Journal of Biosocial Science (2024), 56: 3, 445–458
doi:10.1017/S0021932024000026

CAMBRIDGE UNIVERSITY PRESS

RESEARCH ARTICLE

Consanguinity in northwest Pakistan: evidence of temporal decline

Sajid Malik[1], Anisa Bibi[1], Rubbiya Farid[1], Sidra Khan[2], Javaid Awan[2] and Atta Ur Rehman[2]

[1]Human Genetics Program, Department of Zoology, Quaid-i-Azam University, Islamabad, Pakistan and [2]Department of Zoology, Faculty of Biological and Health Sciences, Hazara University, Mansehra, Pakistan
Corresponding author: Sajid Malik; Email: malik@qau.edu.pk

(Received 11 February 2022; revised 20 November 2023; accepted 9 January 2024; first published online 05 February 2024)

Abstract
Pakistan has a high burden of hereditary and congenital anomalies and their incidence rate almost doubles against the background of parental consanguinity. Consanguineous unions (CU) are customary in Pakistan and deeply rooted socio-cultural norms favour CU. This study aimed to elucidate the determinants and temporal change in CU in four northwestern populations of Pakistan. In a cross-sectional study, data on marital union types, bio-demographic factors, and paternal consanguinity were collected from 6,323 ever-married individuals in four districts of northwest Pakistan: Haripur, Muzaffarabad, Mansehra, and Shangla. We used descriptive statistics and multivariable logistic regression analysis. The CU were calculated to be 55%, and inbreeding coefficient F (ICF) was estimated to be 0.029. Eight factors, including district, rural origin, age of husband, occupational group of husband, literacy of husband, parental consanguinity, exchange marriage, and extended family type, were found to be significant predictors of consanguinity in the multivariable logistic regression analysis. The rate of consanguinity decreased significantly in the younger age categories of individuals. The rate of CU was seen to be declining over time and in marriages that started 'before 1980' and 'after 2010', respectively, and there was a decline in ICF from 0.030 to 0.027. These analyses also showed that the literacy rate improved, the average age at marriage increased, and the frequency of exchange marriages decreased over time. This study employs a sizable first-hand dataset to demonstrate a lowering CU rate in northwest Pakistan. It is anticipated that the burden of inherited and congenital anomalies may likely to diminish in the study populations along with the fall in ICF.

Keywords: inbreeding coefficient; cousin marriage; epidemiology

Introduction

Consanguinity is a common practice in most of the developing world, whereas, with few exceptions, it is generally not noteworthy in many of the developed nations (Bittles, 2010). Rapid demographic change is affecting developing nations, and new patterns of fertility, parenthood, and family formation are emerging (Bongaarts *et al.*, 2013a; Ranganathan *et al.*, 2015; Goujon *et al.*, 2020).

Numerous demographic features have been linked to changes in the pattern of marriages and the decline in consanguinity. Consanguineous unions (CU), for example, typically decline as a result of social modernization, which involves a number of changes from a traditional, rural, and extended family, agro-based society to a secular, urban and nuclear family, industrial society. These changes have a significant positive impact on employment, education, and health (Bittles and Black, 2010). Furthermore, the rate of CU is projected to decline due to rising marriage age,

postponed motherhood for women, and declining teenage fertility (Bongaarts *et al.*, 2013b; Goujon *et al.*, 2020).

In many developing nations particularly the Muslin counties, there is a clear shift in marital union patterns. Examples include the alignment of first cousin unions, the transfer from CUs to non-CU, and patrilineal types to matrilineal unions (Hamamy *et al.*, 2005; Al-Kandari, 2006; Al-Arrayed and Hamamy, 2012; Schellekens *et al.*, 2017). A demographic research conducted in Jordan by Hamamy *et al.* (2005) shows a drop in CU over time. In a recent study, Islam (2021) observed a decline in CU in Jordan and identified the factors that contributed to this decline as rising female education levels and marriage-age women, husbands with higher levels of education, declining family sizes, rising rates of urbanization and female employment, media exposure, and higher socio-economic status. Likewise, Al-Kandari (2006) witnessed that the level of education and the expansion of the 'marriage circle' were two important causes in Kuwait's apparent reduction in CU after over two decades. Al-Arrayed and Hamamy (2012) witnessed that in Bahrain, between 1990 and 2009, the percentage of cousin marriage sharply declined from 24% to 7%. A marked decrease in CU has also been witnessed in Muslims in Palestine and Israel (Assaf and Khawaja, 2009; Schellekens *et al.*, 2017). The primary causes of the drop in CU were determined to be school enrolment and educational achievement (Schellekens *et al.*, 2017).

Furthermore, in Morocco, the prevalence of CU declined by 4 percentage points and the researchers showed that improving economic conditions, declining fertility, rural-to-urban migration, and higher female educational levels are all contributing factors (Anwar *et al.*, 2014). A recent study showed a significant overall decline in CU in India. However, the degree of change varied in different states, with major declines in CU being seen in southern areas and moderate increases being seen in certain northern regions (Kumari *et al.*, 2020). Grjibovski *et al.* (2009) showed that there is a decrease in the proportion of consanguineously related parents of children born to women of Pakistani origin in Norway. In the Rahim Yar Khan population of Pakistan, Riaz *et al.* (2016) investigated consanguinity and its socio-biological factors. According to this study, CU decreased from 63% of participants of higher age to 55% of participants of younger age.

On the other hand, CU are still common in some nations in Asia and Africa. Consanguinity was found to be prevalent in several rural and socioeconomically challenged Muslim populations in Kerala, India, and there has been no decline in subsequent generations. Educational and economic backwardness and being strict in Islamic norms are contributing factors to this situation (Lekshmi and Sudhakaran, 2012). Studies from two Pakistani communities, Malakand and Bajaur Agency, found an increase in the rate of CU as a result of civil unrest at the Pakistan-Afghanistan border and turbulent security conditions (Sthanadar *et al.*, 2014; Ahmad *et al.*, 2016a, Ahmad *et al.*, 2016b; Rehman *et al.*, 2016). However, as demonstrated by a recent study in India (Kumari *et al.*, 2020), these data might simply represent localized trends and the overall picture is probably different.

Pakistan faces a huge burden of congenital and hereditary anomalies majority of which are autosomal recessive in nature and are rendered by cousin marriages and CU (Bibi *et al.*, 2022; Shaheen *et al.*, 2023). The high frequency of CU in Pakistan is due to a number of socio-demographic factors, including the usual practice of marrying a blood-related or kin. This study aimed to identify the factors that influence consanguinity in four areas of northwest Pakistan and to clarify any temporal changes in the level of consanguinity.

Methods

Study design and sample collection

The study protocols were approved by the Ethical Review Committees of the Quaid-i-Azam University and Hazara University. Ever-married men/ever-married women (referred to as respondents or individuals) from the study districts of Haripur, Muzaffarabad, Mansehra, and Shangla were recruited during 2018–2021. The majority of the population lives in rural and

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

mountainous areas, and the data collection was possible after the availability of local resource persons and logistical arrangements. The respondents were approached in their homes, public places and community centres.

The sampling strategy was primarily convenience sampling, which ranged from cluster random sampling to door-to-door surveys depending upon the logistical, language, and cultural barriers and the COVID situation. There had been no prior selection based on the ethnicity or socio-demographic characteristics. Because the population of four districts ranged from 0.13 to 1.0 million, hence, sample size of >385 from each district deemed appropriate, considering a background consanguinity rate of 50%, precision of +/− 0.05 (5%) and 95%CI (Calculator.net). In order to reduce sampling error and maximize the likelihood of obtaining a representative sample, we expanded the sample size significantly and used cluster sampling where possible. The random walk method was used in scattered mountainous communities, with randomly selecting a direction to walk, a random starting point and sampling contiguous households. In plain urban neighbourhoods, the area was divided into geographic zones, randomly selected a zone and randomly selected a starting point within the zone.

Only those with permanent residency in a particular district and granted formal approval to their volunteer participation in the study were recruited. A structured proforma was utilized to gather information in face-to-face interviews on marital union types, demographic, and household variables. We removed the few responders who could not recall their exact marital union type.

Definitions

Four types of marital unions were considered as consanguineous, i.e., double-first-cousin (DFC), first cousin (FC), first-cousin-once-removed (FCOR), and second cousin (SC) marriages. The FC marriages were further resolved into four subtypes, i.e., father's-brother's-daughter (FBD), father's-sister's-daughter (FSD), mother's-brother's-daughter (MBD), and mother's-sister's-daughter (MSD) (Bittles, 2010; Jabeen and Malik, 2014). The inbreeding coefficient F (ICF) was estimated from the weighted proportion of individual CU types multiplied with respective coefficient of inbreeding (Bittles, 2010). Hence, ICF was the aggregate of four estimates: (0.125 × DFC unions) + (0.0625 × FC unions) + (0.03125 × FCOR unions) + (0.015625 × SC unions). The demographic variables included District of residence, rural/urban origin, and mother tongue (linguistic group). Data were obtained on self-identified caste systems such as Awan, Sawati, Syed, Rajput, among others. Information was also gathered from the participants regarding their literacy and years of schooling. Literate participants were defined as those who had basic ability to read or write or were able to sign their names. For the occupational categories, self-identified occupations of participants (husbands) were documented which were later recoded to the closest categories established in the Pakistan Demographic and Health Survey (NIPS, 2013).

The household variables included family type defined as either 'nuclear', 'two couples', or 'extended'. Nuclear and two-couples families comprised of 1 couple and 2 couples households, respectively, and extended families comprised 3 or more overlapping generations dwelling as a unit. Data on parental marriage type (consanguineous or non-consanguineous), exchange marriage (reciprocal or non-reciprocal), age of individual, year of marriage, and age at marriage were also collected (Zaman, 2010; Riaz *et al.*, 2016; Tufail *et al.*, 2017).

Statistical analyses

All data were maintained in Excel and analysed through GraphPad Prism (ver.5) and STATA (ver.11). Descriptive summaries were generated; the CU and ICF were calculated across the socio-demographic variables. Chi-square test and Fisher's exact test were used to check the independence between the categorical variables (Garstman, 2006). Chi-square test for trend was utilized for testing the association between a nominal variable with two levels (like CU and

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

non-consanguineous) and an ordinal variable (like age intervals). T-test was utilized to check the differences in the distributions of continuous variables. Bivariate logistic regression was employed to observe the relationship between dependent variable (consanguinity) and a single independent variable (socio-demographic). In order to observe whether two or more variables were correlated with dependent variable bivariate and multivariable logistic regression analyses were performed. The dependent variable (CU) was taken as dichotomous and the socio-demographic factors were coded as independent variables and the results were depicted in odd ratios (OR) (Garstman, 2006). The OR was calculated as the fraction of CU in respective category compared/fraction of CU in Reference category. In each variable, the category with the lowest prevalence of CU and sample size >10% was taken as the Reference. For the multivariable regression analyses, a stepwise logistic regression was performed and the dependent variables were added one by one. Only the significant variables were retained in the final model.

Results

Sample characteristics

A total of 6,323 respondents consented to participate in the survey out of an anticipated 6,700 people that were approached throughout the study period, making the response rate 94%. The major reasons for non-responsiveness include worries about security and privacy, social, and cultural issues, or a refusal to provide information while their family heads are not present. The number of respondents in the sample ranged from 1300 (from Mansehra) to 2023 (from Muzaffarabad). The respondents ranged in age from 15 to 80 years, with mean ages (StdDev) for men and women of 38.4 ± 10.9 and 33.8 ± 10.0, respectively.

The CU were calculated to be 55% for the total sample and the ICF was estimated to be 0.029 (Table 1). The percentages of DFC, FC, FCOR, and SC unions were 1.5%, 37.4%, 7.7%, and 8.4%, respectively. The rate of CU varied by district, from 46% in Shangla to 62% in Muzaffarabad. ICF was calculated to be 0.031, 0.030, 0.028, and 0.026 in Muzaffarabad, Haripur, Mansehra, and Shangla, respectively.

FC unions were the most prevalent marriage type, occurring in 37% of respondents. FBD, FSD, MBD, and MSD types made up 39%, 17%, 21%, and 23% of this category, respectively. As a result, 56% of marriages were patrilineal as opposed to 44% of matrilineal kinds.

Consanguinity and its determinants

Consanguinity rates were significantly higher among respondents from rural areas (vs. respondents from urban areas), those who spoke *Pahari* and *Hindko* (only first two stated), and belonged to the Abbasi, Rajpoot, and Choudhary caste systems (only first three stated) (Table 1).

Consanguinity was found to be statistically significantly higher in literate respondents (compared to the illiterate group), employed in sales, unskilled manual labour, and skilled manual labour, and extended family types (compared to nuclear families) (Table 2). Additionally, the rates of CU were much greater in people with parental consanguinity and exchange marriage. The distribution of CU was statistically non-significant when factors including wife literacy, wife occupation, and family type were taken into account.

In multivariable logistic regression analyses, all the variables were included, and significant variables were kept while omitting the non-significant ones (marriage year was not included due to its high collinearity with age). Thus, eight variables – district, rural origin, literacy (of husband), occupational group (of husband), family type (extended), parental consanguinity, exchange marriage, and age of husband – emerged as significant predictors of consanguinity (Table 3). All these variables were positively associated with CU. Exchange marriages contributed most to the overall effect of these factors (OR: 2.00). The individuals from Mansehra, Haripur and

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

Table 1. Consanguineous Unions, Odds of Consanguinity, and ICF across Demographic Variables

Variable	Consanguineous unions (CU)		Total marriages		OR#	*p*-value	95% CI	Inbreeding coefficient (ICF)
	No.	%	No.	%				
District **								
Shangla	686	46	1500	24	**Ref.**			0.026
Mansehra	694	53	1300	20	1.36	<0.0001	1.17–1.58	0.028
Haripur	840	56	1500	24	1.51	<0.0001	1.31–1.74	0.030
Muzaffarabad	1259	62	2023	32	1.96	<0.0001	1.71–2.24	0.031
Total	**3479**	**55**	**6323**	**100**				**0.029**
Rural/urban origin *								
Urban	1016	53	1923	30	**Ref.**			0.027
Rural	2463	56	4400	70	1.14	0.021	1.02–1.26	0.030
Mother tongue **								
Pashto	758	48	1593	25	**Ref.**			0.027
Kohistani	18	41	44	1	0.76	0.383	0.41–1.40	0.025
Gujari	110	43	254	4	0.84	0.205	0.64–1.09	0.024
Others	57	53	108	2	1.23	0.296	0.83–1.81	0.026
Hindko	1283	55	2315	37	1.36	<0.0001	1.20–1.55	0.029
Pahari	1253	62	2009	32	1.82	<0.0001	1.59–2.08	0.031
Caste system **								
Awan	728	58	1250	20	**Ref.**			0.029
Others	797	53	1499	24	0.81	0.008	0.69–0.95	0.028
Syed	260	52	504	8	0.76	0.011	0.62–0.94	0.028
Sawati	305	52	590	9	0.77	0.008	0.63–0.93	0.028
Gujar	243	52	465	7	0.78	0.026	0.63–0.97	0.029
Pathan	206	52	393	6	0.79	0.042	0.63–0.99	0.027
Tanoli	122	56	216	3	0.93	0.629	0.69–1.25	0.031
Yousafzai	151	45	333	5	0.60	<0.0001	0.47–0.76	0.025
Mughal	134	60	224	4	1.06	0.659	0.79–1.43	0.032
Choudary	148	62	240	4	1.15	0.323	0.87–1.53	0.029
Rajput	269	62	434	7	1.17	0.172	0.93–1.46	0.031
Abbasi	116	66	175	3	1.41	0.043	1.10–1.97	0.034

*$\chi^2 = p < 0.05$;
**$\chi^2 = p < 0.0001$; OR = odd ratios depicting bivariate regression; Ref. = reference category.

Muzaffarabad had 28%, 35% and 62% higher odds of having CU, respectively, compared to those from Shangla; the individuals from rural areas had 44% higher odds of CU compared to those from urban areas; individuals with parental consanguinity had 87% more odds of having CU compared to those without parental consanguinity. Exchange marriage increased the odds of CU by 100%; the individuals belonging to extended family types had 46% higher odds of having

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

Table 2. Consanguineous Unions, Odds of Consanguinity, and ICF in Socio-economic and Household Variables

Variable	Consanguineous unions (CU)		Total marriages		OR#	*p*-value	95% CI	Inbreeding coefficient (ICF)
	No.	%	No.	%				
Literacy (husband) **								
Illiterate	920	52	1785	28	**Ref.**			0.028
Literate	2559	56	4538	72	1.22	<0.0001	1.09–1.36	0.029
Occupational group (husband) **								
Govt. Job	782	54	1444	23	**Ref.**			0.028
Agriculture	315	48	652	10	0.79	0.013	0.65–0.95	0.027
Unemployed	206	53	392	6	0.93	1.572	0.75–1.17	0.029
Business	228	46	498	8	0.71	0.001	0.58–0.88	0.024
Professional	212	56	380	6	1.07	0.569	0.85–1.34	0.028
Skilled manual	385	56	686	11	1.08	0.394	0.90–1.30	0.029
Unskilled manual	1074	59	1831	29	1.20	0.010	1.05–1.38	0.031
Sales	277	63	440	7	1.43	0.001	1.15–1.79	0.032
Family type **								
Nuclear	748	47	1576	25	**Ref.**			0.025
Two couples	1079	55	1950	31	1.37	<0.0001	1.20–1.57	0.028
Extended	1652	59	2797	44	1.60	<0.0001	1.41–1.81	0.032
Parental marriage type **								
Non-consanguineous	1485	47	3141	50	**Ref.**			0.024
Consanguineous	1932	63	3090	50	1.86	<0.0001	1.68–2.06	0.033
Exchange marriage **								
Non-reciprocal	3200	54	5928	94	**Ref.**			0.028
Reciprocal	279	71	395	6	2.05	<0.0001	1.64–2.56	0.040
Age (years; husband) **								
Up to 30	806	49	1643	26	**Ref.**			0.027
>30–40	1187	52	2287	36	1.12	0.078	0.99–1.27	0.027
>40–50	832	57	1449	23	1.40	<0.0001	1.21–1.61	0.030
>50–60	460	69	666	11	2.32	<0.0001	1.92–2.81	0.036
>60	194	70	278	4	2.40	<0.0001	1.82–3.15	0.035
Marriage year **								
After 2010	584	50	1172	19	**Ref.**			0.027
2001–2010	1311	55	2401	38	1.21	0.007	1.05–1.39	0.029
1991–2000	851	57	1501	24	1.32	<0.0001	1.13–1.54	0.030
1981–1990	477	58	819	13	1.40	<0.0001	1.17–1.68	0.031
Before 1980	256	60	430	7	1.48	0.001	1.18–1.85	0.030
Age at marriage (wife) **								
>24–29	242	48	511	15	Ref.			0.025
>19–24	843	60	1412	40	1.65	<0.0001	1.34–2.02	0.030
>14–19	921	63	1451	41	1.93	<0.0001	1.57–2.37	0.032
Up to 14	93	62	149	4	1.84	0.001	1.27–2.68	0.033

**$\chi^2 = p < 0.0001$; OR = odd ratios depicting bivariate regression; Ref. = reference category.

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

Table 3. Significant Predictors of Consanguinity in the Multivariate Model

Variable	Odd ratio	Std. Err.	*p*-value	95% CI	Coef.	Std. Err.
District						
Shangla	Ref.					
Mansehra	1.28	0.12	0.01	1.06–1.55	0.25	0.10
Haripur	1.35	0.14	0.00	1.10–1.64	0.30	0.10
Muzaffarabad	1.62	0.17	0.00	1.32–2.00	0.48	0.11
Rural/urban origin						
Urban	Ref.					
Rural	1.44	0.09	0.00	1.27–1.63	0.36	0.06
Literacy (husband)						
Illiterate	Ref.					
Literate	1.23	0.08	0.00	1.07–1.40	0.20	0.07
Occupational group (husband)						
Govt. Job	Ref.					
Agriculture	1.13	0.13	0.27	0.91–1.41	0.12	0.11
Unemployed	1.03	0.13	0.83	0.80–1.31	0.03	0.13
Business	0.97	0.11	0.80	0.78–1.22	−0.03	0.11
Professional	0.98	0.12	0.90	0.77–1.25	−0.02	0.12
Skilled manual	1.23	0.12	0.04	1.01–1.49	0.20	0.10
Unskilled manual	1.21	0.09	0.02	1.04–1.41	0.19	0.08
Sales	1.45	0.17	0.00	1.15–1.84	0.37	0.12
Family type						
Nuclear	Ref.					
Two couples	0.95	0.09	0.63	0.79–1.16	−0.05	0.10
Extended	1.46	0.12	0.00	1.25–1.72	0.38	0.08
Parental marriage type						
Non-consanguineous	Ref.					
Consanguineous	1.87	0.11	0.00	1.67–2.10	0.63	0.06
Exchange marriage						
Non-reciprocal	Ref.					
Reciprocal	2.00	0.24	0.00	1.58–2.53	0.69	0.12
Age (years; husband)						
Up to 30	Ref.					
>30–40	1.21	0.08	0.01	1.06–1.38	0.19	0.07
>40–50	1.70	0.13	0.00	1.46–1.99	0.53	0.08
>50–60	2.97	0.31	0.00	2.42–3.65	1.09	0.11
>60	2.92	0.44	0.00	2.17–3.92	1.07	0.15
_cons	0.24	0.03	0.00	0.18–0.31	−1.43	0.14

Coef. = Coefficient; Ref. = reference category; Std. Err. = Standard error.

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

Table 4. Predictors of Consanguinity in Four Districts[#]

Variable	Districts				All	All
	Shangla	Mansehra	Haripur	Muzaffarabad		
District	NA	NA	NA	NA	1.18	NA
					(0.97–1.43)	
Rural origin	0.69	1.79*	1.23	1.42*	1.36*	1.30*
	(0.44–1.09)	(1.41–2.80)	(0.91–1.67)	(1.17–1.72)	(1.16–1.60)	(1.12–1.52)
Mother tongue	0.94	1.08*	1.02	1.07	1.02	1.06
	(0.82–1.09)	(1.02–1.14)	(0.93–1.12)	(0.88–1.32)	(0.94–1.11)	(0.99–1.13)
Caste system	0.98	1.03	1.01	0.99	0.99	1.00
	(0.94–1.03)	(0.98–1.09)	(0.98–1.05)	(0.97–1.02)	(0.98–1.02)	(1.12–1.52)
Age (husband)	1.41*	1.27*	1.80*	1.27*	1.40	1.42*
	(1.27–1.57)	(1.15–1.41)	(1.55–2.09)	(1.16–1.39)	(1.30–1.52)	(1.31–1.53)
Age at marriage (wife)	–	–	1.31*	1.27*	1.27*	1.28*
			(1.13–1.52)	(1.13–1.44)	(1.16–1.40)	(1.16–1.40)
Literacy (husband)	1.29*	0.89	1.69*	1.25	1.41*	1.40*
	(1.03–1.61)	(0.70–1.15)	(1.20–2.40)	(0.94–1.65)	(1.13–1.74)	(1.13–1.73)
Occupational group (husband)	0.99	1.03	1.03	1.05*	1.04*	1.04*
	(0.93–1.05)	(0.98–1.08)	(0.98–1.08)	(1.01–1.08)	(1.01–1.07)	(1.01–1.07)
Parental marriage type	2.85*	1.38*	1.72*	1.84*	1.80*	1.83*
	(2.22–3.65)	(1.05–1.80)	(1.37–2.15)	(1.51–2.23)	(1.56–2.08)	(1.58–2.11)
Exchange marriage	0.97	1.43	5.56*	3.22*	3.97*	3.98*
	(0.68–1.38)	(0.12–17.08)	(2.82–10.95)	(2.02–5.13)	(2.71–5.82)	(2.72–5.84)
Family type	1.19*	1.16*	2.06*	1.49*	1.67*	1.66*
	(1.06–1.34)	(1.02–1.32)	(1.62–2.61)	(1.22–1.81)	(1.43–1.94)	(1.43–1.93)
_cons	0.44	0.11*	0.01*	0.03*	0.01*	0.02*
	(0.15–1.14)	(0.06–0.23)	(0.00–0.03)	(0.01–0.15)	(0.01–0.03)	(0.01–0.04)

[#]Reporting odd ratios and 95% CI; NA, not applicable; –, not included due to small data size.
*p-value was statistically significant.

CU compared to those with nuclear family. Mother tongue appeared to be significant when district was not included in the analyses. When the analyses were stratified for marriage year, six variables emerged as significant predictors: district, rural origin, occupation of husband, parental marriage (consanguinity), exchange marriage, and extended family; all variables were positively associated with most prominent were exchange marriage, parental consanguinity and rural origin (odd ratios 1.97, 1.91, and 1.36, respectively); and model was highly significant.

We further hypothesized that the combination of variables potentially influencing CU among the district communities might be different from sample as a whole. Hence, the multivariable analyses were repeated in the district-wise samples (Table 4). These analyses indeed revealed that different variables were significant predictors of CU among four districts.

For instance in Shangla, four variables were significant, i.e., age of husband, literacy of husband, parental marriage type, and family type. In Muzaffarabad district, eight variables were significant

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

predictor of CU: rural origin, age of husband, age at marriage (wife), occupation of husband, parental marriage type, exchange marriage, and family type. Three variables were observed to be significant predictors of CU in all districts, i.e., age of the husband, parental marriage type, and family type.

Temporal decline in CU rate

The rate of CU decreased with decreasing age categories of the respondents; consanguinity was substantially higher in respondents belonging to higher age groups compared to respondents in lower age groups (chi-square test for trend: $p < 0.0001$) (Table 2).

With regard to marriage years, the distribution of CU was evaluated, and five groups of 10-year intervals were developed. In addition to the rate of CU dropping through time, there was also a notable drop in ICF, from 0.030 in marriages 'before 1980' to 0.027 in marriages 'after 2010' (Fig. 1a). Three of the four districts – Haripur, Muzaffarabad, and Mansehra – showed a temporal drop in CU (Fig. 1b). Up to 1991–2000, there was a minor increase in CU in the Shangla district, but the rate then remained largely steady.

The rate of MSD marriages increased significantly among FC unions, while FBD types decreased (Fig. 1c). As a result, matrilineal marriage rates rose over time, whereas patrilineal kinds decreased (Fig. 1d). Further, an increase in the average age at marriage was evident (Table 2; Fig. 1e), that both husband and wife's literacy rates significantly increased (Fig. 1f) and that the frequency of exchange marriages decreased over time.

Discussion

The objective of this study was to examine the factors influencing consanguinity in four populations located in northwest Pakistan. A total of 6323 individuals were recruited, and the data analysis revealed that the prevalence of consanguinity stood at 55%, with an estimated coefficient of inbreeding (ICF) of 0.029. The study identified eight variables, namely district, rural origin, age of husband, occupational group (of husband), literacy (of husband), parental consanguinity, exchange marriage, and extended family type, as significant predictors of consanguinity.

Surprisingly, rural origin – a strong predictor in the entire sample – seemed to be significant only in two districts, namely Mansehra and Muzaffarabad, and not in Shangla and Haripur. This may be explained by the fact that in many areas of Pakistan, the metropolitan areas are expanding rapidly by overtaking rural settlements. The urban conglomerations have grown significantly beyond the city borders to include the nearby 'rural' areas and the 'peri-urbanization' phenomenon has been caused (Jabeen and Malik, 2014; Ullah, 2022). As a result, there are less differences in the demographics between urban and rural populations including the marital union types.

Exchange marriage was the most significant predictor of CU in multivariate model. The practice of exchange marriage has been deeply rooted in the cultural and social traditions of many communities of Pakistan. Such unions are often influenced by social and economic factors. They can be a way to maintain or enhance family honour and status, forge alliances between families, and distribute assets, including dowries and property (Zaman, 2011). Curiously however, among the district-wise analyses exchange marriage appeared to be non-significant in Shangla and Mansehra districts. These differences highlighted the cultural and social heterogeneity in the marital union decisions. Our analyses show that different communities and regions in northwest Pakistan may have varied customs regarding exchange marriages.

Nonetheless, parental consanguinity was the second most significant predictor of CU in the study sample. The type of parental marriage can indeed influence a child's decision regarding consanguineous marriage (marriage between close blood relatives), though it is just one of many factors that can play a role in this decision. Parents who have had consanguineous marriages may

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

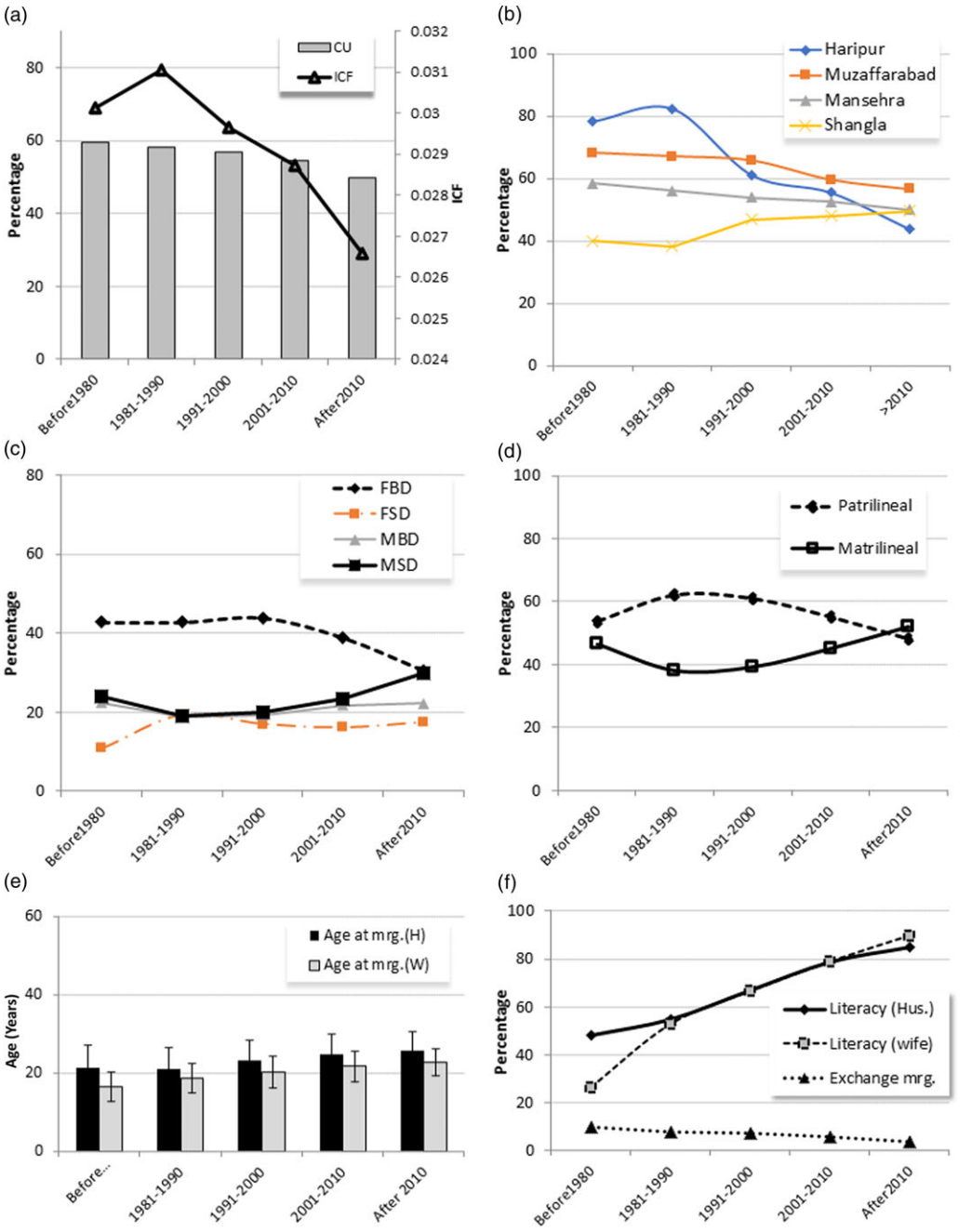

Figure 1. (a) Bars Showing the Percentages of CU at Y-axis and Line Depicting ICF at Y-secondary-axis; (b) Temporal Changes in the Prevalence of CU in Four Districts; (c) Temporal Trend of Subtypes of FC Unions; Increase in the Rate of MSD and Decrease in FBD are Evident; (d) Temporal Shift between Matrilineal and Patrilineal Marriages is Evident; (e) Temporal Increase in the Mean Age at Marriage; (f) Literacy Rates of Husband and Wife are Rising Over the Time, and the Rate of Exchange Marriages is Declining.

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

have certain expectations for their children to also marry within the family or the same ethnic group. These expectations can influence a child's decision of marrying within the family (Shenk *et al.*, 2021).

However, in the study sample, parental consanguinity was the second most important predictor of CU. The type of parental marriage can indeed have an impact on a child's decision, albeit there are numerous other factors that may also come into play. Consanguineous parents may have expectations for their children's future spouses to be from the same family or ethnicity as them. According to Shenk *et al.* (2021), these expectations may have an impact on a child's decision to marry within the family.

Contrary to earlier studies, it is interesting to note that women's literacy did not seem to affect the occurrence of CU in this study. Women's education is widely argued to have a negative impact on CU frequency (Wahab and Ahmad, 1996; Fuster and Colantonio, 2004; Hamamy *et al.*, 2011). On the other hand, our analyses revealed that increasing consanguinity was linked to the husband's literacy. It has been suggested that the strong correlation between consanguinity and literacy may be indirectly related to the subjects' socio-economic status, with subjects from lower socio-economic strata not only having lower literacy levels but also having a tendency to marry more frequently outside of their close kinships (Jabeen and Malik, 2014).

Additionally, the results show a considerable decline in the frequency of CUs among these populations in Northwest Pakistan, from 60% prior to 1980 to 50% between 2010 and subsequent years. The study observed a decrease in the consanguinity rate as the age categories of the respondents decreased. Additionally, it was found that over time, the average age at marriage increased, literacy rates improved, and there was a decline in exchange marriages. When comparing respondents to their parents' marital union types, a decrease in consanguinity rate was evident. The parental consanguinity was 63% compared to the 55% of respondents. Furthermore, FC unions have decreased in frequency throughout time, from 39% to 34%. On the other hand, marriages between people who were distantly related grew from 15% to 19%, and marriages between unrelated people went from 24% to 31% (data not shown). There has been a noticeable shift in marriage patterns among FC unions, particularly with an increase in MSD marriages and a decrease in FBD types. Matrilineal marriages have seen a rise in frequency, while patrilineal marriages have experienced a decline. This trend of increasing matrilineal marriages is noteworthy, as it suggests a more influential role for elder females or mothers in marriage decisions and domestic affairs. This shift challenges the perception of Pakistani society as traditionally portrayed male-dominated. The significant increase in matrilineal marriages may also indicate a transition from patriarchy to matriarchy, as supported by a similar study conducted in South Punjab, Pakistan by Zaman (2011). As expected, transitions are evident in many of the demographic variables in the study populations. For instance, both the husband and wife's mean age at marriage increased (Fig. 1e). Similar to this, the sampled population's literacy rates for the husband and wife both significantly increased. However, the frequency of exchange marriages has decreased over time. The rate of CU is expected to continue to drop in northwest Pakistan as a result of these demographic shifts. Previous research has revealed that Pakistan's average marriage age has increased over time, especially in metropolitan areas (Ahmed and Rukanuddin, 1987; Aziz, 1994). The increased accessibility of education also significantly contributed to the rise in marriageable age. Higher-educated men are more likely to be exposed to modernization pressures and have a larger pool of potential spouses to choose from outside of their immediate family (Khoury and Massad, 1992). The drop in CU is similarly related to rising female school enrolment and educational achievement (Schellekens *et al.*, 2017).

Study limitations

This study has several limitations. The findings of this study may only apply to Northwest Pakistan and may not be generalizable to Pakistan's total population. Second, just one generation

https://doi.org/10.1017/S0021932024000026 Published online by Cambridge University Press

data of marital union types have been used to compute ICF. In cultures where CU are traditionally and historically encouraged, the computation of ICF from one generation may be underestimated (Tufail *et al.* 2017). Furthermore, the results were based on convenience sampling because of the COVID situation at the time. This study did not mention any of the numerous negative health impacts of CU, including morbidity, death, and fertility. For the occupational groups, we also used data from self-reported. Due to the wide range of occupational types and several competing scales, it was frequently difficult to identify a certain occupation. Additionally, a lot of people switch employment based on the season. So, we used the self-reported occupation types for our analysis.

Conclusion

It is concluded that continued drop in CU in Northwest Pakistan, a phenomenon that is also common in many other Middle Eastern nations and India, may be caused by rising literacy, a delayed marriageable age, urbanization, and economic improvements. Furthermore, it is very likely that the burden of recessive genetic defects will decrease, and the morbidity and death associated with consanguinity may also decrease. However, it is anticipated that the genome homozygosity that has accumulated through the generations as a result of persistent inbreeding would not decrease significantly in just one or two generations. Despite an obvious decline in the rate of CU in the study population, which is mainly due to demographic transition, there is still a lack of awareness about the health risks associated with consanguinity. Therefore, community-based counselling and education initiatives should be started to raise public knowledge of the effects of consanguinity and related risks to maternal, child, and public health.

Acknowledgments. The participation of the individuals in this study is highly acknowledged. The helpful comments of Dr. Ijaz Hussain, Department of Statistics, Quaid-i-Azam University, are highly appreciated.

Funding statement. HEC-Pakistan and PSF-Islamabad.

Competing interests. None declared.

Ethical standard. The study protocols were approved by the Ethical Review Committees of the Quaid-i-Azam University and Hazara University.

References

Ahmad B, Rehman AU and Malik S (2016a) Consanguinity and inbreeding coefficient in tribal Pashtuns inhabiting the turbulent and war-affected territory of Bajaur Agency, North-West Pakistan. *Journal of Biosocial Science* **48**(1), 113–128.

Ahmed F and Rukanuddin AR (1987) *Age at Marriage, Contraception and Fertility Levels*. Analysis of PCPS 1984–85. Islamabad: National Institute of Population Studies.

Ahmad I, Rehman AU and Malik S (2016b) Determinants of consanguinity and inbreeding coefficient F in Dir Lower district, north-west Pakistan: a multivariate approach. *Iranian Journal of Public Health* **45**(4), 537–539.

Al-Arrayed S and Hamamy H (2012) The changing profile of consanguinity rates in Bahrain, 1990-2009. *Journal of Biosocial Science* **44**(3), 313–319. doi: 10.1017/S0021932011000666.

Al-Kandari Y (2006) Consanguineous marriages and its relationship to some sociocultural determinants. *Annals of Arts and Social Sciences, Kuwait University* **252**, 26.

Anwar WA, Khyatti M and Hemminki K (2014) Consanguinity and genetic diseases in North Africa and immigrants to Europe. *European Journal of Public Health* **24**(Suppl 1), 57–63. doi: 10.1093/eurpub/cku104.

Assaf S and Khawaja M (2009) Consanguinity trends and correlates in the Palestinian *Territories. Journal of Biosocial Science* **41**(1), 107–124. doi: 10.1017/S0021932008002940.

Aziz A (1994) Proximate determinants of fertility in Pakistan. *Pakistan Development Review* **33**, 727–742.

Bibi A, Naqvi SF, Syed A, Zainab S, Sohail K and Malik S (2022) Burden of congenital and hereditary anomalies in Hazara population of Khyber Pakhtunkhwa, Pakistan. *Pakistan Journal of Medical Sciences* **38**(5), 1278–1284. doi: 10.12669/pjms.38.5.5486.

Bittles AH (2010) Consanguinity, genetic drift, and genetic diseases in populations with reduced numbers of founders. In Speicher MR, Antonarakis SE and Motulsky AG (eds), *Vogel and Motulsky's Human Genetics*. Berlin Heidelberg: Springer-Verlag, pp. 507–728.

Bittles AH and Black ML (2010) Evolution in health and medicine Sackler colloquium: consanguinity, human evolution, and complex diseases. *Proceedings of the National Academy of Sciences of the United States of America* **107**(Suppl 1), 1779–1786.

Bongaarts J, Mir AM and Mahmood A (2013b) Policies for Capturing the Demographic Dividend in Pakistan. Chp. 8. In Sathar ZA, Royan R and Bongaarts J. (eds), *Capturing the Demographic Dividend in Pakistan*. Islamabad, Pakistan: Published by Population Council. pp. 91–99.

Bongaarts J, Sathar ZA and Mahmood A (2013a) Population Trends in Pakistan. Chp. 2. In Sathar ZA, Royan R and Bongaarts J. (eds), *Capturing the demographic dividend in Pakistan*. Islamabad, Pakistan: Published by Population Council. pp. 13–23.

Fuster V and Colantonio SE (2004) Socioeconomic, demographic, and geographic variables affecting the diverse degrees of consanguineous marriages in Spain. *Human Biology* **76**, 1–14.

Garstman BB (2006) *Basic Biostatistics*. Sudbury, MA: Jones and Bartlett Publishers.

Goujon A, Wazir A and Gailey N (2020) Pakistan: a population giant falling behind in its demographic transition. *Population and Societies* **576**, 1–4.

Grjibovski AM, Magnus P and Stoltenberg C (2009) Decrease in consanguinity among parents of children born in Norway to women of Pakistani origin: a registry-based study. *Scandinavian Journal of Public Health* **37**(3), 232–238. doi: 10.1177/1403494808100939.

Hamamy H, Antonarakis SE, Cavalli-Sforza LL, Temtamy S, Romeo G, Ten Kate LP, Bennett RL, Shaw A, Megarbane A and van Duijn C (2011) Consanguineous marriages, pearls and perils. Geneva international consanguinity workshop report. *Genetics in Medicine* **13**(9), 841–847.

Hamamy H, Jamhawi L, Al-Darawsheh J and Ajlouni K (2005) Consanguineous marriages in Jordan: Why is the rate changing with time? *Clinical Genetics* **67**(6), 511–516. doi: 10.1111/j.1399-0004.2005.00426.x.

Islam MM (2021) Consanguineous marriage and its relevance to divorce, polygyny and survival of marriage: evidence from a population-based analysis in Jordan. *Annals of Human Biology* **48**(1), 30–36.

Jabeen N and Malik S (2014) Consanguinity and its sociodemographic differentials in Bhimber District, Azad Jammu and Kashmir, Pakistan. *Journal of Health, Population and Nutrition* **32**(2), 301–313.

Khoury SA and Massad D (1992) Consanguineous marriage in Jordan. *American Journal of Medical Genetics* **43**(5), 769–775. doi: 10.1002/ajmg.1320430502.

Kumari N, Bittles AH and Saxena P (2020) Has the long-predicted decline in consanguineous marriage in India occurred? *Journal of Biosocial Science* **52**(5), 746–755. doi: 10.1017/S0021932019000762.

Lekshmi PJ and Sudhakaran MV (2012) Trends and prevalence of consanguineous marriages in Mudaliars of Palakkad district of the state of Kerala. *Journal of Human Ecology* **38**(1), 1–5.

NIPS. National Institute of Population Studies [Pakistan] and ICF International. (2013) Pakistan Demographic and Health Survey 2012–13 [Internet]. Calverton, MD, USA: National Institute of Population Studies and ICF International. URL: http://www.nips.org.pk/abstract_files/PDHS%20Final%20Report%20as%20of%20Jan%2022-2014.pdf

Ranganathan S, Swain R and Sumpter D (2015) The demographic transition and economic growth: implications for development policy. *Palgrave Communication*, 15033. doi: 10.1057/palcomms.2015.33.

Rehman AU, Ahmad I, Zaman M and Malik S (2016) Transition in consanguinity in Dir Lower district, a victim of war, natural disaster and population displacement, in north-west Pakistan – a response to Sthanadar *et al.* (2015). *Journal of Biosocial Science* **48**(3), 421–426.

Riaz HF, Mannan S and Malik S (2016) Consanguinity and its socio-biological parameters in Rahim Yar Khan District, Southern Punjab, Pakistan. *Journal of Health, Population and Nutrition* **35**, 14.

Schellekens JJ, Kenan G and Hleihel AS (2017) The decline in consanguineous marriage among Muslims in Israel: the role of education. *Demographic Research* **37**, 1933–1948.

Shaheen F, Humayoon QS, Malik S and Mumtaz S (2023) Clinical and genetic attributes of congenital anomalies ascertained at a tertiary care hospital in Rawalpindi, Pakistan. *Pakistan Journal of Medical Sciences* **39**(6), 1673–1679. doi: 10.12669/pjms.39.6.7408.

Shenk MK, Naz S and Chaudhry T (2021) The persistence of intensive kinship: why Pakistan has the highest rates of cousin marriage in the modern world. International Population Conference. International Union for the Scientific Study of Population. URL: https://ipc2021.popconf.org/uploads/211683

Sthanadar AA, Bittles AH and Zahid M (2014) Civil unrest and the current profile of consanguineous marriage in Khyber Pakhtunkhwa Province. *Pakistan Journal of Biosocial Science* **46**(5), 698–701.

Tufail M, Rehman AU and Malik S (2017) Determinants of consanguinity and inbreeding coefficient in the multiethnic population of Mardan, Khyber Pakhtunkhwa, Pakistan. *Asian Biomedicine* **11**(6), 451–460.

Ullah I (2022) Re-identifying the Rural/Urban: a case Study of Pakistan. *Espaço e Economia* **23**, 1–12.

Wahab A and Ahmad M (1996) Biosocial perspective of consanguineous marriages in rural and urban Swat, Pakistan. *Journal of Biosocial Science* **28**, 305–313.

Zaman M (2010) Marriage of cousins: congenital diseases and people's perception in Pakistan, a public health challenge. *Journal of Public Health Policy* **31**(3), 381–383.

Zaman M (2011) *Exchange Marriages in South Punjab, Pakistan: A Sociological Analysis of Kinship Structure, Agency, and Symbolic Culture*. Frankfurt am Main: Peter Lang Publishers.

Cite this article: Malik S, Bibi A, Farid R, Khan S, Awan J, and Rehman AU (2024). Consanguinity in northwest Pakistan: evidence of temporal decline. *Journal of Biosocial Science* **56**, 445–458. https://doi.org/10.1017/S0021932024000026