). The multivariate analysis, shown below, further tests for the significant differences between the computed probabilities of dying in the life table analysis, and how the result changes when the effects of the socio-economic and proximate determinants of child mortality are controlled.

Polygyny and child survival : multivariate results

Table 3 shows estimates of logistic regression equations for neonatal mortality and hazards models of post-neonatal mortality and childhood mortality. The results for neonatal mortality are expressed as odds ratios and the hazards model results for post-neonatal and childhood mortality are expressed as relative risks. The model equation estimates for determinants of neonatal, post-neonatal, and childhood mortality are similar, and Model 1 in each case shows the bivariate relationship between polygyny and child mortality for the different age periods. Model 2 controls for the effects of socio-economic variables, and Model 3 introduces the proximate determinants of child mortality. Model 4 adds the community level variables, place of residence and region of residence. Table 3 does not include breastfeeding and immunization in the models for neonatal mortality and the results are adjusted for the effect of child clustering.

The results show that the effect of polygyny on neonatal mortality is weak (Table 3). The gross effect of polygyny on neonatal mortality (Model 1) is negative and only significant at the 10 per cent level. This effect is reduced from 1.39 in Model 1

Table 3 Logistics and hazard models estimates of neonatal mortality, post-neonatal mortality and childhood mortality for marriage type, Nigeria, 1990

Marriage type	Model [a] 1	2	3	4
	Neonatal mortality (odds ratios)			
Monogamous (Ref)				
Polygynous	1.39*	1.30	1.24	1.23
–2 log likelihood chi-squared	2.99*	20.03**	158.52***	161.01***
Degrees of freedom	1	11	20	22
N	7818	7818	7818	7818
	Post-neonatal mortality (relative risks)			
Monogamous (Ref)				
Polygynous	0.81	0.75*	0.74*	0.74*
–2 log likelihood chi-squared	1.55	18.33*	192.00***	203.15***
Degrees of freedom	1	11	23	25
N	7501	7501	7501	7501
	Childhood mortality (relative risks)			
Monogamous (Ref)				
Polygynous	1.13	0.97	0.95	0.95
–2 log likelihood chi-squared	0.71	38.64***	131.76***	134.94***
Degrees of freedom	1	11	20	22
N	5691	5691	5691	5691

* = p < .10; ** p = < .05; *** = p < .01

a Model 1 = Bivariate estimate for polygyny

Model 2 = Model 1 + Socio-economic variables

Model 3 = Model 2 + Birth interval + Breastfeeding + Maternal age at child's birth + Birth order + Sex + Prenatal care + Place of delivery + Tetanus injection + Immunization + Birth weight (baby size at birth) +Food supplement + Types of toilet (Proximate determinants)

Model 4 = Model 3 + Place of residence + Region of residence

Source: As for Table 1.

to 1.30 in Model 2 once the socio-economic and cultural variables are introduced, becoming non-significant. The effect is further reduced from 1.30 to 1.24 after introducing the proximate determinants of child health in Model 3. Introducing place of residence and region of residence (Model 4) does not change this result.

The bivariate result (Model 1) for the effect of polygyny during the post-neonatal period is not significant, but becomes significant at the 10 per cent level once the socio-economic and cultural variables are introduced (Model 2). This is maintained when additional variables (Models 3 and 4) are included. For the childhood period (12–59 months), there is no difference in survival between children in the two types of families after all controls are introduced. Although the net effect of polygyny on post-neonatal mortality is marginally significant ($p = 0.08$), the magnitudes of the effect are large, and children in polygynous families are about 26 per cent less likely to die during the post-neonatal period (Model 4).

Summary and discussion

The effect of marriage type, monogamous or polygynous, on neonatal mortality in Nigeria is non-significant after controlling for the socio-economic and demographic factors related to polygyny. In contrast, after controlling for the effects of important socio-economic and demographic factors, polygyny has a protective effect on post-neonatal mortality, and children in polygynous families are about 26 per cent more likely to survive than those in monogamous families (Model 4). The net effect of polygyny on post-neonatal mortality is significant at the 10 per cent level. Marriage type also has no significant impact on survival during childhood.

Although the rate of polygyny is high in Nigeria, certain factors may help to explain the weak effect of polygyny observed. First, women are economically active in most of southern Nigeria, and make some contribution to family resources; therefore, women do not depend solely on their husbands' resources to care for their children (Brown 1981; Oni 1996). Hollos (1991) noted that there is greater autonomy or independence among women in polygynous marriages in southern Nigeria than in monogamous marriages. Sellen *et al.* (2000) found little effect of polygyny on child survival in Datoga families of Tanzania, and the result was attributed to the considerable economic autonomy of women in Datoga. Secondly, in the northern region of Nigeria, dominated by the Muslim religion, many women depend on their husbands for resources. However, Islamic law requires that a man must have enough wealth to support an extra wife, and must give equal treatment and attention to each woman (Chamie 1986). This may also contribute to the weak effect of polygyny on child mortality.

The descriptive analysis showed evidence for poorer health among polygynous women in Nigeria. They are more likely than monogamous women to give birth at later ages, have higher-parity children, and have low-birthweight children. Note that these factors associated with polygynous marriage are often found to be related to greater maternal mortality. Poorer health among polygynous women is partly expected in Nigeria; Oni (1996) noted that women in Nigeria are becoming increasingly dependent on their husbands owing to the economic hardship in the country. Sellen *et al.* (2000) acknowledged that polygyny's effect on child health would be greatest in poorer households and when women's economic activity cannot provide them with enough resources to care for themselves and their children.

Although nepotistic investment is not directly implicated by available data, Oni (1996) noted differential treatment of women in polygynous households by their husbands. The status of a woman in a polygynous household determines the amount of resources she can obtain from her husband. Differential treatment of women can generate intra-household differences in child health (Oni 1996).

The protective effect of polygyny during the post-neonatal period emphasizes the relevance of the theory of co-wife co-operation (Chisholm and Burbank 1991). This stressed the importance of childcare provided by the many adult members in polygynous families, as suggested by Isaac and Feinberg (1982). This issue is not well explored in this study, and needs further attention. If childcare is important in explaining this result, it will provide supporting evidence for the advocacy of better childcare for working mothers in Nigeria, including provision for breastfeeding. Infants become very active at age 1–11 months, and need adequate supervision to reduce infections and avoid accidents that could cause death. Brown (1981) suggested that one of the reasons a wife in a monogamous marriage might suggest that her husband marry is to provide another woman to share childcare responsibilities.

Finally, this study demonstrates the need to control for the influence of possible confounders of polygyny's effect on infant and child mortality. The negative effect of polygyny on survival during the neonatal period disappeared, while the protective effect on survival during the post-neonatal period became significant, after controlling for the effect of important socio-economic, cultural and proximate determinants of infant and child mortality.

Acknowledgments

Grant No. HD07237 for Research Training in Population Statistics from the National Institute of Child Health and Human Development supported the preparation of this paper. We are grateful to the computer support group from the Department of Agricultural Economics and Rural Sociology at Pennsylvania State University, especially Claudio Frumento for technical assistance during the early stages of this paper. We are also grateful to Phil Bardsley of the computer technical group at the Carolina Population Center, UNC-Chapel Hill for technical assistance during the final preparation of the paper.

Notes

1 Polygyny is a form of marriage between one man and multiple women. This is different from polygamy, which means a marriage between one man and multiple women or one woman and multiple men.

2 Environmental scientists were the first to present this view. In spite of the lack of a consensus on the differences in coital frequency between polygynous and monogamous couples (Ezeh 1997), the existing evidence is that polygyny has a positive effect on breastfeeding and birth intervals (Amankwa 1996).

3 Children whose older siblings died during infancy have been found to have a lower post-neonatal mortality risk. This has been attributed to the fact that the deaths of older siblings may remove competition among siblings for parental care and resources (Alam 1995).

4 Because the study emphasizes the importance of a child's age and in order to evaluate the effect of the heaping on the results of the study, models were run using 1–12 months as infant mortality instead of 1–11 months. This did not change the findings of the study.

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