J.biosoc.Sci, (2007) **39**, 287–300, © 2006 Cambridge University Press
doi:10.1017/S0021932006001441 First published online 3 Jul 2006

POLYGYNY, REPRODUCTIVE SUCCESS AND CHILD HEALTH IN RURAL ETHIOPIA: WHY MARRY A MARRIED MAN?

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Summary. This study examines the reproductive success of men and women in rural Ethiopia as a function of their marital status, specifically by comparing polygamously and monogamously married individuals. In line with predictions from evolutionary theory, polygamy is beneficial to male reproductive success (i.e. producing larger numbers of surviving offspring). The success of polygamously married females depends on wife rank: the first wives of polygamous husbands do better than monogamously married women and much better than second or third wives. These effects are mirrored in child nutritional status: the children of second and third wives have lower weight for height. Due to potential, largely unmeasurable differences in marriageability (quality) between individuals, it was not possible to support a model of either resource-holding polygyny combined with female choice or female coercion into unwanted marriages. First wives of polygamously married men marry at a younger age and attract a higher brideprice, suggesting that both the males and females in the marriage are likely to be of higher quality (due to wealth, family status or some other factor such as beauty). Unions that end up monogamous are likely to be between slightly lower quality individuals; and second and third wives, who marry at the oldest ages and attract the lowest brideprice, may be 'making the best of a bad job'. The relatively long gap between first and second marriages may mean that first wives of highly marriageable males can enjoy considerable reproductive success before their husbands marry again.

Introduction

Evolutionary anthropologists have sought to distinguish various conditions under which polygyny (marrying more than one wife concurrently) might arise in humans by investigating the differential costs and benefits for each sex. Studies have emphasized the benefits of polygyny for male fitness in terms of greater numbers of surviving offspring (Betzig, 1986; Borgerhoff Mulder, 1987; Sellen, 1999) and also

male material wealth in societies where women contribute to subsistence (Hartung, 1982; Luttberg *et al.*, 2000). Conversely, negative effects of polygyny have been reported for female fertility (Bean & Mineau, 1986; Garenne & van de Walle, 1989) and child growth and well-being (Brabin, 1984; Strassmann, 1997, 2005; Sellen, 1999; Hadley, 2005).

Resource-holding polygyny

Given the greater costs incurred by women, evolutionary anthropologists have attempted to explain the paradox presented when females and/or their parents choose a polygamous rather than a monogamous union. Models exploring the costs and benefits of polygyny, developed by ecologists studying bird mating systems, are broadly categorized as either (or a combination of) the female-choice or the male-coercion models (Searcy & Yasukawa, 1989; Davies, 1990). 'Resource-holding polygyny' – a branch of the female-choice model – posits that where males gain access to and monopolize resources, females distribute themselves according to resource availability (Orians, 1969; Bensch & Hasselquist, 1992). In humans, where disparities of wealth exist among men, women may maximize their reproductive success by choosing men with the most resources, even it this means marrying a man who is already married. In other words, when already-married men provide more resources than unmarried ones, women do equally well or better (reproductively) in polygamous marriages than monogamous ones (Chisholm & Burbank, 1991; Hames, 1996).

Among East African pastoralists inherited male wealth has been positively correlated with number of wives (Borgerhoff Mulder, 1990; Luttberg *et al.*, 2000), and accordingly number of children (Borgerhoff Mulder, 1987; Mace, 1996). In egalitarian societies, which are less stratified in terms of resources, a man's ability to attract wives has been positively correlated with his economic productivity (Hill & Hurtado, 1996) or political status (Chagon, 1983; Hames, 1996). Further studies have highlighted the importance of resources and assistance provided by co-operating co-wives, in effect suggesting that women are 'choosing' co-wives as much as husbands (Irons, 1983; Chisholm & Burbank, 1991).

Male coercion

Among the Arsi Oromo, as in other African agro-pastoralist societies (Borgerhoff Mulder, 1987, 1989; Strassmann, 1997; Sellen, 1999), females are not able to exert choice with respect to their marriage partners, leading some authors to speculate that polygny arises through male coercion – which may not serve the interests of women (Chisholm & Burbank, 1991; Sellen, 1999). Here it is argued that even among societies where female choice is not operative, polygyny may be adaptive for some women if this means gaining access to higher quality males. Marriages are arranged by parents who are in effect choosing polygyny on behalf of their daughters, whose reproductive interests they share. However, parents should only be willing to marry their daughters polygynously if this choice offers fitness payoffs that are at least as high as the ones offered by monogamy.

However, payoffs may vary between women within polygynous households. Large-scale demographic studies suggest that the fertility of polygynous women may

decrease as a wife's rank status in the union increases (independent of age differences between wives and length of marital exposure) (Bean & Mineau, 1986; Garenne & Van de Walle, 1989; Josephson, 2002), but evidence of an effect of wife order/rank on children's well-being remains inconclusive (Strassmann, 1997; Sellen, 1999; Hadley, 2005). Often constrained by small sample sizes, research to date has frequently dismissed the role of wife rank status within polygynous unions, claiming no inequality in treatment between wives (Borgerhoff Mulder, 1989). In order to understand the reproductive decision-making process that leads to polygyny we need to account for such rank variation that exists between women. Our data provide an opportunity to assess the effects of rank, specifically the distinction between first and later wives, a pertinent topic given that first wives (or their parents) do not choose polgyny (Josephson, 2002). The differences between women who enter polygynous marriages, those who enter monogamous marriages but later become polygamous first wives, and those who remain in monogamous unions are explored.

Using demographic and anthropometric data collected in an agro-pastoralist community in southern Ethiopia between 1999 and 2004, this study a) documents the effect of polygyny for both sexes on a direct measure of reproductive success, i.e. number of surviving offspring to date; and b) explores the characteristics of co-wives and their children within the household.

Study population

The study site is situated within an Arsi Oromo agro-pastoralist community in southern Ethiopia. Traditionally semi-nomadic pastoralists, the Arsi Oromo now practise a mixed subsistence economy based on maize, sorghum and wheat cultivation, as well as cattle herding. The region suffers from acute and regular water shortages and chronic food insecurity, particularly in the low-lying areas. Despite efforts to improve local services (including the construction of a water pipeline, health clinics and schools) and recent access to food aid to buffer shortfalls during drought years, infant mortality rates remain high (at 143·6 per 1000) and malnutrition is common (Gibson, 2002; Gibson & Mace, 2006). Over 20% of children die before the age of five. Of those surviving, 47·5% are stunted indicating long-term malnutrition and/or high infection and physical activity levels and 10·0% are wasted, reflecting acute recent malnutrition (Gibson & Mace, 2006).

The current land tenure system derives from the federal land reform proclamation of 1975, which nationalized and redistributed all rural land holdings. Redistribution has occurred four times, most recently in 1987, with each household's allocation being determined by family size (0·5 hectares per family member). Since 1987 land holdings can be inherited and fathers subdivide their small plots between sons upon their marriage (approximately 0·5 hectares per son). The mean household land holding is 1·57 hectares ($\pm$ 0·99), but 21·7% of households own less than 0·5 hectares. Both the new land available for cultivation and herding, and economic opportunities, remain limited (Gibson, 2002). While some gain access to small amounts of extra land through the lease market (sharecropping or renting), young men are increasingly seeking additional employment in the cities, while others have accepted resettlement outside the region.

Loss of grazing land and the sale of livestock have resulted in substantial changes to the cultural life of the community. Today the average household herd includes fewer than five cattle (4·21 ± 4·13) and 13% of households have no cattle. Herd size was traditionally an important indicator of both economic status and social prestige, reflected in Oromo marriage practices which favour marriage payments (cattle and money) being transferred from the groom's to the bride's family in bridewealth. While proportion and size of marriage payments in cash have changed little since land reform (on average 1471 Ethiopian birr = US$200), the transfer of cattle at marriage has become the privilege of a small minority (<18% of marriages). The proportion of marriages including marriage payments in cattle has dropped by 50%. The average bridewealth payment now includes fewer than three cattle (2·59 ± 1·94).

Oromo marriages are arranged between clans in differing villages, permitting important alliances to be forged between communities with differential access to resources such as water and grazing land (Terefe, 2000). Marriage outside the clan is desirable, and to avoid conflict between clans there is said to be a strong tradition for all marriage proposals to be accepted, irrespective of a male's wealth or marital status. However, poor families, wishing to avoid sizeable bridewealth payments, may agree to 'exchange' daughters with other poor households within the village (Gibson & Mace, 2005). Since household wealth is inherited through the male line, most newlyweds reside in the groom's village, at which point the woman becomes entirely dependent on her husband's land and cattle.

Among the Arsi Oromo, divorce or separation is extremely rare; however, men are permitted to marry polygynously. One-third of all married women in the community are married to men who have additional living wives. Although having many wives is considered highly prestigious for men, not all men are able to afford bridewealth payments for additional wives: 60·2% of men in the sample had only married once; 28·7% married twice, and only 11·1% had three or more wives. Furthermore, there are few non-agricultural employment opportunities in this region, population growth driving the declining ratio of land (Gibson & Mace, 2006). Men may take years to accrue bridewealth payments for a second or third marriage; as such the mean interval between marriages for Arsi Oromo men is 12·6 years.

Within the household the interests of Arsi Oromo women are subordinate to those of both men and children in many respects. Women assume both the energetic demands of childbearing, and those of hard physical labour (e.g. grinding maize, and carrying water and firewood). Women suffer from the ill effects of very high workloads, short birth spacing, inadequate diets and harmful cultural practices, such as cliterodectomy (Gibson, 2002). Maternal mortality rates are high: one in four Ethiopian female deaths are due to pregnancy-related causes (Central Statistics Authority & Macro ORC, 2001) and fewer than 3% of all women living in the survey villages had ever used contraception (Gibson, 2002).

Within polygynous households resources are reported as being shared equally among wives. Each wife maintains her independence, living in a separate hut with her own hearth and managing her household budget independently. Furthermore, there is little co-operation amongst co-wives in daily activities. Due to age differences between co-wives, conflict frequently arises between first wives, who claim greater access to resources due to their larger family sizes, and more youthful co-wives, who may

receive greater attention of the husband. Furthermore, there is a strong sex preference for sons among the Oromo, and the woman who bears the first male heir is given the greater respect among the co-wives.

Methods

Data collection

Since 1999, demographic and anthropological data have been collected from four villages in the Arsi lowlands. Demographic census surveys were undertaken in 1999 and 2003, during which birth histories were collected from 1919 reproductive-aged women (15–50 years) using calendars that recorded the monthly timing of births and deaths over the preceding six years. In 2004, a marriage and livelihoods survey was undertaken among a sample of 222 married men, which recorded detailed information on household livelihoods (e.g. herd size, land holdings, crop yield) and all marital events (e.g. marriage start and end dates, age at marriage, bridewealth payments). This provided information on 353 marital unions.

In 2003, a sample of 700 children (<16 years) was included in an anthropometric survey across the four villages. Measures of height and weight were performed based on the guidelines set out by Lohman and colleagues (Lohman *et al.*, 1988). The median age of children measured during the survey was five years and seven months. The sample included a roughly equal number of children of both sexes (50·4% females and 49·6% males).

Demographic analyses

In the analyses of demographic data, multivariate general linear models were used to assess the partial effects of age, wealth and marital status on number of surviving offspring at the survey date. General linear models (GLM) provide adjusted means and standard errors. Two separate sets of analyses were performed to identify positive predictors of family size for men and for women. In both sets of analyses age and age squared were entered in the model to reflect the non-linear relationship between age and family size. Both husband's age at first marriage and wives' age at marriage were also entered into the models since age at entry into marriage is known to influence the timing of births and deaths. Co-variates for total land holding size and herd size (at the survey date) were included in the models to control for wealth differences between households.

To assess the impact of husband's re-marriage on family size, a variable recording a man's total number of wives (to the survey date) was added to the both models. In the female model, a co-variate reflecting duration of marriage (in months) was added. A woman's marital status was defined using a categorical co-variate recording a woman's wife rank status (monogamous, wife rank 1, wife rank 2 and wife rank 3+). As noted in other studies on polygyny, any monogamous marriage is potentially polygynous or vice versa (Borgerhoff Mulder, 1989). In this case, wife rank status reflected the highest marital status that women achieved in a polygynous union during the reproductive years of her marriage, or to date if the marriage was censored by the interview. In other words, a woman who entered a monogamous marriage, but

subsequently become a first wife when her husband re-married concurrently was coded as 'Wife Rank 1'. The code wife rank status was used to reflect the conditions under which a woman bore and raised most of her children. However, without more detailed data on marital change in status over a lifetime, it was difficult to explore the effects of temporal overlap among women in raising offspring (Garenne & Van de Walle, 1989).

Household wealth measures (land size and herd size) refer to the current status information collected in the survey in 2003–2004. A total of 353 women and 222 men contributed demographic data to the final analyses. SPSS software version 12·0 was used to perform the statistical analyses.

Growth analyses

In the analyses of child growth, multivariate general linear models were used to assess the partial effects of child's age, square of child's age, sex, maternal age, parity, family size and wealth (household cattle herd size), as well as mother's marital status (wife rank) on two child growth indices: Body Mass Index (BMI) and Weight for Height *Z*-scores (WHZ). General linear models (GLM) provide adjusted means and standard errors.

Body mass indices are calculated by dividing weight in kilograms by the square of height in metres^2 (WHO, 1995). Standardized *Z*-scores represent the distance from the mean of the reference population in terms of standard deviations, for children of the same age and sex. By convention, children with a WHZ of more than two *Z*-scores below the median of the WHO/NCHS international reference population are considered seriously or acutely malnourished (WHO, 1995). The standardized scores control for age and sex-specific patterns of growth and allow direct comparisons of children of all ages and both sexes (WHO, 1995). The *Z*-score values based on the WHO/CDC international reference population (WHO, 1993) were calculated using Epi-Info 3·2.2 software. The final dataset was limited to a maximum of two children per mother/household, to control for hierarchical structures of the data relating to family characteristics (genetic and/or environmental similarities within families). A total of 495 children ($\leq$10 years) were included in the final analyses. SPSS version 12·0 was used to perform the statistical analyses.

Results

The characteristics of the sample of men and women included in the multivariate analyses are presented in Tables 1 and 2. Simple univariate GLM analyses were performed to determine whether men who married more than one woman differed with regard to their age, level of education, land holdings and herd size (Table 1). Similar analyses were undertaken to assess whether women who married polygynously differed according to age, age at marriage, bridewealth paid in cash and current nutritional status (BMI in 2003; Table 2).

Table 1 reveals that men with two wives were on average 13·9 years older than those with only one wife. After controlling for secular changes over time, there were no differences in educational attainment between men according to marital status. It

https://doi.org/10.1017/S0021932006001441 Published online by Cambridge University Press

Table 1. Characteristics of study males (n=222)

Lifetime total wives	n	Age (years) ± SD	Education (years) ± SE [a]	Land size (hectares) ± SE [a]	Herd size ± SE [a]
One	135	35·6 ± 11·6	2·34 ± 0·26	1·54 ± 0·9	3·77 ± 0·4
Two	63	**49·5 ± 11·0**	2·98 ± 0·41	**2·02 ± 0·1**	**6·22 ± 0·6**
Three+	25	**53·1 ± 8·7**	1·51 ± 0·63	**2·28 ± 0·2**	4·59 ± 0·9
Total ± SD	223	41·5 ± 13·3	2·40 ± 2·92	1·76 ± 1·02	4·57 ± 4·80

Bold type indicates where dependent variable was significantly different from the reference category (one wife) in GLM.
[a]Age adjusted for mean age: 41 years.

Table 2. Characteristics of study females (n=353)

Marital status [d]	n	Age (years) ± SD	Age at marriage ± SE[a]	Bridewealth (Ethiopian birr) ± SE[ab]	n[c]	BMI in 2003 ± SE [a]
No co-wife	189	31·4 ± 10·8	17·25 ± 0·3	1634 ± 197	180	20·15 ± 0·2
First wife	72	**45·4 ± 10·4**	**15·32 ± 0·5**	1579 ± 768	30	**20·93 ± 0·4**
Second wife	80	**34·7 ± 10·4**	**18·73 ± 0·4**	**1259 ± 173**	50	20·67 ± 0·4
Third+ wife	12	31·1 ± 7·4	**20·12 ± 1·2**	**955 ± 312**		
Total ± SD	353	3 5 ± 11·8	17·29 ± 4·2	1471 ± 1473	260	20·34 ± 2·3

Bold type indicates where dependent variable was significantly different from the reference category (no co-wife) in GLM.
[a]Age adjusted for mean age: 35 years.
[b]Husband's wife order.
[c]Anthropometric measurements only available for a sub-sample of women.
[d]Wife rank status during reproductive years of marital union.

is interesting to note that education and wealth were not positively associated. However, men who had married more than one wife had access to more land and a larger household herd size.

Table 2 reveals that age was a predictor of marital status among women. Among the polygynously married women, first wives were on average 10·7 years older than second wives, who were in turn 3·6 years older than third or later wives. After controlling for secular changes, a woman's age at marriage increased proportionately with wife rank; on average first rank women were married 3·4 years younger than second wives, and 4·8 years younger than third wives. Furthermore, first wife rank women were married 1·9 years younger than monogamously married women, indicating that there may be fundamental differences between those women who remain in monogamous union and those whose husbands become polygynous at a later date (first wife rank).

https://doi.org/10.1017/S0021932006001441 Published online by Cambridge University Press

Variation in marriage payments (bridewealth in Ethiopian birr) was apparent between women of differing marital status. Among polygynous women, after controlling for secular changes to marriage payments over time, wife rank status (at marriage) was inversely related to the bridewealth paid. On average, a drop in one wife rank was associated with a 300 birr reduction (US$40) in marriage payments. In this case there were no statistical differences in marriage payments between first wife rank women and monogamously married women.

On the survey date, first wife rank women appeared to be among the better-nourished women in the community. In the reduced sample of women with anthropometric data (excluding pregnant women, but including lactating women) (n=260), controlling for age effects, first wife rank women had the highest mean BMI.

Family size

The results of the multivariate GLM analyses, performed to assess the partial effects of age, wealth and marital status on male and female reproductive success or number of surviving children to the survey date, are presented in Table 3. These analyses reveal that a male's family size increased as a linear function of age. The relationship between a woman's family size and age can be represented by a parabolic curve, indicative of an initial increase following a period of adolescent subfecundity, followed by later decline in reproductive function associated with the menopause and other social factors affecting exposure to intercourse. A husband's age at marriage was a negative predictor of his surviving family size; the later a man married, the fewer his number of surviving children at the survey. There was no similar significant effect on women's age at marriage, for either her own or her husband's family size, possibly due to the low level of variation in age at marriage between women in the sample.

Household wealth (size of household land holdings and herd size) was a positive predictor of male and female reproductive success. The fact that household land size was positively associated with family size may simply be an effect of the 1987 land redistribution initiative which reallocated land according to total family size. However, herd size, which may represent a better measure of inherited household wealth, had a similarly positive association with family size.

After controlling for all other age, wealth and exposure effects, there was a strong positive association between men's total number of surviving offspring and total number of wives to date. Table 4 reveals the estimated marginal mean number of surviving children according to number of wives from the multivariate GLM (controlling for age, wealth and other marital effects). On average a man obtained an additional two surviving children from each additional wife.

Among women duration of marriage was an important determinant of family size. The longer a woman had been married, the larger her family size. Additionally, a woman's marital status predicted her total number of surviving children. First wife rank women had significantly larger families than monogamous or lower ranked women. On average they had two more children than their monogamous and lower ranked counterparts, after controlling for age, wealth and other marital disparities (Table 5).

Table 3. Multivariate GLM predicting number of surviving offspring

	Husband (n=222)			Wife (n=353)		
	$\beta \pm$ SE	t	p	$\beta \pm$ SE	t	p
Age effects						
Age	**0·179 ± 0·09**	**2·12**	**0·035**	**0·153 ± 0·05**	**2·88**	**0·004**
Age squared	− 0·001 ± 0·001	− 0·54	0·589	**− 0·002 ± 0·001**	**− 3·14**	**0·002**
Husband's age at marriage [a]	**− 0·119 ± 0·26**	**− 4·64**	**0·000**	− 0·011 ± 0·01	− 0·93	0·353
Wife's age at marriage [a]	− 0·003 ± 0·06	− 0·06	0·956	0·004 ± 0·03	0·12	0·907
Wealth effects						
Land holdings	**0·697 ± 0·20**	**3·42**	**0·001**	**0·290 ± 0·12**	**2·41**	**0·016**
Herd size	**0·126 ± 0·04**	**3·29**	**0·001**	**0·047 ± 0·02**	**2·21**	**0·028**
Marital unions						
Total number of wives [b]	**1·195 ± 0·37**	**3·23**	**0·001**	0·552 ± 0·403	1·37	0·172
Married previously [c]				− 0·428 ± 0·607	− 0·71	0·481
Duration of marriage				**0·007 ± 0·002**	**4·86**	**0·000**
Wife rank						
No co-wives				Reference category		
First wife rank				**3·206 ± 0·20**	**2·67**	**0·008**
Second wife rank				− 0·716 ± 0·96	− 0·75	0·454
Third wife rank				− 1·977 ± 1·27	− 1·552	0·122
Intercept	− 4·031 ± 1·86	− 2·17	0·03	− 2·023 ± 1·28	− 1·61	0·109

Bold type indicates a significant predictor of number of surviving offspring in GLM.
[a]For analysis on men this refers to age at first marriage.
[b]For analysis on men 'total number of wives' includes all marriages to date. For analysis on women this refers to the maximum number of wives co-resident during the marital union.
[c]Reference category is 'no previous marriage'; 10·4% (36/346) women had been previously married.
[d]Mean interval to re-marriage is 12·6 years (± 7·79).

Table 4. Men's marginal mean number of surviving children by number of wives

	n	Mean children ± SE	$\beta \pm$ SE	t	p
One wife	134	4·75 ± 0·25	Reference category		
Two wives	64	**6·04 ± 0·36**	**1·29 ± 0·48**	**3·70**	0·007
Three+ wives	24	8·24 ± 0·59	3·49 ± 0·69	5·07	0·000

Bold type indicates where family size was significantly different from the reference category (one wife) in GLM, controlling for all age, wealth and exposure factors.

https://doi.org/10.1017/S0021932006001441 Published online by Cambridge University Press

Table 5. Women's marginal mean number of surviving children by woman's current marital status

	n	Mean children ± SE	*β* ± SE	*t*	*p*
No co-wives	189	3·58 ± 0·37	Reference category		
Wife rank 1	72	**5·26 ± 0·55**	**3·206 ± 1·96**	**2·68**	0·008
Wife rank 2	80	3·08 ± 0·44	− 0·716 ± 0·96	− 0·75	0·454
Wife rank 3+	**12**	**1·69 ± 0·83**	**− 1·977 ± 1·27**	**− 1·55**	**0·122**

Bold type indicates where family size was significantly different from the reference category (monogamous) in GLM, controlling for all age, wealth and exposure factors.

Table 6. Parameter coefficients and marginal mean values from GLM analyses of child growth performance (separately modelled for BMI and *Z*-score) (0–10 years) according to mother's current wife rank (n=495)

	BMI[a]				WHZ[a]			
	n	Mean ± SE	*β* ± SE	*p*	Mean ± SE	*β* ± SE	*p*	%< − 2[b]
No co-wives	361	15·22 ± 0·28	Ref.		− 0·72 ± 0·05	Ref.		10·8
Wife rank 1	47	15·56 ± 0·62	1·61 ± 1·85	0·39	− 0·86 ± 0·14	− 0·22 ± 0·21	0·30	13
Wife rank 2	75	**14·65 ± 0·19**	**− 0·92 ± 0·31**	**0·00**	**− 0·89 ± 0·11**	**− 0·30 ± 0·16**	**0·07**	11·8
Wife rank 3+	12	**14·15 ± 0·50**	**− 1·13 ± 0·67**	**0·09**	**− 1·26 ± 0·27**	**− 0·67 ± 0·36**	**0·06**	25

Bold type indicates where nutritional status was significantly different from the reference category (no co-wives) in GLM, controlling for age, sex, birth order, family size and household herd size.

[a]Age adjusted for mean child age: 4 years.

[b]Percentage of children below the cut-off defining serious malnutrition:< − 2 WHZ.

Child growth

A mother's marital status was a significant predictor of her child's nutritional state (in separate models for BMI and WHZ; Table 6). After controlling for any effects of age, sex, birth order, socioeconomic status and family size, children whose mothers were wife rank two or more were significantly more likely to be malnourished (low WHZ or low BMI) than children of first wife rank and monogamously married women. Children of the lowest ranked wives were at the greatest risk of malnutrition. Twenty-five per cent of the children of third rank wives were seriously wasted (WHZ< − 2·00, the cut-off used to define children in urgent need of supplementary feeding; WHO, 1995).

Discussion

Human evolutionary ecologists studying polygyny have frequently invoked 'the conflict of the sexes' in accounting for the benefits for males versus the costs for

https://doi.org/10.1017/S0021932006001441 Published online by Cambridge University Press

females. Among Arsi Oromo men who can afford extra bridewealth payments, having more than one wife has clear fitness advantages in terms of number of surviving children. This supports the hypothesis that even in the absence of large wealth differentials, polygyny (possibly maintained through social prestige) is associated with higher fitness gains for men (Chagon, 1983; Hames, 1996). Furthermore, in some cases polygyny appears to be less detrimental than monogamy for Arsi Oromo women and their children. Polygynous women had equal or higher body mass indices than monogamous women on the survey date, possibly reflecting the greater resource availability, e.g. access to food aid, in polygynous households, or greater quality in some unmeasured way, such as ability to resist infections. Considerable variation was identified in the status of co-wives within Arsi Oromo households, affecting both reproductive outcome and child well-being, with second and third ranked wives tending to do less well than first ranked wives on all measures.

How are polygynous first wives advantaged over later wives?

Concurrent with a number of previous findings this study found that there are considerable costs associated with polygyny for later wives and their offspring: family size and child nutritional status decrease as wife rank in the union increases (Bean & Mineau, 1986; Garenne & Van de Walle, 1989; Josephson, 2002; Strassmann, 2005). Polygynous first wives achieve the largest family sizes and improved levels of child growth. These women are married at a younger age, and elicit a higher brideprice at marriage. Additionally, first wives spend the greatest part of their reproductive career in a monogamous union, as observed among the Mormon (Josephson, 2002). Additionally, first wives may achieve higher status in the household and thus wield control over both resources and the activities of younger wives (Borgerhoff Mulder, 1989). Arsi Oromo wives here are not strictly ranked in importance, as husbands do not reportedly practise sexual or economic favouritism; however, younger wives will bear respect for their elders, and as such first order wives may obtain seniority within the household. Furthermore, if the first wife has borne the first male child, she is likely to gain greater respect from her husband and the wider community.

Why marry a married man?

Later wives clearly have little to gain by marrying a married man. Evidence presented here supports the hypothesis that there are high costs to joining a polygynous marriage (becoming a later wife): lower reproductive fitness (Table 5) and poor child growth (Table 6). Resource dilution, co-wife competition, favouritism and low paternal investment have all been invoked to varying degrees to explain this effect (Dorjahn, 1959; Brabin, 1984; Borgerhoff Mulder, 1989; Strassmann, 1997). Parents may only resort to polygyny – in turn marrying their daughters off for a lower brideprice – if they have no alternative due to the surplus of females in the marriage market (Strassmann, 1997). The length of time taken for men to accrue bridewealth creates large age differences between spouses (on average eight years). Furthermore, higher male mortality, widowhood and male out-migration may contribute to a surplus of women relative to men (Dorjahn, 1959). The sex ratio of the population

is currently biased towards females (0·88), possibly implying higher male fetal loss (Gibson & Mace, 2003). Scarcity of males may contribute to the lack of marriage options for some females. Oromo parents report that they prefer to marry their daughters to men who are already married rather than face the social stigma for associated with a woman 'not getting married on time'.

How are polygynous first wives advantaged over monogamous wives?

These results indicate that Arsi Oromo first wives in polygynous unions are advantaged over women who remain in monogamous unions. Even after controlling for differences in age, wealth and marriage exposure, first wives have significantly larger numbers of surviving children, at no cost to child growth performance. These results indicate that first wives may experience a uniquely favourable period of monogamous marriage to a higher quality husband, possibly relating to unmeasured social variation between households. In the 1980s the traditional feudal land tenure system was replaced with a communist system reallocating land based on family size, reducing wealth inequalities between households. In the absence of wealth differences, the status differential between men may have become a social feature rather that one based in material wealth. The tradition of hierarchy among the Oromo, based on social prestige rather than wealth, could explain the fitness advantage of being a first wife in a polygynous union, particularly during the long period of monogamous marriage. Advantages of being married to Oromo political leaders (the annual community-voted Peasant Association leaders) include gaining better access to community resources such as food aid, household building materials and rare opportunities for income-generating employment. Equally there may be variation in wife quality: first wives are married at a younger age than all other wives, indicating that they may be more desirable partners (being more physically attractive or from higher status families). It is possible that high quality wives are married as first wives to high status men who subsequently take additional wives. However, differences in wife quality are not reflected in differential marriage payments: monogamous first wives command equally high bridewealth as women who remain monogamous wives.

Factors influencing differences in female reproductive fitness based on social differences between households (male prestige) and within households (co-wife competition, inequalities between wives) can be difficult to measure. Measuring hormonal stress levels is one method that could help to explain differences in reproductive outcome and child health associated with women's marital status. Stressful family environments, including residence with a stepfather and/or half-siblings, have been shown to influence child cortisol level, and can lead to immunosuppression and a high frequency of illness (Flinn & England, 1995; Flinn *et al.*, 1996).

Overall, it was not possible to find support for either the 'resource-holding polygyny' model, which emphasizes the adaptive benefits to women who distribute themselves according to resource availability, or the 'male coercion' model, which conversely emphasizes the greater fitness costs to women. The decision-making process resulting in polygyny appears to be more complex. Amongst the Arsi Oromo only some women appear to suffer fitness costs from polygyny. A subset appear to

be less disadvantaged from polygynous unions, either by exploiting junior co-wives or experiencing a long period of monogamy with a high status male, consequently maximizing both offspring quality and quantity.

Acknowledgments

The authors should like to acknowledge with grateful thanks the generous participation of the people of Hitosa and Dodota districts, Arsi zone, Ethiopia. Additional thanks go to Eshetu Gurmu and the Demographic Training and Research Centre, Addis Ababa University and Regional Government of Oromiya for permission and assistance to undertake this research. The dedicated work of many field assistants including Hanna Abate, Burka Tessema and Mekdes Alemu has contributed greatly to this study. Useful comments on an earlier version of this paper from Fiona Jordan and the Human Evolutionary Ecology Group at UCL led to important improvements. Financial support was through a Wellcome Trust (Project Grant GR068461 MA) and an ESRC PhD studentship. The authors extend grateful thanks to them all.

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