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Assessment of Association between Consanguinity and Fertility in Asian Populations

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ABSTRACT

Although a high proportion of marriages in Asia are consanguineous (i.e. contracted between close biological relatives), with some notable exceptions, there is a dearth of demographic and anthropological literature on the association between consanguinity and fertility. This paper presents an overview of the prevalence of consanguineous marriages in selected South and Southeast Asian countries, followed by an assessment of the association between consanguinity and fertility. The association between consanguinity and fertility was assessed reviewing published literature and analyzing demographic and health survey (DHS) data from Pakistan and India. Results of the review of published literature showed higher fertility among women in the first-cousin unions compared to those married to non-relatives. In the DHS analyses, consanguinity was found to be associated with a number of direct and indirect determinants of fertility, including lower maternal education, lower maternal age at marriage, lower contraceptive use, and rural residence. At the multivariate level, adjusted mean fertility was found to be lower among women in the first-cousin unions in the Pakistani DHS data, while for the Indian DHS, adjusted mean fertility levels were similar in the first-cousin and non-consanguineous marriages. The pathways through which consanguinity affects fertility in Asian populations are evaluated and discussed.

Key words: Consanguinity; Fertility; Asia, South; Asia, Southeast

INTRODUCTION

Although consanguineous marriages (marriage between close biological kin) are preferential across many parts of North Africa, West and South Asia (1), limited information on the topic is available in the mainstream demographic literature. Available demographic data are largely restricted to the Iran Fertility Survey (2) and Demographic and Health Surveys (DHSs) in selected countries, including Egypt, Morocco, Tunisia, Pakistan, and India. Consequently, there is a notable lack of evidence with respect to the major sociodemographic determinants of fertility, such as age at marriage and contraceptive use in consanguineous unions.

Empirical data suggest that women in consanguineous unions generally have lower education, younger age at marriage, lower contraceptive use, and higher fertility (3). There is also substantial evidence of higher infant death rates among consanguineous unions (4,5). In this regard, while some earlier studies did not adequately control for background socioeconomic factors, more recent data from the Middle East and South Asia and information on migrant communities in Western Europe clearly indicate that the offspring mortality differential is not solely a manifestation of socioeconomic disadvantage (6-12). Thus, the main aims of the present study were to compare the reported prevalence of consanguineous unions in selected countries of South, Southeast and East Asia and to evaluate the association among consanguinity, fertility, and associated sociodemographic factors.

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MATERIALS AND METHODS

Sources of data

A comprehensive database on consanguineous marriage has been developed by one of the authors [AB]. The database includes almost all available published and unpublished information on the global, regional and

country-level prevalence and outcomes of consanguineous marriage (http://www.consang.net) (13). This database was used for reviewing the prevalence of consanguineous marriages in specific countries of South and Southeast Asia, including India, Indonesia, Bangladesh, Pakistan, Malaysia, Thailand, The Philippines, Singapore, and People's Republic of China, and also for making an initial assessment of the association between consanguinity and fertility.

For the purposes of the present paper, 21 published studies conducted in various parts of the Indian Subcontinent were selected from www.consang.net. Studies were included according to the data available on fertility differentials by consanguinity status and had been undertaken over the past three decades. General lack of large-scale recent data on fertility differentials by degree of consanguinity limited in-depth analysis of the association between consanguinity and fertility in Pakistan and India. (While a five-country study on the status of women and fertility [SWAF], conducted during 1993-1994, collected data from India and Pakistan on consanguinity and fertility, lack of information on specific levels of consanguinity [first cousin, second cousin, etc.] necessitated their exclusion from our analysis). DHS reports were used as the main source of data, i.e. Pakistan Demographic and Health Survey (PDHS) conducted in 1990-1991 and Indian National Family Health Survey (NFHS) conducted in 1992-1993. Since both the surveys formed part of DHS for low-income countries, the sampling strategies and questionnaire used were near-identical. PDHS interviewed 6,611 ever-married females aged 15-49 years across all four provinces of Pakistan (14). NFHS collected information on 89,777 ever-married females aged 13-49 years and was conducted in all states of India, with the exception of the predominantly Muslim sub-state of Kashmir where civil unrest prevented data collection (15).

Inclusion/exclusion criteria

To aid comparability of results between the two selected datasets, analysis of NFHS was restricted to data on Muslim respondents. Of the 89,777 ever-married females enrolled in NFHS, 9,485 (10.56%) were Muslims. By comparison, as some 98% of the Pakistani population are Muslims and PDHS did not include a specific question on religion of respondents, the entire PDHS sample was selected for the present study.

A number of pre-analysis exclusion criteria were applied to both the datasets: these comprised the omission of non-resident women (i.e. temporary household visitors) and women who reported more than one marital union. At a later stage, consanguineous unions other than between first cousins were omitted due to lack of specificity in data with respect to other categories of consanguineous marriage. This decision had a limited effect as the first-cousin marriages accounted for 80.4% and 90.8% of all consanguineous unions contracted between Pakistani and Indian Muslims respectively (16,17). Thus, in the case of the PDHS dataset, the analysis sample was 5,533 ever-married women, and the analysis sample for the NFHS data was based on 7,965 ever-married women.

Analysis

As one of the primary interests of the study was to monitor regional variations in the consanguineous marriage and fertility patterns for each country, the final samples for analysis were weighted according to the sample weights provided in the PDHS and NFHS datasets. At the univariate level, unadjusted mean fertility values were obtained for each of the variables of interest, and statistical significance was tested by the *F*-statistic using ANOVA. A multiple classification analysis (MCA) was adopted for multivariate assessment in preference to ordinary least squares regression (OLS). To adjust for differentials in fertility due to varying periods of exposure for reproductive events, age at cohabitation and duration of marriage were included in the multivariate model. In addition, the number of child deaths was included to control for higher offspring mortality in consanguineous unions. Since the variables—current age and duration of marriage—were highly correlated at the bivariate level, age was excluded from the multivariate model. Furthermore, the magnitude and direction of the relationship between current age and educational status, and duration of marriage and educational status were similar. Thus, the inclusion of age at cohabitation and duration of marriage together in the model can be considered a surrogate measure for age. All analyses were run using SPSS for PCs (version 11.0, SPSS Inc.). Throughout the paper, the terms mean fertility and mean number of livebirths have been used interchangeably.

RESULTS

Prevalence of consanguineous marriage

In reporting the prevalence of consanguineous marriage, it is customary to exclude marital unions beyond second cousins. Second cousins inherit 1/32 of their genes from a common ancestor, which means that their offspring inherits identical genes at 1/64 (1.56%) of all loci. In numerical terms, this is conventionally expressed as

coefficient of inbreeding (*F*), which for second-cousin progeny is 0.0156. By comparison, the *F* value for the first-cousin progeny is 0.0625 (i.e. they have inherited identical genes at 6.25% of all loci), whereas the *F* value for uncle-niece or double first-cousin offspring is 0.125.

Data from selected Asian countries varied considerably in terms of period of assessment, the nature of the study population, e.g. household survey or antenatal clinic, and the prevalence of consanguineous marriage. As previously stated, country-level data were available only for Pakistan and India, with smaller, geographically or ethnically-limited datasets for other countries (Table 1). The highest overall prevalence of consanguineous marriage in South and Southeast Asia was recorded in Pakistan (62.7%) and represents one of the highest national levels of consanguinity yet reported. By comparison, 11.9% of marriages in India were consanguineous. This figure, however, conceals substantial variation by religious affiliation and region of residence. For example, while 10.6% of marriages among Hindus and 10.3% among Christians were consanguineous, 23.3% of marriages among Muslims and 17.1% of marriages among Buddhists were consanguineous (15). North Indian Hindus rigorously avoid close kin marriages, whereas consanguineous unions are widely preferential in the majority of Hindu populations of the southern states of Andhra Pradesh, Karnataka, and Tamil Nadu (15,18). Likewise, the prevalence of consanguineous marriage in the Indian Muslim population varied from 3.8% in the northeast state of Assam to 40.4% in Jammu in the northwest of the country adjacent to Pakistan (17).

Information on the prevalence of consanguineous marriage in Bangladesh is limited to a study by Khan *et al*. who reported that 17.6% of all marriages in Teknaf were consanguineous (Khan NU, Wojtyniak B, Saha S. Personal communication, 1997), while the corresponding proportion in the Matlab area was 6.7%. Similarly, information on the prevalence of consanguineous marriage in Indonesia, another predominantly Muslim country, is limited to a 1990 household survey in West Timor and West Flores, based on minority Roman Catholic subgroups with 17.8% of consanguinity (19). In contrast, more recent information is available from sample surveys conducted in Malaysia, Thailand, and the Philippines as part of the SWAF survey (20). The

Table 1. Prevalence of consanguineous marriage in South and Southeast Asia

Country	Location	Year	Sample size	Consanguineous marriage (%)	Reference
India	National	1992-1993	89,777	14.0	IIPS, 1995 (15)
Pakistan	National	1990-1991	6,611	62.7	Ahmed *et al*., 1992 (14)
Bangladesh	Matlab	1985	8,000	6.7	Khan *et al*.*
	Teknaf	1985	4,266	17.9	Khan *et al*.*
Indonesia	West Timor and W. Flores	1990	970	17.8	Glinka, 1994 (19)
Malaysia	Rural	1993-1994	488	31.9	Smith *et al*., 2000 (20)
	Market	1993-1994	592	27.3	Smith *et al*., 2000 (20)
	Urban	1993-1994	568	23.2	Smith *et al*., 2000 (20)
Singapore	Chinese	1980	16,698	0.3	Tay, 1982 (22)
	Indian	1980	989	4.0	Tay, 1982 (22)
Thailand	Malay-speakers	1993-1994	194	18.9	Smith *et al*., 2000 (20)
	Thai-speakers	1993-1994	202	21.8	Smith *et al*., 2000 (20)
Philippines	Zamboanga, Oriental Mindoro, La Union, and Camarines Sur	1993-1994	800	12.2	Smith *et al*., 2000 (20)
China	Zejiang (Han)	1981/1991	17,381	2.5	Zhan *et al*., 1992 (27)
	Yunnan (Mong)	1992	525	27.4	Yang *et al*., 1994 (28)
	Laioning (Man)	1998	418	3.1	Wang *et al*., 2002 (29)

* Khan NU, Wojtyniak B, Saha S. Effects of parental consanguinity on offspring mortality in rural Bangladesh. Demographic surveillance system. Dhaka: ICDDR,B: Centre for Health and Population Research, 1997. (Unpublished)
Figures in parentheses refer to reference numbers

overall prevalence of consanguineous marriage in Malaysia was 40.0% but, as in India, there were marked ethno-religious and regional differences. For example, the prevalence of consanguineous marriage among Muslims was 20.0%, whereas 54.7% of marriages among Hindus, mostly of South Indian ancestry, were consanguineous, as were 7.3% of Chinese unions. In Thailand, comparable types of difference were recorded, with 36.8% consanguineous marriages among Muslims versus 3.5% consanguinity in the majority of the Buddhist community (21). A higher prevalence (37.5%) of Muslim consanguineous unions was also reported in the Philippines as opposed to 4.0% among Christians. In Singapore, the reported prevalence of consanguineous unions was 0.3% in the Chinese majority and 4.0% among the Indian community (22).

Cross-cousin but not parallel-cousin marriage was traditionally acceptable for the Han majority (23). In surveys conducted throughout the People's Republic of China, the prevalence of consanguineous unions among the Han ranged from 0.7% in Beijing to 5.7% in Guizhou province (24-25). These data, mainly collected during 1951-1976, may not reflect current practices, especially since the introduction in 1981 of legislation banning the first-cousin marriages (26). A full list of all published studies is available at www.consang.net, but for the purposes of the present paper, information on consanguinity was limited to three of the more recent studies. A household survey on the majority of Han population in Zejiang showed that 2.5% of 17,381 respondents had consanguineous marriage (27). However, among the Mong minority in Yunnan province, the prevalence of consanguineous marriage was 27.4% (28), while a rural survey of the Man (Manchu) in Liaoning during 1998 reported 3.1% consanguinity (29) (Table 1).

Association between consanguinity and fertility

Results of review of data from 21 studies in India and Pakistan showed substantial variations in the mean fertility levels, but in most cases, the mean number of livebirths reported by women in cousin marriages was higher than in non-consanguineous unions. In particular, women in the first-cousin unions had a higher mean number of livebirths compared to non-consanguineous couples in 19 of the 21 studies (Table 2).

As stated earlier, the lack of recent large-scale datasets limited further assessment of the association between consanguinity and fertility to DHS data from Pakistan and India. Analysis of both PDHS and NFHS data confirmed the association between formal education and consanguinity noted in other populations (1,16), i.e. women married to a first cousin were less likely to have undertaken formal education, particularly post-secondary education (Figs. 1 and 2). Significantly, in terms of fertility, Pakistani women in the first-cousin unions were more likely to be married at a younger age and were less frequent users of modern contraceptive methods. The differential in age at marriage between women in consanguineous and non-consanguineous marriages was, however, not so marked in the Indian subjects, and the contraceptive use showed a different pattern with women in the first-cousin unions more likely to use contraception than their non-consanguineous counterparts (Figs. 1 and 2). PDHS showed that consanguineous marriages were more common in rural areas of Pakistan, whereas NFHS indicated a higher prevalence of such marriages among the urban Indian Muslim population (Figs. 1 and 2).

At the univariate level, the association between consanguinity and mean number of livebirths differed in the two datasets. In PDHS, women in the first-cousin unions reported fewer livebirths (mean 3.9, SD 2.9) compared to those in non-consanguineous unions (mean 4.2, SD 2.9). In NFHS, consanguinity exerted a minimal role, and the corresponding mean number of livebirths was 3.7 for both women married to first cousins (SD 2.6) and those in non-consanguineous unions (SD 2.7). Stratification by age showed that younger women (<20 years) in the first-cousin unions were likely to have more livebirths, possibly a reflection of their earlier age at marriage. At the other end of the age spectrum (40-49 years), PDHS showed a little difference in the mean fertility levels by consanguinity status, while higher mean fertility was observed for women in the first-cousin unions in NFHS (Fig. 3).

Among the other sociodemographic variables considered, statistically-significant differences in the mean number of livebirths were observed for characteristics, such as education of females, education of husbands, and place of residence. Mean fertility also varied by age at cohabitation, duration of marriage, and one or more child death(s) (data not shown). Although similar patterns were seen on stratification by consanguinity status, the mean fertility levels varied between consanguineous and non-consanguineous couples by both respondent's and husband's education in PDHS only. Among women and men with no formal education, the mean number of livebirths was higher among non-consanguineous couples, whereas among

Table 2. Study populations in initial analysis of consanguinity-associated fertility

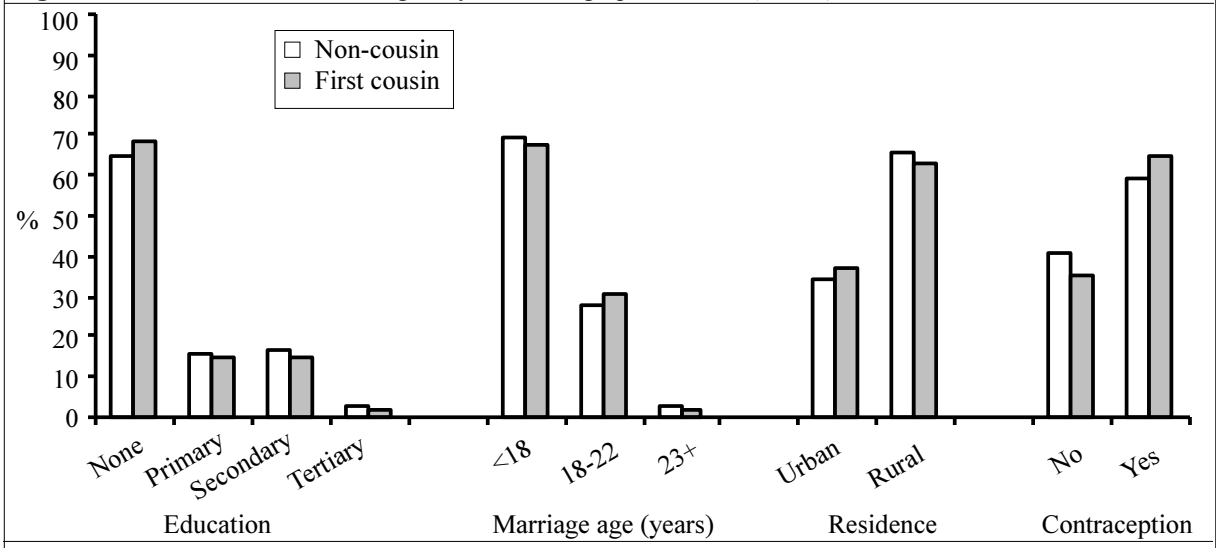
Location	Study population	Consanguineous marriage (%)	No. of women	Mean no. of livebirths		Reference
				First cousin	Unrelated	
India						
Delhi	Urban, Muslim	42.6	296	7.05	5.83	Basu, 1978 (50)
Lucknow	Urban, Muslim	46.8	267	7.48	5.41	Basu, 1978 (50)
Udaipur	Urban, Muslim	35.0	718	4.83	5.65	Basu, 1978 (50)
Pondicherry	Urban, all	54.9	1,494	6.69	3.60	Puri *et al.,* 1978 (51)
Tamil Nadu	Rural, all	46.9	11,628	3.59	3.24	Rao and Inbaraj, 1977 (52)
Tamil Nadu	Urban, all	29.1	8,998	3.28	3.09	Rao and Inbaraj, 1977 (52)
Andhra Pradesh	Rural <40 years	33.2	1,418	2.94	2.89	Reddy, 1992 (53)
Andhra Pradesh	Rural ≥40 years	30.8	660	6.10	5.97	Reddy, 1992 (53)
Karnataka	Urban, Hindu	33.5	86,448	2.28	2.14	Bittles *et al*., 1992 (54)
Karnataka	Urban, Muslim	23.6	17,019	2.62	2.58	Bittles *et al.,* 1992 (54)
Karnataka	Urban, Christian	18.5	4,038	2.26	2.16	Bittles *et al*., 1992 (54)
Pakistan						
Lahore	Urban, Muslim	47.2	966	3.36	3.35	Shami and Zahida, 1982 (55)
Sheikhupura	Urban, Muslim	48.9	1,007	4.61	4.19	Shami and Iqbal, 1983 (56)
Gujrat	Urban, Muslim	48.5	1,002	4.65	4.16	Shami and Hussain, 1984 (57)
Jhelum	Urban, Muslim	44.3	1,027	4.41	4.34	Shami and Minhas, 1984 (58)
Rawalpindi	Urban, Muslim	48.1	1,000	3.96	4.13	Shami and Siddiqui, 1984 (59)
Gujranwala	Urban, Muslim	58.9	1,059	4.15	3.66	Bittles *et al*., 1993 (35)
Sahiwal	Urban, Muslim	56.1	1,003	5.24	4.65	Bittles *et al*., 1993 (35)
Faisalabad	Urban, Muslim	52.1	1,033	4.58	3.97	Bittles *et al*., 1993 (35)
Sialkot	Urban, Muslim	51.8	1,037	4.34	3.99	Bittles *et al*., 1993 (35)
Karachi	Urban, Muslim	58.7	1,009	5.27	4.72	Hussain and Bittles, 1999 (36)

Figures in parentheses refer to reference numbers

Fig. 1. Association between consanguinity and demographic factors (PDHS)

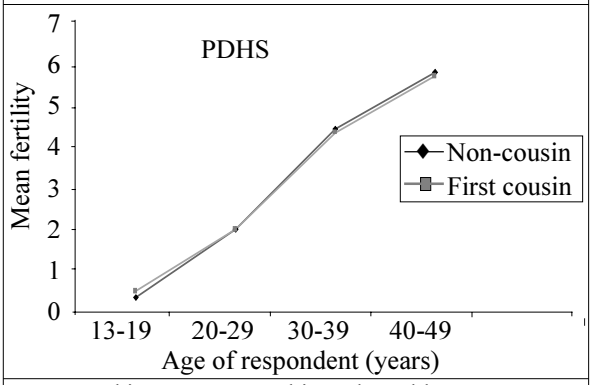
PDHS=Pakistan Demographic and Health Survey

Fig. 2. Association between consanguinity and demographic factors (NFHS)

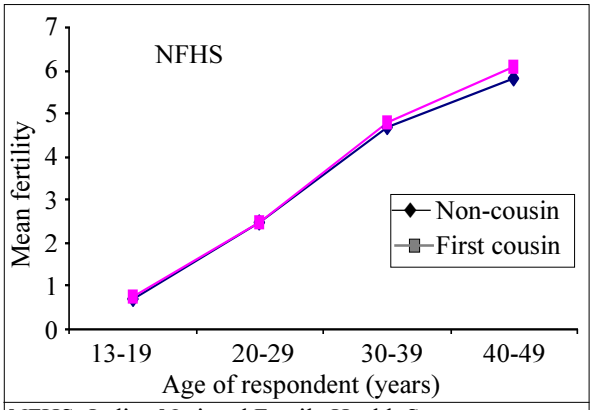


NFHS=Indian National Family and Health Survey

Fig. 3. Mean fertility differentials by consanguinity status and age



PDHS=Pakistan Demographic and Health Survey



NFHS=Indian National Family Health Survey

those with tertiary education, the mean number of livebirths was higher in the first-cousin unions (Table 3).

The mean fertility differentials by age at cohabitation showed different patterns in PDHS and NFHS. For example, while there was a strong inverse association between age at cohabitation and mean fertility, the difference was more marked at younger ages for women in non-consanguineous unions in PDHS but at older ages for women in consanguineous unions in NFHS (Table 4). Furthermore, among Pakistani subjects, mean fertility at first use of contraception was similar for women in consanguineous and non-consanguineous unions (at 3.1 livebirths), while in India, women in the first-cousin unions initiated contraceptive use at higher fertility, although the difference was not statistically significant (data not shown).

The mean fertility levels appeared to be markedly influenced by the number of offspring deaths in both the datasets. In PDHS, the mean number of livebirths was 3.2 (SD 2.5) for women with no child deaths, 5.1 (SD 2.5) livebirths among women who reported the death of a single child, and 7.3 (SD 2.6) livebirths to those with two or more child deaths. Similarly, in NFHS for women reporting zero, one, and two or more death(s), the mean number of livebirths was 2.9 (SD 2.2), 4.9 (SD 2.2), and 7.1 (SD 2.4) respectively (data not shown). On stratification by consanguinity status, mean fertility was marginally higher among non-consanguineously-married women who had experienced greater child losses (Table 4).

Analyses of PDHS and NFHS differed with regard to the foetal loss variable, which was not available for all women in PDHS and, therefore, could not be included. With this exception, the relative contributions of the various explanatory variables on the adjusted mean fertility values are presented for both the datasets (Table 5). In both the cases, 57% of the variance in the mean fertility levels (R^2) was explained by the variables included in the model. As seen for the univariate analysis presented above, the mean fertility levels were markedly influenced by level of female education, number of child deaths, and duration of marriage. However variables, such as age at cohabitation, occupation of husbands, region and place of residence, were non-significant for PDHS, but in the case of NFHS, only place of residence was not significant (Table 5). Contrary to a large majority of previous studies, in PDHS, women in the first-cousin unions had a lower mean number of livebirths (3.6) than those in non-consanguineous unions (4.0), while in NFHS, the mean number of livebirths was similar for both the groups (3.7).

Table 3. Unadjusted mean fertility levels by sociodemographic variables (PDHS and NFHS data)

Variable	PDHS (n=5,533)			NFHS (n=7,965)		
	No.	Unrelated	First cousin	No.	Unrelated	First cousin
Education			c			c
None	4,420	4.5 (3.0)	4.1 (3.0)	5,234	4.1 (2.8)	4.0 (2.7)
Primary	474	3.6 (2.6)	3.9 (2.7)	1,214	3.6 (2.4)	3.7 (2.6)
Secondary	584	3.2 (2.3)	3.1 (2.2)	1,295	2.4 (1.9)	2.8 (2.2)
Tertiary	55	2.2 (1.3)	2.6 (1.9)	222	2.2 (1.8)	2.2 (1.9)
Education of husband			c			c
None	2,686	4.6 (3.0)	4.2 (3.1)	3,252	4.1 (2.8)	3.9 (2.7)
Primary	934	4.2 (3.0)	4.0 (2.9)	1,708	3.9 (2.7)	4.2 (2.8)
Secondary	1,630	3.8 (2.8)	3.6 (2.7)	2,274	3.2 (2.4)	3.4 (2.4)
Tertiary	270	2.9 (2.1)	3.5 (2.2)	709	3.0 (2.2)	2.9 (2.2)
Occupation of husband			c			c
White collar	1,270	4.2 (2.9)	4.1 (2.9)	1,952	3.6 (2.5)	3.7 (2.6)
Blue collar	2,203	4.1 (2.9)	3.8 (2.9)	3,576	3.6 (2.6)	3.6 (2.5)
Agriculture/animal husbandry	1,720	4.4 (3.0)	4.2 (2.9)	2,116	4.0 (2.8)	4.0 (2.9)
Other	340	4.3 (3.2)	3.6 (3.0)	291	3.7 (3.0)	3.6 (3.3)
Residence						
Urban	1,698	4.1 (2.9)	4.1 (2.9)	2,791	3.6 (2.6)	3.8 (2.6)
Rural	3,835	4.3 (3.0)	3.9 (2.9)	5,174	3.7 (2.7)	3.7 (2.7)
Region (PDHS/NFHS)			a			c
Punjab/North	3,291	4.2 (2.9)	3.9 (2.9)	1,074	3.8 (2.6)	3.5 (2.5)
Sindh/South	1,302	4.3 (3.0)	4.2 (3.0)	1,785	3.2 (2.4)	3.5 (2.4)
NWFP/East	737	4.4 (3.1)	3.7 (2.9)	2,521	3.9 (2.8)	3.8 (2.7)
Balochistan/West	204	4.1 (2.7)	3.7 (2.7)	845	3.2 (2.1)	3.7 (2.5)
Central	–	–	–	1,740	4.1 (2.8)	3.9 (2.8)

a=p<0.05, c=p<0.001
NFHS=Indian National Family Health Survey
PDHS=Pakistan Demographic and Health Survey
Figures in parentheses indicate standard deviations

As will be discussed, the PDHS results are at odds with a large majority of the published data that show higher fertility among women in close consanguineous unions.

DISCUSSION

Although much research on nuptiality has been conducted by demographers, there appears to be either a lack of interest or lack of understanding of the need to consider the patterns and dynamics of cousin unions and their associated fertility and mortality implications, despite the widespread popularity of these marriages in Asia and Africa. There are no reliable recent data on the prevalence of cousin unions in countries, such as Bangladesh, which shares similar cultural norms with Muslims in the rest of the Indian Sub-continent. This is

very surprising, given the significant influence of consanguinity on intellectual disability in rural Bangladesh (30) and the substantial alleged prevalence of consanguineous marriage in the U.K. Bangladeshi community with one study focusing on perinatal health, indicating that 13% of all marriages among Bangladeshi immigrants were consanguineous (31). A similar situation prevails in Indonesia despite anthropological evidence of consanguinity in different regions of Indonesia, with the first-cousin marriages preferred or permitted in 12 of 17 societies studied (32). Consanguineous unions have been reported to be locally preferential in countries as diverse as Nepal and Cambodia. The initial question on consanguineous marriage in PDHS was almost a reluctant inclusion, and the data showing very high levels of consanguineous unions came as a surprise to many. However, since publication of the PDHS results, an increasing number of studies have investigated the issue of consanguinity in Pakistani populations in greater depth.

Table 4. Unadjusted mean fertility levels by sociodemographic variables (PDHS and NFHS data)

Variable	PDHS (n=5,533)			NFHS (n=7,965)		
	No.	Unrelated	First cousin	No.	Unrelated	First cousin
Age at cohabitation (years)		c				c
<18	2,688	5.0 (3.1)	4.4 (3.0)	5,518	4.0 (2.7)	4.1 (2.7)
18-22	1,992	3.8 (2.7)	3.6 (2.8)	2,245	3.0 (2.3)	3.0 (2.4)
≥23	853	3.3 (2.5)	3.4 (2.7)	185	1.8 (1.8)	2.3 (1.8)
Marriage duration (years)		c				c
0-10	2,150	1.8 (1.5)	1.7 (1.4)	3,266	1.7 (1.3)	1.8 (1.3)
11-20	1,832	5.0 (2.1)	4.7 (2.2)	2,604	4.4 (2.0)	4.3 (2.0)
21-30	1,058	6.9 (2.7)	6.5 (2.6)	1,667	5.8 (2.6)	5.9 (2.6)
≥31	211	8.0 (2.5)	7.0 (3.3)	411	6.7 (2.8)	6.8 (2.8)
Contraception			c			c
No	4,434	3.9 (3.0)	3.7 (2.9)	3,264	4.0 (2.3)	4.3 (2.3)
Yes	1,100	5.4 (2.6)	5.2 (2.6)	4,990	3.4 (2.8)	3.4 (2.8)
Foetal loss						c
Zero	N/A	–	–	6,472	3.5 (2.6)	3.5 (2.6)
One				1,021	4.3 (2.5)	4.1 (2.4)
Two or more				472	4.9 (2.8)	5.1 (2.7)
Childhood death			c			c
Zero	3,919	3.5 (2.6)	3.1 (2.5)	5,619	2.8 (2.2)	2.9 (2.2)
One	833	5.2 (2.6)	5.1 (2.4)	1,446	4.9 (2.2)	4.9 (2.3)
Two or more	781	7.7 (2.7)	7.1 (2.6)	900	7.2 (2.4)	6.9 (2.4)

c=p<0.001
N/A=Not available
NFHS=Indian National Family Health Survey
PDHS=Pakistan Demographic and Health Survey
Figures in parentheses indicate standard deviation

The association between consanguinity and fertility was assessed in a number of different populations. For example, in a case-control study of endogamy in north Indian Muslim communities, both mean numbers of pregnancies and livebirths increased systematically with the strength of the biological relationship between spouses (33), and in the predominantly Hindu state of Tamil Nadu in southern India, the mean fertility levels (number of pregnancies, children ever born, and living children) were higher in consanguineous unions (34). Similar higher fertility outcomes in consanguineous couples were reported by a multi-centre study in the Punjab province of Pakistan (35), and among multi-ethnic and multi-religious communities in Karachi, the capital of Sindh province (36). As illustrated in Table 2, a large majority of studies reported higher fertility among consanguineously-married women. As part of a comprehensive review of biological and sociodemographic factors linking consanguinity and fertility, Bittles *et al*. undertook a pooled analysis of fertility differentials by consanguinity status across 30 populations, based on 552,061 livebirths reported by 227,1354 women (3). The analysis showed that women married to their first cousins had, on average, 0.26 more

Table 5. Multivariate analysis of mean fertility levels (PDHS and NFHS)

Variable	PDHS	NFHS
Education (years)	c	c
None	3.9	3.8
1-5	3.7	3.6
6-10	3.3	3.4
≥11	2.6	3.3
Consanguinity	c	
Non-cousin	4.0	3.7
First cousin	3.6	3.7
Occupation of husband		c
White collar	3.7	3.8
Blue collar	3.8	3.6
Agriculture/animal husbandry	3.8	3.7
Other	3.6	3.5
Residence		
Urban	3.8	3.8
Village	3.7	3.7
Region (PDHS/NFHS)		c
Punjab/North	3.8	3.8
Sindh/South	3.7	3.4
NWFP/East	3.9	3.6
Balochistan/West	4.0	3.6
Central	–	4.0
Age at cohabitation (years)		c
<18	3.8	3.8
18-22	3.7	3.6
≥23	3.7	3.2
Duration of marriage (years)	c	c
0-10	2.0	2.2
11-20	4.5	4.2
21-30	6.1	5.4
≥31	6.5	5.8
Contraception	c	c
No	3.5	4.0
Yes	4.7	3.5
Foetal loss		b
Zero	N/A	3.7
One		3.8
Two or more		3.8
Childhood death	c	c
Zero	3.4	3.2
One	4.6	4.4
Two or more	5.4	5.9
Grand mean	3.8	3.7
R^2	0.57	0.57

b=p<0.01, c=p<0.001
N/A=Not available
NFHS=Indian National Family Health Survey
PDHS=Pakistan Demographic and Health Survey

livebirths than women in non-cousin unions, in part as compensation for higher postnatal losses.

Analyses of the DHS data from Pakistan and India provided somewhat different results. Despite adjustments for marital duration, number of child deaths and other key predictors, women in Pakistan who are in close cousin unions had somewhat lower mean fertility values, while in India, there were no fertility differentials by consanguinity. Results of a detailed study of the PDHS data suggest either random under-reporting of fertility figures or some misclassification of women by consanguinity status. The suspicion of a misclassification bias is reinforced by the results of the re-interview survey conducted on 10% of the original PDHS respondents, which revealed 17% discrepant responses for consanguineous marriage between the main and the re-interview samples. Further, among those reported to be consanguineously married, there were 37% discrepant responses as to the exact nature of the consanguineous relationship (37).

In our opinion, the latter misclassification is the underlying reason for the anomalous fertility values by consanguinity status in PDHS, especially since the levels of the first-cousin marriage reported in PDHS were higher than in other household surveys conducted in Pakistan (16,35,38). Given the highly endogamous nature of the Pakistani society and its strong *biraderi* (clan) orientation (39-40), second cousin or more distant relationships may mistakenly be reported as first cousin, and disentangling reported family pedigrees requires greater training and time than are generally available to the PDHS field staff. As would have been expected from the results of other international surveys, a contemporary study conducted in Karachi that used detailed genealogical information did record a higher number of pregnancies and livebirths for women in the first-cousin versus unrelated unions, although this differential largely disappeared when adjustments were made for other variables at the multivariate level, particularly for child deaths (36).

While there were no overall fertility differentials in NFHS, an analysis of fertility among women aged 40 years and above as a surrogate for completed fertility did reveal a higher mean number of livebirths among women in the first-cousin unions. The excess fertility appeared to be of the same magnitude, i.e. an average of 0.3 additional births, as that observed for the pooled analysis of over half a million livebirths (3). In addition, while no statistically-significant interaction was observed for consanguinity and place of residence, the higher prevalence of consanguineous unions among urban dwellers in India with smaller family norms is likely to mask any fertility differential that could be attributed to consanguinity.

Several potential pathways for higher fertility associated with consanguinity can be identified. There is much evidence that consanguineous unions occur at a younger age (18,36). The higher fertility is probably also related to lower contraceptive use (36), in part mediated by a lower level of maternal education and rural residence and reflecting both an attitudinal factor and issues of access and availability of contraceptives. Among the PDHS subjects, the apparently-anomalous higher mean number of livebirths in women who ever used contraception or were current users is due to the fact that, in Pakistan, many women start contraceptive use only at relatively high fertility. Hence, a large proportion of contraceptive use is for limiting fertility, subsequent to completion of the desired family size.

In virtually all studies, there is excess offspring mortality among consanguineously-married couples (4,5,41). Prenatal losses, and especially infant mortality, were consistently higher among the offspring of women in the first-cousin unions in PDHS and NFHS (42-43). While acknowledging that not all early losses would necessarily be replaced, the lack of fertility differential corresponding to the excess mortality losses among women in the first-cousin unions in both the surveys is at variance with earlier studies and needs further investigation.

Consanguineous marriages are not limited only to Muslim societies in South and Southeast Asia, since there are a number of perceived social advantages in contracting such unions. The question of whether a consanguineous relationship leads to empowerment or disempowerment of women is complex. Across many Asian societies, women's autonomy, including reproductive choices, is largely determined by a combination of age, education, social status, family-living arrangements, and most importantly, the number of children, especially sons. At least in Pakistan, consanguineous unions are generally perceived to have no direct positive or negative impact on their autonomy in relation to fertility (40). The situation may be different in India since Hindu women in the southern states, where consanguinity is preferential, generally have much greater autonomy and lower fertility than those in the north of the country (21,44,45).

To conclude, barring a few exceptions, information on the prevalence of consanguineous marriage through large-scale nationally-representative surveys is lacking for most of Asia, which makes any assessment of current and future trends a near-impossible task. As was evident from the five-country SWAF survey (20,21), consanguinity is common among many communities in countries, such as Thailand, Malaysia, and the Philippines. However, the usefulness of data collected was limited by the general nature of the question posed, i.e. a simple yes or no, with no further details requested on the closeness or types of consanguineous unions contracted.

Within Pakistan and India, the prevalence of consanguineous marriage among Muslims remained essentially stable over the four-decade assessment period of PDHS and NFHS, and there is no evidence to suggest that a decline in consanguineous unions is likely in the near future (39,40). The situation among Hindus in South India is more equivocal (46-47), and given the smaller family sizes now observed, some decline in consanguineous unions appears inevitable, especially uncle-niece marriages where age differences between potential partners may exceed the locally-accepted norms (48-49). The lack of a significant positive association between fertility and consanguinity at the first-cousin level in PDHS and NFHS remains puzzling and contrary to the meta-analysis of published literature. Given the high prevalence of consanguineous unions in the region and their cultural significance in many communities, it is important that nationally-representative surveys, such as DHS, which collect information on a range of demographic, reproductive and child-health parameters, should routinely include consanguineous marriage as an integral component rather than an occasional one-off question. The availability of these data would allow an ongoing assessment of trends in both prevalence of such unions and association among consanguinity, fertility, and mortality in infancy and childhood. Conversely, their exclusion could effectively invalidate any conclusions reached on fertility levels and trends.

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