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Review Article

Study of Prevalence and Determinants of Consanguinity: When Parents are Related

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Abstract: ***Background:*** Consanguinity, which is defined as marriage between close biological relatives (first and second cousins) is a deeply rooted cultural norm in India. Although socially acceptable in sore communities, it carries a genetic and health cost for children. ***Objectives:*** This paper investigates the prevalence and correlates of consanguinity in India, with particular reference to its socio-cultural patterning and health implications. ***Methods:*** A review of the published literature, of national survey data and regional interventions was undertaken to measure the prevalence of consanguinity, its social determinants and its genetic outcomes. ***Results:*** It is the aim of the current report to summarize what is currently known about consanguinity in India among Hindu and Muslim populations. While deemed desirable for social and economic reasons by families, offspring from consanguineous relations have a higher chance of congenital anomalies, hereditary diseases, and early death. ***Conclusion:*** The practice of consanguinity in Indian population is still turning on the wheel due to culture, religion, and financial reasons. Nevertheless, increased knowledge of genetic health hazards, prematrimony counselling, and expanded educational privilege are slowly bringing this to an end. Education and community-based interventions are needed to prevent negative health consequences while respecting local traditions.

Keywords: Consanguinity, Prevalence, Marriage Practices, Genetic Disorders, India.

INTRODUCTION

Definition and Concept

The term consanguinity is derived from the Latin words con (together/related) and sanguis (blood) which imply the people are united through one ancestor (Bittles, 2001). The most usual type is first-cousin marriage, followed by marriage to second cousins, uncle-niece or relations even closer than these in some groups. For the purpose of genetics, consanguinity is described by an inbreeding coefficient (F) ≥ 0·0156, representing the probability that those born as children of the same founder have the same genes from both parents (Bittles, 2012).

Global Context

Consanguinity marriages are common in many countries worldwide, especially in the Middle East, North Africa, and South Asia, where they represent 20-50% or more of all unions (Bittles, 2009; Hamamy *et al*., 2011). The custom is continued by migrant communities in Europe, North America and Australia (Modell & Darr, 2002). Conversely, in China, Taiwan, and the Philippines, these relationships are forbidden by law or by norms (Hamamy & Alwan, 2016).

India as the historical and cultural setting

India has a traditional practice of consanguineous marriage, particularly in those communities where kinship relations and caste dominated the marriage process. They are usually preferred as they help maintain property within families, maintain cultural continuity and build trust between relatives (Sandridge *et al*., 2010). Regional patterns vary:

- It is high in Southern India (Tamil Nadu, Andhra Pradesh, Telangana, Karnataka) and this might be due to the fact that uncle–niece and cross-cousin marriages are permissible (Sharma *et al*., 2021).
- It is generally discouraged in northern India, but it still exists among Muslims and some tribal population (Acharya & Sahoo, 2021).
- Jammu & Kashmir demonstrates a higher prevalence, as statistics between 35% and 50% have been recorded in districts of Rajouri and Poonch, which is related to endogamy and

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geographic isolation (Bhasin & Nag, 2017; Sharma, 2016).

Medical and Genetic Implications

In the biomedical model, consanguinity increases the homozygosity of the offspring, increasing the risk of the expression of autosomal recessive genetic diseases (Bener & Mohammad, 2017). Consequences such as congenital malformations, mental retardation, visual and auditory disabilities, increased infant mortality rates have been reported (Kumaramanickavel *et al*., 2002; Selvarajan *et al*., 2013; Fareed *et al*., 2017). Though many offspring are not affected, the chances of congenital anomalies in first-cousin marriages increase up to 5-6%, as opposed to approximately 2-3% in marriages between non-relatives (Centre for Genetic Education, 2021). It is further exacerbated by repeated cousin marriages throughout the generations (Kalam *et al*., 2024).

Emerging Awareness and Research Gap

Though deeply rooted in culture, the medical risks are becoming more widely known. Prevalence is also dropping in younger generations (especially in urban and well-off families), owing to education, urbanization, and genetic counseling services (Sharma *et al*., 2020). Yet, the NFHS-5 data suggests that consanguineous marriages still continue to make up about 11% of all the matrimony in India which may rise up to 28% in southern states (Sharma *et al*., 2021; Kalam *et al*., 2024). This emphasises the importance of culture sensitive community projects and interventions including social and medical approaches to reduce stigma.

Aim of the Study

The present review paper addresses the prevalence and determinants of the consanguinity and finds the social and cultural motive for the continued practice of consanguineous marriages in India and the health implications. This is needed to guide policy makers, health professionals, and community leaders to enhance awareness and establish premarital counseling programs (Modell & Darr, 2002; Saba *et al*., 2021).

PREVALENCE OF CONSANGUINITY

General Overview

Consanguineous marriages are still a major concern from a demographic perspective on the global scale. Around a billion people probably live in communities where these marriages occur (Bittles & Black 2010; Modell & Darr 2002). But it is not evenly distributed and it varies according to geography, religion and custom. It is particularly common in the Middle East, West Asia and North Africa, where 20–50% of unions are between kin (Hamamy *et al*., 2011; Bittles, 2009).

National Prevalence in India

In India, the prevalence of consanguinity is approximately 11% nationally as per the National Family Health Survey-5 (NFHS-5). That is almost 1/10 of marriage is between relatives, but the prevalence varies widely across regions and communities (Sharma *et al*., 2021; Kalam *et al*., 2024).

Southern: Average prevalence rates of 23-28% have been recorded in states including Tamil Nadu, Karnataka, Andhra Pradesh, Telangana and Puducherry, while some communities have reported even higher rates. Uncle–niece and cross-cousin marriages are prevalent and approved of social practice in the areas (Metgud *et al*., 2012; Acharya & Sahoo, 2021).

- **Northern India:** The general rate is less (approximately 13%), but Muslim groups report a greater prevalence than Hindus. Practice is higher among some castes and rural populations among Hindus (Sharma *et al*., 2021).
- **North-East India:** It shows least prevalence for consanguinity (3.1%), There exist different cultural practices and more rigidness against marriage with cousins (Sharma *et al*., 2021).
- **Central and Eastern India:** The prevalence varies between 20–23% with an intermediate prevalence between north and south states (Sharma *et al*., 2021).

Religion and Community Differences

Religious affiliation strongly influences prevalence. Muslims have been found to practice a higher rate (15%) of consanguinity than the Hindus (9%) as per studies (Sharma *et al*., 2020). This mirrors wider Islamic culture which allows and even advocates cousin marriage to maintain family and tribe cohesiveness. In Hinduism, the ritual is more prevalent in the south which is influenced by caste systems and local traditions (Saba *et al*., 2021).

Regional Case Studies

- **Belgaum District, Karnataka:** Metgud *et al*. (2012) found 52% of rural females to be first-cousin married.
- **Malda District, West Bengal:** Kalam (2021) reported a prevalence of 92% first-cousin marriage among the Darbhangia Khotta Muslim caste.
- **Jammu & Kashmir:** Research suggests prevalence of CYPs at 35–50% in particular districts such as Rajouri and Poonch, resulting from limited mobility coupled with endogamy (Bhasin & Nag, 2017; Sharma, 2016). The high rate of cousin marriages in the region has also been associated with the increased prevalence of several rare genetic diseases like cystic fibrosis, Wolfram syndrome, and metabolic disorders (Sharma, 2016).

Trends Over Time

Consanguinity has been common but is reported to be declining in the younger generations, particularly among urban, educated and wealthy groups. Women with college education, from a nuclear family and having a greater decision-making power are far less likely to be

married to their family (Sharma *et al*., 2020). These changes not only owe to urbanization, migration, and inter-community mixing, but also have been due to factors that have resulted in a decrease in the intensity of B. ovalae infections. But this practice is still rampant in the country's rural hinterland, particularly in South India and Kashmir.

Summary of Indian Data

The table below summarizes prevalence findings across studies:

Table 1: Prevalence of Consanguineous Marriages in India

Authors	Prevalence	Data
Kalam *et al*, 2024	13.6%	Pan Indian
Sharma *et al*., 2021 North India Central India East India North Eastern India West India South India	9.9% 13.1% 22.0% 23.4% 3.1% 14.8% 23.5%	Pan Indian
Kalam, 2021	34.0%	Regional
Das, 2003	35.5%	Regional
Kumaramanickavel *et al*., 2002	28.8%	Regional
Banerjee and Roy, 2002	16.6%	Pan Indian

Key Insights

1. Regional disparity is the most significant determinant: highest in South India, lowest in the North-East.
2. Religion and caste play a crucial role, with higher rates among Muslims and certain Hindu castes.
3. Socio-economic status and education inversely correlate with consanguinity, as urban and affluent groups increasingly abandon the practice.
4. Despite modernization, pockets of extremely high prevalence persist, particularly in rural and isolated regions.

Social Reasons for Consanguinity

Arranged/ consanguineous marriages in India are formed largely due to social, cultural and economic reasons rather than for medical reasons. General knowledge and awareness of genetic risk has increased, but in many societies consanguineous marriages are still preferred due to cultural, social stability, and benefits (Sandridge *et al*., 2010; Bittles, 2001).

Protection of Family Wealth and Assets

Consanguineous marriage is most common for the retention of property and wealth in the family. In many families, such intra-familail ties are seen as a means of stemming the subdivision of family's land, businesses or ancestral property. Well-to-do families and landowners in particular promote cousin marriage to retain property and prevent arguments about inheritance (Hamamy & Bittles, 2008).

Strengthening Kinship Bonds

Cousin marriages are also advocated for enhancing family relations and unity. The extended family is maintained by marrying within the family, and Trust is maintained in successive generations due to the clan and kinship. Families argue that these marriages will be compatible since spouses already have the same cultural background and values (Bittles, 2012). This ongoing relationship also encourages easier bride-in-laws living relations, and a more supportive household environment.

Social Security and Women's Security

Consanguineous marriages are usually considered to offer women more protection and social security. When the groom is a known relative, much of the unpredictability in dowry talks, financial situations, and their concealed health factors eliminated. parents tend to trust daughters to close kin because they assume that the daughter is more likely to be better treated and to experience greater marital stability (Sandridge *et al*., 2010). Further, women frequently wish to live near their own extended families after marriage, which is easier when they marry cousins.

Cultural Continuity and Tradition

The cousin marriage is also part of Indian culture and religion. It is beyond a historical culture itself, because it is the carrier of the national spirit, the blood of life education, the gene of personality and the cradle of national soul in information society. First cousin marriage is a sanctioned religious practice for Muslims both in India and overseas, and is still held in high regard and in South Indian Hindu communities, the caste system maintains its practice (Sharma *et al*., 2021; Saba *et al*., 2021).

Compatibility and Marital Harmony

Sociological reports consider consanguinity unions more harmonious and stable, as spouses are already related by social networks and family environment (Sandridge *et al*. 2010). That way there's

less chance of spat with their partner and their families and a more stable family home to live in.

Reduced Costs and Simpler Negotiations

Lower cost of bargaining in marriage is another social benefit. When the relatives are already intermarried, dowry demands frequently decrease and the logistics of a wedding is more manageable. These marriages may be less formal, which tends to appeal to low- and middle-income families (Bittles 2001).

Endogamy and Restricted Social Circles

Consanguinity is found in isolated geographic or socially isolated communities as a result of endogamy (marrying within the same familial, ethnic, or social group). This is especially marked in the rural parts of South India and J&K, where the low interaction with external communities yields high level of endogamy within the families (Bhasin & Nag, 2017; Sharma, 2016).

Summary of Social Drivers

1. **Economic motivation:** Protecting family property and wealth.
2. **Cultural preservation:** Upholding caste, religious, and traditional norms.
3. **Social security:** Ensuring better treatment and support for women.
4. **Compatibility:** Greater marital harmony due to shared background.
5. **Practical benefits:** Lower costs and easier marriage negotiations.
6. **Geographic isolation:** Limited marriage pools in rural and endogamous populations.

Benefits and Risks

Consanguineous marriages are complex social phenomena with both positive socio-cultural outcomes and negative biomedical consequences. While many communities perceive such unions as advantageous for social stability, scientific evidence highlights their potential to increase genetic risks among offspring (Bittles, 2012; Bener & Mohammad, 2017).

1. Social and Cultural Benefits

Strengthening Kinship and Family Solidarity

Cousin marriages reinforce family unity and kinship bonds by keeping relationships within the extended family. This practice promotes strong emotional ties, ensures continuity of family traditions, and fosters a sense of loyalty and trust between households (Sandridge *et al*., 2010).

Cultural Continuity

These marriages are considered a mechanism for preserving cultural identity. They transmit family traditions, language, and social customs across generations, especially in communities where cultural continuity is highly valued (Saba *et al*., 2021).

Economic Stability and Property Preservation

Consanguinity allows families to retain wealth and land within the lineage, thereby minimizing disputes over inheritance and strengthening financial security (Hamamy & Bittles, 2008). In agricultural or land-owning communities, this practice is particularly advantageous.

Greater Marital Compatibility

Studies suggest that couples in consanguineous marriages often experience greater compatibility due to shared upbringing, common values, and overlapping social networks. This familiarity reduces marital conflicts and provides a supportive environment for women, who may have better relationships with their in-laws (Sandridge *et al*., 2010).

Lower Costs and Simpler Negotiations

Marrying within the family frequently reduces the economic burden of marriage ceremonies. Dowry expectations are typically lower, and negotiations are simplified because of pre-existing relationships and mutual trust (Bittles, 2001).

2. Biomedical and Genetic Risks

Increased Homozygosity and Genetic Disorders

The most significant risk of consanguinity is the increased expression of recessive genetic conditions. When close relatives marry, their offspring are more likely to inherit identical alleles from both parents, leading to homozygosity (Bittles, 2001; Hamamy *et al*., 2011). This raises the risk of:

- Congenital malformations
- Intellectual disabilities
- Hearing and visual impairments
- Metabolic and rare genetic disorders

For example, Kumaramanickavel *et al*., (2002) observed a higher prevalence of genetic eye disorders in South Indian consanguineous families, while Selvarajan *et al*., (2013) linked cousin marriages to increased congenital hearing impairment.

Infant and Child Mortality

Epidemiological studies consistently show higher rates of stillbirth, neonatal death, and infant mortality in consanguineous unions compared to non-consanguineous ones (Fareed *et al*., 2017; Das, 2003; Kalam *et al*., 2024). For instance, Banerjee & Roy (2002) reported a significant negative effect of parental consanguinity on child survival across India.

Risk of Common Adult Diseases

While the link between consanguinity and non-communicable diseases is still being studied, some evidence suggests increased risks for conditions such as hypertension, cancer, diabetes, and heart disease in highly inbred populations (Bener *et al*., 2007; Bener & Mohammad, 2017).

Intergenerational Accumulation of Risk

Repeated cousin marriages across several generations can amplify genetic risks, particularly for rare autosomal recessive conditions. In certain populations, such as those in the Middle East and South India, uncle–niece and double first-cousin marriages have been associated with extremely high inbreeding coefficients (Hamamy *et al*., 2011).

Variable Outcomes

It is important to note that not all children from consanguineous unions are affected. Approximately 90% of offspring may remain healthy, depending on whether deleterious alleles are present in the family gene pool (Hamamy, 2003). In populations with limited frequency of harmful genes, outcomes may be normal. However, when defective alleles are common, risks increase significantly.

3. Balancing Perspectives

Supporters of consanguinity argue that by exposing harmful recessive alleles, inbreeding may allow natural selection to eliminate deleterious genes from the population over time (Balwan & Saba, 2020). Critics counter that this comes at the cost of increased morbidity and mortality in affected children.

Given these competing perspectives, experts recommend genetic counseling and premarital awareness programs rather than outright bans, as such measures respect cultural traditions while minimizing health risks (Modell & Darr, 2002).

Key Insights

1. **Social benefits**—such as family solidarity, cultural preservation, and economic stability—explain why consanguinity remains common.
2. **Biomedical risks**—including congenital disorders, increased mortality, and chronic disease associations—underscore the need for awareness.
3. **Balanced interventions** that integrate cultural sensitivity with public health education are essential for addressing the challenges posed by consanguinity.

Genetics and Clinical Outcomes

Consanguineous unions affect human health primarily through their impact on genetic variation, inheritance patterns, and reproductive outcomes. By increasing the likelihood that both parents carry identical alleles from a common ancestor, such marriages raise the probability of recessive disorders manifesting in children (Bittles, 2001; Hamamy *et al*., 2011). While many offspring remain healthy, epidemiological evidence demonstrates elevated risks for congenital anomalies, infant mortality, and chronic diseases in populations with high consanguinity.

1. Genetic Mechanisms and Homozygosity

Consanguinity increases homozygosity, meaning offspring are more likely to inherit two copies of the same allele. This raises the expression of autosomal recessive disorders, which normally remain hidden in heterozygous carriers (Bittles, 2012). The degree of risk varies by relationship:

- **Siblings:** share ~50% of genes.
- **Uncle–niece / double first cousins:** share ~25%.
- **First cousins:** share ~12.5%.
- **Second cousins:** share ~3% (Hamamy *et al*., 2011).

Beyond second cousins, the genetic risk approaches that of the general population, whereas repeated cousin marriages across generations can magnify recessive disorders within families.

2. Congenital Disorders and Birth Defects

Several studies in India and abroad confirm higher rates of birth defects and congenital anomalies among children of consanguineous couples.

- **Ophthalmic disorders:** Kumaramanickavel *et al*., (2002) reported increased cases of hereditary eye diseases in South Indian consanguineous families.
- **Hearing impairment:** Selvarajan *et al*. (2013) showed congenital hearing loss was up to **three times more common** in children born from close-relative marriages.
- **Lysosomal storage disorders:** Al-Jasmi *et al*. (2013) found consanguinity to be a major risk factor for Gaucher disease, Fabry disease, and related conditions in Saudi Arabia.
- **Rare genetic syndromes:** In Jammu & Kashmir, consanguineous families reported conditions such as cystic fibrosis, Wolfram syndrome, and abnormalities in sexual differentiation (Sharma, 2016).

These outcomes highlight the connection between restricted genetic diversity and elevated risk for rare disorders in inbred populations.

3. Reproductive Outcomes and Mortality

Consanguinity is strongly associated with adverse reproductive outcomes.

- **Stillbirths and Infant Mortality:** Banerjee & Roy (2002) and Fareed *et al*. (2017) demonstrated higher rates of stillbirth, neonatal, and post-neonatal mortality in consanguineous unions compared to non-consanguineous couples.
- **Pregnancy complications:** Metgud *et al*. (2012) and Bellad *et al*. (2012) observed that rural women in Karnataka with consanguineous marriages had higher incidences of prematurity, low birth weight, and pregnancy loss.
- **Regional evidence:** Das (2003) reported significantly higher spontaneous abortions and infant mortality among Telugu-speaking

populations practicing consanguinity in West Bengal.

NFHS-5 data further confirm that regions with higher consanguinity particularly South India and Jammu & Kashmir report increased prevalence of reproductive wastage and child mortality (Sharma *et al*., 2021; Kalam *et al*., 2024).

4. Risk of Common Adult Diseases

Although most research emphasizes congenital and childhood outcomes, studies also suggest that consanguinity may increase susceptibility to adult-onset diseases.

- Bener *et al*. (2007) found elevated rates of cancer, hypertension, gastrointestinal disorders, and mental illness in consanguineous populations in Qatar.
- Bener & Mohammad (2017) reported increased prevalence of non-communicable diseases such as diabetes and cardiovascular disease in highly inbred communities.
- Kundu & Jana (2024) noted that children and even grandchildren of consanguineous couples showed higher risks of psychotic disorders, stroke, and hypertension.

These findings suggest that the health impact of consanguinity may extend across the lifespan and across multiple generations.

5. Variability and Contextual Factors

It is important to recognize that not all consanguineous unions result in adverse health outcomes. In fact, approximately 90% of offspring may be unaffected, particularly when deleterious alleles are rare in the population (Hamamy, 2003). Risks depend on:

- The frequency of harmful alleles in the community.
- The degree of relatedness between partners.
- The presence of repeated consanguineous marriages across generations.
- Environmental and healthcare factors that may exacerbate or mitigate outcomes.

Thus, the genetic consequences of consanguinity are not uniform but vary across populations.

6. Implications for Genetic Counseling

Public health experts emphasize that rather than banning consanguinity, communities should focus on genetic counseling and awareness programs (Modell & Darr, 2002). Counseling can help families:

- Assess genetic risk.
- Access carrier testing where available.
- Make informed reproductive decisions.

This culturally sensitive approach respects social traditions while helping families reduce the likelihood of genetic disorders.

Key Insights

1. Genetic risks are primarily linked to recessive disorders expressed due to increased homozygosity.
2. Congenital anomalies, infant mortality, and birth defects are consistently higher in consanguineous populations.
3. Emerging evidence links consanguinity with adult-onset chronic diseases across generations.
4. Not all offspring are affected; outcomes vary depending on family history and allele frequency.
5. Genetic counseling offers a balanced solution, integrating cultural respect with medical awareness.

CONCLUSION

Summary of Findings

This review paper reflects on the fact that consanguinity is still a common social custom in India, with the prevalence ranging substantially depending on region, religion and community. National figures indicate that 1:10 marriages are consanguineous, with a much higher incidence (20–30%) in southern states like Tamil Nadu, Andhra Pradesh, Karnataka, and rural, as well as endogamous populations in Jammu & Kashmir. In the northeastern states where cultural values prevent such unions, by comparison, the rate of cohabitation is lowest. It's impacts on practice were also found to be associated with religion where the category of fanatics (Muslim) was observed to be having higher rates than religion (Hindu) category of traditional persons (Sharma *et al*., 2021; Kalam *et al*., 2024).

Social Implications

Consanguineous marriages are still preferred by families for social, cultural and social advantages. These consist of retaining property within the family, solidification of familial ties, alleviation of dowry-marriage pressures and favourable opportunities for mate-selection when spouses are acquainted with one another. Some women consider such marriages a way to protect themselves socially, by being able to stay close to their natal families and minimizing the uncertainty associated with marrying into unknown households (Sandridge *et al*., 2010; Bittles, 2012).

Biomedical Implications

Although the advantages are thought to be worth it, the genetic costs of consanguinity are apparent. The reported rates of congenital anomalies, hereditary eye and hearing disorders, stillbirth, infant deaths, and uncommon hereditary syndromes are significantly higher in consanguineous communities (Kumaramanickavel *et al*., 2002; Selvarajan *et al*., 2013; Fareed *et al*., 2017). Friday, October 16, 2020 Emerging

studies also suggest that these epithelial-stromal relationships contribute to adult-onset diseases; including hypertension, cancer, diabetes and mental illness and, that these may last generations (Bener & Mohammad, 2017; Kundu & Jana, 2024).

Public Health and Policy Implications

The persistence of consanguinity underscores the need for culturally sensitive interventions. Instead of attempting to eliminate the practice which is deeply rooted in tradition and religion—public health approaches should focus on:

- Genetic counseling services to help couples understand potential risks.
- Premarital screening programs in high-prevalence communities.
- Awareness campaigns targeting rural populations and communities with strong traditions of cousin marriage.
- Integration of genetic education into school and college curricula to raise awareness among younger generations.

Countries such as Saudi Arabia and Qatar have already introduced premarital counseling laws that offer genetic testing and awareness programs for couples at risk (Hamamy *et al*., 2011). Similar initiatives in India could help reduce the burden of genetic disorders without clashing with cultural traditions.

Future Directions

Further population-based studies are needed in India to:

- Map regional prevalence with greater accuracy.
- Identify specific genetic disorders linked to cousin marriage.
- Assess the long-term impact of consanguinity on adult health outcomes.
- Evaluate the effectiveness of counseling and awareness interventions in reducing risk.

Final Remark

In summary, consanguinity in India is a complex mix of culture and biology. As much as its socially desired for family unity and economic self-sufficiency, it represents apparent genetic and health problems. The problem is not how to stop doing it but how best to accommodate this ritual with public health priorities while respecting cultural norms. India can progress towards lower morbidity and mortality due to consanguinity coupled with maintenance of culture and tradition with a rise in education, underprivileged women empowerment, counseling, and availability of screening facilities.

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