Relationship between Birth Order of Spouses with Different Degrees of Consanguineous Relationship

B. MOHAN REDDY[1] AND KAILASH C. MALHOTRA[1]

Abstract The relationship between birth order of spouses with different degrees of consanguinity is examined in a sample of 1826 couples belonging to the endogamous Vadde Fisherfolk of Kolleru Lake, Andhra Pradesh, India. We attempt to explain the wide variation in the frequency of different kinds of consanguineous marriages through the age-sex structure of the population in general and especially of the related families. This structure may also be manifested in the association between the birth orders of spouses. A highly significant and large correlation between the birth orders of spouses in uncle-niece marriages and a gradual decrease in the correlation with increase in remoteness of the relationship between the spouses were observed. Given the distribution of age differences between the spouses and assuming a standard age-sex structure, it seems possible to estimate the optimum frequency with which at least close consanguineous marriages occur in any particular population.

A wide variation in the frequency with which different types of preferential consanguineous marriage occur in any particular population is generally observed. For example, uncle-niece (UN) marriages occur with lower frequency than both mother's son with mother's brother's daughter (MBD) and father's son with father's sister's daughter (FSD) first-cousin marriages. Again, there are differences in the frequency of the MBD and FSD types. A few reasons, mostly in the form of sociologic, cultural, and economic factors, have been put forward to explain differences in the frequency of different types (Chekki 1968; Pettener 1985). Although the difference between the MBD and FSD types can be explained by sociologic and cultural reasons to some extent, the relatively low frequency of the UN type compared to first-cousin marriages cannot be similarly explained. From the sociologic point of view, the UN type is understandably preferred—the bride is just a granddaughter of the parents-in-law—and even obligatory (Karve 1961).

The reasons for a relatively low frequency of UN marriages therefore should be different. In this connection, the observations made earlier by Barrai et al. (1962), Hajnal (1963), Cavalli-Sforza et al. (1966), Schull and MacCluer (1968), and Reid (1974) are quite relevant. These researchers used distributional models to predict the relative availability of potential spouses in various genealogic classes under random mating. For example, Barrai et al. (1962) and Cavalli-Sforza et al. (1966) observed that the age effect and especially the sex of the intermediate ancestor in the pedigree are factors affecting the frequency of consanguineous marriages. Later, in a somewhat similar but more extended analysis, Hajnal (1963) comprehensively dealt with the age structure and disparities in the related families that greatly limit different kinds of consanguineous marriages. Demographic factors, such as differential age at death of the relatives, age preference in the choice of the mates, age at parenthood of the husbands and wives, and variance in the number of offspring and sex ratio, influence the frequency expected under random mating.

Most of the data, however, are at variance with theoretical computations based on random mating, especially in non-European communities, among whom close consanguineous marriages are preferred because of social regulations. At the same time, the observed frequencies of consanguineous marriages strikingly reflect several features expected under random mating, presumably because the availability of potential spouses of suitable age is an important determinant of such marriages. By applying an age model to the data collected from the Telaga Kapus of coastal Andhra Pradesh, among whom consanguineous marriages are preferred, Reid (1974) observed that, among the cross-cousins aged 8 years younger, there would be 2 MBD marriages for every FSD marriage under the assumption of random mating. The observed frequencies, however, were much more asymmetric because of the relative availability reinforced by differential social preference in favor of MBD marriages.

As has been shown by Reid (1974) among the Telaga Kapus, reliable age estimation is far from practical among the rural Indian communities that do not keep age records. However, the age and sex structure can be related to a large extent to the birth order of male and female children in the related families. Therefore in this article we explore the nature and extent of relationship between the birth orders of couples with different degrees of consanguinity among a group of fishermen of Kolleru Lake in Andhra Pradesh, India, to see whether the variation observed in the frequencies of different kinds of consanguineous marriages can be explained by this relationship.

Materials and Methods

The data on birth order and consanguinity were collected in 1982 from 1826 Vadde couples of Kolleru Lake. The samples were drawn

Table 1. Coefficient of Product Moment Correlation (r) between Birth Orders of Spouses with Different Consanguineous Relationships

Consanguinity Type	*Number of Pairs*	$r \pm SE$
UN	63	0.404 ± 0.105[a]
MBD	207	0.163 ± 0.068[b]
FSD	154	0.196 ± 0.080[b]
1½ cousins	46	0.074 ± 0.147
2d cousins	121	0.075 ± 0.090
Unrelated	1220	0.036 ± 0.029

a. $p < 0.01$.
b. $p < 0.05$.

from the 15 core villages (out of 60) distributed around the lake. The Vadde number about 30,000 individuals and, like any other caste in southern India, strongly prefer consanguineous marriage. Furthermore, this population is still a traditional rural society with strictly defined customary laws.

Results and Discussion

As expected, a wide variation in the frequencies of different types of consanguineous marriage was observed among the Vadde. The frequency of UN marriage was only 3.7% against frequencies of 8.4% for FSD and 11.3% for MBD marriages. The frequencies of $1\frac{1}{2}$ and 2d cousins are 3.1% and 6.1%, respectively.

The relationship between the birth orders of spouses in different kinds of consanguineous marriages can be deciphered from Table 1. The r value for UN marriage is positive, large, and highly significant (0.40 ± 0.105; $p < 0.01$). r is considerably weaker for both the MBD (0.16 ± 0.068; $p < 0.05$) and FSD (0.20 ± 0.08; $p < 0.05$) types. The relationship is further weakened and rather insignificant for more remote consanguineous marriages types ($1\frac{1}{2}$ and 2d cousins), culminating in the smallest value, which is closest to 0, for unrelated spouses. This would strongly suggest that the birth order of the spouses is not independent in at least the closely related marriages and that an increase in the birth order of husbands is generally associated with the increasing birth order of the wives.

Having observed that the birth order of the spouses is not independent in at least close consanguineous marriages, we now examine how much the birth orders of the husband and of the wife separately influence the frequencies of different forms of consanguineous marriages. This is an interesting undertaking because most of the communities in Andhra

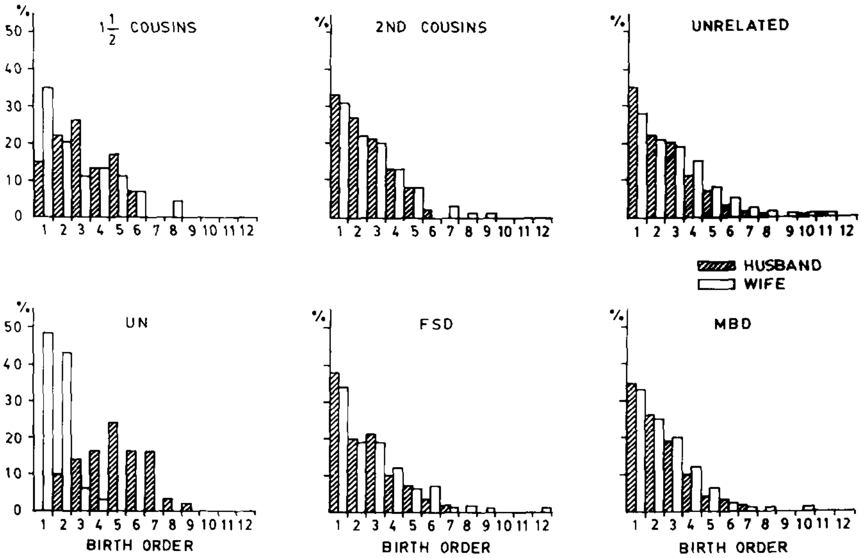

Figure 1. Frequency distribution of birth orders of husbands and wives in different consanguineous relationships.

Pradesh discourage recurrence of marriages between two families in the same generation (e.g., two brothers with two sisters) primarily for social reasons, although certain vague biologic consequences are also cited. Marriages between cousins from these families would result in double first-cousin marriages. But, these unions are by no means strictly prohibited. The frequency of such marriages is, however, extremely low; out of approximately 2000 marriages only 1 case of a double first-cousin marriage was reported among the Vadde.

This situation would imply that each consanguineous marriage dramatically restricts the availability of potential consanguineous mates for the younger siblings of the couple. This may be reflected in the separate distributions of birth orders of the spouses. The frequency distribution of birth orders of husbands and wives is presented in Figure 1, and the mean values are given in Table 2. The following salient features emerge.

1. Although the distribution of birth orders of husbands in UN marriages appears symmetric, ranging from 2 to 10, it is highly skewed, and almost 92% of the nieces belong to the first or second birth order; there was no wife beyond the fourth birth order. On the other hand, 80% of the uncles are from the fourth and above birth orders; there were in fact no husbands who were firstborn. The nieces born as third or fourth children would have most likely married only the uncles who were born as seventh or later. UN

Table 2. Mean Birth Order of Husbands and Wives in Different Consanguineous Marriages

Consanguineous Marriage	*n*	*Husband (Mean ± SD)*	*Wife (Mean ± SD)*	*d*	*t*
UN	63	4.91 ± 1.71	1.65 ± 0.74	3.26	13.93[a]
MBD	207	2.44 ± 1.61	2.47 ± 1.46	−0.03	0.20
FSD	154	2.44 ± 2.77	2.77 ± 1.91	−0.33	1.22
1½ cousins	46	3.15 ± 1.49	2.87 ± 1.95	0.28	0.77
2d cousins	121	2.40 ± 1.30	2.61 ± 1.66	−0.21	1.09
Unrelated	1220	2.51 ± 1.57	2.88 ± 1.80	−0.37	5.36[a]

a. $p < 0.01$.

2. The distributions of both husbands' and wives' birth orders in the FSD and MBD marriage types are extremely leptokurtic and highly positively skewed, although there are differences in minor details. For example, there is a steady decline in the frequency of birth order from 1 to 10 in MBD marriages, whereas this is not the case for FSD marriages; there was a slight increase in frequency from second to fourth birth order. Although the husbands with birth order 6 and above are relatively more frequent in matrilateral cross-cousin marriages, it is the wives who are more frequent in those birth orders for FSD marriages. In general, the highest number of firstborn spouses is observed among MBD and FSD types. As has been stated earlier, this is partly due to the discouragement of further marriages between the same sib groups once a marriage has taken place. This, in conjunction with the age-sex structure of the related pedigrees, would probably be enough to explain the observed distributions.

3. Although the distribution of birth orders of second cousins and unrelated spouses qualitatively resembles a mixed pattern of MBD and FSD types, that of $1\frac{1}{2}$ cousins (especially of husbands) resembles more closely that of the UN type. Unlike in the UN type, the distribution of wives in $1\frac{1}{2}$ cousin marriages is more extended, although approximately 70% belong to the birth orders 3, 2, and 1.

The mean values presented in Table 2, as expected, clearly reflect these patterns. For example, the qualitative similarity observed in mean birth orders of spouses in UN and $1\frac{1}{2}$ cousin marriages is interesting; the husbands in both cases are of higher mean birth order than their wives. The mean difference, however, is much larger and highly significant ($t = 13.93$, $p < 0.001$) for UN marriages compared to $1\frac{1}{2}$ cousin marriages ($t = 0.77$, $p > 0.50$). On the other hand, the mean birth orders of husbands and wives are of similar magnitude and direction for the remaining marriage types; on average, wives are from higher birth orders compared to their husbands; this difference is least with the MBD marriages and largest between unrelated spouses. However, these differences are too small, ranging from −0.03 to 0.37, and can be considered similar birth orders. But even this small mean difference reaches a highly significant level for unrelated spouses because of the large sample (1220).

The least mean difference observed between spouses in the MBD marriages partly supports the contention that, on average, the mother's brother's daughters are younger than the father's sister's daughters (Reid 1974). Because this observation is based on the ages at parenthood of brothers and sisters, it is only partly reflected through the birth orders; the elder brother could have reached parenthood later than the sister and therefore even his first daughter could be younger than his sister's son. Thus in the overall pedigree structure the birth orders of spouses are interdependent to the extent necessary to maintain the age compatibility and therefore the observed correlations between the birth orders. There is no doubt that this dependence on birth order is utmost for UN marriages and, although qualitatively similar, not so much for $1\frac{1}{2}$ cousin marriages.

Nevertheless, it should be remembered that it is not the birth order per se that is responsible for the choice of a spouse but the implicit age disparity, which in turn depends on the pedigree structure, including the birth orders of the parents of the related spouses, which may reflect the age gap between the prospective spouses.

A simple hypothetical pedigree (Figure 2) representing three generations clarifies the situation vividly. For example, individuals 1a, 2a, and 3b in the third generation are the elder sister's daughters to individuals 4a, 5a, and 6a in the second generation and, if married, result in UN marriages. But, even considering that the eldest in the pedigree in the second generation is a woman (individual 1a) who gets married and produces a daughter as the first child relatively early, the age disparity would be 12, 9, and 6 years, respectively, for individuals 4a, 5a, and 6a. Considering the early marriage age in rural India, only individual 6a, the youngest of the uncles, would be in tolerable age limits to marry even the first daughter of his eldest sister. Thus the greater probability of UN marriage with brides in lower birth orders and grooms in higher birth orders is obvious. It also implies that, in order to maintain the age compatibility of the spouses, the increase in the birth order of brides would generally be matched by the relative increase in the birth order of grooms (for example, individual of birth order 1 with individual of birth order 4, 2 with 5, 3 with 6, etc.), and therefore one obtains the observed positive relationship between the birth orders of the spouses with close consanguineous relationship, especially in the UN type. When the sister gives birth to a female child relatively later in birth order, the situation regarding the age disparities and scope for UN marriages will be reduced further.

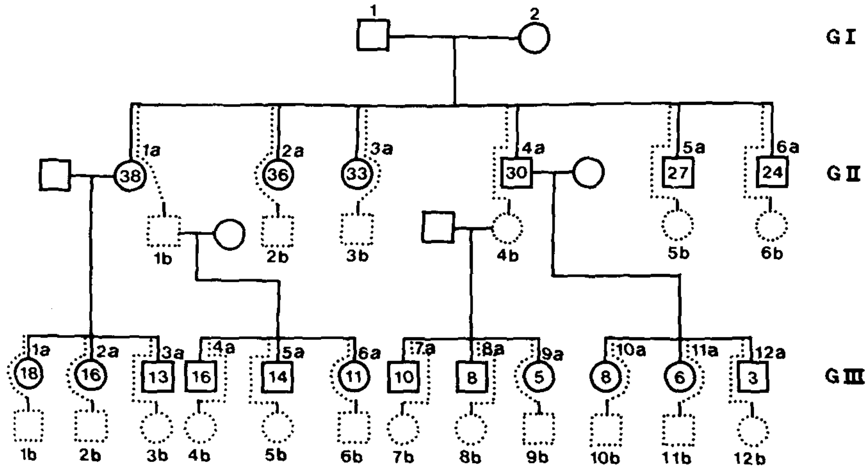

Figure 2. Hypothetical pedigree demonstrating birth order and age structure, which can affect the probability of mate choice among consanguineous relatives. In each generation the children are represented in two tiers (solid and broken lines) to facilitate the changed situation of sex and birth order structure. The waiting time between successive births is assumed to be constant in both the second and third generations. Numbers inside the blocks are ages and those outside are individual identities. G I, G II, G III are generations.

On the other hand, when the sisters themselves are relatively later born (younger sisters), creating the situation of individuals 7b, 8b, and 9a of generation 3 being the younger sister's daughters for individuals 1b, 2b, and 3b in generation 2, the age gap between uncles and nieces would be so large that marriages between them would be almost impossible. That is why, perhaps, marriages with younger sister's daughters are scarce, although not socially prohibited. Such marriages are known to occur usually under exceptional conditions, such as when the sister has only female children, to safeguard the ancestral property from slipping into the hands of a stranger. Even if the age disparity is too large, the groom will have enough economic incentive to wait for the girl to mature for marriage. This hypothetical situation clearly illustrates the importance of birth order of couples and their parents, thereby implying the significance of age and sex structure in the pedigrees in minimizing the scope for UN marriages.

Furthermore, individuals 10a, 11a, and 12b in generation 3 are the mother's younger brother's daughters in relation to individuals 1b, 2b, and 3a in the same generation, whereas individuals 4b, 5b, and 6a are the mother's elder brother's daughters in relation to individuals 7a, 8a, and 9b. Age disparities seem obvious, but there is a fair degree of compatibility when spouses with opposingly extreme birth orders are considered. When one considers the alternative sex structure of the pedigree (for example, MFMFMF instead of MMMFFF or vice versa) in the second generation, age disparities narrow down remarkably, giving much greater scope for MBD marriages, which is not the case for the UN type. By increasing the number of children in each nuclear family, the importance of birth order can be even better demonstrated.

Similar arguments hold for FSD marriages because individuals la, 2a, and 3b are the father's elder sister's daughters in relation to individual 10b, 11b, and 12a, whereas individuals 7b, 8b, and 9a are the father's younger sister's daughters in relation to individuals 4a, 5a, and 6b. When this pedigree is extended to more remote relationships, the greater number of relatives and the least dependence on birth order are obvious. Because social preference for such marriages would not be as strong compared to marriages of close kin, the observed low frequency is not incompatible despite the larger scope.

This logic can be extended to unrelated spouses whose pedigrees are independent. A general trend of decreasing relationship between birth orders of the spouses with increase in remoteness of the consanguinity observed in the present study is therefore naturally expected. Thus these observations suggest that it may be possible to estimate the optimum frequency of at least close consanguineous marriages that can occur in any particular population when its general pedigree structure is known. However, only a systematic study with this particular design can answer this question more precisely. Although Barrai et al. (1962), Hajnal (1963), and Cavalli-Sforza et al. (1966) attempted to accomplish this for Western communities, more meaningful results would be obtained from populations that show optimal preference for all types of consanguineous marriages. The Vadde, with their traditional social structure, strongly prefer consanguineous marriages, like most other rural communities of Andhra Pradesh. Given the optimal preference, the observed frequencies result from demographic constraints, such as age disparity and variance in family size, imposed on the selection of suitable consanguineous mates. This also suggests that, under the changing demographic structure and because of the restricted family size, there will be a drastic reduction in the frequency of UN marriages even among contemporary southern Indian populations.

In view of the foregoing observations regarding the limited scope for UN marriages under a normal age-sex structure, notwithstanding greater preference it is difficult to account for some of the highest frequencies of UN marriages reported among the Andhra populations (Table 3); at least 9 of the 16 groups listed show 20–33% of the total marriages between uncles and nieces, against only 4% among the Vadde fishermen of Kolleru Lake, who have an equally strong preference for consanguineous marriages.

Table 3. Frequency (%) of Different Types of Consanguineous Marriage and Inbreeding Coefficient (F) in Some Andhra Pradesh Populations and Areas

		Frequency (%)					
Population	*Number of Couples*	*UN*	*1st Cousin*	*1½ Cousin*	*2d Cousin*	*Total*	*F*
1. Fishermen	106	13.21	36.79	1.89	2.83	54.72	0.041
2. Konda Dora	103	13.59	49.51	-	-	63.10	0.048
3. Jalary	102	13.73	33.33	-	-	47.06	0.038
4. Madigas	68	14.71	13.23	1.47	-	28.41	0.027
5. Kummaris	72	15.30	18.00	1.40	1.40	36.10	0.031
6. Yadavas	82	17.07	13.42	1.22	6.10	40.24	0.031
7. Fishermen	308	17.86	38.96	-	-	56.82	0.047
8. Visakapatnam District	602	19.27	38.71	-	-	57.98	0.048
9. Gollas	20	20.00	5.00	5.00	-	35.00	0.030
10. Mukha Dora	101	20.80	59.40	-	-	80.20	0.061
11. Vadde (stone workers)	32	21.90	3.10	-	-	25.00	0.029
12. Jatapu	116	23.28	51.72	-	-	75.00	0.061
13. East Godavari District	647	24.88	21.64	-	-	46.52	0.045
14. Padmasalis	441	24.93	37.88	-	-	62.81	0.055
15. Savara	109	26.60	34.88	-	-	61.48	0.055
16. Gadaba	106	33.02	48.11	-	-	81.13	0.071

Sources: 1, Reddy and Rao (1978); 2, Veerraju (1978); 3, Veerraju (1973); 4, 5, 9, and 11, Subramaniam (1985); 6, Rao and Reddy (1982); 7, 8, and 13, Sanghvi (1966); 10, 12, 15, and 16, Sirajuddin and Basu (1984); 14, Balagopal (1977).

Further empirical evidence—a resurvey of some of these populations using this particular methodologic design—is desirable before making any firm statement on the probability of occurrence of such high frequencies of UN marriages. Efforts are being made to generate such data.

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Literature Cited

Balagopal, K. 1977. Fertility and mortality among Padmasalis of Chittor district. M.Sc. thesis, Sri Venkateswara University, Tirupati, India.

Barrai, I., L.L. Cavalli-Sforza, and A. Morani. 1962. Frequencies of pedigrees of consanguineous marriages and mating structure of population. *Ann. Hum. Genet.* 25:347–377.

Cavalli-Sforza, L.L., M. Kimura, and I. Barrai. 1966. The probability of consanguineous marriages. *Genetics* 54:37–60.

Chekki, D.A. 1968. Interkin marriage: Theoretical framework, part A. *Man in India* 48:337–344.

Hajnal, J. 1963. Concepts of random mating and the frequency of consanguineous marriages. *Proc. R. Soc. London*, ser. B, 159:125–177.

Karve, I. 1961. *Kinship Organization in India.* Bombay: Asia Publishing House.

Pettener, D. 1985. Consanguineous marriages in the Upper Bologna Appennine (1565–1980): Microgeographic variations, pedigree structure, and correlation of inbreeding secular trend with changes in population size. *Hum. Biol.* 57:267–288.

Rao, A.P., and V.R. Reddy. 1982. Inbreeding among the three endogamous groups in a multicaste village of Andhra Pradesh, South India. *Soc. Biol.* 30:109–111.

Reddy, V.R., and A.P. Rao. 1978. Inbreeding effects in a coastal village and other parts of Andhra Pradesh. *Acta Genet. Med. Gamellol.* 27:89–93.

Reid, R.M. 1974. Relative age and asymmetrical cross-cousin marriage in a South Indian caste. In *Genealogical Mathematics*, P.A. Ballonoff, ed. The Hague: Mouton, 257–273.

Sanghvi, L.D. 1966. Inbreeding in India. *Eugen. Q.* 13:291–301.

Schull, W.J., and MacCluer, J.W. 1968. Inbreeding in human populations, with special reference to Takushima, Japan. In *Haldane and Modern Biology*, K.R. Dronamraju, ed. Baltimore, Md.: Johns Hopkins Press, 79–98.

Sirajuddin, S.M., and A. Basu. 1984. Population structure, consanguinity, and its effects on fertility and mortality among Chenchus of Andhra Pradesh. *Hum. Sci.* 33:179–200.

Subramaniam, K.S. 1985. Inbreeding among the Kshatriyas of Chittoor District, Andhra Pradesh. Ph.D. thesis, Sri Venkateswara University, Tirupati, India.

Veerraju, P. 1973. Inbreeding in coastal Andhra Pradesh. In *Proceedings of the International Symposium on Human Genetics*, M.R. Chakravartti, ed. Waltair: Andhra University Press, 309–318.

Veerraju, P. 1978. Consanguinity in tribal communities of Andhra Pradesh. In *Medical Genetics in India*, I.C. Verma, ed. Pondicherry: Auroma Enterprises, vol. 2, 157–163.