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Consanguineous Marriage and Associated Risk of Congenital Malformations: A Study among the Muslims of Barpeta District, Assam

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KEYWORDS

Consanguinity, Congenital, Inbreeding, Char, Non-char

ABSTRACT

Consanguinity refers to the practice of marrying or having children with close relatives. Congenital malformation, on the other hand, refers to physical or structural abnormality that is present at birth. Consanguinity can increase the risk of congenital malformations because close relatives are more likely to carry same harmful genes which can increase the risk of child inheriting two copies of the same harmful genes. The present study was conducted among the Bangla speaking Muslims of Barpeta district, Assam because among the Muslim consanguineous marriage is a permissible form of marriage. The aim of the study is to look into the frequency of consanguineous marriage and also the prevalence of congenital malformation among the children born out of consanguineous mating. Genealogical method was used to assess the consanguinity status of the population. A total of 836 married couples have been considered under the present study out of which 273 are consanguineous marriages and 563 are non-consanguineous. Data have been collected from two geographical locations, Char (mid-channel bars) and Non-char (built up area). The average coefficient of inbreeding for char areas is 0.035229 and for non-char areas is 0.0291. The populations mean coefficient of inbreeding for char areas is 0.004003299 and for non-char areas is 0.0026358. The combined mean coefficient of inbreeding is 0.003335722. The frequency of consanguineous marriages is found to be high in char (40.68%) than non-char (25.93%). A statistically significant result has been observed in the prevalence of congenital malformations among the children born out of consanguineous and non-consanguineous marriages.

Introduction

A consanguineous marriage is one where the spouses have at least on common ancestor. In medical genetics the definition of consanguinity is normally restricted to a preferential union between a couple related as second cousins or closer (Bittles 2010). Inbreeding is the genetic consequences of consanguineous marriage.

When two individuals who are closely related reproduce, there is a high risk of passing on genetic disorders to their offsprings. This is because they are more likely to carry the same genetic mutations due to their shared ancestry. Several studies have investigated the relationship between consanguinity and the expression of genetic disorders. The prevalence of congenital heart disease was found to be higher among the offspring of consanguineous marriages compared to non-consanguineous marriages (Bener and Alali 2010). The frequency of autosomal recessive disorders, such as cystic fibrosis and sickle cell disease, was also higher among the offspring of consanguineous marriages (Bittles 2019). Furthermore,

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consanguinity was associated with a higher prevalence of several genetic disorders, including hearing loss, intellectual disability and metabolic disorders (Hamamy 2012). In North Eastern part of India on the above concern no such studies have been conducted yet to see this association. The present study is an attempt to see association between consanguineous marriage and prevalence of congenital malformationsamong the Bangla speaking people living in char and non-char.

Objectives

The present study was conducted with the following objectives:

- To calculate the inbreeding co-efficient of Bangla speaking Muslims of Barpeta district.
- To study the prevalence of congenital disorders among the children born out of consanguineous and non-consanguineous marriages.

Methodology

The present study is a cross sectional study done with the help of purposive sampling technique among the children born out of 836 couples. Out of which 273 are consanguineous couples and 563 non- consanguineous. The present study was conducted among the Bangla speaking Muslims of Barpeta district. The population is again divided into two localities on the basis of their different geographical settings. One section of the sample is collected from the char (the mid-channel bars) area and another is from Non-char (Built up area). Genealogical method was used to assess the consanguinity status of the population.

Two basic measures are employed to quantify genetic relationships. The first is the coefficient of relationship (r), which is the proportion of genes identical bydescent (IBD) shared by two individuals. The coefficient of relationship is calculated from the formula: r = {(1/2) n} where n is the number of steps apart on a pedigree for these two individuals via their common ancestor. Thus for two persons related as first cousins: r = {(1/2) 4} + {(1/2) 4} = 1/8

The coefficient of inbreeding (F) is the probability that to alleles at any locus are identical by decent from the common ancestor (s) of two parents.

$$F = \sum[(½)^{n+1}(1 + F_A)]$$

Where, N is the number of connecting links between the two parents through common ancestors.

F_A is the co-efficient of inbreeding of the common ancestor A.

The mean coefficient of inbreeding ($\propto$) can be calculated to provide a measure of the intensity of inbreeding in the population, according to the formula:

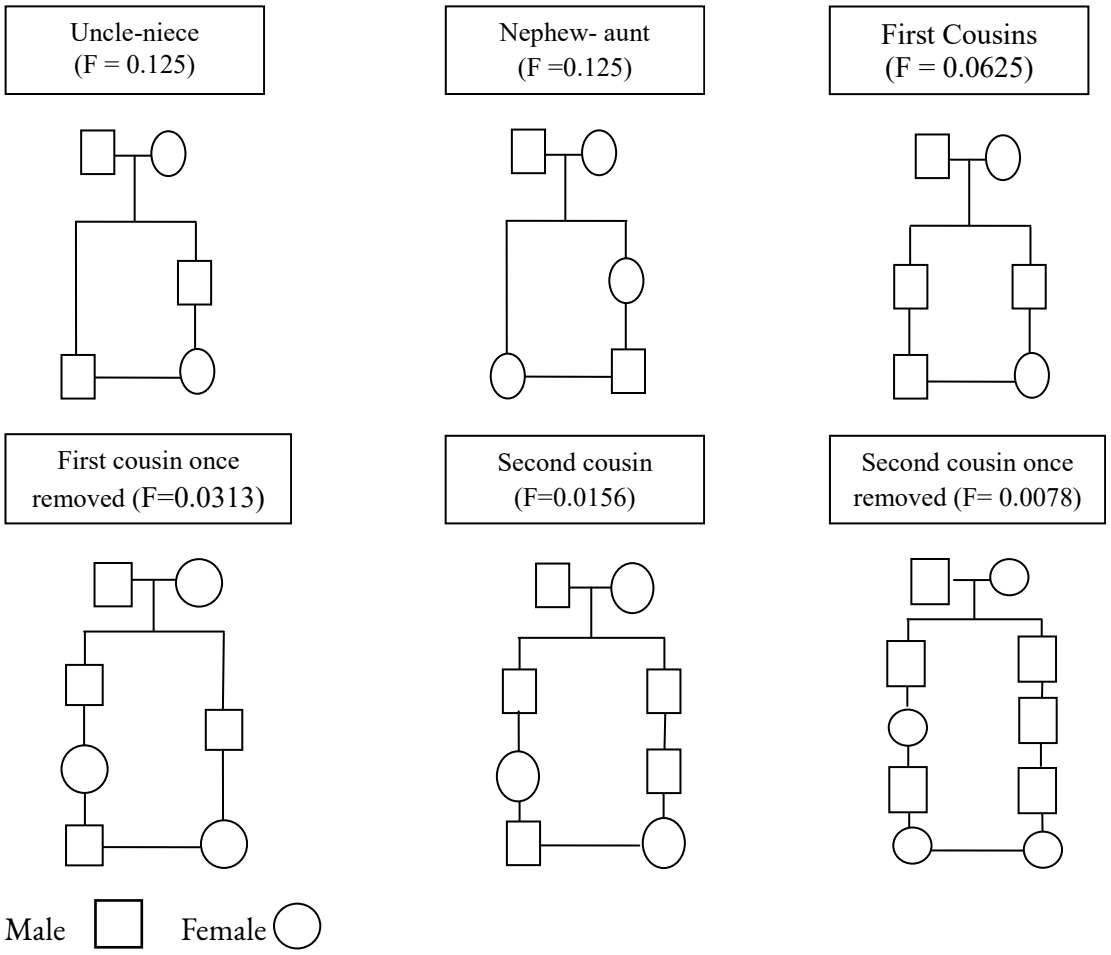
$$\propto = \sum \text{pi } Fi$$

where, $\sum$ is the summation of the proportion of individuals pi in each consanguinity category *Fi* (Wright 1922).

Results and Discussion

From the Table: 1, it could be seen that in char area the total no. of marriages is 381, out of which total no. of consanguineous marriages is 155 (40.68%). In the non- chararea, the total no. of marriages is 455 out of which the total no. of consanguineous marriage is 118 (25.93%).

The following are some of the common types of consanguineous marriage-



From the Table 2, it could be seen that there are eight types of consanguineous marriages identified in the study areas, these are uncle-niece, nephew-aunt, double first-cousin, first-cousin, half first-cousin, second-cousin, third-cousin marriage out of which the second-cousin marriage is found to be higher in both char and non-char (32.26%, char, 32.20%, non-char) area followed by first-cousin (30.32%, char, 31.36% non-char).The average coefficient of inbreeding for char areas is 0.035229 and for non-char areas is 0.0291.The populations mean coefficient of inbreeding for char areas is 0.004003299 and for non-char areas is 0.0026358.The combined mean coefficient of inbreeding is 0.003335722.

From the Table 3, it could be seen that there are five types of congenital disorders found in the study area. Out of which polydactyly (9.52%) is found to be more than other four types like albinism (8.05%), cleft lip with or without palate (8.79%), deaf and dumb (7.69%), skeletal abnormality (4.76%)

From the Table 4, it could be seen that the no of congenital disorders is more in the inbreds than in non-inbreds and the frequency is found to be higher in case of first- cousin inbreds.

The Muslims practice inbreeding and has been doing so for longer than any Egyptian dynasty. This practice also predates the world's oldest monarchy (the Danish) by 300 years. Consanguineous marriage is common in all Indian Muslim communities (Bittles and Hussain 2000). Variations are, however, seen in the levels of consanguineous unions contracted in different branches of Islam and between specific communities and these differences emphasize the important influence of local and regional customs in the arrangement of marriage contacts.

Based on 1992 – 93 National Family and Health Survey (IIPS 1995), unions between biological kin are uncommon in the northern, eastern and northeastern states because of a general prohibition on consanguineous marriage in the majority Hindu population. But, uncle - niece marriage and first

cousin unions between a man and his maternal uncle's daughter (mother's brother's daughter) have a long tradition in South India (Sastri 1976).

In a broad sense, it is necessary to consider that inbreeding can occur under two quite different biological situations. There may be inbreeding because of restriction of population number. Thus, inbreeding is a phenomenon frequently associated with small populations. On the other hand, inbreeding can occur in a large population as a form of non-random mating when the frequency of consanguineous mating is higher than that expected by chance.

In the present population, a variation in the prevalence of percentage of consanguinity could be noticed between the char and non-char areas. In the char areas 40.68% of marriages are found to be consanguineous whereas in the non-charareas it is only 25.93%. The average coefficient of inbreeding is 0.035229 for char and 0.0291 for non-char areas. The population mean coefficient of inbreeding has been found to be 0.004003299 for char areas and 0.002635818 for non-char areas respectively. The combined populations mean coefficient of inbreeding is 0.003335722.

Puri*et al*. (1978) have reported the highest levels of consanguineous marriage so far in a single generation from the former French colony of Pondicherry in South India with 54.9% consanguinity (mean coefficient of inbreeding $\propto$= 0.0449; and among army recruits in the province of Punjab, Pakistan with 77.1% consanguinity ($\propto$= 0.0414) (Hashmi 1997). Most of the consanguineous marriages in Punjab were between first cousins (F = 0.0625) whereas in Pondicherry uncle-niece marriages (F = 0.125) predominated (Bilttes 2010).

In 1998, a still higher average coefficient of inbreeding has been reported F = 0.0477 in North India, in particular Aligarh by Badaruddoza *et al*. In more than 60% of the consanguineous marriage, the spouses were first cousins.

Devi *et al*. (1981) found the coefficient of inbreeding in Bangalore, Karnataka as 0.02308, higher than in comparable, urban populations in other South Indian states. The highest rates of consanguineous marriage in South India are usually reported in traditional rural areas and among the poorest and least educated groups (Srinivasan and Mukherjee 1976).

In the present study also a similar result could be noted when in the rural areas a higher mean coefficient of inbreeding has been found than the peri - urban non-char areas.

In the Muslim populations of India, there has been no evidence of a reduction in consanguineous marriage during the last 40 years (Hussain and Bilttes 2000). In the North – Eastern part of India consanguineous marriage is not present in the populations except among the Muslims. Limbu in 1998 have reported that due to demographic compulsion in the North Cachar Hills district consanguineous marriages have been found among the Semsa an off shoot of the Dimasa. The mean coefficient of inbreeding is reported as 0.000318078.

Two instances of consanguinity have also been reported among the War khasi (Khongsdier and Ghosh 1996). Barua*et al*. (1994) have reported that nearly 11.24% of all the marriages in the Khampti of Assam are consanguineous. Barua (1986) found a much higher frequency of 15.13% among the DirangMonpa in DjongDirang and 28.13% in Mandlaphudung, Arunachal Pradesh. The practice of consanguineous marriage is absent among the indigenous Assamese Muslims of Assam. Rizvi and Buzarbarua in 1991 have found 6.37% of consanguineous marriages among the Garia Muslims of Assam. The mean coefficient of inbreeding for the total population of India in the 1992 – 93 was α = 0.0075 (National Family and Health Survey) (IIPS 1995). Very less percentage of consanguinity has been reported from the different states of the North – Eastern region (Table: 5) (Bittles 2002).

In the present study, among both the char and non-char people cousin marriages are more frequent than other types of consanguinity. Highest frequency is found for the second-cousin marriages (32.43% in char areas and 32.20% in the non-char areas). This is followed by the first-cousin marriages (29.05% in the char areas and 31.36% in the non-char areas) and third-cousin marriages (20.27% in the chars and 25.42% in the non-chars). The highest level of consanguineous marriage reported as far is in Pondicherry (54.9%) where uncle-niece marriages (F = 0.125) predominated.

The coefficient of consanguinity (coefficient of inbreeding) F is the probability of an offspring of a consanguineous marriage being homozygous at a locus for an identical gene derived from a common ancestor. Parental consanguinity increases the frequency of homozygote in the offspring at the expense of heterozygote, hidden recessives and additive alleles would thus increase in frequency in the inbred individuals. A large numbers of infant and childhood disorders of rare single lethal and sub lethal recessives or polygenic combinations of rare recessives due to inbreeding have been observed by several authors (Schull *et al*. 1970; Badaruddoza and Akhtaruzzaman 1994; Badaruddoza*et al*. 1995).

In the present study a total of five congenital disorders have been found (Table. 3). The incidence of congenital disorders among the consanguineous was found to be higher (P <0.001) than that among the non – consanguineous marriage. A total of 5 congenital disorders have been found in the present population. A similar result of higher occurrence of congenital malformations has been noticed by Badaruddoza*et al*. (1998). They have found 14 disorders, which was significantly higher among the consanguineous than the non-consanguineous. In the general population the risk of having a child with a severe or lethal medical condition is 2% if there if no known recessive family history of disease and the couple have not had a previous abnormal child. This risk increases to 5 – 6% for a first – cousin couple (Saggar and Bittles 2008).

As per a Latin American collaborative study of congenital malformations, based on 34,102 newborn infants with one of 47 types of congenital anomaly, a significant association with consanguinity was detected only for hydrocephalus, postaxial polydactyly and bilateral cleft lip ± cleft palate (Saggar and Bittles 2008). In Europe and Japan the frequency of first cousin marriages among the parents of affected individuals with recessive traits such as albinism, phenylketonuria, ichthyosis congenital and microcephaly is remarkably higher than frequency of first cousin marriages in the corresponding general population (Bodner and Cavalli Sforza 1976). On the other hand it has also been claimed that inbreeding effects depend not only on the magnitude but also on the period during which inbreeding is practised in the population (Sanghvi and Perin 1974). Significantly higher congenital malformations have also been found in consanguineous couples. Rates were higher in uncle-niece marriages than in first cousin marriages (Kulkarni and Kurian 1990).

Higher rates of inbreeding leads to gradual elimination of deleterious genes by segregation (Sanghvi 1966; Rao and Inbaraj 1980). This has been questioned by Chakraborty and Chakravarti (1977) and Bittles (1980).

Conclusion

In conclusion, an association between consanguinity and expression of genetic disorders could be observed. Individual who are closely related are more likely to carry same genetic mutations, which can increase the risk of passing the genetic disorders to their offspring.

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Conflicts of interest*: None*

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Tables

Table :1 Consanguinity profile among the Muslim

Place of residence	Consanguineous marriage	Non-Consanguineous marriage	Total	χ^2 value
Char	155 (40.68%)	226 (59.32%)	381	20.5097* p-value is <.00001 d.f=1
Non-Char	118 (25.93%)	337 (74.07%)	455	
Total	273 (32.66%)	563 (67.34%)	836	

**Statistically significant at 0.05% level.*

Table:2 Consanguinity profile among the Muslim according to types of Consanguinity

Types of Consanguinity	Inbreeding coefficient (F)	Char		Non-Char	
		Frequency (n)	%	Frequency (n)	%
Uncle-niece	0.125	4	2.58	-	-
Nephew- Aunt	0.125	1	0.65	-	-
Double First- cousin	0.125	3	1.94	-	-
First-cousin	0.0625	47	30.32	37	31.36
Half First- cousin	0.0313	14	9.03	11	9.32
First-cousin once removed	0.0313	6	3.87	2	1.69
Second-cousin	0.0156	50	32.26	38	32.20
Third-cousin	0.0039	30	19.35	30	25.42
Total		155	40.68	118	25.93

(Medhi and Begum, 2014)

Table: 3 Prevalence of congenital disorders according to type of marriage

Types of disorders	Consanguineous marriage		Non-Consanguineous marriage		χ^2 value
	No	(%)	No	(%)	
Polydactyly	26	9.52	2	1.06	9.871* p-value is .04265 d.f=4
Skeletal abnormality	13	4.76	6	0.18	
Albinism	15	8.05	1	0.35	
Cleft lip with or without palate	24	8.79	1	0.89	
Deaf and Dumb	21	7.69	5	0.18	
Total	106	38.81	15	2.66	

**Statistically significant at 0.05% level.*

Table: 4 Consanguineous disorder as per consanguinity classes

Parental Relationship	Number
Non Consanguineous	15
Consanguineous	106
Uncle-niece	2
Nephew-Aunt	-
Double first-cousin	-
First-cousin	35
Half first-cousin	24
First-cousin once removed	20
Second-cousin	19
Third-cousin	6

Table: 5 Consanguineous marriage in the North East, 1992-93

State	Consanguineous marriage (%)	Mean coefficient of inbreeding ($\propto$)
Arunachal Pradesh	3.9	0.0029
Assam	1.7	0.0010
Manipur	2.1	0.0013
Meghalaya	2.7	0.0018
Mizoram	0.5	0.0002
Nagaland	1.5	0.0009
Tripura	1.9	0.0010
Present Study Char areas	42.53	0.004463
Non-Char areas	25.93	0.001855