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Exploring sex differences and associated risk factors of hypertension among the Bhil tribe of rajasthan, India

Mir Azad Kalam[1*] and Saptamita Pal[2]

Abstract

The present study aimed to determine sex differences in the prevalence of hypertension among the Bhil tribe. The study was conducted among the Bhil tribe in Kanoi village, district Jaisalmer, Rajasthan, with a total sample size of 150 participants (55 males and 95 females). Socio-demographic, physiological, and lifestyle variables were considered as predictor variables. Chi-square tests were performed to examine associations between hypertension and predictor variables, while binary logistic regression was used in four models to assess sex differences in hypertension prevalence. The study found that 55.33% of the respondents were hypertensive, with a significantly higher prevalence of 76.36% among males and 43.16% among females ($p=0.000$). Bivariate results showed that respondents' age ($p=0.051$), employment status ($p=0.002$), anaemic status ($p=0.001$), family history of hypertension ($p=0.013$), smoking status ($p=0.034$), and intake of salt ($p=0.000$) were found significantly associated with the prevalence of hypertension. Binary logistic regression showed that females were significantly less likely to be hypertensive than males in Model I (OR = 0.24, CI = 0.12, 0.50, $p=0.001$). After adjusting for all variables, females remained significantly less likely to be hypertensive than males in Model IV (OR = 0.13, CI = 0.02, 0.84, $p=0.01$), indicating that sex of the participants plays a significant role in the prevalence of hypertension. The respondents who belonged to the age group 28–37 years were more likely to be hypertensive compared to the age group 18–27 years (OR = 6.07, CI = 1.0,36.83,$p=0.05$). Respondents who intake more sugar (OR = 3.41, CI = 0.89, 13.11, $p=0.05$) and intake more salt (OR = 38.68, CI = 11.12, 98.23, $p=0.001$) were significantly more likely to be hypertensive compared to their respective counterparts. Although with a small sample size, the study suggests that the prevalence of hypertension varies significantly by sex of the participants, with males being more prone to hypertension than females. Despite its limitations, this study provides valuable insights into public health and highlights the need for targeted, sex-specific healthcare interventions in a broader context.

Keywords Bhil, Determinants, Sex, Salt, Hypertension, Rajasthan, India

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Introduction

Hypertension, a leading cause of global morbidity and mortality, is strongly linked to cardiovascular diseases and death [1–4]. Global variations in blood pressure (BP) levels reveal higher mean BP in South Asia, sub-Saharan Africa, and Central/Eastern Europe, while lower levels are observed in high-income Western and Asia-Pacific regions [1]. Studies show males are at a higher risk of hypertension than female at the same age [1, 2]. These disparities are driven by several socio-environmental factors such as healthcare access, obesity, alcohol use, unhealthy diets, and physical inactivity [1, 3, 4] and hormonal differences between sexes at same age [5–7]. Studies found blood pressure is a sexually dimorphic trait and found higher prevalence of hypertension among males than females [6]. Similarly, other studies also observed sex differences in the prevalence of hypertension and analyses certain phenomenon behind the differences [7].

In India, hypertension is highly prevalent and is one the most significant risk factor for death and disability in urban and rural areas [8–12], and also among the neglected tribal population in India [13, 14]. Studies report prevalence of hypertension was 23.0–91.5% in Indian tribal groups [15, 16]. Through a meta-analysis of more than forty review articles, estimated the prevalence of hypertension among Indian tribal populations to be 16.68% [42]. Their findings also indicated a marginally higher prevalence of hypertension among tribal males (23.67%) compared to females (23.37%) [42]. Recently, in pan-Indian level, the National Family Health Survey (NFHS-5) 2019–2020 reported a hypertension prevalence of 24% and 21% among males and females respectively, an increase from 19% to 17% in man and female respectively from the previous round of NFHS (2015–16) [17]. Tribes, who make up 8.6% of India's population [18], often reside in remote regions and exhibit a higher prevalence of hypertension [10, 11, 16, 42]. Research identifies key contributors to hypertension in these communities as high salt intake, elevated urinary sodium excretion, increased body mass index (BMI), and advancing age [19, 20]. Occupational exposure significantly influences hypertension rates globally, including in India [43, 44]. In India's patriarchal society, males typically work outside and exposed to job stresses while female manage household duties, caregivers—only 3.0% of males are homemakers versus 34.0% of female [21]. Studies showed in India, 20.0% of males make key household financial decisions, compared to just 6.0% of female [21]. These lifestyle differences emphasize in different risk factor exposures, and thus sex-specific interventions in the prevalence of hypertension is needed. Tackling hypertension in tribal populations requires a holistic approach that accounts for both prevalence and socio-cultural determinants unique to these communities. Given this context, the present study aimed to explore sex differences and the associated risk factors of hypertension among the Bhil tribe in Rajasthan.

Materials and methods

Population and area

The present cross-sectional study was conducted among the Bhil tribe in the Jaisalmer district of Rajasthan. The name *Bhil* is derived from the word *billu*, which means *bow* [22]. They were classified as part of the Dravidian racial tribe of Western India, belonging to the Australoid group. In the Jaisalmer district, the population predominantly consists of Bhil, Rajput, and Mali communities. For this study, *Kanoi* village of Jailsalmer district of Rajasthan was selected randomly. *Kanoi* is a large village located in Jaisalmer Tehsil of Jaisalmer district, Rajasthan with total 366 residing households. The *Kanoi* village has population of 2410 of which 1234 are males while 1176 are females [23], residing in 366 households. A systematic sampling method was employed to select 122 households from the total 366, thereby ensuring that at least one-third of the household was represented. Each household had an equal and independent chance of being included in the sample, which helps reduce sampling bias and enhances the generalizability of the findings. Among 122 households, a total number of 200 participants of above 18 years of age were initially approached using random sampling, 55 males and 95 females consented to participate in all aspects of the study, forming the final sample size of 150. Informed consent was obtained from all participants to ensure transparency and ethical compliance.

Variables

Socio-demographic variables

Data on age, sex, literacy, occupation, marital status, family income and expenditure were collected to assess the socio-demographic profile and determinants of hypertension. Age was categorized into four groups due to small sample size and to gain better statistical results (i.e., 18–27 years, 28–37 years, 38–47years, and 47 + years) [48]. Sex was categorized as Male and Female category. Literacy plays a significant role in enhancing understanding of the causes and consequences of hypertension. Individuals with formal literacy generally possess greater knowledge about hypertension compared to those with no literacy. Therefore, literacy can be categorized into two groups: those who have attended school (literate) and those with no school attendance (non-literate). Occupational hazards often influence the prevalence of hypertension within a population. For the analysis, occupational groups (employment status) have been classified into two categories: those engaged in wage-earning sectors (employed) and those not engaged in any wage-earning activity (non-employed). Marital status of the

respondents also plays a crucial role in the prevalence of hypertension. For the purpose of this study, marital status has been categorized into two groups: ever-married and never-married. Socio-economic class of the respondents was determined by using Kuppuswamy socioeconomic status scale (47). This index uses literacy, occupation and family income per month. Thus the socioeconomic classification was grouped into three categories: Lower Class (LC), Middle Class (MC), and Upper Class (UC).

To minimize recall bias in collecting age and marriage data, especially from elderly respondents, national reference points such as historical, political, and natural events were used.

Physiological variables

Physiological data included blood pressure levels, measured using a digital sphygmomanometer (Omron HEM 7120). Systolic and diastolic blood pressure readings were taken twice in cases of major fluctuations. Blood pressure was categorized as hypertensive based on the standard guidelines [24]. Additional data on anaemic status (anaemic/non-anaemic), diabetic condition (diabetic/non-diabetic), and family history of hypertension (Yes/No) were also recorded Table 1.

Life styles variables

Data on various lifestyle factors were also collected, including smoking habits, alcohol consumption, physical activity, and dietary patterns—such as the intake of sugars, salt, animal protein, and green vegetables. Smoking and alcohol consumption were reported among both males and females, with a higher prevalence observed among tribal respondents. During the interviews, participants were asked whether they were regular smokers (Yes) or had never smoked (No), and whether they consumed alcohol regularly (Yes) or had never consumed alcohol (No). To assess physical activity, respondents were asked about their engagement in physically demanding work, such as daily wage labor, brick-making, or agricultural work. In contrast, activities such as household chores (e.g., cooking, childcare) were considered low in physical exertion. Based on this, physical activity was categorized into two groups: individuals involved in regular physical hard work (Yes) and those not involved in such work (No).

Dietary pattern variables were classified based on the respondents' regular consumption habits. The intake of sugars was recorded as 'Yes' if the respondent reported consuming sugars in at least one meal per day, and 'No' if there was no such intake. Similarly, the intake of extra salt in meals was coded as 'Yes' for individuals who regularly added salt to their food during meals, and 'No' for those who did not. The intake of animal protein—including eggs, chicken, or other forms of animal-based food consumed at least once per week—was categorized as 'Yes', while respondents reporting no consumption of animal protein were coded as 'No'. Lastly, the intake of green vegetables was categorized as 'Yes' for respondents who regularly included green vegetables in their diet, and 'No' for those who had minimal to no inclusion of green vegetables.

Table 1 Categories and Stages according to the American Heart Association, 2017

Blood Pressure Category	Systolic BP(mmHg)	Diastolic BP(mmHg)
Normal	< 120	< 80
Elevated	120–129	< 80
Stage 1 Hypertension	130–139	80–89
Stage 2 Hypertension	140 or higher	90 or higher

Statistical analysis

The outcome variable was the prevalence of hypertension, categorized into two groups: normal and hypertensive. For the study purpose and limited number of responses, blood pressure was grouped into two, one is non-hypertensive includes participants with normal and elevated blood pressure (high-normal) and other was hypertensive includes stage-1- hypertension and stage-2-hyperstion. Pearson correlation was used to identify the factors associated with hypertension (Eq. 1).

$$Chi\,(\mathrm{X})^2 = \frac{\sum (Oi-Ei)^2}{Ei} \quad (1)$$

Oi = observed numbers; Ei = expected numbers.

Binary logistic regression was performed to find out the risk factors of hypertension in four successive models (Eq. 2). The first model assessed the independent effect of sex , while subsequent models (Model II, III, and IV) included socio-demographic, physiological, and lifestyle variables to evaluate the cumulative effect of sex of the participants on hypertension. Data analysis was performed using STATA-14.

In the binary logistic regression analysis, the dependent variables were recorded as 0 if no, and 1 if yes.

$log_e\ [P(Y_i=1|\ X_i)\ /\ 1-\ P(Y_i=1|\ X_i)] = \log_e[\pi|1-\ \pi] = \alpha + \beta_1 Xi_1, \ldots\ldots\ldots\ \beta_k X_{ik}$ .....(Eq. 2).

where, Yi is the binary response variable and Xi is the set of explanatory variables like socio-demographic, physiological variables and lifestyle characteristics, and $\beta_1\ \beta_{2\ldots\ldots}\ \beta_k$ are the coefficient of the Xi variables. The results are given in the conventional form of odds ratios (OR) Table 2.

Table 2 Models and variables in Binary logistic regression

Binary logistic regression Models	Outcome variable	Predictor variables
Model I	Hypertension (Yes = 1, No = 0)	Sex(Male*, Female) [*= reference category]
Model II	Hypertension (Yes = 1, No = 0)	**Model I** + Age group, Literary, Occupation, Marital status, Socio-economic class
Model III	Hypertension (Yes = 1, No = 0)	**Model II** + Anaemic status, Pre-diabetic status, Family history of Hypertension,
Model IV	Hypertension (Yes = 1, No = 0)	**Model III +** Smoking, Alcohol consumption, Physical activity, Intake of vegetable, intake of animal protein, intake of sugars, intake of salt intake

Results

Table 3 show that the characteristics of the participants involved in the study. Table 3 shows that majority of respondents were hypertensive (55.33%). The same table shows that the median age of the participants was 37.0 years, with most belonging to the lower age group of 18–27 years. It was also found that 51.33% of respondents were literate, 70.67% were employed in different wage earning sectors, and 38.00% came from middle-class families.

Table 4 shows bivariate Chi squire (X^2) results of the variables associated with the prevalence of hypertension, only the significant variables were presented in the Table 4. However, potential associations between hypertension and other variables (though non-significant) were presented in Appendix Table 1. Table 4 showed a significant relationship between sex of the participant and the prevalence of hypertension ($p = 0.000$), with 76.36% of males and 43.16% of females being hypertensive (Fig. 1). The highest prevalence was found in the 38–47 age group (66.67%), followed by those aged 48 and above (59.38%) ($p = 0.05$). Employed individuals (75.00%) ($p = 0.002$), non-anaemic participants (70.00%) (($p = 0.001$) were more prone to be hypertensive. Table 4

Table 3 Characteristics of the studied population

Characteristics	*N* = 150 (100.0%)
Hypertension	
Normal	67(44.67)
Hypertensive	83(55.33)
Sex	
Male	55(36.67)
Female	95(63.33)
Age group	
18–27	46(30.67)
28–37	33(22.00)
38–47	39(26.00)
48+	32(21.33)
Median age of the population (year)	**37.0**
Literacy	
Non literate	73(48.67)
Literate	77(51.33)
Employment status	
Employed	106(70.67)
Not employed	44(29.33)
Socioeconomic status	
LC	53(35.33)
MC	57(38.00)
UC	40(26.67)

(Parentheses indicate percentage)

Table 4 Bivariate results of hypertension by background characteristics (significant variables)

Background characteristics	Normal	Hypertensive	Total	Chi squire (X^2), *p*-value
Sex				**15.5400**, $p = 0.000$
Female	54(56.84)	41(43.16)	95 (100.00)	
Male	13(23.64)	42(76.36)	55 (100.00)	
Age group				**5.9685**, $p = 0.051$
18–27	27(58.70)	19(41.30)	46 (100.00)	
28–37	14(42.42)	19(57.58)	33 (100.00)	
38–47	13(33.33)	26(66.67)	39 (100.00)	
48+	13(40.63)	19(59.38)	32 (100.00)	
Employment status				**9.7438**, **$p = 0.002$**
Non-employed	56(52.83)	50(47.17)	106 (100.00)	
Employed	11(25.00)	33(75.00)	44 (100.00)	
Anaemia status				11.4233, $p = 0.001$
Non-anaemic	21(30.00)	49(70.00)	70 (100.00)	
Anaemic	46(57.50)	34(42.50)	80 (100.00)	
Family history of hypertension				6.1122, $p = 0.013$
No	48(52.75)	43(47.25)	91 (100.00)	
Yes	19(32.20)	40(67.80)	59 (100.00)	
Smoking status				4.5035, $p = 0.034$
No	54(45.76)	64(54.24)	118 (100.00)	
Yes	13(40.63)	19(59.37)	32 (100.00)	
Intake of extra salt				55.3902, $p = 0.000$
No	49(81.67)	11(18.33)	60 (100.00)	
Yes	18(20.00)	72(80.00)	90 (100.00)	

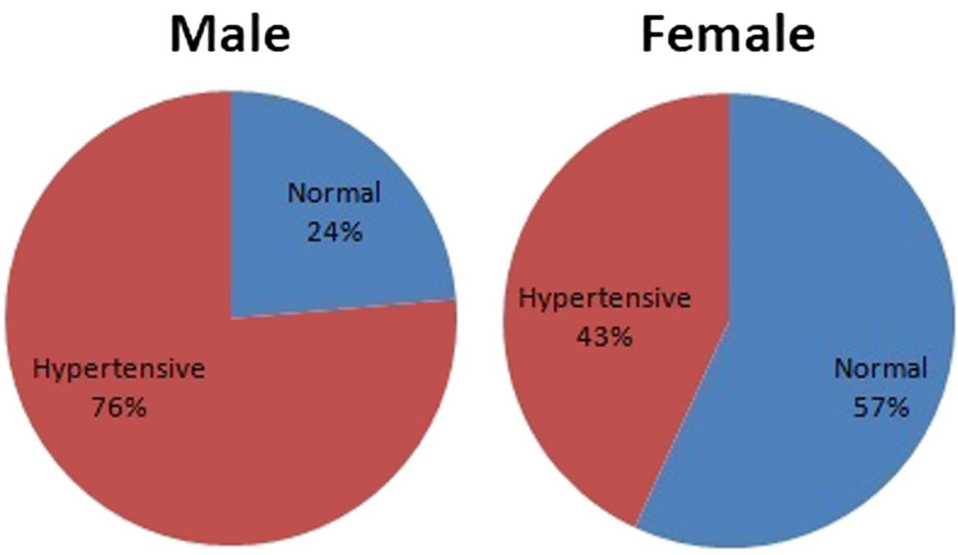

Fig. 1 Comparative distribution of Hypertension status by sex among the Bhil tribe

also showed that participant with family history of hypertension (67.80%) (p = 0.013), smokers (59.37%) ($p = 0.03$), and those who intake more salt (80.00%) ($p = 0.000$) were more hypertensive followed by non-smoker (54.24%) and those who does not consume more salt (18.33%) counterparts.

Table 5 shows the binary regression results of the predicting variables that affects the prevalence of hypertension. Table 5 shows that females were significantly less likely to be hypertensive than males (OR = 0.24, CI = 0.12, 0.50, $p = 0.001$) in Model I, where no other variables were included in the analysis. After adjusting for socio-demographic variables, physiological variables, and lifestyle variables in Model IV, it was found that females were still significantly less likely to be hypertensive compared to males (OR = 0.13, CI = 0.02,0.84, $p = 0.01$). Age of the respondents were found to have a significant effect on hypertension, with participants of 28–37 years age group were more likely to be hypertensive (OR = 6.07, CI = 1.00, 36.83, $p = 0.05$) compared to the 18–27 group. The Table 5 showed that respondents who intake more sugar regularly were significantly more likely to be hypertensive compared to those who do not consume sugars (OR = 3.41, CI = 0.89, 13.11, $p = 0.05$). Participants who intake more salt in their meals were significantly more likely to be hypertensive compared to those who intake minimum salt in their meals (OR = 38.68, CI = 11.12, 98.23, $p = 0.001$).

Discussion

The result of the study shows that the majority of the participants aged above 18 years were hypertensive compared to other tribal population in India (16, 42). The study also shows sex differences in the prevalence of hypertension where males being more hypertensive compared to females. In a meta-analysis of review papers, earlier study found that the prevalence of hypertension among Indian tribal populations was 16.68%, which is considerably lower than the 55.33% observed in the studied Bhil population [42]. They also reported a slightly higher prevalence of hypertension among males compared to females [42]. Compared to the adult population in China, where the prevalence of hypertension is 23.2%, a significantly higher percentage (55.33%) of adults in our study was found to be hypertensive [41]. Present study reveals a significant sex difference in hypertension prevalence, with males exhibiting a higher risk than females which found to be consistent to earlier studies [25, 26, 42]. Research from global community, for example, China and the United States has similarly shown that males are more prone to hypertension than females [25, 27], which aligns with our study's observations. In India, for instance, it has been found that males were at greater risk of hypertension than female in the general population [27]. India's patriarchal society, particularly in rural and tribal populations, has historically defined distinct roles for male and female [21]. Males predominantly engage in outdoor work, exposing them to numerous risk factors, while females primarily remain within the household and child caring activity might reduce hypertension [21]. The Bhil tribe, largely engaged in farming labour and sometimes hunting, living in harsh environmental condition faces a range of health challenges. Earlier study observed that workplace stress often increases the risk of hypertension [45]. In patriarchal society like Indian society, males were mostly work as outside labour while females were homemakers and busy with childcares. This may incline males in different stress and exposed risk factors than females. However, in the present study the risk of hypertension is not associated with the working status

Table 5 Binary logistic regression in the prevalence of hypertension by background characteristics

Background characteristics	Model-I OR(CI, *p*-value)	Model-II OR(CI, *p*-value)	Model-IIII OR(CI, *p*-value)	Model-IV OR(CI, *p*-value)
Sex				
Male ®				
Female	0.24***(0.12, 0.50)	0.28**(0.11, 0.75)	0.37(0.13, 1.05)	0.13**(0.02,0.84)
Age group				
18–27®				
28–37		3.75*(1.10, 12.77)	4.23*(1.20,14.71)	6.07*(1.0,36.83)
38–47		4.74*(1.32,17.03)	4.52*(1.15, 17.79)	3.74(0.58,24.25)
48+		3.51(0.89, 13.76)	2.47(0.56, 10.84)	1.15(0.13,10.44)
Literacy				
Non-literate®				
Literate		1.50(0.69, 3.24)	1.35 (0.61,2.98)	1.35 (0.47,3.92)
Employed status				
Employed ®				
Unemployed		1.69(0.64, 4.46)	1.48(0.53, 4.10)	1.75 (0.41,7.50)
Marital stat				
Never-married ®				
Ever-married		0.60 (0.21, 1.72)	0.44(0.14,1.34)	1.10 (0.24,5.05)
Socio-economic class				
LC®				
MC		0.98(0.42, 2.27)	0.93 (0.39, 2.21)	1.33(0.41,4.34)
UC		0.56(0.21, 1.47)	0.53(0.19,1.46)	0.39(0.10, 1.45)
Anaemia Status				
Non-anaemic®				
Anaemic			0.48*(0.21, 1.10)	0.50(0.16, 1.56)
Diabetic status				
Non-diabetic®				
Diabetic			0.84(0.28, 2.47)	1.27(0.25,6.45)
Family history of hypertension				
No ®				
Yes			2.17 (0.83, 5.70)	1.51(0.40,5.75)
Smoking status				
No ®				
Yes				0.58(0.11,3.16)
Alcohol consumption				
No ®				
Yes				0.35 (0.09, 1.39)
Physical activity				
No ®				
Yes				0.65 (0.24,.77)
Intake of green vegetables				
No ®				
Yes				1.74(0.51,5.87)
Intake of animal product				
No ®				
Yes				0.69 (0.25,1.91)
Intake of Sugar				
No ®				
Yes				3.41*(0.89,13.11)
Intake of extra salt				
No ®				
Yes				38.68***(11.12,98.23)
_cons	3.23 (1.73, 6.02)	1.26(0.32, 4.94)	1.79(0.40, 8.06)	0.13 (0.01,2.33

Table 5 (continued)

Background characteristics	Model-I OR(CI, *p*-value)	Model-II OR(CI, *p*-value)	Model-IIII OR(CI, *p*-value)	Model-IV OR(CI, *p*-value)
Hosmer-Lemeshow chi2				8.46
pseudo R^2				0.39

®= Reference group; ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; OR = Odds Ratio; CI = Confidence Interval: Base category = Non-hypertension.

of the population in contrast to earlier studies [45]. Earlier studies [29, 30] found marital status of the participant significantly affects the prevalence of hypertension. For example, being never married was an important risk factor for hypertension. However in the present study, the marital status of the Bhil population does not show any significant risk in the prevalence of hypertension [29].

The prevalence of hypertension in India is rising rapidly among the general population as well as among tribal [13, 14], which highlights the growing health burden in the country [11]. Our findings underscore this trend, with more than 50% of the studied population being hypertensive, a figure slightly higher than those reported in other studies [17, 29, 45]. Sex differences in the prevalence of hypertension have been observed significantly. Among the *Lepcha* tribal community of the Sikkim Himalayas, males had a higher rate of hypertension than females, aligning with the findings of the present study among the Bhil tribe [20]. Tribal communities in India, mostly living in remote and marginalized areas far from urban healthcare facilities, are at an increased risk of developing hypertension [27, 28]. Health facilities are very scarce in rural regions, especially in the tribal belt [49]. In the present study, it was observed that hypertension prevalence was high, which may be partly attributed to limited access to healthcare and socioeconomic factors. However, belonging to different socioeconomic class did not appear to be a significant determinant in the prevalence of hypertension in the present study, despite some evidence linking economic affluence with hypertension in previous research [27, 30]. The lifestyle and food consumption behaviour is another important determinant of hypertension worldwide [31] and also among the studied population. For example, the consumption of alcohol significantly affects the prevalence of hypertension [20, 32]. However, the finding of the present study does not find any association between alcohol consumption with hypertension. Earlier studies found intake of sugar is significantly associated with the prevalence of hypertension [46]. The present study also shows a similar and significant higher prevalence of hypertension among those who consume more sugar. Intake of salt remains a significant determinant of hypertension in global population, including India [11, 33]. Studies show that excessive salt consumption is a key contributor to high blood pressure [34, 35, 37, 40]. Studies show 21.3% of females and 24.0% of males in India having hypertension due to excessive salt intake [11]. The present study confirms this association, with individuals who consume extra salt in their diet exhibiting a higher likelihood of hypertension. Studies show Bhil community, mostly from lower socioeconomic backgrounds, may be more likely to add salt to their meals due to the limited availability of alternative food resources [8, 34]. This dietary habit may contribute to the higher hypertension prevalence observed in this population [35]. Studies observed that reduction in intake of salt significantly helps in the reduction in hypertension [36, 37].

While there have been improvements in the accessibility and availability of public health services in India over the past few decades, challenges such as social inequality and remote habitation still hinder equitable access to healthcare, particularly for tribal populations [28, 35, 38, 39, 49]. The Bhil tribe's living conditions may limit their ability to benefit from the public health system, making them more susceptible to hypertension and other health issues. Addressing these disparities requires targeted interventions that consider the unique socio-cultural and economic factors influencing tribal health [28, 35, 40].

Limitations

While the study offers valuable insights, it is not without limitations. First, the relatively small sample size of 150 participants reduces the statistical power and constrains the generalizability of the findings to the broader Bhil population or other tribal groups in India. Second, the cross-sectional design limits the ability to establish causal relationships between risk factors and hypertension; longitudinal studies would be better suited to track disease trajectories over time. Third, several variables—such as dietary intake, alcohol consumption, and smoking habits—were based on self-reported information and may therefore be affected by recall or reporting bias. Fourth, the study did not include biochemical parameters (e.g., serum lipid levels, renal function markers, or hormonal assays), which could have provided deeper insights into physiological differences between males and females. Finally, the geographically remote and scattered nature of the Bhil settlements created challenges for fieldwork, potentially affecting both participation and representativeness.

Conclusion

The study observed a significant difference in the prevalence of hypertension between Bhil males and females in Rajasthan, with males being more prone to hypertension than females. The study also found high consumption of sugar and salt increases the risk of hypertension among the population. Although, with the small sample size, this study provides valuable insights that can be helpful in public health professionals develop sex-specific interventions to address hypertension in tribal populations more effectively. These interventions should prioritize access to healthcare, dietary changes, and lifestyle modifications tailored to the needs of both male and female, ultimately contributing to the overall health and development of the nation.

Future research with larger, multi-site samples, complemented by additional biological and socio-cultural parameters, is recommended for a more comprehensive understanding of hypertension in tribal populations. Long-term ethnographic engagement, along with qualitative methods such as focus group discussions and in-depth interviews, would further help to capture community perceptions and lived experiences of hypertension.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-24630-y.

Supplementary Material 1

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Author contributions
MAK and SP collected the data.MAK analysed the data.MAK wrote the manuscript.SP edited the manuscript. All authors reviewed the manuscript.

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Data availability
The data for the present study were collected through fieldwork, and informed consent was obtained from all participants. It was ensured that the data would be used solely for academic purposes.

Declarations

Ethical approval
The research was carried out by using questionnaire and household schedule. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees. The study does not contain any invasive method of data collection, and participants consent was taken before the data collection.

Consent for publication
All authors have read and approved the final version of the manuscript and consent to its publication in the journal.

Competing interests
The authors declare no competing interests.

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Generational Shifts in Fertility Behaviour: Evidences from an Ethnographic Study from Howrah District of West Bengal, India

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ABSTRACT: This ethnographic study examines generational shifts in fertility behaviour among ever-married women in Howrah district, West Bengal, India—a region characterised by the convergence of agrarian rural and rapid urbanisation. Utilising a cross-sectional sample of 665 women across three generational cohorts, the analysis applies a negative binomial regression framework to assess the impact of socio-demographic, economic, and cultural determinants on fertility outcomes. One-way ANOVA result reveals a significant generational decline in mean number of children (p = 0.004); with participants of Generation I (1.89) showing the highest mean number of children than the participants of Generation III (1.38). Negative binomial regression results showed that women from Generation II (IRR = 0.99; CI: 0.72–1.37; $p < 0.001$) and Generation III (IRR = 0.95; CI: 0.60–1.49; p = 0.001) exhibiting significantly lower fertility compared to those from Generation I. Key predictors of reduced fertility include higher educational attainment among women (IRR = 0.95; CI: 0.72–1.26; $p < 0.01$) and their spouses (IRR = 0.99; CI: 0.85–1.25; $p < 0.05$), engagement in white-collar occupations (IRR = 0.93; CI: 0.72–1.22; $p < 0.01$), prioritisationof leisure time (IRR = 0.51; CI: 0.85–1.18; $p < 0.05$), fewer siblings (1–2) of the husband (IRR = 0.99; CI: 0.81–1.28; $p < 0.05$), higher household crowding (HCI) (IRR = 0.99; CI: 0.85–1.14; $p < 0.05$), and greater economic status within the upper expenditure quintile (IRR = 0.95; CI: 0.79–1.15; $p < 0.01$). Fertility preferences increasingly reflect modern aspirations related to lifestyle enhancement and personal autonomy. However, traditional influences—such as perceived necessity of children for life fulfilment and old-age dependency—continue to exert a reduced but noticeable effect. Significantly, higher fertility rates among Muslim participants (IRR = 1.04; CI: 0.81–1.14; $p < 0.01$) highlight the enduring impact of religious and economic disparities. IDIs observed a clear generational shift; older generations follow traditional childbearing norms, while younger ones lean toward modern views. The study concludes that fertility transition in the Howrah district is shaped by a dynamic interplay between persisting traditional norms and evolving individualistic values, positioning generational change as a crucial lens for interpreting India's ongoing demographic transformation.

Keywords: Generation; Fertility transition; Education; Ethnography; Howrah; India

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1. Introduction

Fertility patterns are closely intertwined with socioeconomic development, female educational and occupational upliftment, and access to reproductive healthcare facilities [1–4]. Studies found declining fertility is frequently associated with increased literacy, delayed marriage, and enhanced family planning efforts [2,3]. There are several other aspirational factors, focus on desired family size, as well as values related to child and family, that significantly decline the fertility [4]. Studies in the Philippines and Zambia showed perceptions of couples, especially females, were important for fulfilling desired family planning objectives, and knowledge about fertility and family planning measures are indispensable for reducingthe birth rate [5,6]. India's fertility transition has unfolded over the past three decades, with significant progress achieved across most regions during the last ten years [4,7,8]. Southern and many western states of India have reached replacement-level fertility, while northern, Hindi-speaking states continue to report higher fertility rates. Scholars attribute the regional disparities in fertility decline to various factors, including female education, effective family welfare programs, widespread media exposure, and socio-political movements such as backwards-class mobilisation[1,4]. Research also shows that in low-fertility states, women increasingly follow a structured life course—marriage followed by early childbirth and timely adoption of sterilisationto limit higher-order births [4]. Conversely,

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fertility remains relatively high in northern states, where patriarchal norms, agrarian economies, and low female educational attainment persist [4,9].

West Bengal, positioned between these two demographic extremes, has experienced a significant fertility decline in recent decades [1,4,10]. Historical evidence indicates that the birth rate (BR) in undivided Bengal experienced a sharp decline between the 1940s and 1944s, likely due to severe economic distress during that period [4,7]. Despite a slight increase in the age at marriage, recent analyses employing period parity progression ratios suggest that the age at first birth among women in West Bengal has remained largely unchanged. Nonetheless, a marked fertility decline—particularly evident during the 1990s—has occurred. This decline appears to be driven not by delayed initiation of childbearing but by a growing tendency among women to limit their family size to two children, increasingly avoiding higher-order births [4,10]. However, this transition has not been uniform across the states and districts of the states. Howrah district, a rapidly urbanisingarea with industrial urban zones and agrarian rural belts, provides a unique context for studying fertility trends. Situated next to Kolkata—one of the earliest Indian megacities to reach an exceptionally low fertility rate—Howrah district has been significantly shaped by the city's aspirations and prevailing behavioural trends [4]. Existing evidence suggests that age at marriage, early childbearing, and short birth intervals remain prevalent in several parts of the district [11]. At the same time, increased exposure to education and family planning services has contributed to a gradual reduction in the average number of children per woman. Earlier studies indicate that early years of marriage are particularly crucial for fertility regulation, as a majority of births occur within the first decade of marital life [12,13]. Additionally, perceptions of ideal family size, contraceptive use, and gender norms play a vital role in shaping fertility behaviour across generations [8,9].

Understanding fertility behaviour in the Howrah district necessitates an analysis of generational shifts, household dynamics, and the socio-cultural context shaping reproductive choices. Adopting a generational perspective and grounded in ethnographic data, the study aimed to trace shifts in fertility behavior across generations and identify key socio-demographic factors influencing fertility decisions and transitions within a rapidly evolving socio-economic landscape.

2. Materials and Methods

2.1. Study Participants

This community-based cross-sectional ethnographic study was conducted between October and November 2024, using random sampling among ever-married women in both urban and rural areas of Howrah district, West Bengal, India. A total of 695 women were approached for the study, of whom 665 agreed to answer all questions and were included in the final analysis.

Out of the 23 districts in West Bengal, Howrah was randomly selected for this study. Data were collected from various wards of the Howrah Municipal Corporation to represent the urban population, and from the community development blocks of Uluberia to represent the rural population. Only the female participant was selected from each household. Data were collected using a pre-designed and pre-tested household schedule through face-to-face interviews. Anthropologically trained ethnographers conducted house-to-house visits to interview eligible women. In-depth interviews (IDIs) were conducted with six participants—two from each generation—to explore issues related to fertility behaviour and the influence of social and economic changes on fertility patterns. Three focus group discussions (FGDs) within each generational cohort were also conductedto explore generational perspectives on fertility behaviour further.

Data entry was performed using Microsoft Excel, and the dataset was later imported into STATA-14 for final analysis.

2.2. Variables

The study examined variables influencing fertility behaviour, as presented in Table 1. These included individual and household-level control variables, factors that constrain childbearing and childrearing, and variables reflecting family and individual values. International research has widely tested and accepted these variables [4].

The primary outcome variable in this study, a count variable, was based on responses to the question about the total number of children. The explanatory variables were organisedinto three main categories: individual and household-level control variables, factors constraining childbearing and childrearing, and variables reflecting family and individual values (see Table 1).

Table 1. Variables tested for significance of association in multivariate binary logit regression models.

Individual and household-level control variables: number of own siblings/number of siblings of the husbands (continuous); sex of the child (categorised as boy and girl)/total number of children; type of family (categorised as nuclear and joint); religious belief (categorised as Hindu and Muslim); economic status has been categorisedas per capita monthly expenditure (categorised as bottom quintile, middle quintile and upper quintile), marital duration (continuous), Household crowding (<2.0 and ≥2.0), Place of residence(Urban and Rural)
Variables indicating constraints for childbearing and childrearing: years of schooling for males and females (categorisedas Primary, Secondary and Higher); degree of media exposure (categorised as Exposed and Non-exposed); work-status/type of work (categorised as Blue collar, White collar and Not-employed for women; and Blue-collar and White collar jobs for men); and importance of leisure time for own (categorised as not important/rather important and very important)
Variables specifying family and individual values: marriage is an outdated institution (categorised as fully/partially agree and do not agree at all); child is essential for life-fulfilment (categorised as fully agree and partially agree/do not agree at all); parents should sacrifice for their children (categorised as fully agree and partially agree/do not agree at all); wealth flows from parent to child now a days (categorised as fully agree and partially agree/do not agree at all); whether depend on children during old age (categorised as fully/partially agree and no agree at all)

2.3. Estimation of Generation Length

The estimation of generation length was carried out using the method originally proposed by Glass et al. (1952) [14], and later adopted by Srinivasan and Mukherjee (1976) and Mukherjee et al. (2007) [15,16]. The average age at first childbirth was calculated separately for men and women. Weighted means were used to determine the average age for both sexes, resulting in an identified generational span of 27 years. Based on this, three generational cohorts were defined for the study: Generation I (56 years and above), Generation II (28 years to 55 years), and Generation III (27 years and below).

To avoid the recall problem during the collection of data on age, age at marriage, age at first childbirth of the participants, especially those who were elderly, some reference points (historical, political and natural disaster) spread across the country were used. Participants undergoing neurological or psychological distress treatment were excluded to minimisepotential biases and ensure greater accuracy in recall-based responses.

2.4. Statistical Analysis

The primary outcome variable in this study is the 'number of children,' which constitutes non-negative count data. Accordingly, a Poisson regression model was initially considered. However, given the data's dispersion characteristics, a negative binomial regression analysis was ultimately employed across four successive models, as presented in Table 2.

Table 2. Negative binomial regression models analysing fertility behaviour.

Negative Binomial Regression Models	Outcome Variable	Explanatory Variables
Model I	Number of children (count variable)	Generation (Generation I, Generation II, Generation III)
Model II	Number of children (count variable)	Model I + Variables indicating constraints for childbearing and childrearing
Model III	Number of children (count variable)	Model II + Individual and household-level control variables
Model IV	Number of children (count variable)	Model III + Variables specifying family and individual values

3. Results

Table 3 presents the key socio-demographic and economic characteristics of the surveyed participants (N = 665). Participants were stratified into three generational cohorts: Generation I (aged 56 years and above) comprised 19.10% of the sample; Generation II (aged 28–55 years) represented the majority at 65.26%; and Generation III (aged 27 years and below) accounted for 15.64%. The mean age at marriage among participatory women was 22.25 years (±4.4). Around 47.0% of the women had completed secondary education. By contrast, educational levels among their husbands were notably lower; around 69.77% had received only a primary education.Around 64.96% of the women were not engaged in paid employment at the time of the survey, while 20.00% held blue-collar jobs and 15.04 per cent were employed in white-collar occupations. In comparison, a majority of their husbands (77.44 per cent) were employed in white-collar professions.A predominant 91.28% of the participants identified as Hindu, while 8.72% were Muslim. Caste-wise distribution revealed that 56.99% of the participants belonged to the General category, followed by 24.36%

from Scheduled Castes (SC), 11.58% from Other Backwards Classes (OBC), and 7.07% from Scheduled Tribes (ST).The median number of siblings reported by participants was 3.0, while that of their husbands was 2.9. The average number of children per woman in the current sample stood at 1.64. Furthermore, the median monthly per capita monthly household expenditure was estimated at INR 4687 (approximately USD 55.12).

Table 3. Sample characteristics of the study population.

Background Characteristics	N = 665
% of participants belonged to Gen-I	127(19.10)
% of participants belonged to Gen-II	434(65.26)
% of participants belonged to Gen-III	104(15.64)
Mean age at marriage for women	22.25 ± 4.4
Educational attainment of the participant	
Primary	144(21.65)
Secondary	312(46.92)
Higher	209(31.43)
Educational attainment of the participants' husbands	
Primary	464(69.77)
Secondary	81(12.18)
Higher	120(18.05)
Occupational attainment of the participant	
Blue Collar	133(20.00)
White Collar	100(15.04)
Not Employed	432(64.96)
Occupational attainment of the participants' husbands	
Blue Collar	150(22.56)
White Collar	515(77.44)
Religion belief	
% of participants believer in Hinduism	607(91.28)
% of participants believer of Islam	58(8.72)
Caste	
% of participants belonged to General	379(56.99)
% of participants belonged to OBC	77(11.58)
% of participants belonged to SC	162(24.36)
% of participants belonged to ST	47(7.07)
Median number of siblings of participants	3.0
Median number of siblings of the husbands	2.9
Mean number of children per woman (participant)	1.64
Percapita monthly household expenditure (median)	4687.0INR(USD 55.12)

(Parentheses indicate percentage).

Table 4 further disaggregates the sample by number of living children. A sizeable proportion of women (42.41 per cent) had one living child, followed by 38.95 per cent with two children. About 12.33 per cent had three or more children, while a small segment of participants (6.32 per cent) did not have any children at the time of the survey.

Table 4. Percentage of participants by number of living children.

Number of Living Children	Number (N = 665)
0	42(6.32)
1	282(42.41)
2	259(38.95)
3 and more	82(12.33)

(Parentheses indicate percentage).

Table 5 illustrates a one way ANOVA test results of generational difference in the mean number of children among the study participants. Participants of early generation,*i.e.*, Generation I, exhibited the highest mean number of children

(1.89), whereas Generation III, representing the youngest cohort, had the lowest mean (1.38), indicating a statistically significant decline ($p = 0.004$) in the mean number of children per woman among the study participants.

Table 5. ANOVA test for generational difference in the mean number of children per woman.

Generations	Number of Participants (N)	MeanNumber of Children	ANOVA Test
Generation I	127	1.89	
Generation II	434	1.52	p-Value = 0.004
Generation III	104	1.38	

Table 6 describes the negative binomial regression analysis identifies generational shift and statistically significant factors influencing the fertility behaviour (number of children) among participants in four successive Models. It was found that generational differences emerge as a strong determinant of fertility behaviour. It was observed that the likelihood of producing more children was significantly less among the participants of Generation II (IRR = 0.81, CI = 0.69, 0.94, $p < 001$) and Generation III (IRR = 0.73,CI = 0.59,0.90, $p = 0.001$), respectively, compared to the participants of Generation I in Model I. After inclusion of other variables (mentioned in Table1) through Model II to Model IV (described in Table 2), the final, Model IV shows that the participants of Generation II (IRR = 0.99, CI = 0.72, 1.37, $p < 0.01$) and Generation III (IRR = 0.95, CI = 0.60, 1.37, $p < 0.01$) were significantly less likely to produce more child compared to the participants of Generation I.

The same table also shows that the higher educated participants (IRR = 0.95, CI = 0.72, 1.26, $p < 0.01$) and the participants whose husbands were higher educated (IRR = 0.99, CI = 0.85, 1.25, $p < 0.05$) were significantly less likely to have more number of children compared to their primary educated counterparts. Participants who were engaged in white collar jobs were significantly (IRR = 0.93, CI = 0.72, 1.22, $p < 0.01$) less likely to have more children than those in blue-collar jobs. The importance of leisure time for the participants was found to significantly affect fertility behaviour, including those who found leisure time very important (IRR = 0.51,CI = 0.85, 1.18; $p < 0.05$), less likely to have more children than those who found no importance in leisure time. Table 6 also shows that participants whose husbands had three or more siblings were significantly (IRR = 0.99, CI = 0.81–1.23; $p < 0.05$) less likely to have a higher number of children compared to those whose husbands had no siblings Household crowding found to be significant predictor of fertility behavior showing that household crowding 2 or more (≥2.0) were significantly (IRR = 0.99, CI = 0.85, 1.14; $p < 0.05$) less likely to have more number of children compared to those living in household crowding below 2.0 (<2.0). The Muslim participants were significantly (IRR = 1.04, CI = 0.81, 1.35; $p < 0.01$) more likely to have more number of children compared to their Hindu counterparts.

Table 6 showed that the participants who belonged to the upper quintile of per capita monthly household expenditure were significantly (IRR = 0.95, CI = 0.79, 1.15; $p < 0.01$) less likely to have more number of children compared to those who belonged to the bottom quintile of per capita household expenditure. It was found that participants with long marriage duration were significantly (IRR = 1.01, CI = 0.99, 1.01; $p < 0.05$) more likely to have a higher number of children than those with short marriage duration.

Among variables specifying family and individual values, wives who disagreed that marriage is an outdated institution were significantly (IRR = 0.99, CI = 0.86, 1.16; $p < 0.05$) less likely to have more children than those who fully agree with the aforesaid statement. Participants who partially or do not agree with the statement that a child is essential for life were significantly (IRR = 0.95, CI = 0.76, 1.18; $p < 0.05$) less likely to have more children than those who agree with the aforementioned statement. Participants who did not agree that wealth flows from parent to child nowadays were significantly (IRR = 1.04, CI = 0.88, 1.23; $p < 0.05$) more likely to have a higher number of childrenthan participants who fully agree with the aforesaid statement. Participants who partially or do not agree that old age dependency on children were significantly (IRR = 0.98, CI = 0.84, 1.15; $p < 0.01$) less likely to have more childrenthan those who fully agree with the statement of old age dependency on children.

Table 6. Negative binomial regression in the number of children among the participants.

Background Characteristics	Model I IRR(95%CI)	Model II IRR(95%CI)	Model III IRR(95%CI)	Model IV IRR(95%CI)
Generation Length				
Gen-I(56 &above)®				
Gen-II(28-55)	0.81***(0.69, 0.94)	0.86*(0.73, 1.00)	0.99**(0.73, 1.35)	0.99**(0.72, 1.37)
Gen-III(Below 27)	0.73***(0.59, 0.90)	0.74**(0.58, 0.93)	0.95(0.62, 1.47)	0.95**(0.60, 1.49)
Variables indicating constraints for childbearing and childrearing				
Education of the participant				
Primary®				
Secondary		0.99(0.79, 1.23)	1.01(0.80, 1.19)	1.03(0.82, 1.30)
Higher		0.73*(0.56, 0.95)	0.91*(0.75, 1.29)	0.95**(0.72, 1.26)
Education of the participants' husbands				
Primary®				
Secondary		1.03(0.75, 1.29)	1.03*(0.82, 1.32)	1.03(0.83, 1.28)
Higher		1.08(0.91, 1.29)	1.07(0.80, 1.28)	0.99*(0.85, 1.25)
Occupation of the participant				
Blue collar®				
White Collar		1.05(0.81, 1.37)	0.94*(0.72, 1.23)	0.93**(0.72, 1.22)
Not Employed		1.05(0.87, 1.21)	0.96(0.80, 1.10)	0.98(0.83, 1.17)
Occupation of the participants' husbands				
Blue collar®				
White Collar		0.99 (0.85, 1.16)	1.02(0.84, 1.20)	1.02(0.87, 1.19)
Media exposure				
No®				
Yes		1.01(0.80, 1.26)	1.05(0.82, 1.29)	1.03(0.81, 1.32)
Important of leisure time				
Not important/rather important®				
Very important		1.02 (0.89, 1.17)	1.00 (0.88, 1.15)	0.51*(0.85, 1.18)
Individual and household-level control variables				
Number of siblings of the participant				
No sibling®				
1-2			1.01(0.86, 1.29)	1.04 (0.85, 1.28)
3 or more			1.04(0.83, 1.29)	1.01(0.81, 1.26)
Number of siblings of the participants' husbands				
No sibling®				
1-2			1.01(0.80, 1.24)	1.04(0.84, 1.23)
3 or more			0.91*(0.80, 1.25)	0.99*(0.81, 1.23)
Number of sons of the participants			1.70(1.60, 1.99)	1.75 (1.59, 1.93)
Number of daughters of the participants			1.71**(1.60, 1.92)	1.75 (1.59, 1.92)
Family type				
Joint®				
Nuclear			1.04(0.88, 1.10)	1.01(0.87, 1.17)
HCI				
<2.0®				
≥2.0			0.92*(0.86, 1.12)	0.99*(0.85, 1.14)
Religion				
Hindu®				
Muslim			1.01*(0.86, 1.39)	1.04**(0.81, 1.35)
Caste				
General®				
OBC			0.93 (0.78, 1.20)	0.94(0.75, 1.18)
SC			0.91 (0.84, 1.16)	1.00 (0.85, 1.19)
ST			0.95 (0.71, 1.15)	0.98(0.76, 1.25)

Per capita monthly household expenditure		
Bottom quintile®		
Middle quintile	0.99 (0.79, 1.24)	0.98 (0.84, 1.14)
Upper quintile	0.93**(0.80, 1.20)	0.95**(0.79, 1.15)
Place of delivery		
Govt. hospital®		
Home	0.89*(0.59, 1.12)	0.85(0.67, 1.07)
Nursing home	1.06(0.85, 1.32)	1.04(0.91, 1.19)
Place of residence		
Rural®		
Urban	1.00(0.77, 1.20)	1.00 (0.86, 1.17)
Marital duration	1.06(0.95, 1.09)	1.01*(0.99, 1.01)
Variables specifying family and individual values		
Marriage is an outdated institution		
Fully agree®		
Do not agree at all		0.99*(0.86, 1.16)
Child is essential for life		
Fully agree®		
Partially/do not agree at all		0.95*(0.76, 1.18)
Parents sacrifice for their children		
Fully agree®		
Partially/do not agree at all		1.05(0.84, 1.30)
Wealth flow from parents to children		
Fully agree®		
Partially/do not agree at all		1.04*(0.88, 1.23)
Old age dependency on child		
Fully agree®		
Partially/do not agree at all		0.98**(0.84, 1.15)
Pseudo R^2		0.33

®= Reference group; *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; IRR = Incidence rate ratio; CI = Confidence Interval: Outcome variable= 'Number of children (count variable)'.

Excerpts from an In-Depth Interview

The in-depth interviews reveal a generational shift in perceptions and beliefs regarding childbearing and childrearing among the participants. Individuals from the earlier generation (Generation I) appeared more rigid in adhering to the traditional belief systems and showed limited autonomy in decision-making. In contrast, participants from the later generations (Generation II and Generation I) showed a willingness to challenge traditional norms and adopt more modern perspectives, suggesting a potential link between changing attitudes and the observed fertility decline in Howrah.

During an open-ended in-depth interview (IDI), a 59-year-old homemaker (Participant of Generation I) with a primary level of education, stated:

I got married at a young age and didn't really know how to adapt to a whole new family. So, I ended up following the example I'd seen growing up—mostly what I saw my mother do. There was a lot of pressure from both side families,to have children. Nowadays, looking neighbourhood, I feel that having more kid's feels like a kind of safety net—if one can't support in older age, maybe another will be able to.

On the other hand, a 25-year-old homemaker (Participant of Generation III) with a higher level of education, stated:

Being a graduate,I aspire to pursue a governmentjob—not just for income but for life-fulfillment. I have convinced my husband and in-laws to delay having children until I am 30years old. They also see that one income isn't enough for a comfortable life and medical needs.

A 26-year-old, working in a call-centre (Participant of Generation III) with a higher level of education, stated:

Caring for more than one child feels like a heavy burden—what about our own lives? We are human too. I also want some time for myself, and having more children would leave little time for me, and ours.

A participant of Generation I, aged 63 years, a retired school teacher, expresses her concern:

In my time, I managed both school and raising six children, with help from my mother-in-law. Nowadays, relationships with in-laws aren't as strong, and young women seem less willing to take on childbearing—they're often preoccupied with mobile phones and personal relationships.

The in-depth interviews reveal that, at times, members of the parental generation quietly support their daughters in pursuing education, delaying marriage, and seeking employment. In some cases, they navigate resistance from their husbands or even confront them directly, all to secure a better future for their daughters.

A participant of Generation II, aged 41 years, a graduate and homemaker, reveals that:

Yes, it's okay to have children, but we are not machines to keep producing them just because our husbands or parents expect it. We have our own lives, the right to enjoy them, and the right to be heard. I didn't allow my daughter to marry early and will support her in getting a job—regardless of what my husband or hers might think.

4. Discussion

This community-based study highlights a generational shift in fertility behaviour, analysingthe various factors influencing the number of childbearing among the participating women in Howrah. The findings reveal a marked decline in fertility across generations, with women from the earlier generation exhibiting higher fertility rates, while those from the later generations demonstrate a noticeable reduction. Since the mid-1970s, India has witnessed a remarkable decline in fertility, with the average number of children per woman dropping from approximately six to three within a span of three decades [17]. Significant fertility reductions have also been observed across many country regions since the early 1980s [18].

Earlier studies found several proximate determinants of fertility reduction among the population, such as educational attainments, occupational shifts, economic status, and religious beliefs. For example, the present study's findings that education significantly lowers fertility support the findings of Mohanty et al. (2016)[19], who argued that increased female literacy is one of the most powerful determinants of fertility decline in Indian districts. Ghosh (2016) similarly documents a decline in childbearing within Kolkata's lowest-low fertility context, attributing this trend to the influence of education in reshaping women's aspirations regarding lifestyle and family size [4]. The study underscores that increased educational attainment enhances reproductive autonomy and broadens life goals, leading urban, professionally employed women—particularly those in white-collar occupations—to postpone or limit childbearing [4] as observed in the present study. This pattern significantly contributes to the observed decline in fertility in West Bengal, India.Our study also observed that white-collar occupation correlates with reduced fertility,aligning with the earlier study [4]. In fact, like Ghosh's participants [4], our participants did not exhibit widespread voluntary childlessness or rejection of family and marriage, but rather sought a balance between modern ambitions and normative expectations around family life. In patriarchal Indian society, women in early generations were restricted to go outside the home, neither for academic nor for wage-earning purposes.None of their voices were accounted for, while females of younger generations are well aware about their rights and were significantly engaged in higher education as well as wage wage-earning sector,which often helps in shifting fertility behaviour from high to low.

Generational differences in fertility behaviour—specifically, the lower fertility rates observed among younger cohorts—align with the expectations of transition theory in demographic study (DTT). However, as Mohanty et al. (2016) argue [19], the demographic transition in India has not followed a uniform trajectory. Persistent religious and socioeconomic differentials remain evident; for instance, our study found higher fertility rates among Muslim women, which is consistent with the findings of Jha et al. (2014) and Ghosh (2016)[1,4], who reported substantial variations in fertility knowledge, practices, and perceptions across religious groups in West Bengal. A common perception, echoed in the work of Cerroni-Long (1985), suggests that minority communities may adopt higher fertility as a strategy for demographic survival in the context of their relative minority size compared to majority groups [20].Muslims comprise approximately 14% of the population in India, compared to 80% Hindus [21]. The minority status, coupled with prevailing narratives about demographic marginalisation, may contribute to higher fertility among Muslims. Additionally, Nasreen et al. (2024) observed that contraceptive use remains relatively low among Muslims, further contributing to elevated fertility rates [22]. Economic disadvantage is another important factor. Muslims in India experience significantly lower economic conditions compared to other religious groups [21], which may influence reproductive behaviour. Our study found that higher household expenditure—a proxy for economic affluence—was associated with lower fertility. This finding aligns with Mohanty et al. (2016), who reported that poverty had only a marginal and statistically insignificant effect on fertility reduction [19]. These results suggest that material affluence

alone does not fully explain fertility behavior; rather, fertility decline appears to be more closely linked to evolving aspirations, value systems, and structural determinants such as education and wealth.

Interestingly, the significance of utilisationof leisure time as a predictor of lower fertility in our study aligns with Ghosh's (2016) interpretation that urban families often adopt low fertility as a strategy to preserve lifestyle choices [4]. This reflects a shift in aspirations rather than a complete departure from traditional familial norms. Such patterns indicate a nuanced form of the second demographic transition, wherein individualistic preferences increasingly influence, but do not entirely replace, conventional social structures. With the spread of urbanisationand widespread access to the internet, media, and various entertainment options across both rural and urban settings, women are more inclined to prioritisepersonal enjoyment and leisure, often at the expense of time traditionally allocated to childbearing and rearing. Furthermore, the rising involvement of Indian women in wage-earning employment [23] has been associated with a reduction in fertility-related behaviours. As noted by Ahn et al. (2021) [24], the considerable time and physical demands of such work often limit the ability and inclination to engage in childbearing and childrearing.

The influence of family background variables in the present study—such as the husband's number of siblings and household crowding—echoesAnyara and Hinde (2006) analysis of fertility in Kenya, where fertility was found to be mediated by contextual family and kinship structures, even when broader social changes were underway [25]. These structures continue to mediate reproductive norms, suggesting that fertility transitions in South Asia are embedded within enduring familial logics. The higher household crowding increases the expenditure in families,which often becomes a barrier to lifestyles, medical needs, and enjoying leisure times.

Since the effect of modernisationaround the world, every sector of the population,whether living in rural or urban areas, whether belonging to Hindu or Islamic religion, the perceptions related to specifying family and individual values is changing. These variables, such as views on child essentialism, old-age dependency, and the importance of marriage, offer a rich anthropological insight into fertility behaviour. Ghosh (2016) found that, in Kolkata, aspirations for children's success and anxieties about economic costs often lead to limiting family size, even in the absence of complete ideological shifts associated with the demographic transition [4]. Our findings reflect a similar dynamic, where fertility decisions are shaped less by radical value departures and more by pragmatic negotiations between traditional expectations and modern ambitions. Nowadays, the participants of younger generations are well aware of the educational development, career opportunities and other amenities they need to fulfil their aspirations compared to the earlier generation. The participants of earlier generations adhered more strictly to traditional social values, whereas the participants of the younger generation are more open and adaptive to the changes brought about by a modernisingworld. A generational shift in the traditional belief system may lead in the less number if child among the younger generation compared to their early generation counterpart. The individual beliefs and narratives of the women often echoed the findings of Ghosh's (2016) in-depth study in Kolkata [4]. Being geographically adjacent to Kolkata—the first Indian megacity to experience lowest-low fertility—it is likely that women in Howrah have been significantly influenced by Kolkata's urban aspirations and its prevailing trends toward declining fertility.

Indian patriarchal society plays a significant role in shaping social, economic, and familial structures, where men have traditionally held authority and control over household and reproductive decision-making [7,26]. Women have historically been socialisedinto roles focused on domestic work, caregiving, and childbearing, with limited autonomy over personal and reproductive choices [27]. However, with the advancement of modernisation, increased female education, and growing participation in white-collar employment, women's roles have gradually evolved across generations, leading to greater agency and involvement in decision-making processes [23]In this changing socio-economic context, the traditional dominance of men in fertility decisions appears to be declining, contributing to a overall decline in fertility in the region.

5. Conclusions

This community-based study underscores a significant generational shift in fertility behaviour, reflecting broader patterns of demographic transition in India. While earlier generations exhibited higher fertility rates, younger cohorts demonstrate a marked decline, shaped by increased educational attainment, economic aspirations, and participation in wage-earning sectors. Education, occupation—especially among women—emerges as a key determinant, enhancing reproductive autonomy and reshaping life goals. Occupational shifts toward white-collar employment and growing lifestyle aspirations among the younger generation have further contributed to fertility decline in urban and rural settings. However, religious and socioeconomic disparities persist, with higher fertility observed among Muslim women, influenced by economic disadvantage and demographic perceptions. Familial structures, leisure preferences, and

individualistic aspirations also shape reproductive choices, indicating a nuanced evolution rather than a complete ideological transformation. These findings suggest that fertility behaviour in contemporary India is increasingly influenced by pragmatic negotiations between traditional norms and modern opportunities, with generational transitions serving as a vital lens for understanding these changes.

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Author Contributions

M.A.K. conceptualized the study and wrote and edited the manuscript. S.P. reviewed and edited the manuscript.

Ethics Statement

This study did not involve any invasive experimental procedures. All research activities adhered to the guidelines outlined in the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all individuals who participated in the study.

Data Availability Statement

The data used in this study were collected through fieldwork.

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Declaration of Competing Interest

The authors declare that they have no known financial or personal conflicts of interest that could have influenced the work presented in this paper.

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Why is the Trend in Consanguineous Marriage Declining among the Darbhangia Khotta Muslim Community of Malda District of West Bengal, India?

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Abstract

This study examines the factors that are likely to be responsible for the decline in the prevalence of consanguineous marriage among a group of *Darbhangia Khotta* Muslim population of the Malda district of West Bengal. The group migrated from the Darbhanga district of undivided Bengal and got settled in twelve villages in Malda district, commonly known as *Bara Gaon Darbhangia Beradari*. 736 ever-married women from this community participated in this study and were categorised under three generations (Generation I is the oldest and Generation III is the youngest). We used a mixed-method approach to examine the causes and nuances in the decline of consanguineous marriage. Results showed that consanguinity had declined significantly from Generation-I to Generation-III ($p <= 0.05$). Binary logistic regression showed that respondents who belonged to Generation III were significantly 0.67 times less ($p<0.05$) likely to marry cousins compared to the respondents of Generation I. Respondents who married after 18 years of age and belonged to the middle socio-economic class were significantly 0.76 times ($p<0.05$) and 0.55 times ($p<0.05$) less likely to marry cousins compared to their respective counterparts. Qualitative analysis of the study revealed the following reasons behind the decline in consanguineous marriage: (1) Consanguineous marriages are no longer helping in maintaining family bondage, may generate conflict (2) members of the younger generation are increasingly involved in the decision-making process due to their enhanced educational and emancipation levels, and increased awareness of social and legal prohibitions of marriage types, and (3) there has been a change in the mode of marital payments (from property to cash), which has also contributed to the decline in consanguineous marriages among the study population.

Keywords: Consanguineous Marriage; Decline; Generation; *Darbhangia Khotta* Muslim; Malda; India.

INTRODUCTION

Globally, there has been a trend in the decline of consanguineous marriage (Islam, 2018), barring a few countries like United Arab Emirates (Al-Gazali *et al.,* 1997). Scholars argue that modernisation and socioeconomic transition of the world populations are some of the reasons behind this declining trend (Goode, 1963; Lichter *et al.,* 2015; Islam, 2018). In India, Kalam *et al.,*

(2021) found that consanguinity has declined by around sixteen percent, but the trend in decline varies with the socio-demographic profile of the specific region and composition of its population.

In traditional Indian societies, selection of partner is often found to be influenced by family, community, as well as by the religious practices in vogue (Prakash and Singh, 2014; Bhinder *et al.,* 2019; Gupta, 1976). At the local level, the declining trend of consanguinity is likely to be affected by local geo-political situation, rising age at marriage, increase in dowry (Bittles *et al.,* 1993), occupational change (Chandrasekar *et al.,* 1993), psychological discomfort (Rao *et al.,* 2009), increase in women's education (Sharma *et al.,* 2021), increasing spousal violence (Rahaman *et al.,* 2022), and acculturative pressure (Berry and Annis, 1974). For example, the migrant groups, owing to the challenges in the host region (Cerroni-Long, 1985), are often compelled to practice interethnic marriage for survival (Uddin, 2021). In a similar way, the stateless *Rohingya* Muslims of Mayanmar taking shelter in Bangladesh (Ahmed, 2010) are more inclined to marry local Bengali citizens to get Bangladeshi citizenship for survival, which results in the decline of intra-ethnic marriages. Lichter *et al.,* (2015) observed that Asian Indian immigrants in the US are more likely to marry out-group native-born Whites to get citizenship. Increasing influence of different kinds of media and educational attainments contribute to greater exposure of the regional communities to the outer world, which also helps younger generations gain knowledge about existing laws, social change directions, as well as economic opportunities (Prakash and Singh, 2014). Begum (2021) found consanguinity as a social capital among the Muslims of Char Areas in Barpeta District, Assam, contributing to higher prevalence of consanguinity (18.53%).

With this background knowledge, we intended to examine the trend in consanguineous marriage among a group of migrant *Darbhangia Khotta* Muslim populations in India and to get a first-hand idea about the community's perception regarding consanguineous marriage. Our hypothesis as applied to this study was that the prevalence of consanguineous marriage, where it is in practice, has declined from Generation I(eldest) to Generation III(oldest).

MATERIALS AND METHODS

The Study Population

This study focused on a group of *Darbhangia Khotta* Muslims residing in the Malda district of the State of West Bengal in India. The group migrated from the undivided Darbhanga district of the State of Bihar (India) approximately 400 years ago and still prefer to identify themselves as '*Darbhangia'* to uphold their native identity. The group, settled in twelve villages of Malda district, are collectively known as *'Bara Gaon Darbhangia Beradari* (twelve villages of Darbhanga migrated brothers)' named after the ancestral villages from where they had migrated (Table 1). These villages are located 20-34 kilometers away from the district headquarters, along the State Highway number 10. The Government of West Bengal categorizes this community under the 'Other Backward Classes' (OBC) as *Khotta Muslim*. Members of this community speak *Khotta* dialect, which is a blend of Hindi, Bhojpuri, Bengali, and Urdu.

For this study, only households belonging to *Darbhangia Khotta* Muslims were selected from all the twelve villages using proportionate stratified random sampling method. A total number of 537 households were sampled comprising of 736 ever-married women, who were then interviewed (Table 1).

Table 1: Distribution of the households in the villages and the sampled *Darbhangia Khotta* households

The Villages	*Total households*					
	Darbhangia Khotta households	*Momin households*	*Seikh households*	*Nadap households*	*Hindu households*	*Sampled Darbhangia Khotta households*
Chandipur	538	80	0	40	3	53(9.9)
Nathinagar	105	58	73	0	0	2(0.4)
Rajnagar	314	0	0	0	30	18(3.4)
Enayetpur	793	500	25	0	280	115(21.4)
Miragram	507	0	0	0	12	47(8.8)

Figures in parenthesis indicate percentage

The Villages	*Total households*					
	Darbhangia Khotta households	*Momin households*	*Seikh households*	*Nadap households*	*Hindu households*	*Sampled Darbhangia Khotta households*
Lakhkhipur	450	0	0	0	25	37(6.9)
Mohona	362	5	0	0	22	24(4.5)
Sheikhpura	865	0	0	25	11	137(25.5)
Modhupur	412	0	0	0	3	31(5.8)
Pirpur-dira	347	0	0	0	50	22(4.1)
Chandpur	347	0	0	0	50	22(4.1)
Shahebnagar	398	0	125	0	125	29(5.4)
Total	5438	*643*	*223*	*65*	*611*	537(100.0)

Figures in parenthesis indicate percentage

Data Types

Data on socioeconomic status includes household sizes, family types, group identity, education, occupation, and household and land assets, degree of media exposure and household expenditure. All the married women belonging to the selected households were interviewed for recording their marital status, age at marriage, marital distance, marital preference and types of marriage. We examined the consanguineous nature of marriage by probing whether the husbands of the respondents were biologically related to them before marriage; and, if so, what was the exact nature of the relationship. Data on group identity, assets, and household sizes were used in the qualitative analysis of how group identity, household size, and differential assets influence the mental attitudes of the married couples and their parents.

At the next stage, husbands of the respondents were identified who were uncles (paternal or maternal), accounting for a coefficient of inbreeding of F=0.125 in their progeny, along with occurrence of paternal or maternal first cousin (F=0.0625), and second-cousin (F=0.0156). The type of marriage has been categorized into groups, such as husbands related through blood (consanguineous marriage) and those not related (non-consanguineous marriage).

The generation length was estimated by the method introduced by Glass *et al.,* (1952), and followed by Srinivasan and Mukherjee (1976) and Mukherjee *et al.,* (2007). The average age at the first child birth for both women and men was determined. The average ages of both women and men were determined taking the weighted mean, and the generation length of 23 years has been identified. Three generations have been identified for the study, such as first generation length (Generation I) = 48 years and above, second generation length (Generation II) = 24years-47 years and third generation length (Generation III) =23 years and below.

To avoid the recall problem during the collection of data on age, age at marriage, age at first childbirth of the respondents, especially who were elderly, some reference points (historical, political and natural disaster) spread across the country were used. Pedigrees were drawn for each family to estimate the coefficient of inbreeding.

Variables

The primary outcome variable in the statistical analyses was the nature of marriage - consanguineous or non-consanguineous.

In this analysis, the variable generation length (i.e., variable Generation) was used to examine whether there were any changes in the likelihood of consanguineous marriage prevalence across generations. Other predictor variables likely to be associated with the marriage pattern of the respondents include types of family, educational attainments, working status, age at marriage, socio-economic status (Kuppuswamy index) (Kuppuswamy, 1981), media exposure and the amount of land acquired by the family (both residential and agricultural land) of the respondents. The type of family was classified either as nuclear family (parents, living with unmarried children) or joint family (parents with married children and other relatives). It has generally been realised that the educational level of the respondents significantly affects the marriage type. A person with higher education is likely to have more exposure to progressive or reformmative ideas than those with lower education level. Here, education was classified as primary, secondary, and higher education levels and working status of the respondents as non-working and working. Age at marriage of the respondents was categorized into two groups, i.e., married below 18 years and married 18 years and above. Socio-economic class of the respondents was determined by using Kuppuswamy socioeconomic status scale. This index uses education, occupation and family income per month. Degree of media exposure was obtained from the information provided by the respondents regarding regularly watching television/smart mobile/internet/newspaper reading and respondents having no such

exposure (media exposure was grouped into 'Yes' and 'No' categories). It is also well documented that access to the use of and exposure to general and content-specific media are strongly associated with socio-economic position (Viswanath, 2006; Jung, 2014). Property ownership, which also influences the prevalence of consanguineous marriage (Bittles, 1994), has been calculated from the household assets. Property ownership has been measured in 'katha' (1 katha =720 square feet) and used as a continuous variable in the study. Hierarchies in social identities in the form of group identity are integrally related to divergences in socio-economic status (Dasgupta *et al.,* 2022). Here, identity of group was identified as Darbhangia Khotta and Non-Darbhangia Khotta Muslim groups.

Statistical Analysis

Chi-square tests have been conducted to investigate the relationship between marriage patterns and background features of the respondents. Binary logistic regression was used to analyze the likelihood of consanguineous marriage across generations. In this analysis, consanguineous marriage was represented by '1' and non-consanguineous marriage was represented by '0'. Two models were used in the analysis. The first model examined generational changes in consanguineous marriage independently, while the second model included demographic and socioeconomic variables as predictors along generation length (Table 2).

Census and survey processing system (CSPro v6.3) was used for data entry during and after the completion of the fieldwork. STATA (v14) was used for the statistical analysis of the data.

Table 2: Models used in the binary logistic regression analysis

Model	Outcome variables	Predictor variables
Model 1	Type of marriage Consanguineous marriage (1) Non-consanguineous marriage (0)	Generation Length
Model 2	Types of marriage Consanguineous marriage (1) Non-consanguineous marriage (0)	Generation length, type of family, working status, education, age at marriage, socio-economic class (Kuppuswamy index), media exposure, Amount of land

Qualitative Analysis

In-depth semi-structured interviews and case studies were conducted among the participants to get insights about the perceptions and socio-cultural incentives of the community members. The schedules include open-ended questions that enable the participants to describe their viewpoints in the context of changing pattern of consanguineous marriage. This also includes such aspects such as partner choosing, situation before and after marrying cousins, and adjustments made. To understand these micro-changes, 25 in-depth interviews and 54 case studies were conducted among the respondents belonging to the three generations. It has been observed that persons living in any social environment try to find a structure of meaning behind their actions, and thus a phenomenological approach was considered for the analysis of the qualitative data (Giorgi, 2009).

Ethical Considerations

The research and all the questions asked during the fieldwork were approved by the Institutional Ethical Committee, University of Calcutta, Kolkata.

RESULTS

Background characteristics of the respondents

The median age and the median years of education of the respondents were 36 years and 8 years, respectively. The median age at first marriage was 17.0 years, and the average age at first child birth for females and males were 18.5 years and 27.5 years, respectively. Around 24.18 percent, 59.24 percent and 16.58 percent populations belong to Generation-I, Generation-II, and Generation-III respectively. More than fifty percent of the respondents belonged to nuclear family. More than sixty percent of the respondents got married before reaching 18 years of age (Table 3). The per capita expenditure was around 1670.0 INR. Majority of the respondents (56.93 percent) belonged to upper-lower class according to the Kuppuswamy socio-economic scale. Around 34.78 percent respondents were married to their blood relatives, and most of them (92.58 percent) were married to their first cousins.

Table 3: Characteristics of the Respondents.

Background characteristics	N=736
Current age (grouped into generation)	
Generation I(≥48years)	178(24.18)
Generation II(24-47years)	436(59.24)
Generation III(≤23years)	122(16.58)
Median age of the respondents (years)	36.0
Educational attainments	
Primary standard (below class 5)	232(31.52)
Secondary standard (class 6-12)	141(19.16)
Higher standard (graduate and above)	363(49.32)
Median years of schooling	Class 8
Types of family	
Nuclear family	382(51.90)
Joint family	354(48.10)
Median age at marriage	17.0 year
Respondents married before 18 years of age	463(62.91)
Per capita household expenditure (median) (INR)	1670.0
Respondents socio-economic scale class (Kuppuswamy Index)	
Lower class	127(17.26)
Upper lower class	419(56.93)
Middle class1	90(25.82)
Respondents who married to blood relatives	256(34.78)

Figures in parenthesis indicate percentage

Bivariate results showed significant successive decline of consanguineous marriage across generations (Generation I> Generation II>Generation III) (Table 4) (p=0.051). The prevalence of consanguineous marriage was the highest in Generation I, but lowest in Generation III. The same table showed the prevalence of consanguineous marriage as higher among the respondents who live in joint family compared to those living in other family set ups (p=0.169). The prevalence of consanguineous marriage differed between non-working and

working respondents; the respondents who attained higher levels of education show lower prevalence of consanguineous marriage (p=0.967). The practice of consanguineous marriage was slightly higher among the respondents who got married before reaching 18 years of age (36.93 percent) (p=0.111). Consanguineous marriage was found to be higher among those falling in lower per capital expenditure group (p=0.144) (Table 2).

Table 4: Bivariate results of consanguineous marriage by background characteristics.

Background characteristics	*Non- Consanguineous marriage*	*Consanguineous marriage*	*Total(N=736)*	χ^2, *p*
Generation				
Generation I	109(61.24)	69(38.76)	178 (100.00)	2.7443, p= 0.051
Generation II	285(65.37)	151(34.63)	436 (100.00)	
Generation III	86(70.49)	36(29.51)	122 (100.00)	
Types of family				1.8875, p= 0.169
Nuclear	258(67.54)	124(32.46)	382 (100.00)	
Joint	222(62.71)	132(37.29)	354 (100.00)	
Working status				0.0092, p=0.923
Non-working	287(65.08)	154(34.92)	441 (100.00)	
Working	193(65.42)	102(34.58)	295 (100.00)	
Education				0.0672, p=0.967
Primary	150(64.66)	82(35.34)	232 (100.00)	
Middle	93(65.96)	48(34.04)	141 (100.00)	
Higher	237(65.29)	126(34.71)	363 (100.00)	
Age at marriage				2.5446, p=0.111
Below 18 years	292(63.07)	171(36.93)	463 (100.00)	
18 and above	188(68.86)	85(31.14)	273 (100.00)	
Socio-economic class				
Lower	81(63.78)	46(36.22)	127 (100.00)	3.870, p= 0.144
Upper lower	264(63.01)	155(36.99)	419 (100.00)	
Middle	135(71.05)	55(28.95)	190 (100.00)	
Media exposure				
Yes	323(65.78)	168(34.22)	491 (100.00)	0.2088, p=0.648
No	157(64.08)	88(35.92)	245 (100.00)	
Total	480(65.22)	256(34.78)	736 (100.00)	

Figures in parenthesis indicate percentage

Results of the binary logistic regression (Table 5) showed that with increase in Generation length (I through III), the prevalence of consanguineous marriage did not decline automatically (Model I). But this variable became a significant predictor in the subsequent model (Model II), when demographic and socio-economic variables were included. The likelihood of consanguineous marriage was 0.62 times ($p<0.05$) less among the Generation III, compared to the Generation I. Results also showed that the respondents who got married after 18years of age were significantly 0.76 times ($p<0.05$) less likely to marry their cousins compared to those respondents who got married before 18 years of age. The respondents who belonged to a higher socio-economic class were 0.55 times ($p<0.05$) less likely to marry their cousins compared to those in the lower socio-economic class. Types of family, educational attainment, working status as well as media exposure were not significant predictors in the prevalence of consanguineous marriage.

Table 5: Logistic regression results of generational likelihood in consanguinity among the *Darbhangia Khotta* Muslim population of Malda, West Bengal.

Background Characteristics	**Consanguineous marriage**	
	OR(CI)	OR(CI)
Generation		
Generation I®	1.00	1.00
Generation II	0.84(0.58,1.20)	0.90(.61, 1.34)
Generation III	0 .66(0.40,1.08)	0.62*(.37,1.05)
Types of family		
Nuclear®		1.0
Joint		1.33(.95, 1.85)
Education		
Primary®		1.0
Secondary		1.20(.73, 1.99)
Higher		1.33(.84, 2.11)
Working status		
Non-working®		1.0
Working		1.13(.79, 1.65)
Age at marriage		
Below 18 years®		1.0
18 and above		0.76*(.55, 1.06)

Table 5 continued ....

Background Characteristics	Consanguineous marriage	
	OR(CI)	OR(CI)
Socio-economic class		
Lower ®		1.0
Upper lower		0.93(.57, 1.53)
Middle		0.55*(.29, 1.05)
Media exposure		
Yes®		1.0
No		1.05(.76, 1.46)
Amount of land		1.01(.99, 1.01)
Constant	0.63 (0.47,0.855)-	0.49(0.28,0.86)
Log likelihood	474.14057	-468.22055

®= Reference category;***p < 0.001; **p < 0.01; *p < 0.05; OR=Odds ratio; CI = Confidence interval; Base category = 'Non-consanguineous marriage'

Results of qualitative analysis (Socio-cultural incentives of generational change in consanguineous marriage)

Our qualitative data shed light on the reasons behind the decrease in consanguineous marriage across generations. Through interviews, we found that among those of Generation I, the decision to marry a cousin was largely made by their parents in accordance with culturally accepted normative practices. However, many of the respondents of Generation III questioned the tradition of cousin marriage. Analysis of these data cover the following themes:

Maintaining solidarity and peace in the family

The respondents were of the opinion that marrying cousins may help them to stay with the kin members (uncle's/aunt's home) with whom they are familiar, thereby reducing chances of worries and bickering in the nuptial life as well as with the in-laws. The respondents from Generation I pointed out that maintaining familial recognition and peace was one of the major reasons of marrying cousins. According to one female respondent of Generation I [Age-57year, married to cousin],

> *Knowing my in-laws before marriage brought contentment and much-needed familiarity among us before our marriage. Visiting my aunt's home frequently helped in removing any doubt that I had my mind about my new home. After 44 years of marriage to my cousin I still feel connected to my roots.*

Respondents of Generation III believed that they were not bound to agree with the thoughts and perceptions of the respondents belonging to Generation I. They were not ready to blame themselves for trifling reasons to maintain familial peace or community solidarity. One of them from Generation III [Age 23 years, married to non-cousin] opined that,

> *Both of us and our families are responsible for maintaining peace. If my in-laws are comfortable, peace will automatically come to the family, whether I am married to my cousin or not. It is not solely my responsibility.*

Being a migrant group, the elders of the population believed that sustaining the group identity would be challenging in the presence of other communities in the neighbourhood. Thus, marrying within the group was considered by them as the best approach, necessary to uphold their ethnic identity. A respondent of Generation I [Age-60 years; married to cousin] said,

> *I remember of being told by my elders that I'm betrothed to my cousin. My family insists that this is a good thing, as it means I won't have to move into someone else's home after marriage and the group solidarity will be maintained.*

Respondents of Generation II and Generation III did not prioritize maintaining social solidarity and identity for practicing consanguinity, unlike the respondents of Generation I. It was observed that many respondents of Generation III were comfortable in interacting with neighbouring groups, since their family members attended the same educational institutions, participated in each other's festive life, and shared the same workplaces with the other group members. One such respondent of Generation III [Age- 23 years; married to non-cousin] said,

> *I prioritize my career and personal happiness over marrying a blood relative for the sake of my community's well-being.*

The thought that cousin marriage helps in maintaining peace in the family was found to be not always true and many such marriages ended in separation. A respondent of Generation III [Age 22 years, married to cousin, separated later] sadly said,

> *I became a victim of domestic violence. My husband and his family members tortured me mentally and physically. So, I took divorce from my husband. My parents supported me at that time. What I believed to be a more secure form of marriage had turned out to be nightmarish experience.*

Changing temperament in decision making:

Being members of a patriarchal society, the respondents, mostly from Generation I and Generation II, were neither aware of nor had the right to express their opinion on marital decisions. One such respondent of Generation I [Age- 55 year; married to cousin] opined,

When I was 15, my father arranged my marriage with my cousin. Since many of my peers got married with their cousins, I agreed to it.

Decision making in fixing marital alliance was neither associated with occupation nor with education as was revealed by the respondents of Generation I. During the course of interview, many of the well educated and working respondents said that their parents and grandparents were the decision makers. A respondent of Generation I [Age 54 year; married to cousin] said,

People in the neighbourhood revered my grandfather and used to come to him, seeking advice and proper justice in settling any family and village level disputes. So, his position in the family and the society did not leave any scope for contesting his decisions. Naturally, I could not raise my voice against his decision to get me married to my cousin .

Similar was the situation with most of the respondents of Generation II. But some of them expressed their desire to give freedom to their children to choose their spouses from outside the group. For example, a respondent of Generation II [Age-38 years; married to cousin] confessed,

I had to marry my cousin since it was the decision of my grandfather. For me it was so absurd and claustrophobic that I struggled to adjust with this marriage during initial years. But I will give my daughter the freedom to choose her spouse.

The respondents of Generation III have more communication with the outer world. They were found to be more inclined in taking self-decision about their life and livelihood. A respondent of Generation III [Age 22 years; married to non-cousin] opined,

Although my aunt suggested me to marry my cousin, I respectfully declined as I knew that it was not a suitable option for me.

The waning popularity of consanguineous marriage has been found to have been influenced by the aspirations of the larger section of the community. Education and active participation in the labour force have led community members to interact more with the neighbouring groups. Those who have migrated to urban areas for higher education have been able to connect with open-minded peers, resulting in the cultivation of independent decision-making abilities. One such opinion comes from a respondent of Generation III [Age 23 year; married to non-cousin],

My father sent me to Kolkata for pursuing higher education. Living away from my family members and simultaneously finding company of a new set of peers in the hostel and college, my orientation towards life got changed. I created a new identity of my own, which was unacceptable to my family members.

Knowledge about social and legal sanctions regarding marriage

The awareness about the statutory age at marriage of this country, the right of an individual to choose marital partners and non-consensual marriage as an offence in the Indian Penal Code seems to be more pronounced among the respondents of Generation III compared to the preceding generations.

For example, a respondent of Generation I [Age-57years; married to cousin] explained,

> *In the past, marrying cousins was accepted. Nowadays, younger women have different ideas. If parents force them to marry a cousin, they may run away or seek help from legal authorities like the police. This was unheard of during our time.*

The respondents of Generation I and Generation II believed that going against the social norm was not a good idea. There was a fear of facing ostracism from the community. According to a respondent of Generation II [Age-41 years; married to cousin],

> *I was in love with a person belonging to another community since my school days. But when I saw a couple in my neighbourhood being ostracised by the community members for marrying outside the group, I became apprehensive to marry that person.*

It appears that the respondents of Generation III showed greater concern about marital decisions taken by the family members without their consent, unlike those of Generation I. One such opinion comes from a respondent of Generation III [Age- 23 years; married to non-cousin],

> *I told my parents not to force me in getting married at an early age and that too with a person of not my choice. I even threatened them that I would complain to the police if they impose their decisions on me. After a thorough discussion, we agreed that I'd get married at 21, but only to someone I approve of.*

Respondents of Generation I and Generation II were not ready to challenge the social sanctions and systems in operation. They follow the way their parents/grandparents/religious leaders taught them. They believed that marrying cousins will be a step to follow the footsteps of Prophet Muhammad (*Sunnah*) to enter into heaven (*Jannah*). For example, a respondent of Generation I [Age-52 years; married to cousin] expressed,

> *I learnt from the teachings of the Prophet Muhammad that one should never contradict parents. And marrying cousins was following the way our Prophet told us to do. I am just following him. I believe by so doing I will secure a place in Jannah.*

Respondents of Generation III also believed in the Prophet and his teachings, but simultaneously, they had alternative viewpoints regarding marriage with cousins. One of them from Generation III [Age-22 years; married to non-cousin] said,

> *The Prophet never said that one must marry a cousin. He said not to force anyone to do something which he/she did not like. I left home when my parents forced me to marry my cousin. As a consequence, they had to change their decision.*

Changing nature of marriage payment

The payment of dowry (bride price) and *denmohar* (a deposit paid by the groom's family for the wife's future security) are customary practices associated with consanguineous marriage. Over time, such practices have undergone a change in terms of its nature of implementation. For example, in case of respondents of Generation I, dowry was typically paid in the form agricultural land, cattle, and crafts, with little or no monetary exchange. In consanguineous marriages, the groom's family didn't see any need for *denmohar*, as they believed that the bride was actually returning to her own home (her uncle's or aunt's home). In recent years, there has been a rise in cases of divorce in the community. As a consequence, the brides' families are now demanding more amount of *denmohar* than earlier to ensure the financial security of their daughters. For example, a respondent of Generation I [Age-57 years, married to cousin] said,

> *During the preparations for my wedding, my prospective in-laws requested for a sizeable dowry of 40 acres of land and 10 heads of cattle. They were fully cognizant of the fact that my father's estate would ultimately be passed down to me, as the sole heir. In the same way, as a safeguard for my future, my father requested for a substantial amount of denmohar.*

Dowry demand in case of consanguineous marriage was very dishonourable. In contrast, dowry was highly demanded either in cash or kind in case of non-consanguineous marriage. It results into less interest among the groom's side to choose brides from relatives. A respondent of Generation I (Age-54years, married to cousin) said,

> *The situation has changed over the years. The value of money was not important during our time. And denmohar or dowry was not important in marrying cousins. Now I see demand of a high amount of dowry in every marriage.*

Cash is more valuable than land in the present society, so the parents of the respondents prioritize saving money over owning land, which might come to help during the daughter's marriage. One respondent of Generation II (Age-50 years, married to cousin) confessed,

> *We had to sell 350 bighas of ancestral land at a low price to meet the wedding expenses of our daughters and to pay the broker who had negotiated on behalf of our prospective son-in-law.*

Demand for money was found to be increasing day by day in case of dowry either for the settlement of a small business or for any other purpose. The parents of the prospective brides wondered what would happen to their daughters if the marriages end up in divorce. The demand for *denmohar* in terms of money was thus increased. In this situation, marrying non-cousins is found to be the suitable option. A respondent from Generation III [Age-22 years, married to non-cousin] said,

> *My father's friend proposed marriage between his son and me, but demanded money in exchange. My father accepted the arrangement, and the dowry payment helped my husband to secure a job as a school teacher. My husband's salary for the first five months has been deposited in the bank as denmohar.*

Changing family relations

Altering family structures and social practices may affect the concept of social cohesion. Among the respondents of Generation III, there are numerous instances of separation, leading to significant conflicts between the parents of the cousin couples. These situations tend to cast consanguineous marriages in a negative light, creating imbalances within the community. Most of Generation I respondents relied on their husbands and were unwilling to sever the relationship between the two families. A respondent [Generation I, Age 54 years, married to a cousin] elaborated,

> *Initially, I experienced difficulties in my marital life. However, I found solace in the support of my parents and uncles (father-in-law). This realization made me contemplate that seeking a divorce or severing the marital bond could potentially strain the relationship between our families. Thus, I decided to refrain from going for such actions.*

Respondents of Generation III were reluctant to marry cousins due to the increasing instances of separations and divorces in the community, especially in the case of cousin marriages. The separations caused by such marriages become a stigma for the recent generation and make them less interested in cousin marriage. One such opinion comes from the respondents of Generation III [Age 22 years, married to non-cousin],

> *In recent years, the increasing number of divorces in cousin marriages and the subsequent decline in family relations have deeply affected me. Two families were entirely devastated by such separations. If I were to marry my cousin and experience a similar outcome, I would not be able to forgive myself.*

DISCUSSION

We have found a significant decrease in the occurrence of consanguineous marriage among the study populations from Generation I to Generation III, spanning across three generations. The decrease in the prevalence (24.0%) is slightly higher than what is prevailing at the national level (16.0%) (Kalam *et al.,* 2021). In the present study, the main reasons behind the decline are attributed to a change in attitude towards marriage and an increase in self-reliance. This trend is also observed in some regional populations of India, such as the *Kamma* of Andhra Pradesh (Chandrasekar *et al.,* 1993). Our study supports an earlier research that suggests that an increase in the age at marriage changes in the nature of dowry (Bittles *et al.,* 1993), women's income strategy (Chandrasekar *et al.,* 1993), psychological discomfort in cousin couples (Rao *et al.,* 2009), all of which significantly contribute to the decline of consanguineous marriage among the studied groups.

In the Muslim community, marrying one's cousin is often seen as following the example set by the Prophet, known as the *Sunnah* (Bittles, 2012). As a result, many Muslims worldwide practice consanguineous marriage (Assaf and Khawaja, 2009; Sharma *et al.,* 2021) as a way of securing a place in *Jannah*. In this study, the participants were all followers of this tradition. However, there were differences in beliefs and practices between the older and younger generations. The respondents of older generation adhered more strictly to this tradition, while those representing the younger generation ware more influenced by modernization (Goode, 1963), with emphasis on greater freedom in mate selection. This changing prevalence of consanguinity aligns with Goode's proposed idea, which is also applicable in the situation prevailing in South Asia.

Studies have found that cousin marriage in Muslim communities can vary according to local culture and region of residence (Sharma *et al.,* 2021). The spread of Islam in India has led to the formation of various sects, which merge with local groups having their respective customs. Some Muslims in certain regions of India have adopted local practices not prescribed in Islam, such as the practice of applying vermillion on their foreheads (Singh, 2019). During the initial period of migration, consanguineous marriage was found a necessary step for the survival of this numerically minority population in their new settlement area. Today, however, the situation is different. As mentioned earlier, younger generations tend to assume greater freedom in mate selection, which may often be attributed to modernization (Goode, 1963) leading to a decline in

the prevalence of consanguineous marriages. However, it still provides opportunities for cultural transmission and continuity (Sandridge *et al.,* 2010).

Studies have shown that increasing women's education levels, raising the age of marriage, and improving socioeconomic status can help reduce the prevalence of consanguineous marriages (Sahoo *et al.,* 2021; Islam, 2018; Kelmemi *et al.,* 2015; Shenk *et al.,* 2016; Kalam *et al.,* 2021). Our research confirms that those who belong to a higher socioeconomic class and marry at a later age are significantly less likely to practice consanguineous marriage, regardless of their educational attainment. However, contrary to previous studies (Sahoo *et al.,* 2021), education was not found to be a significant predictor in the declining trend of consanguineous marriage among our study population, just as it was not an indicator of higher socioeconomic status.

Property inheritance can have a significant impact on the prevalence of consanguineous marriage (Bittles *et al.,* 1993). However, our research shows that having property in the family did not affect the prevalence of cousin marriages that could be statistically significant. Nonetheless, socio-cultural incentives imply that property ownership might still have some impact on the prevalence of consanguineous marriage. 'Socio-cultural incentives' mean socio-cultural stimulus of the community, such as projecting a positive social image and reputation, gaining social acceptance, and gaining a better place in the social hierarchy depending on wealth, property, and status. The respondents, especially from the Generation I believed that they must maintain social prestige by continuing to retain their social status and performing the normative role, and accordingly, marrying cousins may be viewed to be helpful in strengthening their families' prestige and status. The respondents of Generation III believed otherwise. To them, changing socio-cultural incentives only signified change from social prestige to gain in economic status. The question is whether social prestige be delinked from economic status in all situations. The research focused on migrants whose beliefs about consanguineous marriage were influenced by the teachings of the Prophet. Traditionally, such marriages were thought to promote compatibility, economic benefits, female autonomy, reduced domestic violence, lower divorce rates, and fewer unknown risks (Bhinder *et al.,* 2019; Kalam and Roy, 2014; Assaf and Khawaja, 2009). However, findings suggest that beliefs held earlier have been changing due to increased exposure to different cultures in a plural situation. Our study included respondents primarily from Generation II and Generation III, who have had more exposure to the outside world and who have been progressively more empowered by the contemporary socio-political developments.

The reduction in consanguineous marriage within the study population can be attributed to changing socio-political conditions and regional influences. In order to address these challenges and strengthen community bondage, the migrant *Darbhangia Khotta* Muslims, who are numerically minor in this region, practises community endogamy in a manner which corroborates with earlier studies (Cerroni-Long, 1985; Bhinder *et al.,* 2019). Nevertheless, as the population has been subjected to greater political engagement and awareness, women have become increasingly empowered and better informed, resulting in a decline in consanguineous unions. Studies (Dasgupta *et al.,* 2022) have observed that increased education and exposure to media significantly empower the population, especially the women. As a consequence, the younger generation, in particular, is more attuned to their freedom to select their own life partners, compared to their elders.

It has been observed that the majority of the decisions regarding cousin marriage were made by parents, corroborating to another study (Hussain, 1999). However, in recent decades, there has been a shift in decision-making process, as children's opinions are also being considered. Generation III individuals may now claim more control over their own marriage decisions due to increased knowledge of the legal provisions and focusing more on career prospects. Parents are also becoming more aware of the importance of their children to make their own decisions about their future. Studies have shown that an increase in women's social status, educational achievements, workforce participation, and economic contribution can lead to greater freedom in choosing a partner and the age at which to get married (Dyson and Moore, 1983; Givens and Hirschman, 1994; Rao *et al.,* 2009). Studies (Kalam *et al.,* 2021; Bittles, 2012; Hussain and Bittles, 1998) have shown that a higher age at marriage results in a decrease in the occurrence of consanguineous marriages, which has also been confirmed by this study. The study has revealed that those who marry at an older age are more likely to make their own decisions of not marrying a cousin.

Marriage payments, including dowry, bride wealth, and *denmohar* significantly impact the modalities of the marriage pattern, more so in the case of consanguineous marriages. Low dowry payments make these marriages economically viable (Bittles *et al.,* 1993). Among the study population it has been observed that among early generations there was a practice of payment of dowry and *denmohar* in the form of land and/or livestock. Among the younger generation of people, in contrast, there has been an increasing demand of dowry and *denmohar* in terms of cash; this is not encouraged in consanguineous marriage. Consequently, there has been

a growing trend in the increase of non-consanguineous marriages among younger generations. In recent decades, women have been actively participating in wage earning, entrepreneurship, and in the field of national development (Datta and Gailey, 2012). Goode (1963) predicted that with increasing modernization and social development, the prevalence of consanguineous marriages will decrease, particularly among the younger generation, who are economically independent and which has also been confirmed by the study. The phenomenon of globalization has brought about a notable shift in the matrimonial landscape, with a decline in the prevalence of arranged marriages and a rise in marriages based on personal preferences. In particular, Indian women, who are active in entrepreneurship and national development activities, are increasingly opting for marriages of their choice (Chatterjee and Ramu, 2018). Similar were the findings of Goode (1963).

CONCLUSION

Much in line with Bayakara-Krumme (2016), the present research also finds a decline in the prevalence of marriages within close biological relatives with increasing autonomy of women in the wage-earning sector and growing modernization of societies.

The study suggests that the decrease in consanguineous marriage among the *Darbhangia Khotta* Muslim population is not simply due to demographic and socioeconomic factors, but transformation in social and cultural belief system also plays a significant role in this decline. Globalization has impacted the recent generations to the extent that they are now not ready to get married to their cousins. Nevertheless, further investigation is required to gain a better understanding of the community perspective, more particularly, the intricacies of the changing male perception about consanguineous marriage, at times with contradictory revelations.

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CONFLICTS OF INTEREST

The authors of this paper do not have any conflicts of interest.

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The dual narratives of Indian cinema: Glorified smugglers and the silence on India's deforestation crisis

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KEYWORDS

Deforestation, Cinema, Environmental Ethics, Forest Movements, Matha, West Bengal

ABSTRACT

This paper examines the contradictions between popular cinematic narratives and ecological realities in India, focusing on recent films such as Pushpa. *The film's protagonist – a wood smuggler turned community saviour – is depicted with empathy and heroism, despite his involvement in the illegal trade of* Lal Chandan *(Red Sandalwood). While such portrayals resonate with audiences and achieve commercial success, they risk romanticising deforestation and normalising environmental exploitation. Drawing on ethnographic observation in the Matha Hill range of Purulia, the study documents rapid, infrastructure-driven deforestation in the name of development. Cement constructions, including staircases cutting through forested hills, have displaced wildlife and disregarded local ecological knowledge. Selective enforcement of environmental laws continues to penalise marginalised communities while enabling elites. The study concludes that cinema must play a more responsible role in shaping environmental values, and calls for stronger policy enforcement, increased public awareness, and equitable governance to address India's escalating deforestation crisis.*

'একটি গাছ, একটি প্রাণ'/ 'গাছ লাগান, প্রাণ বাঁচান'

'One tree, one life'/ 'Plant trees, save lives'

Background

The Indian film industry, often regarded as a reflection of society, has once again attracted widespread attention with the release of *Pushpa 2*, the sequel to the highly acclaimed *Pushpa 1*. Although the film has achieved significant commercial success both in India and abroad, it presents a troubling paradox: the glorification of illicit activities such as the smuggling of *Lal Chandan* (Red Sandalwood)—a rare and highly valuable tree species– at a time when India is grappling with increasing concerns over deforestation. The central character, a smuggler who rises from a humble labourer to the leader of a powerful syndicate, has captured the imagination of audiences. His stylised dialogues, charismatic presence, and emotional attachment to his family have elevated him to heroic status among the contemporary generation. Yet, this empathetically portrayed anti-hero raises a pressing question: does such cinematic representation inadvertently legitimise environmental exploitation under the guise of entertainment?

A recent ethnographic fieldwork visit to the Matha Hill range in Purulia highlights a similar tension between development and ecological preservation. The region has experienced rapid infrastructural expansion, marked by the construction of numerous hotels, restaurants, and recreational facilities,

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including swimming pools, adjacent to the hill range. These large-scale cement structures, primarily intended for leisure and tourism, have come at a significant ecological cost. Thousands of trees have been felled to make way for roads and buildings, resulting in extensive deforestation under the pretext of development. A brick-and-cement staircase constructed through the middle of the forest, leading to the top of the hill, has significantly jeopardised the habitat and movement of forest-dwelling animals. According to local residents, there was no genuine necessity for such a structure; its construction was primarily intended to accommodate and attract tourists. This intervention reflects a broader pattern of development that prioritises short-term economic gains over long-term ecological sustainability and local ecological knowledge.

India's environmental history offers several instructive precedents for forest conservation, often marked by acts of collective resistance. Movements such as the Bishnoi resistance in the 1700s, the *Chipko Movement* (1973), the *Silent Valley Movement* (1978), and the *Appiko Movement* (1983) have underscored the socio-cultural and ecological significance of forests. These movements were often met with violent suppression, including killings by royal soldiers or state police, highlighting the high stakes of environmental advocacy. However, in recent years, large-scale protests against deforestation have become increasingly rare.

In films such as *Pushpa 1* and *Pushpa 2*, the character of the impoverished labourer-turned-wood smuggler is portrayed as a protector of his community, endowed with a grandiose personality and acts of compassion that foster audience empathy. While these portrayals provide narrative depth and social resonance, they also obscure the severe ecological consequences of unregulated forest exploitation. Such cinematic frameworks raise important ethical considerations. Although films often reflect socio-political realities, they also have the power to shape public perception, potentially distorting moral boundaries. The romanticisation of such figures risks normalising illegal deforestation, as audiences may become emotionally invested in the character's journey without fully recognising the environmental destruction it entails.

The situation in the forested Matha region of Purulia further highlights this shift. Field observations reveal the absence of any prominent local figure actively advocating for forest protection or the rights of indigenous communities. Residents are subject to stringent restrictions, with even the collection of small bundles of firewood for cooking criminalised, often under threat of physical violence or arrest. In stark contrast, individuals with connections to bureaucratic or governmental entities appear to have unfettered access to forest resources. This disparity reveals the structural inequalities that govern resource access and environmental governance, further disenfranchising already marginalised communities.

Both cinematic narratives and real-world developments reveal a troubling gap between environmental ideals and socio-political realities. As popular culture shapes public consciousness, it is essential to critically examine the ethical implications of glorifying characters whose actions, however complex or sympathetic, are based on ecological harm.

The alarming state of deforestation in India

The concern over deforestation is not merely a theoretical discussion– it is a pressing environmental crisis. According to *Global Forest Watch* (2024), India lost approximately 2.33 million hectares of tree cover between 2000 and 2023, accounting for nearly 6% of the country's forest area. The situation became especially grim between 2015 and 2020, when the annual deforestation rate rose to 668,400 hectares, making India the second-highest contributor to global deforestation during that period, after Brazil (Jha, 2023). The primary drivers of this deforestation are infrastructure development, mining, and agricultural expansion, particularly for oil seed cultivation. Notably, while countries such as Brazil and Indonesia have reduced deforestation rates, India's forest loss has increased, highlighting the need for more effective forest conservation strategies. This loss of tree cover has significant consequences, as forests play a crucial role in maintaining ecological balance, conserving biodiversity, and combating

climate change (Aggarwal and Tiwari, 2023; Mahesh, 2023).

The National Green Tribunal (NGT), recognising the severity of this issue, recently issued a notice to the Indian government regarding the alarming loss of tree cover. Northeast India, particularly Assam, has been affected the most, with the state losing 324,000 hectares of forest over the past two decades. The destruction of primary humid forests, which are home to countless species of flora and fauna, underscores the urgent need for action. Other regions, such as Hasdeo Jungle, are experiencing similar patterns of destruction, driven by development projects and illegal activities.

Despite the existence of numerous environmental laws and regulations, effective implementation remains elusive. While policies often target poor tribal communities for their small-scale forest activities, large-scale smugglers and syndicates continue to operate with impunity. This double standard highlights the need for greater accountability and stricter enforcement of environmental laws.

Cinema's role in shaping perceptions

Cinema holds immense power to influence public opinion. Films are not merely a source of entertainment– they shape values, perceptions, and behaviours. Scenes from select films such as *Kantara* and *Kadvi Hawa* compellingly depict the urgent need for environmental protection and the deep interconnection between human lives and ecological balance. These narratives highlight themes such as forest conservation, climate change, and the struggles of indigenous communities. However, despite their powerful messages, such films have not received widespread recognition or resonance at the pan-Indian level. Their limited reach and relatively niche audience hinder the broader national discourse on environmental justice that they seek to initiate. In contrast, films like *Pushpa 1* and *Pushpa 2* portray a smuggler as a hero with emotional depth, risking the normalisation and even glorification of illegal activities such as deforestation, and receive global acclaim. Audiences may inadvertently sympathise with such characters, overlooking the environmental consequences of their actions. This creates a dangerous disconnect: while society acknowledges the importance of forests, it simultaneously celebrates the destruction of these very resources on the big screen.

Historically, cinema has been a platform for raising awareness about social and environmental issues. For example, the *Chipko Movement*, led by villagers in the 1970s, highlighted the value of trees and forests in India. This grassroots initiative inspired an entire generation to take a stand against deforestation. Unfortunately, the current generation rarely sees such movements or values depicted in mainstream cinema. Instead, films often focus on narratives that prioritise profit and entertainment over responsibility.

The need for awareness and action

At a time when India faces unprecedented environmental challenges, public awareness is more crucial than ever. Films that glamorise environmental destruction may inadvertently undermine efforts to combat deforestation. While art does reflect life, the reverse can also occur: life may begin to imitate art. Audiences, particularly younger generations, are strongly influenced by what they see on screen. Rather than glorifying characters who destroy natural resources, filmmakers have a unique opportunity to create stories that inspire environmental stewardship and sustainable living.

In early April 2025, students from the University of Hyderabad (UoH) led local protests against the Telangana government's plan to clear approximately 400 acres of green cover in Kancha Gachibowli for IT infrastructure development. Although the protests did not attract widespread national attention, the Supreme Court intervened by taking suo motu cognisance of the deforestation issue (ELD, 2025). The Court ordered an immediate halt to all tree-felling activities and directed the Telangana High Court Registrar (Judicial) to inspect the site and submit a report. The Registrar's findings highlighted significant ecological concerns, including the presence of wildlife and a nearby lake, prompting the Court

to question the urgency and legality of the development activities. The Supreme Court's intervention effectively paused the deforestation, underscoring the impact of local student activism in prompting judicial review and environmental protection measures.

The responsibility, however, does not rest solely with filmmakers. We, as citizens, must also engage critically with the content we consume. Deforestation is not just an environmental issue; it is a crisis that affects our air, water, climate, and livelihoods. The government must also move beyond rhetoric and take decisive action to curb illegal activities and implement policies that prioritise forest conservation. Planting saplings alone will not compensate for the loss of ancient forests– we need stringent measures to protect existing green cover.

Conclusion

The success of films like *Pushpa 2* is a testament to the power of cinema in shaping cultural narratives. However, it also serves as a wake-up call to examine the messages we celebrate. At a time when deforestation rates are soaring and environmental crises are escalating, glorifying activities such as smuggling sends the wrong message to society. Forests are not merely resources to be exploited– they are essential to our survival and well-being. It is time for filmmakers, policymakers, and citizens to unite in promoting narratives that value sustainability and environmental protection. As a nation, we must move beyond discussion and take meaningful action to preserve our forests for future generations.

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Rural–urban differentials in selection intensity: Insights from fertility and mortality indicators in Howrah district of West Bengal

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KEYWORDS

Selection intensity, Fertility, Mortality, Rural, Urban, Differential, West Bengal, India

ABSTRACT

Darwinian principles of natural selection highlight fertility and mortality differentials as key drivers of evolutionary change. Quantifying these pressures with demographic selection indices provides insight into how health disparities shape evolutionary dynamics in human populations. This study examines rural–urban differences in the intensity of natural selection in Howrah district, West Bengal, using Crow's Index and the Johnston and Kensinger Index. A cross-sectional ethnographic field study was conducted among 665 ever-married women, randomly sampled from both rural and urban areas. For analysis, reproductive and mortality data from women aged 45 years and older were evaluated (rural: 113; urban: 169). The results show that rural populations experience stronger evolutionary pressures, primarily due to higher mortality rates and greater fertility variance. These differences reflect the impact of socioeconomic inequality, unequal access to healthcare, and environmental conditions on demographic and evolutionary processes. The study highlights the usefulness of demographic selection indices in assessing health inequalities and evolutionary dynamics in contemporary populations.

Introduction

The theory of natural selection, as conceptualized by Darwin (1859), highlights differences in demographic behavior and survival as mechanisms driving evolutionary change. In human populations, this selection is shaped by fertility and mortality rates that reflect socioeconomic, environmental, and cultural factors (Fisher 1930; Crow 1958). To quantify these pressures, Crow's Index of opportunity for natural selection and its modification by Johnston and Kensinger (1971) provide demographic tools to estimate the maximum potential for natural selection through variance in reproductive success and survival to reproductive age.

India, with its significant rural-urban divide, provides an ideal setting to examine the effects of modernization, healthcare access, and fertility behavior on selection intensity. Urban populations benefit from improved medical infrastructure and family planning services, while rural communities often continue to experience higher rates of mortality and fertility. These differences are captured through selection indices, which distinguish between fertility- and mortality-based components of natural selection. The literature consistently affirms these patterns across India. For example, a study among the Kshatriyas of Andhra Pradesh observed greater selection intensity in rural areas, with higher

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mortality contributions attributed to inadequate health services (Dharani Priya *et al*. 2003). Similarly, the Bhuiyan tribe of Odisha exhibited a high total selection index, with mortality far outweighing fertility as the main driver, illustrating the selection burden in socio-economically disadvantaged tribal groups (Kuiti and Bose 2014). Notably, even among coastal populations– typically exposed to climatic vulnerabilities– the role of mortality in determining selection potential has become increasingly dominant. Kapoor *et al*. (2012) found that after 1991, the contribution of mortality to total selection intensity in coastal groups reached 92.5%, significantly higher than in non-coastal populations (56.4%). This trend reflects a broader epidemiological transition in which survival-related disparities remain more persistent in rural and hazard-prone areas. Regional studies echo this divergence; for example, among the Gowdas of Karnataka, the fertility component was found to dominate due to better living conditions and healthcare, resulting in moderate total selection intensity (Sohkhlet 2013). In contrast, studies among tribal populations in Odisha and Andhra Pradesh highlight high child and embryonic mortality, linking poor sanitation, inadequate prenatal care, and lack of education to elevated mortality indices (Kapoor *et al*. 2012; Kuiti and Bose 2014).

Such patterns are not merely demographic observations but also provide insight into the evolutionary pressures and genetic structuring within these populations. Populations under higher selection intensity may experience stronger directional shifts in gene frequencies over time. The rural-urban gap in selection potential suggests differential exposure to evolutionary pressures, which could result in varying health outcomes, adaptive capacities, and reproductive strategies.

Furthermore, the comparative utility of Crow's Index and Johnston and Kensinger's Index provides nuanced insight. While Crow's Index (1958) reflects postnatal mortality, Johnston and Kensinger's method (1971) includes prenatal losses, offering a more comprehensive picture in populations where embryonic loss is substantial (Gautam 2009; Kapoor *et al*. 2012). However, the inclusion of prenatal deaths is subject to underreporting, especially in rural or less literate groups, which may underestimate the true selection burden (Dharani Priya *et al*. 2003).

Under these circumstances, the rural–urban differentials in selection intensity highlight the complex interplay between demographic behavior, public health systems, and socioeconomic development. This underscores the need to interpret evolutionary indicators through the lens of environmental and structural inequalities. The present study aims to investigate the rural–urban differentials in the intensity of natural selection among Indian populations using demographic indicators.

Materials and Methods

Study participants and data collection

This cross-sectional ethnographic study was conducted using random sampling among ever-married women in both urban and rural areas of Howrah district, West Bengal, India. A total of 695 women were approached, of whom 665 agreed to answer all questions and were included in the final analysis. Anthropologically trained fieldworkers conducted house-to-house visits to interview eligible women.

Data were collected from different wards of the Howrah Municipal Corporation to represent the urban population and from the community development blocks of Uluberia to represent the rural population. Only one female participant was selected from each household. Data were collected using a pre-designed and pre-tested household schedule through face-to-face interviews. Fertility and mortality data were collected using the household census method. Fertility data included the number of children per mother, while mortality data covered both prenatal and postnatal deaths up to the age of 15 years, which marks the onset of reproductive age. Detailed demographic data for rural and urban populations were collected. For the present study, women above 45 years of age were separated from the complete data set, as they had completed their reproductive behavior (i.e., ≥45 years), which included 113 rural and

169 urban women, bringing the total sample size to 282. The data were analyzed using STATA software to calculate the selection intensity index. Several critical metrics related to reproduction and mortality were evaluated to assess the strength of natural selection operating within these two populations.

Calculating selection intensity index

The selection intensity index (It) and its fertility (If) and mortality (Im) components were calculated using Crow's formula (1958) and the Johnston and Kensinger formula (1971).

Crow's formula (1958)

I = Im + (If/Ps), where Im = Pd/Ps, If = Vf/(X)^2, Ps = (1 − Pd)

where It is the selection intensity index; Im is the index of selection due to mortality; If is the index of selection due to fertility; Ps is the probability of survival up to reproductive age; Pd is the probability of death before reproductive age (i.e., before 15 years); Vf is the variance in the number of live births due to fertility; and X is the mean number of live births per woman of completed fertility (i.e., age ≥ 40 years).

Johnston and Kensinger formula (1971)

I = Ime + Imc / Pb + If / (Pb × Ps), where Ime = (Ped / Pb), Pb = (1 – Ped), Imc = (Pd / Ps), Ps = (1 – Pd), and If = (Vf / X^2),

where It = selection intensity index, Ime = index of total selection due to prenatal mortality, Ped = probability of dying before birth, Pb = probability of surviving until birth, Imc = index of total selection due to postnatal mortality, Pd = probability of dying before reaching reproductive age (i.e., before 15 years), Ps = probability of surviving until reproductive age, If = index of total selection due to fertility, Vf = variance due to fertility, and X = mean number of live births per woman.

Results

Differentials in Fertility and mortality components

Table 1 presents the reproductive performance of the participants. Urban women gave birth to more children (mean live births per mother = 1.88) than rural women (1.68). However, despite the lower average, rural women showed greater variability in fertility, as indicated by the higher variance of live births (Vf = 0.69 for rural vs. 0.62 for urban). This greater variation in rural fertility results in a higher fertility-based selection index (If = 0.245 for rural vs. 0.175 for urban), indicating that reproductive differential is more pronounced in rural areas. The proportion of children dying before age 15 (Pd) is notably higher in rural areas (0.136) compared to urban areas (0.112). Consequently, the proportion surviving to age 15 (Ps) is slightly lower in rural regions (0.864) than in urban areas (0.888). Prenatal mortality is also marginally higher in rural areas, with a prenatal death proportion (Ped) of 0.059 compared to 0.048 in urban areas, resulting in slightly lower survival to birth (Pb) in rural settings (0.941 vs. 0.952).

Differentials in the index

These figures are synthesized into multiple selection indices that quantify total selection intensity from both fertility and mortality. The Index of Prenatal Mortality (Ime) is higher in rural areas (0.068) than in urban areas (0.054), as is the Index due to Childhood Mortality (Imc) (0.136 rural vs. 0.112 urban). The mortality component of selection (Im), calculated as the ratio of the proportion dying to the proportion surviving (Pd/Ps), is also higher in rural areas (0.157) than in urban areas (0.126). When these fertility and mortality indices are combined, they yield Crow's Index of Natural Selection (It), which is significantly greater in rural areas (0.441) than in urban areas (0.323). This indicates that the net effect of differential fertility and mortality is more intense in rural settings.

The Johnston and Kensinger Index (1971), a more comprehensive measure that accounts for prenatal

mortality, childhood mortality, and fertility relative to birth and survival proportions, reinforces this conclusion. The index is much higher in rural areas (0.581) compared to urban areas (0.379), indicating stronger selection pressure on the rural population.

Statistical analysis supports the significance of these differences. The z-test for the proportion difference in the rural–urban comparison yields a p-value of 0.003, confirming that the observed variations are not due to random chance but reflect meaningful differences in demographic and evolutionary dynamics.

Discussion

The comparative analysis of rural and urban populations using the Selection Intensity Index (SII) reveals significant demographic and evolutionary differences. The findings indicate that rural populations still face higher selective pressure, mainly due to higher mortality rates and slightly greater fertility variance. This aligns with patterns observed in various Indian caste and tribal groups in previous studies.

Fertility and Its Contribution to Selection Intensity

In the current study, rural women had a lower average number of live births (1.68) than urban women (1.88), yet showed a higher variance in fertility (0.69 vs. 0.62). This led to a greater fertility-based selection index (If) in rural areas (0.245) compared to urban areas (0.175). These trends suggest that while fertility rates are declining uniformly, variance in reproductive success remains more pronounced in rural areas, possibly due to differences in access to family planning, education, and reproductive healthcare. Comparable findings were reported among rural Kshatriya women in Andhra Pradesh, where the variance in live births exceeded that of their urban counterparts, resulting in a higher fertility component in the rural sample (Dharani Priya *et al*. 2003). Similar results were observed among the Bhuiyans of Odisha, where, despite a moderate average number of children, the fertility component contributed significantly to the total selection index (If = 0.190), indicating heterogeneity in reproductive behavior (Kuiti and Bose 2014). These findings are consistent with earlier reports by Kapoor *et al*. (2012), who showed that fertility differentials continued to play a meaningful role in selection intensity in both coastal and tribal communities, although this influence has declined due to improved access to contraceptives and increased literacy.

Mortality and its dominant role selection intensity

The mortality-based selection component (Im) in rural populations was higher than in urban areas, accounting for approximately 44% of the total selection intensity compared to 35% in urban areas. The rural sample had higher proportions of both prenatal and childhood mortality. The total Crow's Index was significantly higher in the rural group (0.441) than in the urban group (0.323), and the same pattern was observed for Johnston and Kensinger's Index (0.581 rural vs. 0.379 urban), indicating significant mortality-driven selection. Similar findings were reported from coastal and tribal communities, such as the Jalari and Vadabalija of Orissa, where high child loss (up to 16.25%) and embryonic loss (8.46%) produced total selection intensities ranging from 0.221 to 0.417 (Kapoor *et al*. 2012). Among these communities, regression analysis confirmed that mortality contributed more than 90% to total selection pressure– a trend also seen in our rural dataset. Among the Gowdas of Karnataka, relatively lower mortality and improved healthcare access resulted in a dominant fertility component and moderate selection intensity, demonstrating how mortality reduction reshapes evolutionary pressures in transitioning populations (Sohkhlet 2013). A comparative account of the selection intensity index is presented in Table 3.

Significance of Crow vs. Johnston and Kensinger Indices

The comparative use of Crow's and Johnston and Kensinger's indices in this study revealed a consistent pattern: Johnston and Kensinger's index yielded higher total selection intensity in both rural and urban groups because it includes embryonic mortality. The rural-urban gap widened further when

embryonic loss was considered, reaffirming the vulnerability of rural women to poor antenatal care and unrecorded fetal loss. This methodological distinction has been discussed extensively in the literature. Kapoor and Gautam (2012) cautioned that although Johnston and Kensinger's index is theoretically more comprehensive, it may be affected by underreporting of prenatal loss, especially in rural, illiterate, or tribal settings. Dharani Priya *et al*. (2003) also observed that embryonic deaths were more accurately reported in urban areas, possibly inflating urban selection indices slightly, while rural underreporting may result in underestimation of actual selection pressures.

The rural-urban difference in total selection intensity ($p = 0.003$) is statistically significant, reinforcing demographic evidence of uneven evolutionary pressure between these groups. While rural communities remain burdened by preventable mortality, urban populations are increasingly shaped by differential fertility. This shift parallels observations in other Indian populations undergoing socioeconomic transition, as described by Kapoor *et al*. (2012) and Gautam (2009).

Moreover, the total selection index values in this study ($It = 0.441$ rural; 0.323 urban) fall within the moderate range identified in broader Indian studies, where average values typically range from 0.2 to 0.7 (Reddy and Chopra 2010). However, the rural values are approaching the upper bound, indicating stronger selection pressure and reduced buffering against evolutionary change.

Demographic and Socio-economic Correlates

Underlying these demographic patterns are economic and healthcare-related factors. In rural areas, limited access to healthcare facilities, institutional births, sanitation, immunization, and antenatal care contributes to higher child and embryonic mortality. Table 2 also shows that female age at marriage, per capita monthly expenditure, institutional delivery, and female education are significantly higher in urban areas. Traditional reproductive behaviors, such as early marriage and lack of contraception, may further exacerbate fertility variance among rural women. These findings are consistent with studies on the Bhuiyans, Jalaris, and other backward caste and tribal groups (Kuiti and Bose 2014; Kapoor *et al*. 2012). Conversely, urban populations benefit from improved healthcare services, family planning awareness, and social mobility, leading to more homogeneous reproductive patterns and lower selection intensity. However, urban fertility variance, though lower, still contributes meaningfully to total selection intensity, indicating that modernization does not entirely eliminate selection pressures– it merely transforms them.

Conclusion

The present study highlights a clear rural–urban disparity in selection intensity among ever-married women in Howrah, West Bengal. Using Crow's (1958) and Johnston and Kensinger's (1971) indices, the study found that rural populations experience stronger evolutionary pressures, primarily due to higher rates of prenatal and childhood mortality and greater variability in reproductive outcomes. These findings confirm that, despite demographic transitions and declining fertility, rural populations remain vulnerable to higher biological selection intensity, driven by socio-economic disadvantage and limited access to healthcare and reproductive services. The use of both selection indices demonstrates the importance of including both fertility and mortality dimensions– especially prenatal mortality– to comprehensively assess evolutionary dynamics in human populations. The significant statistical difference observed between rural and urban groups further supports the influence of environmental and structural inequalities on demographic patterns.

Future Directions

Given the potential underreporting of prenatal deaths and the cross-sectional limitations of current data, future research should adopt a more comprehensive approach. This should include longitudinal and cohort-based studies to more accurately trace reproductive histories, survival outcomes, and

intergenerational changes. Integrating qualitative and ethnographic methods would help illuminate local understandings of reproductive loss, health-seeking behaviors, and fertility decision-making, particularly in rural and tribal communities. Incorporating nutritional, economic, and educational indicators is also crucial, as these factors likely influence both fertility behavior and child survival. Comparative studies across regions and ethnic groups in India are necessary to capture the diversity of reproductive strategies within different ecological and cultural contexts. Finally, genomic and epigenetic research can provide valuable insights into the biological dimensions of demographic patterns, contributing to a more nuanced evolutionary understanding of human populations shaped by distinct selection pressures.

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Tables

Table 1: The components of selection intensity index

Selection components	Rural	Urban	Total
Demographic metrics			
Women aged 45+	113	169	282
Reported pregnancies	220	357	577
Live births	190	317	507
Premature deaths (<15 yrs)	09	10	19
Childhood deaths (<5 yrs)	08	13	21
Prenatal deaths	13	17	30
Reproductive and mortality parameter			
Mean live births per mother (X)	1.68	1.88	1.80
Variance of live births (Vf)	0.69	0.62	0.65
Proportion dying <15 yrs (Pd)	0.136	0.112	0.121
Proportion of Survival to age 15 year (Ps=1-Pd)	0.864	0.888	0.879
Proportion of Prenatal death (Ped)	0.059	0.048	0.052
Proportion Survival to birth (Pb)	0.941	0.952	0.948
Index of natural selection			
Index of prenatal mortality(Ime=Ped/Pb)	0.068	0.054	0.059
Index due to Childhood mortality(Imc)	0.136	0.112	0.121
Index of fertility(If =Vf/X2)	0.245	0.175	0.201
Index of mortality(Im =Pd/Ps)	0.157	0.126	0.138
Crow's Index [It =Im +If/Ps]	0.441	0.323	0.367
Johnston and Kensinger's Index (1971) =[I= Ime+ Imc/Pb + If/ (Pb ×Ps)]	0.581	0.379	0.438

Rural-urban difference p value (z-test) =0.003

Table 2: Characteristics of the respondents by place of residence

Background Characteristics	Rural	Urban	Total	Chi²-test
Age at marriage				
Mean age at first marriage	17.18±5.2	22.28±3.78	19.28±3.33 (t= -3.0424, p=0.026)	
Percapita expenditure				10.6337 p = 0.005
Bottom	42(37.17)	54(31.95)	96 (34.04)	
Middle	53(46.90)	59(34.91)	112 (39.72)	
Upper	18(15.93)	56(33.14)	74 (26.24)	
Median per capita expenditure	3443.0	4482.0		
Media exp				0.5312 p = 0.466
No	27(23.89)	34(20.24)	61 (21.71)	
Yes	86(76.11)	134(79.76)	220 (78.29)	
Female education				4.4321 p = 0.109
Primary	36(31.86)	52(30.77)	88 (31.21)	
Secondary	47(41.59)	88(52.07)	135 (47.87)	
Higher	30(26.55)	29(17.16)	59 (20.92)	
Husband education				7.3251 p = 0.026
Primary	67(59.29)	125(73.96)	192 (68.09)	
Secondary	16(14.16)	12(7.10)	28 (9.93)	
Higher	30(26.55)	32(18.93)	62 (21.99)	
Place of delivery				0.4877 p = 0.045
Home	11(9.73)	21(12.43)	32 (100.00)	
Hospital/nursing home	102(90.27)	148(87.7)	250 (100.00	
Total	113(100.0)	169(100.0)	282(100.0)	

(Parenthesis indicates percentage)

Table 3: Comparison of Selection Intensity Components across Populations

Population (Region)	Mean Live Births (X)	Fertility Variance (Vf)	Index of fertility (If)	Index of mortality (Im)	Crow's Index (It)	J and K Index(It)	Dominant Component	Source
Rural Howrah (Present Study-Uluberia)	1.68	0.69	0.245	0.157	0.441	0.581	Mortality	Present Study
Urban Howrah (Present Study-HMC)	1.88	0.62	0.175	0.126	0.323	0.379	Fertility	Present Study
Deori (NE India)	-	-	0.202	0.224	0.426	-	Mortality	Das and Sikdar (2010)
Kaibarta (NE India)	-	-	0.169	0.153	0.322	-	Fertility	
Oraon (NE India)	-	-	0.140	0.071	0.211	-	Fertility	
Jalari (Orissa, Coastal)	5.02	7.2	0.286	0.131	0.417	-	Fertility	Kapoor *et al*. (2012)
Vadabalija (Orissa, Coastal)	5.22	4.1	0.150	0.061	0.221	-	Fertility	
Kharvi (Goa, Coastal)	5.14	5.2	0.196	0.064	0.273	-	Fertility	Kapoor *et al*. (2012)
Bhandari (Goa, Coastal)	5.05	6.6	0.259	0.047	0.318	-	Fertility	
Ladakh Muslims (Pooled)	-	-	-	-	-	-	-	Bhasin and Nag (2002)
Sidi-bel-Abbès (Algeria, parents)	7.17	8.52	0.166	0.099	0.281	-	Fertility	Piontek and Krenz (1994)
Hutterites (USA, religious sect)	-	-	0.167	0.053	0.229	-	Fertility	Piontek and Krenz (1994)
Bushmen (Southern Africa)	-	-	0.394	0.264	0.761	-	Fertility	Piontek and Krenz (1994)
Bengali Villages	-	-	0.222	0.450	0.722	-	Mortality	Piontek and Krenz (1994)
Khotta Muslim			0.046	0.343	0.405		Mortality	Kalam and Roy (2016)
Santal (Migrant)			0.253	0.020	0.278	0.540	Fertility	Kalam *et al*.(2023)
Santal (Native)			0.129	0.000	0.129	0.505	Fertility	

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Consanguineous Marriage in Global Perspective: Anthropological Roots, Genetic Risks, Contemporary Relevance, and the Way Forward

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ABSTRACT: Consanguineous marriage—defined as unions between biologically related individuals, typically first or second cousins—has been a culturally embedded practice across diverse societies for millennia. Drawing on publicly available sources, the study seeks to review both regional and global perspectives of consanguineous marriage across time and space. Rooted in anthropological traditions of kinship and alliance, these unions historically served functions such as preserving lineage, consolidating property, ensuring social trust, and reinforcing group identity. Anthropological scholarship, from Morgan's kinship classifications to Lévi-Strauss's alliance theory, situates cousin marriage as a structured and rational social strategy rather than a random or anomalous choice. Contemporary practices, however, are shaped by complex intersections of tradition, religion, gender, and modernity. While biomedical research consistently associates consanguinity with increased risks of congenital disorders, pregnancy wastage, and mental health conditions, many communities continue to view it as beneficial for kin solidarity, economic security, and marital stability. Global prevalence remains heterogeneous: highly normative in South Asia, the Middle East, and North Africa, declining in parts of India and North Africa, and largely absent in Western societies except among diasporas. Recent transformations—including urbanization, women's education, migration, digital matchmaking, and premarital genetic screening—have shifted perceptions, particularly among youth. Ethnographic accounts highlight tensions between generational expectations and individual autonomy, revealing ambivalence and negotiation rather than outright rejection. This review underscores consanguinity as a dynamic institution at the intersection of anthropology, genetics, religion, and public health. Rather than framing it solely as a biomedical risk or a cultural relic, it should be understood as a multifaceted practice continually redefined in response to social, economic, and political change.

Keywords: Consanguineous marriage; Kinship; Inheritance; Genetic risks; Drivers; Cultural adaptation

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1. Introduction

Consanguineous marriage refers to a union between individuals who share a common ancestor, typically first or second cousins, and has been practiced for millennia across diverse societies [1–7]. However, consanguinity was not formally defined by a single individual. Instead, consanguinity has been studied, classified, and interpreted across various disciplines—including anthropology, sociology, genetics, law, *etc*. Scholars like L.H. Morgan (1871) in his foundational work *Systems of Consanguinity and Affinity of the Human Family*, classified kinship systems and documented the social rules governing cousin marriage [5]. C. Lévi-Strauss (1949), a renowned scholar, interpreted consanguineous unions as mechanisms of alliance and reciprocity between groups in his book *The Elementary Structures of Kinship*. Fox (1967), later in his seminal work *Kinship and Marriage: An Anthropological Perspective*, emphasized that cousin marriage represents a culturally regulated form of social organization rather than a biological anomaly [3]. Fox (1967) identified cross-cousin marriage and parallel-cousin marriage, and emphasized that cross-cousin marriage is widely favored in many matrilineal and alliance-based societies, as it promotes exchange and reciprocity between lineages [3]. Fox (1967) argues that cousin marriage preferences are not biologically driven but socially constructed rules that help to organize and reproduce social relationships [3]. He quotes:

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"*The form of cousin marriage a society chooses—if any—is a function of its descent rules and its ideas of where property and authority ought to flow*" (Fox 1967: 158) [3].

Beyond anthropological investigation, consanguineous marriage continues to attract multidisciplinary interest for its implications in bio-medical, genetics, demography, and public health [2,8–12]. While biomedical studies highlight elevated genetic risks such as congenital disorders and infant mortality, anthropological and sociological research demonstrates that such unions often reinforce kin solidarity, economic stability, and cultural continuity. Kalam et al. (2024) found that consanguinity heightens stillbirth and neonatal post-neonatal mortality risks; its effect is milder in close unions, reflecting enhanced alloparental support—a dimension that shows the bio-social aspect of consanguinity [10]. Wright (1922) found that consanguinity tends to reduce genetic variability and may decrease vigour due to inbreeding depression, though it can also help in fixing desirable traits under certain controlled conditions [13]. Sabbagh et al. (2014) found that consanguinity is a significant risk factor for nonsyndromic orofacial clefts (NSOFC), indicating nearly twice the risk among children born to consanguineous parents [14]. Studies have shown that consanguinity may increase spousal violence [15] while also enhancing social solidarity and old age security [16].

Thus, understanding the coexistence of socio-cultural and bio-medical costs underscores consanguinity as a complex bio-social phenomenon. Given the diverse and at times contradictory findings across disciplines, there is a clear need for an integrated and updated review that synthesizes anthropological, sociological, and biomedical perspectives to better understand the multifaceted implications. The present paper seeks to examine global and regional patterns of consanguineous marriage by tracing its historical roots, theoretical foundations, cultural rationales, and shifting dynamics in relation to modernity, migration, and public health. By integrating anthropological insights with recent demographic and biomedical evidence, the presentreview provides a comprehensive understanding of consanguinity as both a culturally embedded social institution and a contemporary health concern.

2. Materials and Methods

We conducted a comprehensive and systematic literature search using multiple renowned academic databases and digital libraries to collect scholarly materials related to consanguineous marriage. These included PubMed, Web of Science (formerly Web of Knowledge), Google Scholar, JSTOR, the National Digital Library of India (NDLI), Wiley, Springer, Elsevier, AnthroSource, Anthropology Plus, the Demographic and Health Surveys (DHS), and reports from the World Health Organization's Eastern Mediterranean Regional Office (WHO EMRO). PubMed, maintained by the U.S. National Library of Medicine, was instrumental in providing access to peer-reviewed biomedical and genetic research articles. Web of Science enables exploring multidisciplinary journals with strong citation tracking for scientific rigor. Google Scholar, as a freely accessible academic search engine, offered a wide array of sources, including articles, theses, books, and conference papers. JSTOR facilitated access to archived literature, especially in anthropology and the social sciences. NDLI, an initiative of the Government of India, allowed for the inclusion of region-specific academic works, institutional repositories, and vernacular publications. Wiley, Springer, and Elsevier databases provided international peer-reviewed journals relevant to genetic counseling and cross-cultural studies. AnthroSource and Anthropology Plus contributed specialized ethnographic and kinship-focused literature. Additionally, demographic patterns and prevalence data were gathered from national and regional DHS datasets, while WHO EMRO reports offered vital insights into the public health implications of consanguinity in Arab and Muslim-majority countries.

We developed the search strategy to capture a comprehensive range of publications, encompassing both seminal early works on consanguineous marriage and the more recent studies that continue to shape contemporary and future debates on the subject. We applied specific filters to collect studies that explored especially anthropological perspectives of consanguineous marriages, along with their types, prevalence, effects of such marriages, changing patterns, policy implications, as well as ethnographic voices. The retrieved literature included peer-reviewed journal articles, book chapters, and online resources. While some studies drew on nationally representative datasets, others provided in-depth insights from local community-level research.

Each database yielded citations in various formats (e.g., APA, MLA, Chicago, Harvard, and Vancouver), and we used Mendeley, a reference management software, to systematically organize, annotate, and cite all references throughout the study. All selected sources were thoroughly reviewed to ensure their relevance, reliability, and academic integrity.

3. Classification of Consanguineous Marriages

The anthropological categorization of consanguineous marriage involves categorizing such unions based on cultural, kinship, and lineage systems across societies. Anthropologists analyze consanguineous marriage not only in

terms of biological relatedness but also as a social institution that reinforces alliances, lineage continuity, property transmission, and identity [3,6,9–11,16,17].

3.1. Classification by Degree of Relatedness

Consanguineous unions are primarily defined by biological proximity. First cousin marriages, *i.e.*, marriagesbetweenindividualswhoshareacommongrandparent, are the most prevalent worldwide, notably in the Middle East, North Africa, and South Asia [1,2,7]. Marriage between the son and daughter of two same-sexsiblings (such as Father's brother or Mother's sister) is classified as a parallel cousin marriage(PCM), in which father's brother's daughter (FBD) is predominant in Arab-Islamic societies and often reinforces agnatic lineage ties [5,12,17]. Whilemarriages between a son and a daughter of two different-sexsiblings (such as Father's sister/Mother's brother) are categorized as cross-cousin marriage (CCM), among which mother's brother's daughter (MBD) is common in South Indian Dravidian kinship systems and often preferred by custom [18]. Second-cousin marriages occur in societies where first-cousin unions are less culturally preferred. Uncle-niece marriages, though rare, are practiced among certain South Indian castes and historically in royal lineages, such as ancient Egypt [3,5]. Double cousin marriages, where both maternal and paternal sides are connected, aim to maximize kinship bonds and property consolidation [19,20]. The common connections and types of cousin marriage have been presented in Figures 1 and 2, respectively.

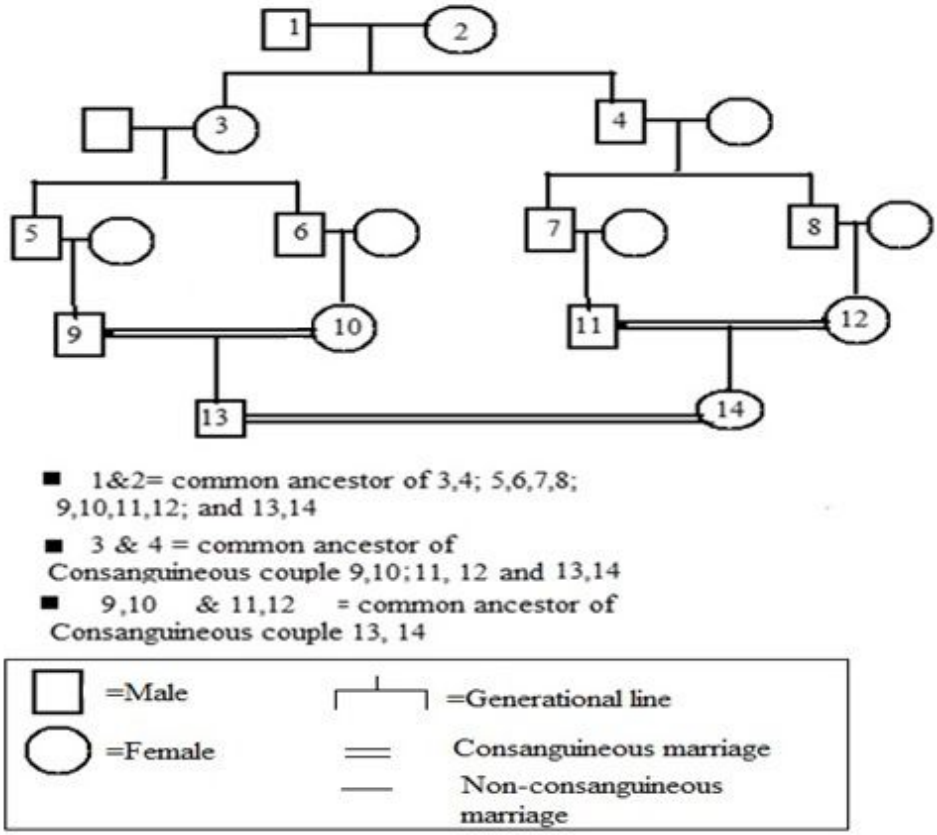

Figure 1. Consanguineous marriage by degree of relatedness (Source: Authors).

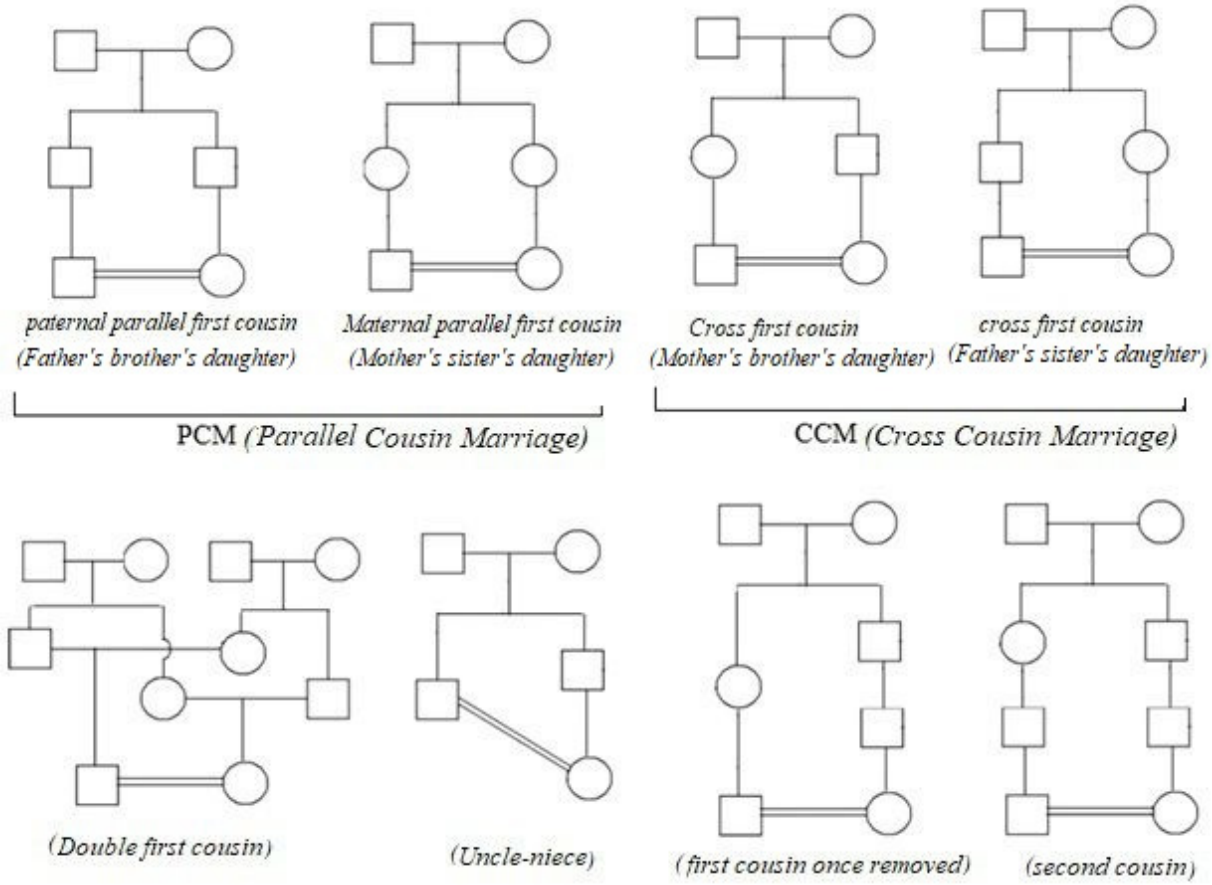

Figure 2. Types of consanguineous marriages (Source: Hamamy et al. (2011) [17]).

3.2. By Cultural-Kinship Systems

Dravidian Kinship Systems: Cross-cousin marriage (mother's brother's daughter or father's sister's son) is often *prescriptive*, facilitating alliances between lineages [18]. Arab-Islamic Kinship: Preference for patrilateral parallel cousin marriage supports endogamy, preserves tribal cohesion, and maintains wealth within the paternal line [19,21]. African Lineage Systems: Varying traditions exist, with some practicing cousin marriage and others favoring exogamy; patterns are often shaped by descent and bridewealth institutions [22]. Christian-European Societies: Canon law historically *proscriptive* cousin marriage, especially under Roman Catholicism, due to concerns over genetic risks and moral doctrine [23].

4. Worldwide Prevalence of Consanguineous Marriages

In prehistoric times, the prevalence of consanguineous marriage varied significantly between hunter-gatherer and early agricultural societies. Among hunter-gatherers, small group sizes and high mobility often resulted in relatively low rates of close kin marriage, especially beyond first cousins. While some degree of consanguinity was inevitable due to limited population sizes, many hunter-gatherer groups practiced forms of exogamy to avoid inbreeding, favoring marriage outside the immediate band or clan [24]. In contrast, with the advent of agriculture during the Neolithic period, sedentary life and increased population densities enabled more stable kinship systems. This transition saw a rise in consanguineous marriages in some regions, particularly among early agriculturalists who began to use marriage to consolidate land, property, and social alliances within extended family groups [25]. In such contexts, cousin marriages—especially between parallel and cross cousins—could become culturally institutionalized to maintain lineage cohesion and resource control. Thus, while consanguineous marriage among hunter-gatherers was typically limited by ecological and social factors, early agricultural societies showed a growing tendency toward kin-based marital practices, which laid the foundation for many historical and contemporary patterns of cousin marriage.

The practice of consanguineous marriage is globally heterogeneous in nature, ranging from cultural normativity in parts of Asia and the Middle East to virtual extinction in Western nations [7]. It reflects deep socio-cultural, economic, and political systems and is undergoing a gradual transformation in many regions due to urbanization, education, and genetic awareness. The detailed compilation of the worldwide prevalence of consanguineous marriage, supported by

authors, years, and reasons behind the practice of consanguinity, is presented in Table 1 and shown in Figure 3. The data is organized region-wise, citing recent and landmark studies where available.

Table 1. Worldwide prevalence of consanguineous marriage.

Region/Country	Prevalence (%)	Author(s) & Year	Observations
Afghanistan	~46%	Saify& Saadat (2012) [26]	Tribal norms, ethnic identity
Pakisthan	~56%	Agha (2016) [27]	Islamic tradition, rural practice
Egypt	30-35%	Temtamy and Aglan (2012) [28]	Family unity, stability
India	~14%	Kalam et al. (2024) [10]	Close consanguineous marriage affects pregnancy wastage less compared to distant consanguineous marriage
Iran	20–40%	Akrami et al. (2009); Saadat (2007) [29,30]	Rural traditions, Shia Islam acceptance
Iraq	~45%	Tadmouri et al. (2009) [31]	War and displacement increase intra-family marriage
Israel (Bedouins)	~45%	Jaber et al. (1998) [12]	Strong kinship ties
Jordan	~40–50%	Jaber et al. (1998) [12]	Cultural tradition, reduced dowry costs
Kwait	~55%	Jaber et al. (1998) [12]	Tradition and dowry costs
Lebanon	~15–20%	Barbour & Salameh (2009) [32]	Declining in urban areas
Morocco	~20%	Bittles & Black (2010) [7]	Rural customs
Pakistan	50–60%	Hussain & Bittles (1998, 2000) [33,34]	Tradition, family integrity, and property consolidation
Qatar	51%	Bener& Denic (2001) [35]	Cultural norms, social preferences
Saudi Arabia	51–58%	El-Hazmi et al. (1995); Al-Abdulkareem (1998) [36,37]	Tribal culture, Islamic legitimacy, wealth retention
Sub-Saharan Africa	<5% (except Sudan)	Tadmouri et al. (2009) [31]	Mostly exogamous cultures
Sudan	40–45%	Tadmouri et al. (2009) [31]	Custom, tribal linkages
Syria	25–30%	Tadmouri et al. (2009) [31]	Tribal and sectarian identities
Tunisia	~20%	Hamamy (2012) [11]	Traditional regions
Turkey	20–25%	Tuncbilek & Koc (1994) [38]	Kurdish areas, cultural continuity
UK (Pakistani diaspora)	38%	Shaw (2001); Proctor and Smith (1997) [39,40]	Transnational continuity of tradition
United Arab Emirates	39–50%	Al-Gazali et al. (1997); Bener et al. (2004) [41,42]	Social cohesion, tribalism
USA & Europe	<1%	Bittles (2001); Modell & Darr (2002) [1,43]	Rare; limited to immigrant communities
Yemen	~40%	Hamamy (2012) [11]	Custom, rurality

5. Anthropological Perspectives on the Origins of Consanguineous Marriage

The inquiry into the origin of consanguineous unions dates back to the prehistoric period [44]. From an anthropological perspective, the prevalence of cousin marriage in many traditional societies can be interpreted as a rational social, economic, and political strategy rather than a random or purely emotional choice. Kinship systems have long been recognized as fundamental to the organization of human societies, and cousin marriage—particularly within the lineage—has often functioned to maintain group cohesion, inheritance, and social trust. One major reason for preferring cousin marriage over affinal (non-kin or distant) unions is its capacity to strengthen kin unity and preserve lineage solidarity. As Fox (1967) observed in *Kinship and Marriage*, cousin marriage is not an anomaly but a rule-governed institution embedded within broader structures of descent and alliance [3].

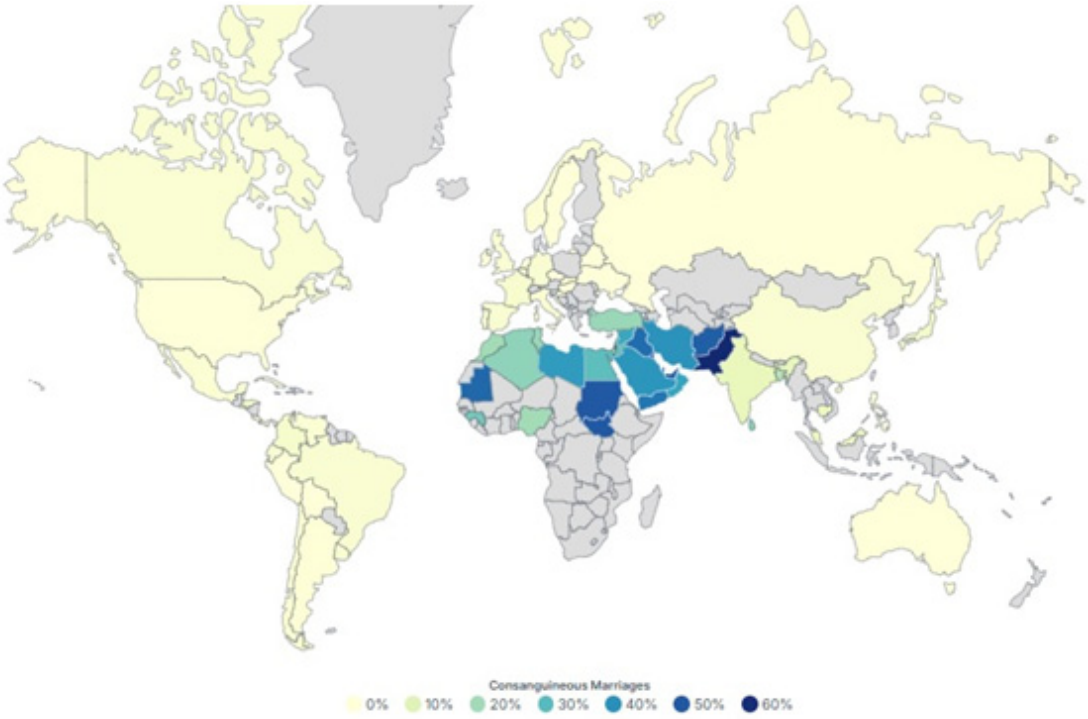

Figure 3. Worldwide prevalence of consanguineous marriages [45].

In segmentary lineage systems such as those among Arab Bedouins or African pastoralists, patrilateral parallel-cousin marriage (father's brother's daughter) ensures that property, authority, and allegiance remain within the patriline, thereby minimizing the fragmentation of wealth and influence [46]. Kin-based unions also help manage risk and reciprocity by promoting marriages within trusted, familiar networks, reducing uncertainty about loyalty and obligations that might arise in affinal alliances [47]. This functioned especially well in stateless or small-scale societies, where kinship provided the primary framework for social regulation and mutual support. Within such settings, cousin marriage reinforced existing kin ties, fostered mutual obligations, and retained bridewealth or dowry within the family that might otherwise be transferred to unrelated groups [23,48]. A recent ethnographic study among Khotta Muslims similarly shows that women often prefer cousin marriages to avoid the insecurity of marrying unfamiliar partners[16].

Ecological anthropology also provides explanatory insights. Ember and Ember (1983) found that cousin marriage is more common in ecologically unpredictable environments, where strong kinship bonds enhance cooperation and resilience [49]. Among endogamous tribal and clan-based groups, reluctance to marry outside the lineage or cultural group often stems from concerns about losing identity, land, or social cohesion [49]. In this sense, cousin marriage acts as a mechanism of cultural continuity, transmitting not only genetic material but also social values, religious identity, and customary rights within a trusted framework [19].

From a bio-cultural standpoint, some anthropologists suggest that mild consanguinity might have offered adaptive advantages in small or isolated populations by stabilizing inherited traits [1]. In contrast, distant or non-kin marriages could introduce uncertainty, dilute resources, and weaken intra-group cooperation. Thus, rather than a deviation from social norms, cousin marriage can be viewed as an adaptive social institution that integrates kin-based economic logic, ecological adaptation, and the reproduction of social order [13,14,44].

6. Evolution of Consanguineous Marriage

The evolution of consanguineous marriage is best understood as part of the broader dynamics of kinship systems, social structure, and cultural logic. Rather than viewing such unions solely through biomedical or legal lenses, anthropologists focus on their socio-cultural functions, symbolic meanings, and economic rationalities across time and space [50,51]. Historically, consanguineous marriages have been practiced in many segmentary lineage societies to maintain the integrity of kin groups, consolidate inheritance, and reinforce endogamous boundaries [52]. These marriages were not simply private choices but were embedded within rules of descent and preferential marriage norms, which varied according to whether a society was organized around patrilineal, matrilineal, or bilateral principles [3]. The anthropological classification of cousin marriages—particularly the distinction between cross-cousin and parallel-

cousin marriage—was pioneered by Lewis Henry Morgan (1871), who saw kinship as a universal system that could be compared across societies [5]. Later, Claude Lévi-Strauss (1949) transformed this understanding through his structuralist theory, positing that cross-cousin marriage was central to the alliance theory of kinship, where marriage acts as a system of reciprocal exchange between social groups, thereby ensuring cohesion and cooperation [6]. Fox (1967) argues that cousin marriage is not a random or biologically determined phenomenon, but a culturally regulated practice that evolves in tandem with a society's rules of descent, property transmission, and authority structures [3]. According to Fox (1967), cross-cousin marriage tends to emerge in societies organized around exchange and alliance, particularly those with matrilineal descent or bilateral kinship systems [3]. In these societies, marriage between cross-cousins helps build alliances and redistribute rights, obligations, and goods between lineages. This form is often seen as promoting exogamy within lineages while maintaining endogamy within the larger community. Fox (1967) noted that consanguineous marriage functions to retain wealth, women, and power within the male line, thereby strengthening lineage cohesion [3]. Fox (1967) emphasizes that the evolution of cousin marriage patterns in any given society reflects broader transformations in social structure, inheritance logic, and political economy [3]. Over time, as societies shift from tribal, segmentary systems to centralized state systems or adopt new religious-legal frameworks, the acceptability and form of cousin marriage also change. Thus, for Fox (1967), cousin marriage evolves not due to genetics or mere tradition, but through its embeddedness in social strategies and cultural logic that adapt to historical and institutional changes [3].

In many Middle Eastern and South Asian societies, however, parallel-cousin marriage—especially father's brother's daughter (FBD) marriage—emerged as a preferred pattern, interpreted not in terms of alliance but of agnatic solidarity and patrilineal closure [6,8]. Anthropologists have pointed out that such practices are deeply tied to concerns over property retention, family honour, gendered power dynamics, old-age security, and community solidarity [20,39,53]. With the advent of post-structuralist and feminist anthropological critiques, attention shifted to how consanguineous marriage affects individual agency, particularly among women, who may face social pressures, limited marital autonomy, or blame for genetic outcomes [27,54]. The focus thus expanded from structural functions to lived experiences, subjectivities, and the inter-sectionality of kinship, gender, and power. In contemporary anthropology, the study of consanguineous marriage is situated at the intersection of tradition and modernity, recognizing that such marriages persist not out of ignorance but often as rational, culturally embedded choices, shaped by evolving social, economic, and political conditions [8,15,16].

Lewis Henry Morgan (1877), in his "*Ancient Society*", outlined an evolutionary scheme of the family, beginning with the *consanguineous* family, in which sexual relations were permitted among cousins within the same kin group [4,5]. This was followed by the *punaluan* family, in which brothers of one group collectively married sisters of another, with sibling incest prohibited, thereby initiating exogamy. The next stage was the *syndyasmian* family, characterized by relatively stable pairings between a man and a woman, though the union could be easily dissolved. Finally, Morgan identified the *monogamous* family as the most advanced form, marked by exclusive unions between one man and one woman, reinforced by inheritance and property rights [4,5].

Consanguineous→ punaluan→ syndyasmian → monogamous

Later on, Engels, in *The Origin of the Family, Private Property, and the State* (1884), adopted Morgan's stages but reinterpreted them through a materialist perspective [55]. He accepted the idea of the consanguineous family as the earliest stage, illustrating primitive promiscuity and the absence of incest taboos. However, Engels linked the evolution of family forms directly to changes in modes of production, property ownership, and social inequality. For him, the rise of monogamy was not merely a cultural progression but a consequence of the emergence of private property and patriarchal control, which he famously described as the "world-historic defeat of the female sex". In this way, Engels (1884) expanded Morgan's anthropological framework into a broader theory of social and economic transformation [55].

7. Dimensions of Consanguineous Marriage

Consanguineous marriage has held deep social, economic, and symbolic significance throughout human history. From an anthropological standpoint, such marriages are not merely familial choices but culturally structured institutions embedded in broader kinship, alliance, and inheritance systems.

7.1. Historical Trend and Cultural Rationales

Consanguineous marriage has a long-standing historical presence across diverse cultures and civilizations. Far from being a marginal or pathological phenomenon, it has historically functioned as a culturally sanctioned and

strategically utilized institution. In ancient civilizations such as Pharaonic Egypt, Mesopotamia, and Zoroastrian Persia, consanguineous marriages—including even sibling unions among elites—were practiced to preserve dynastic purity, consolidate power, and maintain control over royal or priestly lineage [9,23]. Among Muslim societies, cousin marriage gained legal and religious legitimacy based on *Qur'anic* sanction, contributing to its widespread practice in the Middle East, North Africa, and South Asia [21,56]. The cultural logic behind these marriages lies in their utility for preserving wealth and land within the extended family, strengthening social cohesion, and reinforcing trust between kin. In South Asian societies, especially among Muslims and certain Hindu castes of South India, cousin marriage has historically allowed families to uphold notions of *izzat* (honour), reduce the economic burden of dowry or bridewealth, and ensure that daughters marry into known, trusted households [16,57]. Anthropological research demonstrates that cousin marriage is not random or biologically motivated, but rather part of a structured system of alliance and inheritance management [3]. Parallel-cousin marriage is particularly prevalent in patrilineal societies, where it ensures the retention of property within the male line, while cross-cousin marriage is common in systems of reciprocal alliance, such as those found in Dravidian kinship systems [18]. Thus, the historical prevalence of consanguineous marriage reflects adaptive responses to social and ecological conditions, deeply rooted in local systems of kinship, descent, and cultural value.

7.2. Theoretical Perspective

Fox (1967), in his *Kinship and Marriage,* argued that cousin marriage is not anomalous but a "systematic solution" to social needs like alliance formation, alloparenting, and inheritance regulation [3]. He distinguished between patrilateral parallel-cousin marriage (common in Arab tribes) and matrilateral cross-cousin marriage (typical in Dravidian and Australian Aboriginal societies), each serving different alliance and descent functions. Anthropologists have examined consanguineous marriage not merely as a biological arrangement but as a deeply embedded cultural practice shaped by kinship systems, social obligations, and economic strategies. Structuralism and Alliance Theory, developed by Claude Lévi-Strauss (1949), conceptualize cousin marriage—particularly matrilateral cross-cousin marriage—as a system of reciprocal exchanges that sustains alliances and solidarity between kin groups [6]. Descent Theory, as articulated by Radcliffe-Brown and Evans-Pritchard, emphasizes patrilateral parallel-cousin marriage as a means to preserve lineage, property, and identity, particularly in patrilineal societies such as those in the Arab world [54,58]. Transactional and Economic Interpretations, advanced by Jack Goody (1983) and Barth (1960), explain cousin marriage as a strategy to minimize bridewealth, retain land and resources within families, and control women's mobility [16,47]. Symbolic and Cultural Interpretations, notably by David Schneider (1984), reframe kinship—including consanguineous marriage—as a culturally constructed system in which notions of relatedness, incest, and marriage ability vary across societies [59]. Feminist and Postcolonial Critiques highlight the gendered dimensions of cousin marriage, illustrating how such unions may simultaneously reinforce patriarchal structures and offer familial security for women [27,60]. Collectively, these theories interpret consanguineous marriage as an anthropological mechanism for social reproduction and alliance (Structuralism, Alliance Theory), a means to secure lineage and inheritance (Descent Theory), a strategic response to economic and symbolic needs (Transactional/Economic and Symbolic Theories), and a contested site of gendered negotiation and cultural agency (Feminist and Postcolonial Approaches) [6,27,60].

7.3. Colonial Encounters and Modernity in Consanguineous Marriages

Colonialism played a critical role in reshaping discourses and practices around consanguineous marriage, often framing them through lenses of pathology, backwardness, or religious tradition. During the British colonial administration in South Asia, marriage practices such as cousin marriage—common among Muslims and certain Hindu castes—were scrutinized under the influence of Western Christian ideals of the nuclear family and exogamy. British officials and missionaries viewed endogamous and cousin marriages as markers of social stagnation and impediments to progress, linking them to presumed racial degeneration and social disorder [61]. This moral and racial framing shaped colonial legal interventions and census classifications, reinforcing binaries between 'modern' Western marriage and 'traditional' native kinship structures. For example, debates surrounding Muslim personal law in colonial India highlighted cousin marriage as a point of contention between Islamic jurisprudence and colonial modernity [62]. Similarly, in the Middle East, colonial ethnographers and health officials interpreted high rates of consanguinity through a eugenic lens, often ignoring the social logic behind these practices [63]. Postcolonial anthropologists have since challenged such essentialist and Eurocentric views, demonstrating that consanguineous marriage practices are not vestiges of backwardness but adaptive strategies embedded in systems of kinship, inheritance, and gendered security [27]. Moreover, the encounter with modernity—through education, migration, and state health interventions—has led

to changing perceptions and negotiations of cousin marriage within communities, especially among youth who increasingly question the practice while balancing familial obligations and personal autonomy [64]. Thus, colonial and modern state discourses did not erase consanguineous marriage but reconfigured its meanings, often reinforcing patriarchal control while opening spaces for re-interpretation in postcolonial societies. In recent years, in the aftermath of the post-colonial era and under the influence of modernity, factors such as educational advancement, media exposure, and growing awareness of the harmful consequences of consanguineous marriages appear to have contributed to their decline [65–67].

8. Drivers of Consanguineous Marriage

Anthropologists and social scientists have long examined the persistence of consanguineous marriage patterns, highlighting a complex interplay of social, economic, religious, and cultural factors that sustain the practice despite modernization and changing demographic trends [17,33,68,69].

8.1. Socio-Cultural and Kinship Factors

Anthropologically, systems of kinship and lineage organization significantly influence the persistence of consanguineous marriages. Such unions, particularly between cousins, often function as strategies to reinforce familial bonds and uphold clan or lineage unity [16,20]. In many societies where kinship determines social standing and access to resources, marrying within the family helps sustain internal cohesion and strengthens mutual trust among relatives [3,19]. Furthermore, endogamous practices act as cultural mechanisms that preserve social identity and maintain boundaries, especially within tribal and caste-oriented communities [17,56].

8.2. Economic and Property Considerations

Economic rationales are among the strongest drivers of consanguineous marriage. Marrying within the family allows for the consolidation of land, property, and wealth, minimizing fragmentation through inheritance [16,33]. In agrarian and pastoral economies, maintaining property within the patrilineage is considered vital to sustaining household economic stability. Furthermore, such marriages reduce dowry or bride price expenses and enhance the perceived economic security of women within the familiar kin network [16,30,37,69–72].

8.3. Religious and Moral Dimensions

Religious beliefs often reinforce the practice of consanguinity by providing cultural legitimacy. In Islamic societies, for example, cousin marriages are not only permissible but often valorized as a morally sound and socially acceptable form of union [17]. Religious sanction provides a framework for preserving lineage purity (*nasab*) and maintaining moral control within the family. Similarly, among Christian and Hindu groups in certain regions, cousin marriage is influenced more by local customs and interpretations than by strict doctrinal prohibitions [21,73].

8.4. Social Trust, Compatibility, and Marital Stability

Another key driver concerns perceived trust and compatibility among kin. Families often prefer marrying known relatives over outsiders to ensure social security, reduce marital uncertainty, and enhance compatibility through shared upbringing, values, and lifestyle [7,17,30]. Studies in Pakistan, Iran, and India indicate that cousin marriages are often perceived as more stable and emotionally secure, offering stronger support networks for couples [34].

8.5. Gender and Control Dimensions

Consanguineous marriages can also be seen as mechanisms of patriarchal control over women's mobility and sexuality. Marrying within the kin group allows male elders to monitor and maintain authority over female members, preventing "outsider" alliances and potential loss of property or honor [16,20,63]. This dimension intersects with the broader socio-cultural ideals of family honor (*izzat*) and purity, especially in patriarchal rural societies.

8.6. Modernization and Migration

Although modernization and education have altered marriage patterns in many contexts, consanguinity persists even among modern migrant populations in Western countries [48,74]. For diaspora communities, cousin marriage often functions as a strategy to maintain transnational kin networks, cultural identity, and social cohesion [39,53,67,75].

8.7. Psychological and Emotional Familiarity

Emotional security is an important factor influencing partner selection in societies where kinship relations are strong. Individuals who marry within their extended family often share early life experiences, cultural norms, and similar social environments, which help build mutual understanding and trust. Such familiarity reduces the apprehension or *gamophobia*—the fear of marrying a stranger—that may accompany unions with unrelated partners. For women in conservative or patriarchal settings, psychological familiarity with in-laws also eases the process of post-marital adjustment and strengthens feelings of safety and belonging [16,17,76].

8.8. Fear of Cultural Dilution

In certain societies, marrying beyond the kin group is perceived as a potential risk to the preservation of cultural identity and ancestral lineage. Although lacking a scientific foundation, this perception reflects a symbolic desire to protect the integrity of the family's "bloodline" and sustain cultural or ethnic uniformity across generations [39,40].

9. Effects of Consanguineous Marriage

9.1. Beneficiary Effects of Consanguineous Marriage

Despite growing global concerns about the associated genetic risks, such marriages persist for several socio-cultural, economic, and ecological reasons. Anthropological, sociological, and biomedical studies have outlined various benefits of these marital arrangements, contextualized within particular kinship systems and societal structures [17,68].

9.1.1. Strengthening Family and Kinship Ties

One of the most cited advantages of consanguineous marriages is the reinforcement of kinship bonds and familial solidarity. In societies where lineage, clan, or tribal cohesion is central to social organization, marrying within the extended family serves as a mechanism to maintain intergenerational trust and cooperation [1,3,16,17]. This practice often ensures the continuity of mutual obligations, such as caregiving, inheritance, and dispute mediation, within the same kin network.

9.1.2. Economic and Property Consolidation

Consanguineous marriages often help retain property, land, and wealth within the extended family or lineage. This is particularly evident in patrilineal societies where land fragmentation due to dowry or inheritance transfers can be averted through cousin marriages [19,70–73]. Marrying within the family reduces the economic uncertainties associated with external alliances, safeguarding familial assets across generations.

9.1.3. Marital Stability and Social Compatibility

Studies have suggested that consanguineous marriages exhibit lower divorce rates and greater marital stability than non-consanguineous unions [16,68,77,78]. This is attributed to prior familiarity between the spouses and their families, resulting in reduced cultural and behavioral conflict. Pre-existing familial trust and reduced dowry demands also contribute to smoother marital negotiations and post-marital support.

9.1.4. Easier Spousal Selection and Reduced Search Costs

In tightly knit communities, consanguineous marriage simplifies the process of spouse selection, reducing the burden of searching for suitable partners across distant social networks. This can be especially significant in regions with limited access to education and mobility, where kin-based matchmaking reduces logistical, financial, and cultural complications [11,16,17,79].

9.1.5. Support During Crisis and Caregiving

Cousin marriages offer practical advantages in caregiving and support during health, financial, or social crises. Having extended family members as in-laws facilitates cooperation in child-rearing, elder care, and resource sharing [7,10,16,69]. Such networks are particularly valuable in contexts where institutional support is weak or absent.

9.1.6. Reinforcement of Social Identity and Endogamy

In many caste- or tribe-based societies, consanguineous marriage reinforces social identity and preserves community endogamy. This helps maintain ritual purity, social status, and the continuity of cultural practices, especially among marginalized or minority populations who seek to resist assimilation [16,79].

9.1.7. Religious and Cultural Legitimacy

In Islam, for example, consanguineous marriage is religiously permissible, and in many Islamic societies, first cousin marriage is viewed favorably both culturally and scripturally [16,73,75]. Religious sanction often reinforces the social acceptability and perceived moral value of such unions.

9.1.8. Evolutionary and Behavioral Ecology Explanations

From a behavioral ecological perspective, some scholars argue that consanguineous marriages may confer inclusive fitness benefits by enhancing kin cooperation, trust, and resource pooling. Robin Fox (1967) proposed that such marriages could be evolutionarily advantageous in stable, endogamous communities by optimizing reproductive and economic success under particular environmental constraints [3,5,44,80].

9.2. Non-Beneficiary Effect of Consanguineous Marriage

Despite its cultural and social embeddedness in many parts of the world, consanguineous marriage is associated with a range of biological, social, and demographic disadvantages, as widely reported in biomedical, anthropological, and demographic literature [10,81–83].

9.2.1. Hereditary Risk

From a biomedical perspective, consanguinity increases the probability of homozygosity at recessive gene loci, elevating the risk of autosomal recessive disorders. Numerous studies have documented significantly higher incidences of congenital malformations, perinatal mortality, intellectual disability, and inherited metabolic disorders among offspring of consanguineous unions [10,81–83]. For instance, research in the Middle East and South Asia—regions with high prevalence of first-cousin marriages—shows that these unions are strongly correlated with increased rates of neonatal mortality and morbidity [83]. The magnitude of genetic risk is particularly elevated in regions where consanguinity is practiced over multiple generations, leading to an accumulation of deleterious alleles in family gene pools [1,7].

9.2.2. Burden on Healthcare Systems

From a demographic and public health standpoint, consanguinity can impose significant burdens on healthcare systems. Higher rates of disability-adjusted life years (DALYs), increased pediatric care costs, and the need for long-term rehabilitation services are noted in populations with high consanguinity rates [11,31,84]. Additionally, in some low-income and resource-constrained settings, the lack of adequate genetic counseling exacerbates the risks, leading to the persistence of hereditary conditions and contributing to a cycle of poverty and poor health outcomes [12].

9.2.3. Constrain on Women's Autonomy

Socially, the preference for intra-familial unions may constrain women's autonomy and freedom of marital choice, reinforcing patriarchal norms and kin-based control mechanisms [27,85–87]. In some contexts, girls may be married off at an early age within kin networks, potentially violating their rights and increasing their vulnerability to gender-based violence or social isolation. Moreover, while kin marriages may strengthen internal clan cohesion, they may also foster exclusivity, inhibit social mobility, and contribute to ethnic or caste endogamy, perpetuating social divisions and limiting broader societal integration [9,16].

9.2.4. Intra-Familial Conflict

Anthropological perspectives further reveal that while consanguinity is often rationalized in terms of kin loyalty and resource consolidation, it may paradoxically generate intra-familial conflict. Issues surrounding inheritance, resource competition, and intergenerational obligations may intensify in closed kin groups, particularly when economic

inequality exists among close relatives [3,21,69]. This is particularly true in patrilineal societies where property is often retained within agnatic lines, sometimes at the cost of individual well-being.

9.2.5. Evolutionary Trade-Offs in Consanguineous Marriages

From an evolutionary perspective, several behavioral ecologists have argued that consanguineous marriages may confer short-term inclusive fitness advantages, particularly by reinforcing kin solidarity and cooperative behavior among genetically related individuals [3]. These unions can enhance social cohesion, facilitate familial resource pooling, and reduce partner-search costs within tightly knit communities. However, such perceived benefits are often counterbalanced by the long-term evolutionary consequences of reduced genetic heterogeneity. Specifically, consanguinity increases the likelihood of homozygosity for deleterious alleles, thereby elevating the genetic load within a population [7]. Over successive generations, this accumulation of harmful recessive mutations may result in a decline in overall population fitness, especially in small or endogamous groups where genetic diversity is already limited [7,44,72]. While consanguineous marriages may offer certain social and reproductive advantages, they also entail significant evolutionary risks, particularly in terms of genetic health. The most prominent risk is increased homozygosity, which increases the likelihood that offspring will inherit autosomal recessive disorders such as thalassemia, cystic fibrosis, and various congenital anomalies [7,72]. This is due to the fact that relatives are more likely to carry the same deleterious alleles, making their union more genetically hazardous. Moreover, inbreeding can lead to inbreeding depression, a reduction in biological fitness that may manifest as increased infant mortality, reduced cognitive development, impaired immune function, and overall lower survival rates of offspring [72]. From an evolutionary standpoint, such trade-offs reduce the long-term adaptability of populations by limiting genetic diversity, which is crucial for coping with environmental changes and disease pressures. These risks become especially pronounced in small, endogamous communities or isolated populations where genetic drift and founder effects amplify inherited disorders. Hence, while consanguinity may serve short-term social or reproductive goals, it can undermine population health and resilience over generations.

9.2.6. Increases Pregnancy Wastage

Multiple studies across South Asia and the Middle East have demonstrated a significant association between consanguineous unions and increased risks of adverse pregnancy outcomes and early-life mortality [10,75,81]. Of particular note, Kalam et al. (2024)—analyzing pooled data from India's National Family Health Surveys 4 (2015–2016) and 5 (2019–2021)—employed logistic and Cox proportional hazards regression models to assess the impact of close (first-cousin) and distant consanguinity on spontaneous abortion, stillbirth, neonatal, post-neonatal, and under-five mortality [10]. Their findings indicated a statistically significant elevation in the risk of spontaneous abortion (for both close and distant consanguinity) and neonatal mortality (distant consanguinity) when compared to non-consanguineous marriages. Notably, no significant association was observed for child mortality beyond infancy, suggesting that broader socioeconomic developments and improved healthcare services may buffer later survival risks. Earlier research has similarly documented elevated infant and perinatal mortality among offspring of consanguineous unions [10]. For instance, Hussain and Bittles (1998) found that in Pakistan, child mortality was approximately 1.5 times higher among first-cousin couples relative to non-consanguineous couples [34]. Comparable findings emerge from Middle Eastern populations. El-Hazmi etal. (1995) reported notably heightened neonatal and infant mortality in Saudi Arabia, and Tadmouri etal. (2009) emphasized similar risk elevations across multiple Arab countries [31,36]. The biological mechanism underlying this increased risk is the greater likelihood of homozygosity for recessive deleterious alleles in the offspring of related parents, which can manifest as congenital anomalies, prematurity, low birth weight, and reduced vitality immediately after birth [7,43]. These genetic vulnerabilities are most likely expressed during the neonatal and early infant periods, aligning with the elevated risks observed in epidemiological studies.

9.2.7. Consanguinity and Mental Health Illness

Consanguineous marriage has been linked to an elevated risk of certain mental health disorders, particularly those with a strong genetic component. The increased homozygosity resulting from consanguinity raises the likelihood of recessive genetic mutations being expressed, some of which may contribute to neuro-developmental and psychiatric disorders such as intellectual disability, autism spectrum disorders (ASD), epilepsy, and schizophrenia [7,88]. Research in South Asia and the Middle East—regions with high rates of consanguineous marriage—has reported a greater prevalence of cognitive impairment and learning disabilities among children born to closely related parents [83]. Additionally, studies have shown a higher incidence of major depressive disorder and bipolar disorder in certain

populations practicing consanguinity. However, the relationship here is less direct and likely influenced by socio-environmental factors such as stigma, isolation, and lack of access to mental health services [33]. While not all mental illnesses are strongly heritable, consanguinity may increase the risk where multiple recessive genes interact or where genetic vulnerability combines with environmental stressors. Thus, consanguineous unions require careful genetic counseling to mitigate mental health risks, particularly in regions where such marriages are culturally preferred.

10. Consanguinity at the Intersection of Religion, Law, and Identity Politics

Consanguineous marriage is not merely a reproductive or familial choice; it is deeply embedded within religious doctrines, legal structures, and the socio-political constructions of identity. In many Islamic societies, cousin marriage is explicitly permitted and even encouraged under religious law. The *Qur'an* allows such unions (*Surah An-Nisa 4:23–24*), and the Prophet Muhammad's marriage to his cousin Zaynab bint Jahsh is often cited as a religious precedent. Consequently, consanguineous unions are culturally and theologically framed as legitimate, fostering social cohesion, kin solidarity, and preservation of familial resources [73,78]. Similarly, among South Asian Hindus, although Sanskritic traditions (e.g., *Dharmashastra*) generally discourage close-kin marriages, regional practices vary. In northern India, such unions are largely proscribed under clan exogamy norms, while in southern India, cross-cousin and uncle-niece marriages are culturally preferred, aligning with the Dravidian kinship system and the logic of returning daughters and dowry within the natal lineage [18]. These religiously or customarily sanctioned norms, however, often come into tension with secular legal codes. For instance, in India, the Hindu Marriage Act (1955) prohibits marriage within defined degrees of consanguinity unless allowed by custom, while Muslim Personal Law permits cousin marriages, creating a legal pluralism rooted in religious identity [89–91].

This differential legality reveals how consanguinity intersects with identity politics, especially in pluralistic or post-colonial societies. Among diasporic communities—such as British Pakistanis—cousin marriage functions as a marker of cultural preservation, transnational belonging, and resistance against assimilation. Yet, it has also been subjected to racialized public health discourses in Western societies, where cousin marriage is often portrayed as a cause of congenital disorders, thus becoming a site of bio-political governance. These narratives tend to overlook structural determinants such as poverty, lack of genetic counseling, and healthcare inequality. As a result, consanguineous marriage becomes politicized—portrayed either as a backward cultural practice or defended as a human right within frameworks of religious freedom and cultural autonomy. This tension highlights the complexity of regulating intimacy in multicultural states, where laws, religious traditions, and political narratives converge. Ultimately, consanguineous marriage should be viewed not solely through biomedical or legal lenses but within a broader anthropological framework that situates it at the intersection of belief, law, kinship, and identity.

11. Changing Patterns of Consanguineous Marriage

While consanguineous marriage remains culturally normative and strategically valued in many parts of the Global South, including South Asia, the Middle East, and North Africa, migration has introduced significant shifts in how such practices are sustained or transformed in diaspora settings. Among first-generation immigrants, particularly from Pakistan, Bangladesh, or Arab countries, cousin marriage continues to be practiced as a way of preserving kinship ties, ensuring trust within the family, and consolidating transnational resources such as remittances and migration sponsorship, and the demographic transition period [53,65,67,92]. However, second-generation immigrants in host countries like the United Kingdom, Canada, and the Gulf States increasingly renegotiate the terms of consanguinity, navigating between inherited familial expectations and the values of individual autonomy, education, and romantic choice that are emphasized in host cultures [93].

Ethnographic research among British Pakistani communities, for example, illustrates the increasing ambivalence of second-generation youth toward cousin marriage. While some still consent to such unions to maintain familial loyalty or to meet parental expectations, others resist or delay marriage altogether, citing concerns over genetic risk, lack of personal compatibility, and generational dissonance [53,94]. This resistance often leads to intergenerational tensions, where elders perceive the younger generation's reluctance as a threat to family honor and cultural continuity, while younger individuals view arranged cousin marriage as restrictive or outdated [95]. In Gulf countries, where South Asian and Arab expatriates form large transnational communities, employment-linked migration and temporary visa statuses often disrupt kinship continuity, leading to delayed marriages or shifts toward more individualized spousal selection patterns among younger migrants [74].

Moreover, the digital mediation of matchmaking has significantly altered how cousin marriages are arranged and perceived. Online platforms and matrimonial websites increasingly act as sites where tradition and modernity converge. While some families use digital tools to extend traditional matchmaking across borders (e.g., between UK-based youth and cousins in Pakistan or Bangladesh), others find these platforms empowering for youth seeking partners outside kinship lines [71,75]. Education and occupational mobility—particularly for women—also play a critical role in shaping new marital preferences. For instance, highly educated second-generation women often reject consanguineous unions in favor of partners who match their educational and professional achievements, leading to shifts in intra-community marriage norms and the emergence of negotiated or semi-arranged marriages [73].

In India, consanguineous marriage has been showing a declining trend, as demonstrated by earlier studies [53,67,96]. Based on a large-scale, pan-India dataset spanning more than two decades, the study revealed that factors such as modernity, the expansion of women's education, and greater decision-making power among women have significantly contributed to this decline. At the regional level, Kalam and Ghosh (2025) also observed a generational reduction in consanguineous marriages among the *Khotta* Muslim community of West Bengal [66]. This pattern was influenced by multiple factors, including modernization, educational advancement, and increasing interactions with out-group communities.

Despite these changes, the pattern is not uniformly one of rejection. Some studies report reconfigurations of cousin marriage rather than its wholesale decline. In Canadian and Scandinavian Pakistani communities, for example, young people may strategically accept cousin marriages to fulfill immigration sponsorship roles or to retain inheritance rights in their country of origin, demonstrating a pragmatic, rather than purely emotional or ideological, engagement with kinship norms [75]. This ambivalence reflects a hybrid identity space, where cultural continuity is maintained but through adaptive practices that align with the realities of life in a multicultural society.

The practice of consanguineous marriage among diaspora communities is not static but shaped by dynamic negotiations between tradition and modernity, mediated by structural conditions such as migration policy, transnational family obligations, education, and digital culture. Recognizing these changes requires moving beyond a static or risk-centered view of cousin marriage to one that situates it within broader questions of transnational kinship, intergenerational agency, and diasporic identity.

12. Child and Adolescent Rights in the Context of Consanguineous Marriage

While several manuscripts thoughtfully explore women's autonomy within the framework of consanguineous marriage, they remain silent on the critical issue of child and adolescent rights, particularly in relation to early and arranged marriages. This omission is significant given that consanguineous unions are often interwoven with early marriage practices, especially in patriarchal and resource-constrained settings where kinship structures prioritize familial control over individual choice. In such contexts, cousin marriages are frequently arranged during adolescence or even childhood, reflecting broader gendered norms that limit the autonomy and agency of young girls [89–91].

From a human rights perspective, early consanguineous marriage constitutes a violation of a child's right to free and full consent, bodily autonomy, and access to education and health. International conventions such as the Convention on the Rights of the Child (CRC) and the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) have repeatedly highlighted the adverse consequences of child marriage, including increased risks of domestic violence, maternal mortality, early school dropout, and mental health disorders [87,89,90]. When these early unions occur within consanguineous frameworks, the risks are compounded by genetic vulnerabilities and social isolation, particularly in contexts where young brides are transferred from one household to another without adequate support networks.

Moreover, consanguineous child marriages often take place in environments where legal enforcement of age at marriage is weak, and where cultural or religious justifications override statutory protections. In South Asia, the Middle East, and parts of North and East Africa—regions where both consanguinity and child marriage are prevalent—policy efforts have been inconsistent, frequently undermined by customary laws and patriarchal bargaining systems [89,90]. These dynamics not only violate international legal standards but also perpetuate intergenerational cycles of gender inequality and child rights deprivation.

13. Comparative Ethnographic Voices on Consanguinity

While consanguineous marriage is often addressed through demographic, biomedical, and policy-oriented lenses, its everyday enactment is deeply embedded in culturally specific, emotionally charged, and socially situated contexts. Integrating comparative ethnographic voices provides a richer understanding of how such marriages are not only

institutional arrangements but also arenas where gender, generation, and kinship norms are contested, negotiated, or reaffirmed. Drawing from ethnographic studies in Pakistan, Saudi Arabia, Kerala (India), and diaspora communities, we see both continuities and transformations in how consanguineous marriage is experienced and rationalized in everyday life.

In rural and urban Pakistan, for example, cousin marriage is deeply normalized and widely practiced, often underpinned by logics of family trust, resource consolidation, and lineage loyalty. In her fieldwork in Pakistan and among British Pakistani families, Shaw (2001) notes that women often describe cousin marriage as a mechanism for emotional safety, since marrying within the family is believed to provide greater long-term security and reduce the risks of abuse or neglect from unfamiliar in-laws [39]. However, Shaw (2009) also captures the ambivalence and resistance expressed by younger women, particularly in urban contexts, where educational exposure, media, and peer influence encourage them to question the inevitability of cousin marriage, leading to subtle but significant intergenerational negotiations [39].

Hussain (1999) observed [78] that consanguineous marriage has connections with religion, while his participants remarked as:

"*The custom of consanguineous marriage has very little to do with sunnat. It is just a time-honoured tradition*".

Similarly, a Balochi respondent in his study stated:

"*I do not think people go for consanguineous marriage because it is a sunnat, but they do it mainly because they want to enhance their family relationships*".

Similarly, his participants have other views regarding economic aspects of consanguineous marriage, such as participants expressed their concern:

"*In our family, there is no strong tradition of big jahez. However, if one opts for non-consanguineous marriage, then the size of the jahez is larger to ensure that the girl does not have to listen to any taunts…*"

In Saudi Arabia, where patrilineal kinship and tribal identity are central to social structure, parallel-cousin marriage (father's brother's daughter) is considered the ideal match in many regions. Al-Krenawi and Graham (2005) document how in Bedouin communities, cousin marriage is not only culturally valorized but also enforced through tribal expectations, and women often have limited power to refuse such unions [95]. Yet, the researchers also note increasing contestation among younger Saudi women, particularly in cities, who view such marriages as constraining and seek greater autonomy through education and delayed marriage. These voices reveal an ongoing tension between collectivist familial norms and emerging individual aspirations in post-oil, globalizing Saudi society.

In a study among Emirati women [97], Bureun and Gordon (2020) analyses the reasons for marrying cousins, and the participants stated:

"I followed the advice of my family",

Another said

"I married consanguineously because of my family, I was 16, and all our family married like this, there was no other way [of marriage], my parents wanted me to marry him, also my mother wanted him, so I agreed… I took the advice of my parents because they knew best".

In the Indian state of Kerala, particularly among Muslim and Christian matrilineal and bilateral communities, consanguineous marriage patterns differ sharply by caste, religion, and region. While Hindu communities largely follow gotra exogamy, many Muslim communities in northern Kerala prefer cross-cousin and uncle-niece marriages. Osella and Osella (2000), in their ethnographic work among Muslims in Kozhikode, reveal how such unions are motivated not merely by custom but also by economic strategies—especially when property or dowry negotiations are involved [74]. Here, consanguineous marriage serves as a pragmatic solution to preserve dowry investments within the extended family, demonstrating how kinship is tightly interwoven with financial rationalities. However, the Osella and Osella (2000) also note increasing anxiety among some younger Keralites about genetic risks and compatibility, reflecting a growing exposure to biomedical discourse and public health campaigns [74].

Kalam and Roy (2015) also found certain voices regarding consanguineous marriage and how it impinges on family relations. The participants in Kalam and Roy's (2015) study focused more on old age security as a reason behind consanguineous marriage [98]. One such participant stated:

"I got my son married to my brother's daughter. My brother and I took such a decision so that our children can stay in the same family and could look at us when we grow old".

Kalam and Ghosh (2025) also found declining trends in consanguineous marriages and several reasons behind the decline, starting from changing decision-making power, educational upliftment, changing marriage payment, and family relations [53]. Some of their participants stated:

> *"My father sent me to Kolkata to pursue higher education. Living away from my family members and simultaneously finding the company of a new set of peers in the hostel and college, my orientation towards life changed. I created a new identity of my own, which was unacceptable to my family members".*

14. Digital and Technological Mediation in Consanguineous Marriage Practices

The role of digital technology in reshaping consanguineous marriage practices is a rapidly emerging yet underexplored domain within kinship and anthropological scholarship. As cousin marriages remain prevalent across South Asian, Middle Eastern, and North African societies—and their respective diasporas—technological mediation is increasingly influencing how such unions are arranged, perceived, and negotiated, particularly among younger generations. Online matrimonial platforms, social media, mobile matchmaking apps, and genetic screening technologies have collectively begun to transform the logics of kinship, mate selection, and reproductive risk management, thus challenging the assumed continuity of traditional consanguineous marriage practices.

In many communities, especially among British Pakistanis, Canadian South Asians, and Gulf-based expatriates, matrimonial websites and social media have extended the scope and reach of kin-based matchmaking. These platforms often reaffirm consanguinity by facilitating connections within extended kin networks, especially across borders, thus enabling the persistence of transnational cousin marriages [73,92,99]. For example, matrimonial websites such as Shaadi.com or Muslima.com offer customized filters that allow families to search for potential spouses based on caste, religious sect, and even family lineage, subtly reinforcing kin-endogamy. Simultaneously, such platforms are used by second-generation youth to exercise greater autonomy in spouse selection, often negotiating familial expectations with individual preferences [53].

At the same time, digital literacy and access to biomedical information, including online resources about genetic risks, are beginning to reshape youth perceptions of cousin marriage. Studies have shown that younger individuals, especially women, are increasingly aware of the hereditary health risks associated with consanguinity, leading to greater hesitance or conditional acceptance of cousin unions [7,100,101]. In countries like Saudi Arabia and the UAE, state-supported premarital genetic screening programs—some even mandatory—have introduced a new layer of biomedical governance that intersects with traditional kinship expectations [101,102]. These initiatives often utilize mobile apps and web-based portals to deliver screening results and marriage advisories, offering a technological form of risk regulation that can influence marital decisions [101–105]. Moreover, the rise of genetic counseling services and mobile genetic testing kits has contributed to increasing genetic literacy among educated urban youth, who now confront kinship decisions not only through cultural logics but also biomedical ones. While many families continue to value cousin marriage for reasons of trust, property, and social cohesion, growing awareness of autosomal recessive risks and carrier status is generating a generational shift, wherein consanguineous unions are either selectively practiced or coupled with biomedical interventions like carrier testing and pre-implantation genetic diagnosis [11,101–104].

Despite these trends, technological mediation does not uniformly undermine consanguineous marriage. Rather, it facilitates a hybrid model in which tradition and modernity are co-constituted. Digital platforms allow for a strategic recombination of cultural values and individual choice, and biomedical technologies are selectively embraced by families to mitigate perceived genetic burden while maintaining kinship ideals. Technology is not simply a disruptive force but also a tool of adaptive continuity, allowing consanguineous practices to persist in reformulated, context-specific ways.

15. Policy Implications and Public Health Interventions in Consanguineous Marriage

While the biomedical risks associated with consanguineous marriage—such as increased prevalence of autosomal recessive disorders, congenital anomalies, and intellectual disabilities—are well documented [7,11,103], these risks are not addressed uniformly within health systems or policy frameworks across the globe. In regions where consanguinity is prevalent, such as the Middle East, North Africa, South Asia, and communities in Europe and North America, the policy landscape remains uneven, shaped by a combination of religious norms, legal structures, public health priorities, and cultural politics. Effective interventions in this context require culturally sensitive, interdisciplinary, and community-engaged approaches, particularly those that bridge the gap between anthropological insight and public health practice.

Several countries with high rates of consanguineous marriage have introduced premarital genetic counseling and screening programs as part of public health initiatives. For instance, Iran has established a nationwide premarital screening policy that mandates genetic counseling for couples planning to marry, particularly those in consanguineous unions. This policy, grounded in religious legitimacy and delivered through culturally attuned health infrastructure, has shown some success in improving genetic literacy and reducing the incidence of thalassemia and other hereditary conditions [103]. Similarly, Pakistan, despite facing infrastructural challenges, has implemented targeted screening and public education programs through non-governmental organizations and selective regional interventions [103,104]. These efforts, while limited in reach, signal an acknowledgment of the genetic risks associated with cousin marriage and a move toward preventive care.

In the Gulf Cooperation Council (GCC) countries—including Saudi Arabia, Qatar, and the United Arab Emirates—state-sponsored premarital screening for hemoglobinopathies and other recessive disorders has been made mandatory. These programs often integrate digital health tools, mobile applications, and national registries, and provide certificates required for legal marriage registration [102,103]. However, while medically effective, such programs can sometimes lack cultural nuance. Studies have noted that screening results may be ignored or overridden in favor of familial or tribal expectations, suggesting that biomedical knowledge alone does not dictate marital choices in contexts where kinship is highly valued [16].

From a policy standpoint, several key challenges persist. First, many countries, such as developing and underdeveloped, lack comprehensive legal frameworks that ensure informed consent, protect privacy, and provide non-directive counseling in genetic testing—especially for women and adolescents, whose reproductive choices may be constrained by patriarchal kinship systems. Second, public health messaging around consanguinity often fails to address cultural beliefs and social incentives, and may inadvertently stigmatize communities rather than engage them in constructive dialogue [11,16]. Third, there is limited collaboration between biomedical practitioners, anthropologists, and community leaders, which hampers the development of effective, culturally competent outreach.

Thus, there is an urgent need for anthropologists and public health professionals to collaborate in designing interventions that are contextually grounded and ethically responsible. Anthropologists can provide insights into local kinship systems, marriage norms, and decision-making hierarchies, enabling public health initiatives to be better tailored to community realities. For instance, community-based participatory research (CBPR) and ethnographic models that involve elders, religious leaders, and women's groups in dialogue around genetic risk and reproductive health can enhance acceptance and effectiveness. In diaspora contexts, such as among British Pakistanis, interventions that combine peer education, narrative storytelling, and digital outreach have been more successful than top-down biomedical messaging alone [100]. Policy responses to consanguineous marriage must strike a balance between public health imperatives and cultural sensitivity, recognizing that kinship choices are embedded in social, economic, and emotional logics. Rather than seeking to eliminate the practice, interventions should aim to inform, support, and empower communities to make reproductive choices that are both culturally meaningful and medically safe.

16. Is Consanguinity Relevant in the Present Day?

The relevance of consanguineous marriage in the contemporary world is a subject of sustained academic and policy debate, especially as societies grapple with questions of public health, cultural identity, globalization, and legal modernity. From a cultural and anthropological perspective, consanguineous unions are deeply embedded in social identity as well as kinship ideologies, often perceived as a means of strengthening familial ties, preserving lineage, reinforcing group solidarity, and ensuring the control and inheritance of property [3,16,19,20,80]. For many societies, especially those organized around patrilineal or clan-based systems, such marriages are not merely personal but institutionalized strategies to consolidate power, status, and trust within the extended family or tribe [6,79]. In Islamic contexts, for instance, first-cousin marriages are often religiously permissible and socially accepted, creating continuity between cultural norms and religious doctrines [1,7,21,73]. On the other hand, medical and genetic research has raised significant concerns. Numerous studies have established that consanguineous marriages increase the risk of autosomal recessive disorders, congenital anomalies, stillbirths, and childhood mortality [7,10,81,102]. As health systems evolve and genetic counseling becomes more accessible, there is growing pressure—particularly from biomedical professionals and public health authorities—to discourage such unions, especially where genetic disease prevalence is high.

Economically and educationally, globalization and increasing individual autonomy in marriage choice are challenging traditional kinship norms. In urbanizing societies, rising female education and workforce participation are leading to greater negotiation around spousal selection, often resulting in a shift from kin-arranged to love-based

marriages [21]. Migration patterns—especially among diasporic communities from high-consanguinity regions—are also altering practices. In some cases, transnational marriage within kin continues as a strategy to maintain cultural identity abroad, while in others, acculturation has reduced the prevalence of such unions. From a behavioral ecological perspective, the evolutionary benefits once associated with consanguineous marriages—such as enhanced cooperative breeding, kin altruism, and resource pooling—are increasingly being outweighed by the risks posed by reduced genetic diversity and cumulative genetic load in small, endogamous populations [3,4]. Moreover, with declining fertility rates and smaller family sizes in many parts of the world, the social logic of cousin marriage as a strategy for preserving family cohesion may be diminishing. Legally, while most countries do not prohibit first-cousin marriage, many Western and Christian-majority nations have historically criminalized or stigmatized it, influenced by religious and moral codes. However, legal pluralism in multicultural democracies has complicated the regulation of consanguinity, as cultural rights and individual health risks intersect.

However, in the present socio-cultural context, it is difficult to ascertain the continued relevance of consanguineous marriage. From an anthropological perspective, however, the choice to marry a cousin ultimately rests with the individual, reflecting personal agency within democratic circumstances where no one can prescribe whom to marry or not. Nonetheless, what remains crucial is that, irrespective of whether the union is consanguineous or non-consanguineous, proper genetic counseling should precede mate selection.

17. Way Forward and Future Research Directions

Although consanguineous marriage has been widely studied, important gaps remain that call for future research. The following directions are particularly relevant:

17.1. Integrating Multidisciplinary Approaches

Scholarship is often polarized between biomedical studies that emphasize genetic risk [7,11,100–104] and anthropological accounts that highlight kinship, alliance, and economic rationalities [3,6,80,105]. Future research should bridge these approaches, adopting integrative frameworks that can simultaneously address biological outcomes and socio-cultural meanings.

17.2. Longitudinal and Comparative Studies

Most current evidence is cross-sectional, offering only a snapshot of practices. Longitudinal and intergenerational studies would illuminate how consanguinity adapts to processes such as education, urbanization, and migration [16,67,68]. Comparative work across regions where consanguinity is declining (e.g., North India, North Africa) and where it remains stable (e.g., Pakistan, Gulf States) could provide deeper explanatory insights.

17.3. Lived Experiences and Agency

Kinship-centered analyses often overlook the voices of those directly involved, particularly women and youth. More ethnographic research is needed to capture individual experiences of negotiation, resistance, or acceptance of cousin marriage [27,100]. Such studies would enrich our understanding of how agency operates within structural and familial constraints.

17.4. Intersection with Child Rights and Gender Justice

Future work should explicitly examine the overlap between consanguinity and early marriage, adolescent rights, and gender inequality. While feminist and postcolonial critiques have begun to address these issues [27,54,60,87,91], there is scope for connecting these perspectives with international child rights frameworks [87,89,91].

17.5. Technology, Genetic Counseling, and Digital Mediation

The rise of premarital genetic screening and online matchmaking platforms has reconfigured how cousin marriages are arranged and perceived [8,11,92]. Future research should investigate how biomedical knowledge, digital technologies, and kinship logics intersect to reshape marriage practices, especially among diaspora communities.

17.6. Policy-Oriented Ethnography

There is an urgent need for research that evaluates how health interventions, awareness campaigns, and legal frameworks are interpreted at the community level. Studies that combine anthropological insights with public health strategies could help design culturally sensitive interventions, moving beyond top-down biomedical models to community-based participatory approaches [11,102].

18. Concluding Remarks

Consanguineous marriage remains a complex and multifaceted institution situated at the intersection of kinship, genetics, religion, and modernity. Anthropological scholarship demonstrates that such unions are not merely private choices but socially embedded practices that historically served to preserve lineage, property, and identity. At the same time, biomedical research consistently highlights the genetic risks associated with close kin unions, prompting ongoing debates in public health and policy. Contemporary trends reveal a gradual decline in consanguinity in many regions, shaped by modernization, women's education, migration, and digital mediation, though the practice persists where it continues to provide social and economic security. This duality underscores the need to view consanguinity neither as a relic of the past nor solely as a biomedical risk, but as a dynamic practice continually negotiated within changing socio-cultural and political contexts.

19. Future Prospective

As a review, this paper is limited by its reliance on published literature, which may be affected by publication bias and uneven regional representation. Most available studies focus on South Asia and the Middle East, while Africa, East Asia, and Latin America remain comparatively underexplored. Differences in how consanguinity is defined—whether close, distant, or by specific kin categories—also complicate direct cross-study comparisons. Moreover, this review draws primarily on English-language sources, potentially overlooking valuable research published in regional languages. Finally, given that modernization, migration, and digital mediation are rapidly transforming marriage practices, some of the findings discussed here may already be undergoing change. These limitations suggest that conclusions should be interpreted as indicative rather than definitive, highlighting the need for more longitudinal, comparative, and multidisciplinary research on consanguinity.

Statement of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used Grammarly and ChatGPT to improve readability and language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Author Contributions

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Ethics Statement

This study adhered to standard ethical practices in conducting research and reporting findings.

Informed Consent Statement

As this work is based on secondary data from publicly available sources, no human participants were involved, and informed consent was not applicable.

Data Availability Statement

The data used in this study were obtained from publicly accessible search engines and libraries. All materials are freely available in the public domain and were utilized solely for academic purposes.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Navigating Identity: Cultural Impact on the Demographic Behaviors of migrant *Hela* community of West Bengal

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Abstract

This study examines the demographic behaviors of the migrant Hela community residing in Kolkata, West Bengal, with a focus on how ancestral cultural attachment influence fertility, mortality, and marriage patterns. Traditionally marginalized and identified as Dalits, the Hela migrated from Uttar Pradesh to Kolkata to escape socio-economic discrimination. Based on data from 134 ever-married women, the study analyzes the community's marriage practices, reproductive behavior, and adaptive fitness. Results indicate a strong adherence to endogamous and consanguineous marriages within the group, which underscores their cultural solidarity amid a host environment of distinct social dynamics. The Hela's fertility and mortality pattern surpasses that of their Bengali neighbors, closely aligning with their ancestral demographic patterns in Uttar Pradesh, likely as a means of preserving cultural continuity in a new setting. The selection intensity index shows the population is undergoing selection processes. This research emphasizes the importance of social and cultural cohesion in shaping the demographic profile of migrant communities.

Keyword: *Culture, migration, fertility, mortality, marital distance, identity, Hela, India*

Introduction

The basic structure in demography is formed by its population composition, fertility and mortality patterns and migration. Fertility and mortality are the basic indicators of population dynamics and there are a number of factors determine these two variables for a population (Dreze *et al.* 2001; Bhahsin *et al.* 2002; Skirbekk, 2008; Majelantle, 2013; Asghar, 2014). Cultural beliefs and practices often play an important role in understanding the demographic phenomenon (Basu, 1992; Bhatt, 1998; Branson, 2010; Ghosh & Begum, 2015). For example, the cultural practice of *Mukhagni* (last cremation ceremony among Hindus) forced to have at least one male more child in family (Kalam et al. 2020). Caldwell's Wealth Flows Theory marks a crucial shift in demography by suggesting that high fertility rates in Third World countries are economically rational which also highlights the role of culture in influencing demographic stability and change (Caldwell 1977).

On the other hand, the pattern and practice of marriage is often an indicator of cultural homogeneity, especially among the migrants. A community member tried to get married within the same community member, relatively nearer and/or the places from where they migrated (Kalam and Roy 2015; Kalam et al 2020). Ceroni-Long (1985) observed that migrant groups prefer to marry within their own group due to the survival risks posed by the native majority group. Marital preference is another cultural process that signifies a community's cultural identity (Fox, 1983; Murdock, 1947). It is believed that the practice of endogamy plays a significant role in the survival of the social organization of the community by maintaining behavioural isolation from other such communities (Fox, 1983; Chagnon, 2000; Bittles & Black, 2010). For example, the age-set marriage system among the *Rendile* population of North Kenya (Douglas, 1966) and the marriage pattern among the *Mokogodo* population of Kenya (Cronk, 2000) yielded examples of mate selection that depend on their social organization. Another example of maintaining cultural identity through endogamous marriage is the marriage patterns among the *Khotta* population of West Bengal (Kalam & Roy, 2015).

Endogamous marriage patterns may increase the frequency of cousin marriages in a population, leading to a higher probability of marriage within blood relatives i.e., consanguineous marriage (Billtes 2012). In India, the prevalence of consanguineous marriage was around 10.0%, depending on the region of residence (Sharma et al. 2021). Local community level variation in the prevalence has been observed such as the prevalence ranges from 35.5% among the migrant Telgu-speaking population living in West Bengal (Das, 2003) while 34.78% among migrant *Darbhangia Khotta* population (Kalam, 2021). The prevalence of consanguineous marriage varies with socioeconomic condition, educational attainment, geographical region, religious belief and cultural practices (Krishnamoorthy & Audinarayana, 2001; Iyer, 2002). The higher rate of cousin marriage in a population can leads to inbreeding depression and the natural selection of a population fall in a critical situation (Wright, 1922). Differential fertility and mortality are impediment not only in studying the structure and trends of a population but also in measuring the adaptive fitness of a population (Barua 1976). Selection intensity of human population is a measure of adaptive fitness and it has noted variation regarding factors like differential cultural practices (Sphuler, 1962; Mukhopadhyay, 1981), education and social status (Reddy et al. 1990) and environmental condition (Roy et al. 2014; Kalam et al. 2023), etc.

Thus, understanding the importance of ancestral culture is crucial for explaining the dynamics of demographic phenomena in populations. This study specifically aimed to examine the demographic composition, marriage patterns, and adaptive fitness of the migrant *Hela* community residing in the Kolkata district of West Bengal.

Materials and methods

The study population

The '*Hela*' population were referred to under the generic term '*Methar'*. The *Hela* are mainly found in the districts of Varanasi, Ghazipur, and Mirzapur. Majority of the *Hela* are known for being scavengers, some are agriculture labourer, small business, trade, and government services in the sector of scavenging (Singh et al 2010). According to Census of India (2011), in Uttar Pradesh the *Hela* population

was 52,314. They belonged to the Scheduled Castes in India, mostly regarded as *Dalits*. It was reported that the *Hela* wore typical ornaments as well as tattoo markers as their identification. They consume pork and occasionally the meat of "*Bhains*" or '*Beef*', a typical character for a lower caste people. It has also been found that consanguineous marriage was common among them (Singh et al 2010). They prefer to communicate within themselves in *Hindi*.

The *Hela'* community in the present study were living in Kolkata Municipality Corporation (KMC), ward number 79 of the state West Bengal. They were migrated to Kolkata from Uttar Pradesh (Varanasi and Mirzapur district) due to many socio-economic obstacles mostly due to discrimination and untouchability faced in Uttar Pradesh. The demolition of *Babri* mosque in Uttar Pradesh catalysed the rate of migration. The group of *Hela* people shifted their abode from different districts of Uttar Pradesh to Kolkata and settled in *ghetto* in Kolkata Municipal Corporation ward number 79 at Ballygunge region of Kolkata, West Bengal, the residencial area of elite class of Kolkata. This *ghetto* was called as *Hela Basti* by the nearby native Bengali population. They were now able to understand and speak Bengali language due to their living and job opportunities in Kolkata, surrounded by Bengali natives.

For the present study purpose, 125 households of the *Hela* community have been surveyed. Among them, 134 ever married women were interviewed.

Data types and collection techniques

The data for the present study have been collected by using pretested household schedule and pregnancy history form. The household schedule includes age, sex, relationships, monthly household expenditures, marital status, education, occupation, marital distance and marriage preference, age at first marriage of the participants to get an idea of the population. Data on the fertility, mortality, age at first pregnancy, age at last pregnancy have been collected by using pregnancy record form. Pedigree has been drawn to know the family composition, marriage alliance. The data on marital distance were calculated by estimating the distance between husbands and wives birth places. The marital distance was also used to get the data on different

forms of migrations. The schedules were also crosschecked with the pedigree. An in-depth interviews and case studies were conducted to collect data on communities' perception regarding marriage preference, age of marriage, education, migration, job opportunities, and other social issues after migration.

Adaptive fitness or the Index of opportunity for selection of the *Hela* population was calculated based on differential fertility and differential mortality using Crow (1958). The formula for Crow's index was computed using the following steps-

$$\text{Crow's index: } I_t = I_m + I_f / P_s$$

where, $I_m = P_d / P_s$, $P_s = (1 - P_d)$, $I_f = V_f / X^2$; I_t = index of total selection intensity, I_m= index of selection due to mortality, I_f = index of selection due to fertility, P_d = probability of deaths up to pre-reproductive age, P_s= probability of survival up to reproductive age, V_f = variance due to fertility, and X = mean number of live births.

Results and Discussion

Population composition and socio-economic characterises

Table 1 shows the age-sex wise population composition of the *Hela* community in the study area. It shows majority of the population, especially females were belonging the reproductive age group i.e., 15-44 years. Population pyramid (Figure 1) also showed that the base of the population was thick compared to the old age population. The sex ratio and child sex ratio of the studied population was 1207.0 and 1631.0 respectively which were higher compared to the state of their ancestral residence as well as state of migration and the nation. The ancestral place i.e., Varanasi and Mirzapur showed sex ratio of 887 and 900 and child sex ratio of 873 and 902 respectively (CoI, 2011). The demographic situation is changing and improving among the *Hela* people living in Kolkata. It may possible that the *Hela* people believe that having more number of girls in community helps them survival by producing a greater number of children in new environment. Kolkata was one of the first cities where enlightenment began earlier due to the British influence (Ghosh, 2016). Having more females in a population can have a psychological impact, as it helps to produce

more children in migrant places, thereby increasing numerical power while living near the native population.

In Table 3, the occupational status of the population is presented. The data shows that most of the working population (17.83%) was employed as sweepers/scavengers in the Kolkata Municipal Corporation (KMC), with male participation at 27.63% and female participation at 9.71%. Additionally, around 31.22% of females were employed as housemaids, working in others' houses as child caretakers or doing cleaning work monthly. A few people who gain more education joined in higher level of government jobs (2.01%). It was found that working in KMC as sweeper or scavenger did not need high level of educational attainments, completing secondary level of education is enough for this job.

The results revealed that approximately 31.22% of females are employed as domestic helpers for cooking and cleaning in households. The participants recognize that this is mainly possible in Kolkata, where discrimination based on caste is uncommon. As members of lower castes, they can work in households of upper castes, even as cooking assistants.

> A 38-year-old female respondent said, *"in our ancestral place, you wouldn't find a situation where a person from a lower caste works in an upper caste family. However, in Kolkata, it's very normal. At least in my experience, there has been no discrimination based on caste. The people of Kolkata invite us and allow us to work with them*."

Table 4 showed that 42.27% population were educated up to secondary level. During the interviews, it was clear that the candidates were not interested in pursuing higher education. Their rationale was that higher education often leads to better job opportunities, which can be difficult to attain. On the other hand, they believed that obtaining a lower or secondary level of education would enable them to enter government jobs at an earlier stage, even though these were perceived as lower-level positions.

42 years male respondents share that, '*...After studying so much, what will happen? Yet we have to do the cleaning and sweeping related work. You can't get a good job by studying higher, and you can't be interested in doing cleaning work then. So, minimum secondary level of education is enough*.'

Age group (in years)	**Males**	**Females**	**Total**
0-4	12(5.4)	20(7.46)	32(6.53)
5-9	21(9.45)	22(8.21)	43(8.77)
10-14	15(6.75)	26(9.7)	41(8.36)
15-20	23(10.36)	20(7.46)	43(8.77)
20-24	21(9.48)	33(12.33)	54(11.02)
25-29	29(13.06)	32(11.94)	61(12.44)
30-34	25(11.3)	23(8.59)	48((9.79)
35-39	17(7.65)	19(7.08)	36(7.34)
40-44	11(4.95)	17(6.34)	28(5.71)
45-49	16(7.2)	21(7.83)	37(7.55)
50-54	13(5.85)	10(3.73)	23(4.69)
55-59	5(2.25)	7(2.62)	12(2.44)
60-64	9(4.05)	11(4.10)	32(6.53)
65+	5(2.25)	7(2.61)	12(2.45)
Total	222(100.00)	268(100.00)	490(100.00)

Table 1: *Age and sex wise distribution of the population*

Figures in parentheses indicate percentage

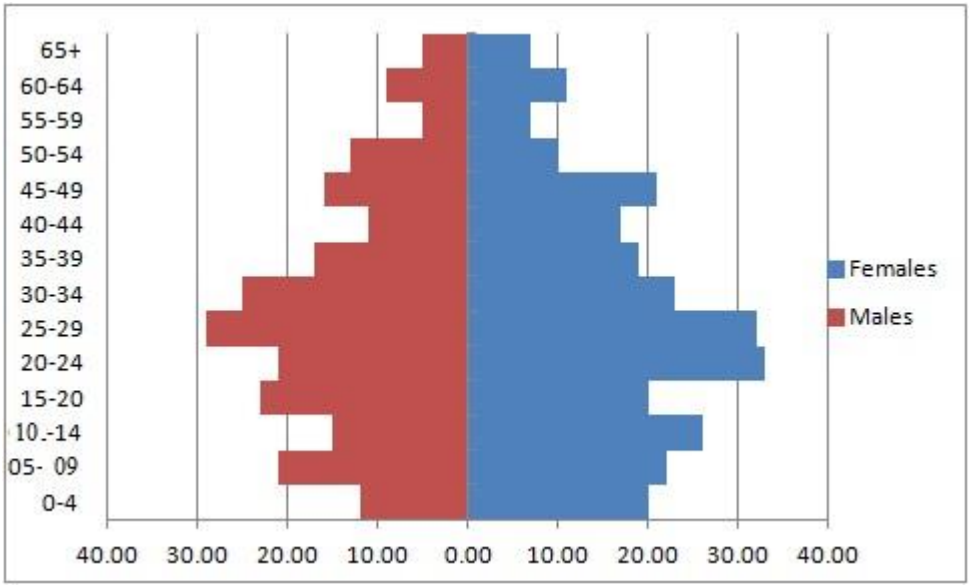

Figure 1: *Population pyramid showing age-sex wise distribution of the Hela population of Ballygunge area of Kolkata*

Types of sex ratio	**Sex Ratio**	**Kolkata**	**Mirzaur, Varanasi**	**Census of India (2011), India**
Total sex ratio	1207	899	903, 918	943
Child sex ratio (0-6 y)	1631	955	899,841	919

Table 2: *Sex ration among the studied population*

Occupation	**Males**	**Females**	**Total**
Kolkata Municipal Corporation sweeper/scavenger	55(27.63)	23(9.71)	78(17.83)
Daily labour	61(28.14)	6(2.53)	67(13.93)
Job seeker	26(13.06)	47(19.84)	73(16.40)
Govt. job	4(2.01)	0(0.00)	4(0.89)
Housemaids	-	74(31.22)	74(16.62)
Homemaker	-	29(12.24)	29(6.51)
Students	48(24.14)	53(22.36)	101(22.69)
Retired	5(2.51)	5(2.10)	10(2.24)
Total	199(100)	237(100)	446(100)

Table 3: *Working status of the population*

Figures in parentheses indicate percentage

Education	Male	Female	Total
Cannot sign(illiterate)	46(22.33)	132(55.23)	178(40.00)
Nursery to 4th standard	30(14.56)	45(18.82)	75(16.85)
Secondary	137(66.50)	52(21.75)	189(42.47)
Higher secondary	6(2.91)	4(1.69)	10(2.24)
Graduated	6(2.91)	6(2.91)	12(2.69)
Total	206(100)	239(100)	445(100)

Table 4: *Educational attainments of the study participants*

Figures in parentheses indicate percentage

Marital preferences

In Table 5, the marriage preferences of the *Hela* population were presented, reflecting their choices of marriage. It was observed that approximately 91% of the respondents married within the same group. The table also indicates that all marriages within the same group were consanguineous, with 97.7% being first-cousin marriages and 3.3%

being second-cousin marriages. Table 6 reveals that about 40.0% of marriages took place within the study area i.e., within zero kilometres distance, and 56.0% of marriages were contracted between ancestral places in Uttar Pradesh. It has raised a question why they marry within the same group and cousins. During interviews, it was observed that due to migration, they were minority Kolkata surrounded by native Bengali people. According to Cerroni-long (1985), migrant groups always prefer to marry within the same group due to the fear of social and cultural agony by the native group. Similarly, it was also observed that the *Hela* group prefers to marry within same group and with cousins to maintain social solidarity within them which corroborates with the study by Kalam et al. (2020). Kalam and Roy (2015) found similar patterns among *Khotta* Muslims, who marry within the group to maintain social solidarity due to their migrant minority status. It seems that ancestral cultural practices encourage the *Hela* community to marry within their own group to preserve cultural integrity, ensuring that their unique heritage remains intact and resilient. This tradition not only reinforces their shared values but also aids in adapting and thriving within new environmental settings, fostering a strong communal identity that endures through generations.

A participant of the age 40 shares her views as, '*marrying with another group may create familial hindrance which will further weaken the group solidarity. We are the migrants here. Thus, we must be careful in this regard.*'

On the other hand, it has been revealed in interviews that individuals from other groups are unwilling to marry the *Hela* participants due to their lower social status. The nearby Bengali group prefers to marry within their own community, matching their castes. Consequently, if someone from the community was not interested in marrying here in the *ghetto* of Kolkata, they went to the ancestral places and marry within the same group, belonging to the same caste. As a result, the marital distance was higher for those who marry in ancestral places (Table 6). Marrying within the same caste group for a long time ultimately leads to marriage within close relatives (NewScience, 2009).

> A 39-year-old participant responded, "*We belong to a lower caste. None of the other caste group members in the neighboring Bengali community were interested in marrying us. They often avoid us, saying we are migrant Biharis*."

The migrant status was attached to them because they migrated from Uttar Pradesh. The *Hela* community members were living there in some kind of fear in their back. Their earlier experiences remind them to understand that if any kind of riot-like situation occurred here, they will be bound to leave the place. However, maintaining social cohesion through culture can be challenging in rapidly changing societies, where external influences and modernization may shift cultural values. Balancing cultural preservation with adaptation becomes essential to sustaining cohesion while embracing progress. Thus, group cohesion is much needed to survive in the 'others place'. Marriage within the same group can be one process through which outside influences can be reduced.

A.	Marriage Within the same Group (*Hela-Hela*)		122(91.04)
	Marriage Outside the group (*Hela-Others*)		12(8.96)
B.	Consanguineous marriage		122(91.04)
		a. First cousin marriage	118(97.7)
		i. Father's Brother's Daughter (FBD)	50(42.4)
		ii. Mother's Brother's Daughter (MBD)	68(57.6)
		b. Second cousin marriage	4(3.3)
	Non consanguineous marriage		12(8.96)
Total			134(100.0)

Table 5: *Marital preference of the studied population*

Figures in parentheses indicate percentage

Distance among	Number of marriages	Distance (K.m)
Within the study area	53(39.55)	0.0
Study area to Uttar Pradesh	75(55.97)	724.0
Study area to other parts of Kolkata	6(4.48)	5.0
Total	134(100.0)	

Table 6: *Marital Distance*

Figures in parentheses indicate percentage

Reproductive behaviour

We assessed the reproductive behavior of the study population by considering fertility, age-specific fertility rate, and infant mortality rate. Table 7 shows the fertility rate of the studied *Hela* population was 2.3, which was higher compared to the neighboring native *Bengali* population. However, it showed similar fertility trends to their ancestral places i.e., Mirzapur and Varanasi. Kolkata shows lowest level of fertility in India (Ghosh, 2016). Surrounded by an urban population in Kolkata's elite region in Bullygunge, the *Hela* community maintained the fertility pattern with their ancestral places. It reflects their demographic affinity with their ancestral place in Uttar Pradesh. An increasing number of members in a population is one kind of strategy to survive in new places. As a result, several studies show higher fertility among the migrant group (Stonawski et al. 2015; Kalam and Roy, 2015). Another important finding was that having male child in a family was very important because of ritualistic performance after death (which is called *Mukhagni* in Hindu ritual). The families among *Hela* continue to have three or four girl children to have at least one child (Kalam et al. 2020). It results into higher sex ratio found (Table 2) among them as well as high fertility.

Table 7 illustrates the mortality pattern within the *Hela* community, which shows similar trends in mortality to their ancestral places despite living alongside urban elite Bengali neighbours. The elite Bengali population exhibited a lower mortality rate.

This raises the question of why fertility and mortality trends still mirror those of their ancestral places, even while living among neighbours with low fertility and low mortality rates. The answer likely lies in their social and cultural ties to their ancestral places, which help maintain similar trends. Living in a close-kin community, the *Hela* people primarily interact with each other before engaging with their neighbours. Consequently, cultural influences compel them to adhere to ancestral patterns.

Table 8 shows the age-specific fertility rate of the *Hela* community. It shows *Hela* women had the highest fertility rate at 24 years of age, with a decline in fertility after 25 years of age (Figure 2). The median age of last pregnancy was 29.9 years, suggesting that *Hela* women typically completed their fertility by the age of thirty. After turning thirty, the women in this community focused on earning money through household work and other tasks. Their ability to earn a living daily may have been hindered by pregnancy and childcare responsibilities. The women strongly believed that completing their fertility at a young age was crucial from both a social and economic perspective. Being pregnant at an older age reduced their social prestige because it was not socially and mentally acceptable within the community.

> A participant of age 34 years said, '*My husband is a daily labourer, and I work as a maid in our neighbour house who are Bengali doctor. When I was pregnant and had to stop working, they stopped paying me, which affected my life and health*.'
>
> Another women of same age group said, '*Pregnancy after thirty years of age is discouraged in our community. It can negatively impact our work as homemaids. Therefore, it is important to avoid pregnancy as early as possible*.'

Among the *Hela*, pregnancy at and/or after thirty years of age was often seen as shameful act. There is a prevailing belief that such a pregnancy represents a diversion from societal norms or expected life paths. This belief reinforces a negative social stigma, making women who become pregnant after thirty feel isolated or judged. The shame is not only internal but also manifests in their interactions with their peer group, where maintaining eye contact may feel uncomfortable, as it can be perceived as a reflection of their non-conformity to social expectations.

A participant who got pregnant at 32 years of age shared her experience as, '*I was stayed in my home for six months meeting no one. Only my family member knew that. They too were uncomfortable with me. I was sent to my parental home in Uttar Paradesh.After delivery of my son, when i came back i feel ashamed to talk with my peers. However, slowly the situation changed and other accepts it.*'

Variable	*Hela* population (Kolkata)	Kolkata West Bengal (RGI 2022)	In Mirzapur, Varanasi, UP
Fertility	2.3	1.2	2.6, 4.2
Mortality	96.7	41.0	80, 89.2

Table 7: *Fertility and mortality among the Hela community*

Age (in years)	Number of wedlock women	Number of live births							
		15 -19	20 -24	25 -29	30 -34	35 -39	40 - 44	45 $^{+}$	Total
15-19	13	0.77(10)							0.77(10)
20-24	22	0.50(11)	0.59 (13)						1.09(24)
25-29	17	0.70(12)	0.58(10)	0.52 (9)					1.82(31)
30-34	20	0.85(17)	0.85(17)	0.6 (12)	0.3 (6)	0.35(7)			2.95(59)
35-39	18	0.77(14)	1.00 (18)	0.65(11)	0.22 (4)	0.11(2)	0.11(2)		2.83(51)
40-44	16	1.00(16)	0.93 (15)	0.75(12)	0.68(11)	0.31(5)			3.68(59)
45^{+}	28	(0.35)10	0.64(18)	0.92(26)	0.46(13)	0.25(7)	0.07(2)	-	2.71(76)
Total	*134*	*0.67(90)*	*0.68 (91)*	*0.44(70)*	*0.25(34)*	*0.10(21)*	*0.01(4)*	-	*2.31(310)*

Table 8: *Age specific fertility structure of the population*

Figures in parentis indicates number of livebirths

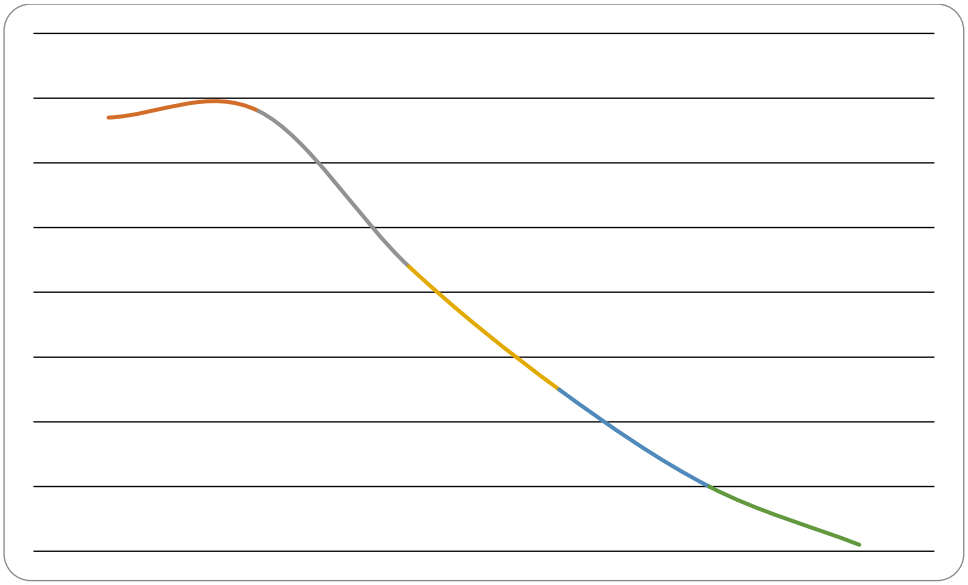

Figure 2: *Age-specific fertility among the Hela population of Kolkata*

Variables	Median age at first marriage(years)	Median age at first child Birth (years)	Median age at last pregnancy(year)	Mean differences in fist and last child birth
Females	18.01	18.9	29.9	9.9±2.3

Table 9: *Median ages at first and last pregnancies of the Hela female population in the study area*

Index of opportunity for selection

The selective fitness of a population depends upon the reproductive efficiency and fertility of the population member and the offspring's survivability (Barua 2007). J.F. Crow (1958) devised a selection intensity index to measure the maximum potential of selective fitness by using differential fertility and mortality (Equation I). In the present study, Table 10 shows that the fertility index (0.550) was higher than the mortality index (0.107). This suggests that improved living conditions and a better healthcare system may be responsible for a lower impact on mortality. Rajanikumari et al. (1985) found that in most Andhra caste populations, fertility has a greater impact

than mortality on selection. In this population as well, the trend was similar, with the lower impact of mortality on fertility being attributed to improved living conditions and healthcare systems after migrating from their ancestral place to urban areas of Kolkata. The total section intensity index was 0.716 which is comparatively lower compared to other population studied by Reddy and Chopra (1990) among *Palle* population (I_t=0.94), Sirajuddin (1984) among *Chenchu* population (I_t=1.45), and higher compared to study by Kalam et al. (2015) among *Darbhangia Khotta* (I_t=0.405), Sohkhlet (2013) among the Gowda population (It=0.470) This result highlights the importance of natural selection in shaping genetic variation. When the total selection intensity index is zero, there will be no genetic makeup change due to selection (Livingstone et al 1965). Further research will be helpful to shed more light on the connection between fertility and mortality indices and their contribution to the evolutionary pattern of this population through natural selection after migration.

Components of index opportunity for selection	Values of the components
Number of women	134
Number of live births	310
Mean live birth(X)	2.3
Variance live birth (V_f)	2.9
Pre reproductive mortality	30
Proportion of death before the age 15 years (P_d)	0.097
Proportion of survival after 15 years age (P_s)	0.903
Index of mortality ($I_m = P_d/P_s$)	0.107
Index of fertility ($I_f=V_f/X^2$)	0.550
Index of opportunity for selection ($I_t=I_m + I_f/P_s$)	0.716

Table 10: *Index of opportunity for selection*

Conclusion

Our research focuses on the anthropological demographic profile of the migrant *Hela* community, which lives in a ghetto near Ballygunge, an urban and elite area in Kolkata, West Bengal. The study revealed that the community members largely practice group endogamy, and all marital alliances were consanguineous. The recorded fertility was above the replacement level, with a high mortality rate, and the selection intensity calculated for this population was comparatively low. An ethnographic account of this community would help to understand the role of gender, culture, and economy in delineating the demographic profile of the *Hela* group. However, a small sample size might be a limitation of this study, but the study to understand culture and its effect on population might not depend on the sample size. Although, comparing this group with a sub-sample drawn from the ancestral population living in Mirzapur and Varanasi districts of Uttar Pradesh would provide a better picture of continuity and change in the demographic profile of the *Hela* population.

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Data availability: The study is a small part of demographic research on migrant communities of West Bengal.

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