# A STUDY ON CONSANGUINITY AND ITS IMPACT ON THE FERTILITY STATUS OF SELECTED COMMUNITIES IN KANYAKUMARI DISTRICT

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***ABSTRACT :*** Union of partners with close biological ancestry is known as consanguineous marriages. This paper examines the effect of consanguineous marriages on fertility, infant and child mortality and morbidity carried out in 5 selected SC communities of Kanyakumari district, Tamil Nadu, India. Data for assessing and evaluating the effect of inbreeding were collected through random sampling using structured questionnaire. A total of 3822 ever married women aged (19 to 90 years) were interviewed for the study. Types of mating patterns observed include 1C, UN, DFC, 2C with predominant 2C marriages. Mean fertility in these communities was observed to be higher for consanguineous (4.32%) unions. Among the inbred the highest value (4.32%) for fertility mean falls in first cousin unions and lowest (1.67%) in uncle niece unions of Sambavars. Mortality pattern was found to follow the mean fertility pattern highest among consanguineous (Thandan, 24.2%) and lowest among non-consanguineous (6.76%). Morbidity conditions was also high among consanguineous group (13.11%). It was also observed that among non-consanguineous (NC) Pallars, morbidity conditions was not observed in any form. The observations of higher mean fertility and higher mortality among consanguineous unions (C) could be due to genetic homozygosis of genes that favour and increase the risk effects, as the case may be, inherited from their common ancestors.

*IndexTerms* - Survival, lethal equivalents, fertility, consanguineous, spouses

## 1. INTRODUCTION

'Legal union of male and female sharing a common ancestor' is defined as consanguineous union [1-4]. The practice of consanguineous marriage who are not siblings is very old social institution and it remains common in many parts of the world and has been reported in various communities [5, 6]. Depending upon the prevalence of consanguineous marriages, four major global areas were defined: regions in which less than 1% marriages are consanguineous (North America, Europe), 1-10% of all marriages are consanguineous (Latin America, Japan, China) and 20-50% of marriages are consanguineous (Middle East, North America, South Asia) [7-9]. Consanguinity is a deeply rooted cultural trend in many of these communities and variation within and between populations and communities depend on ethnicity, religion, culture and geography. The preferable reason for favouring consanguineous marriages in communities are primarily social as it is favourable for the women's status including wife's better relationship with her in-laws, to solve financial issues, thus strengthens family ties and enforces family solidarity.

Consanguineous marriages ranges from first cousins (1C), Double First Cousins (DFC), Uncle Niece (UN), Second cousins (2C), Aunt-Nephew (AN), first cousins once removed, second cousins once removed etc. The preference of specific type of cousin marriage varies with public attitude and are driven by religious and cultural beliefs followed by a community [10, 4]. The most frequently prevailing form of

consanguineous marriage in many societies is first cousin unions [11]. Among first cousin unions, some type of unions are favoured while others are strongly avoided. For example, among Hindus of South India, parallel unions are considered to be incest and tabooed. In Western Europe, People's Republic of China first cousin unions are banned through civil laws [12]. The prohibition to consanguineous unions are perhaps due to its adverse effect on the posterity of inbred. Offspring of inbred have an increased risk of morbidity and mortality. Consanguineous unions bring together autosomal recessive lethal or sub-lethal alleles from their parents sharing common genes. Therefore the offspring of inbred show developmental hazards leading to intrauterine deaths or defects making them non-viable leading to mortality at various pre-reproductive stages as well as show congenital defects with genetic predisposition [13]. Among inbred descendants, first cousin unions are more prone to such defects compared to other type of unions [14, 2].

India is a multicultural, multi-religious, multi-linguistic land where 20-50% of population practice intra community and consanguineous unions for centuries. Growth rate of Indian population is 1.6% [15]. With increase in growth rate the prevalence of genetic disorders is also increasing due to traditional practice of consanguineous mating. Compared to 1-4% of consanguineous marriages in Northern part of India, the Southern region records 40-50% of consanguineous marriages [16]. Studies on the effect of consanguineous marriages on fertility have shown varying results. Consanguinity is assumed to occur mostly in areas of low population density and leads to low fertility [17]. Low fertility levels associated with consanguineous marriages have been reported [18]. The postulate that regular consanguineous marriage could maintain the highest fertility have been observed by various authors in various populations world over [19-21]. Higher fertility among inbred were reported from North India and South India [22, 23]. Studies conducted in Tamil Nadu also revealed increased fertility among inbred [24]. On the other hand certain works point out that increased offspring mortality is not due to parental consanguinity [25, 26]. Above review points shows conflicting opinions in respect to the effect of consanguinity on reproductive status. The present paper concerns the results of consanguinity study carried out in 5 communities of Kanyakumari district in the state of Tamil Nadu.

## MATERIALS AND METHODS

The subjects for the present study Sambavar, Pallar, Bharathar, Paravan and Thandan belong to the Scheduled class of Kanyakumari district. SC population of the district is 0.39% of the total population. The data necessary for the analysis of reproductive status were collected by door to door visit using comprehensive questionnaires. Random samples of families ranging from 10 to 50% of the total households of different communities were collected. Frequency of consanguinity and mean coefficient of consanguinity (F) was calculated to quantify the genetic relatedness between spouses. The rate at which different patterns of marriage such as UN, 1C, 2C etc. occur in the percentage of total union is the frequency of consanguinity (F). The mean F is calculated by the formulae $F= \Sigma Fc \times n/N$ [27] Fc= co-efficient of consanguinity of different degrees of union including non-consanguineous, 'n' is the frequency of different categories, 'N' is the total number of marriages. Co-efficient of inbreeding is the probability that a person with two identical genes (homozygote) received both the genes from an identical ancestor. Fc for different patterns is 1/8 for UN and DFC, 1/16 for 1C, 1/32 for 1.5C and 1/64 for 2C patterns.

Fertility was measured by the number of pregnancies per woman. Fertility mean was calculated from the number of pregnancies and marriages. Pregnancies included full term births, premature live births and reproductive wastage i.e., still births and abortions. The women who missed her period for five or more weeks was considered pregnant and total number of it was calculated by accounting all types of foetal loss and survivors. Risk of mortality and morbidity due to inbreeding was estimated by comparing their occurrence in consanguineous and non-consanguineous groups. For estimating mortality, prenatal (abortion and still births), post natal (neo natal, post neo natal, infant, child and juvenile) and total mortality rates were considered. Foetal loss or abortion before $28^{th}$ week of gestation was considered as prenatal mortality. The loss after $28^{th}$ week of gestation before birth was considered as still births. Deaths after birth but before 28 days were accounted as neonatal mortality. Deaths between $4^{th}$ week and 1 year after birth were considered as post natal mortality. Neonatal mortality and post neonatal mortality together were accounted for infant

mortality. Child mortality was considered as the deaths up to 5 years and up to 20 years of age was considered as juvenile mortality. Morbidity risk was evaluated by analysing the rates in both consanguineous and non-consanguineous groups after categorizing the congenital defects in to sensory, mental, physical etc. The data was analysed statistically to find out the significance.

## RESULTS AND DISCUSSION

Consanguinity is rooted throughout world and the degree varies from region to region based on religion, culture and socio-economic status. The percentage of consanguineous and non-consanguineous marriages obtained for five SC communities are furnished in Table 1. As observed in the table, the percentage of consanguineous unions were more in Paravan (65.92%) and less in Sambavars (40.09%). From the present study, it is evident that high level of consanguinity prevail in all the communities studied. Mostly consanguinity is favoured in Muslim countries and found less in Western countries. In Asia, it is prevalent in West Asian and South East Asian countries. Earlier study on consanguinity from South India have reported fairly high values of 40-60% to highest value of over 70% [28]. South Indians prefer consanguineous marriages than North Indians. North Indians prohibit consanguineous marriages up to $7^{th}$ generation in father side and $5^{th}$ generation in mother side whereas South Indians allow even uncle niece unions. From his observation on inbreeding communities of Kerala state Mathews classified the inbreeding rates into five classes such as <10, 10-30, 30-50, 50-70 and >70 [29]. The present observation of consanguinity rate in the 4 SC (Pallar, Bharathar, Paravan and Thandan) communities fall under 50 to 70 and the other (Sambavar) in 30 to 50 category.

**Table 1 Percentage of consanguinity**

| Community | Consanguinity | Non-Consanguinity | % of Consanguinity |
|---|---|---|---|
| **Sambavar** | 423 | 632 | 40.09 |
| **Pallar** | 577 | 473 | 54.95 |
| **Bharathar** | 300 | 210 | 58.82 |
| **Paravan** | 265 | 137 | 65.92 |
| **Thandan** | 453 | 352 | 56.27 |

The mean frequency of consanguineous marriages for different communities in the study population was reported in the Table 2. The mean frequency values ranged from 13.13% to 28.59%. It was found to be higher for Pallar and lower for Paravan. The most prevalent pattern of consanguineous unions found was 2C type (Pallar, Paravan, Thandan) followed by 1C (Bharathar and Sambavar). The risk for 2C union is 1/16 [30]. Many reports evidence more 1C unions and South Indian Hindu communities prefer matrilateral cross cousin unions [31-33]. Appreciable values of UN union is reported from Tamil Nadu, Karnataka and Andhra Pradesh whereas studies from Kerala reports rare occurrence of such unions [34, 35]. The risk for UN unions is 1/8 and congenital malformations are found to be more [30].

**Table 2 Mean Frequency of consanguineous unions for different communities**

| Caste | Types of Consanguinity (Percentage) | | | | Mean frequency (Percentage) |
|---|---|---|---|---|---|
| | 1C | 2C | UN | DFC | |
| **Sambavar** | 19.81 | 18.67 | 1.33 | 0.28 | 20.96 |
| **Pallar** | 20.48 | 32.29 | 1.71 | 0.48 | 28.59 |
| **Bharathar** | 28.82 | 21.57 | 7.65 | 0.78 | 14.87 |
| **Paravan** | 19.15 | 41.29 | 5.22 | 0.25 | 13.13 |
| **Thandan** | 23.11 | 32.17 | 0.75 | 0.25 | 22.45 |

The fertility mean observed in the present study ranged between 1.67 and 4.32 (Table 3). For non-consanguineous couples the value ranged between 1.70 and 2.82 whereas for consanguineous it was between 2.78 and 3.72. In all the 5 castes studied the fertility mean was higher for consanguineous couples. Fertility mean was found to vary among couples with different degrees of relationship. Higher fertility mean was observed for first cousin marriage (Sambavar, 4.32) followed by uncle niece (Pallar, 3.28) and second cousins (Sambavar, 3.18). Present study evidence fertility mean more than 3% among Sambavars and Pallars and below 3% among Bharathar, Paravan and Thandan communities. It was found more among consanguineous couples in all the five communities studied. Consanguinity studies world over prove its positive association with early mortality and disorders. Consanguineous marriages affect conception, live births and child survival thus affecting the fertility of the inbred. Association between consanguinity and fertility may follow any one of the following trends as reported by earlier workers following negative trend fertility among inbred, positive trend with higher fertility rate or non- clear association [36, 21, 18]. Studies reporting higher rate of fertility among inbred attribute the increase to younger female age at marriage leading to increased maternal reproductive span, compensation for the higher infant mortality among consanguineous couples, or lower prenatal loses among consanguineous couples [37]. Increased fertility as discussed by earlier workers may be due to early marriage, preference for male, joint family system to divide the work, climate, poverty which supplement family income by more children, high infant mortality, inadequate family welfare services, inadequate recreation facilities which makes sex the only entertainment, religion and agriculture [20, 21]. Education, marital age and residential place were also found as the factors responsible for higher fertility [22]. Earlier marriage provide a longer potential fertile period and higher fertility mean among consanguineous couples as maternal reproduction and child bearing occurs mostly in the most fertile years [24, 5]. To compensate mortality and morbidity, consanguineous couples give birth to more offspring which increases the fertility mean [38, 39, 22, 5].

**Table 3 Fertility mean of the selected castes**

| Caste | Fertility mean (Percentage) | | | | | |
|---|---|---|---|---|---|---|
| | 1C | U/N | DFC | 2 C | Total C | NC |
| **Sambavar** | 4.32 | 2.71 | 1.67 | 3.18 | 3.72 | 2.21 |
| **Pallar** | 3.44 | 3.28 | 3.00 | 2.86 | 3.09 | 1.70 |
| **Bharathar** | 2.78 | 3.03 | 3.00 | 2.69 | 2.78 | 2.63 |
| **Paravan** | 3.26 | 2.38 | 2.00 | 2.77 | 2.88 | 2.82 |
| **Thandan** | 2.77 | 2.17 | 2.50 | 2.84 | 2.80 | 2.40 |

Data presented in Table 4 shows the different types of mortality observed in consanguineous and non-consanguineous marriages. The prenatal mortality ranged from 0 to 11.26% while post natal rates ranged from 0 to 9.21%. Total mortality ranged from 6.76% to 24.2%. The data was highly significant in all the communities at all the levels. Mortality was found more among consanguineous couples than non-consanguineous in all communities. Abortions and neo-natal mortality was more than other types of losses. In general the offspring of consanguineous unions exhibit a higher level of early morbidity and mortality up to early adulthood [40]. Relationship between consanguinity and mortality has been reported worldwide including India [28, 41]. Present study evidence more loss of progeny in early stage among consanguineous than non-consanguineous. Ill effects of inbreeding on fitness of natural populations refers to the selection of alleles with higher fitness more common over time resulting in Darwinian evolution [42].

Consanguineous marriage pave way to bring two recessive lethal genes together due to their common ancestry. Depending upon the degree of spousal relationships offspring's with such lethal or sub-lethal genes in homozygous condition show different degrees of developmental hazards ranging from foetal abnormality, intrauterine death or neonatal abnormality and become non-viable leading to mortality at various pre-reproductive stages. However, inbred off-springs who survive to adulthood may show decreased

fertility due to homozygosis of the recessive alleles which may interfere with gametogenesis, hormonal cycling, ovulation, sperm transport, fertilization or implantation.

**Table 4 Mortality observed in the selected castes**

| Caste | | Mortality | | | | | | | | | | | | Total Mortality* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Prenatal mortality | | | | Postnatal mortality | | | | | | | | | |
| | | Still birth* | | Abortion* | | Neonatal* | | Post-neonatal* | | Child* | | Juvenile** | | | |
| | | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Sambavar | C | 32 | 2.04 | 177 | 11.26 | 84 | 6.16 | 23 | 1.69 | 13 | 0.95 | 7 | 0.51 | 336 | 22.61 |
| Pallar | | 20 | 1.12 | 116 | 6.51 | 60 | 3.64 | 69 | 4.19 | 37 | 2.25 | 3 | 0.18 | 305 | 17.89 |
| Bharathar | | 5 | 0.6 | 35 | 4.2 | 65 | 8.19 | 26 | 3.27 | 14 | 1.76 | 11 | 1.39 | 156 | 19.41 |
| Paravan | | 4 | 0.52 | 62 | 8.14 | 55 | 7.9 | 24 | 3.45 | 11 | 1.58 | 10 | 1.44 | 166 | 23.03 |
| Thandan | | 10 | 0.79 | 119 | 9.38 | 105 | 9.21 | 36 | 3.16 | 16 | 1.4 | 3 | 0.26 | 289 | 24.2 |
| Sambavar | NC | 34 | 2.44 | 105 | 7.53 | 59 | 4.7 | 9 | 0.72 | 0 | 0 | 0 | 0 | 207 | 15.38 |
| Pallar | | 0 | 0 | 46 | 5.71 | 5 | 0.66 | 3 | 0.39 | 0 | 0 | 0 | 0 | 54 | 6.76 |
| Bharathar | | 6 | 1.09 | 48 | 8.7 | 12 | 2.41 | 4 | 0.8 | 4 | 0.8 | 2 | 0.4 | 76 | 14.2 |
| Paravan | | 0 | 0 | 29 | 7.51 | 11 | 3.08 | 5 | 1.4 | 3 | 0.84 | 0 | 0 | 48 | 12.84 |
| Thandan | | 6 | 0.71 | 36 | 4.26 | 32 | 3.99 | 19 | 2.37 | 6 | 0.75 | 0 | 0 | 99 | 12.07 |

****Significant (P < 0.99) *Significant (P < 0.05)**

Mortality may be either pre or post natal and suggested significant adverse effects in most studies, marginal in some, no effects in certain instances and beneficial outcomes in a few. Abortion by consanguinity is due to high heterozygosis of alleles and expression of deleterious genes [39, 43]. Aggregation of homozygosis for lethal and sub lethal recessive genes due to consanguinity affect the survival of offspring between birth and adulthood adversely [44]. One fourth of the post natal deaths due to congenital structural abnormalities increases between 1 to 10 years and decline thereafter.

Table 5 shows the different morbid conditions observed in the selected castes. In the present study morbid conditions (abnormalities) were observed in all unions both consanguineous and non-consanguineous. Morbid conditions like change in physical appearance (polydactyly, syndactyly, Brachydactyly, club foot, hare lip), sensory response (stuttering, deafness, squint eye, squint eye, hydrocephalus, epilepsy), mental behaviour (mental retardation and autism) and diseases (tuberculosis, kidney problems, heart problems, asthma, thyroid, diabetes) were accounted.

**Table 5 Morbidity of the selected castes**

| Caste | | Morbidity | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Physical* | | Sensory* | | Mental* | | Diseases* | | Total* | |
| | | No | % | No | % | No | % | No | % | No | % |
| Sambavar | C | 39 | 2.86 | 35 | 2.57 | 17 | 1.25 | 14 | 1.03 | 105 | 7.7 |
| Pallar | | 59 | 3.58 | 51 | 3.1 | 43 | 2.61 | 63 | 3.83 | 216 | 13.11 |
| Bharathar | | 9 | 1.13 | 20 | 2.52 | 4 | 0.5 | 10 | 1.26 | 43 | 5.42 |
| Paravan | | 3 | 0.43 | 18 | 2.59 | 11 | 1.58 | 9 | 1.29 | 41 | 5.89 |
| Thandan | | 32 | 2.81 | 25 | 2.19 | 12 | 1.05 | 44 | 3.86 | 113 | 9.91 |
| Sambavar | NC | 5 | 0.4 | 5 | 0.4 | 5 | 0.4 | 11 | 0.88 | 26 | 2.07 |
| Pallar | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bharathar | | 6 | 1.2 | 2 | 0.4 | 2 | 0.4 | 4 | 0.8 | 14 | 2.81 |
| Paravan | | 0 | 0 | 8 | 2.24 | 8 | 2.24 | 6 | 1.68 | 22 | 6.16 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Thandan** | | 6 | 0.75 | 0 | 0 | 6 | 0.75 | 13 | 1.62 | 25 | 3.11 |

***Significant (P < 0.05)**

Highest value of morbidity among non-consanguineous group observed from 0 to 6.16%. In consanguineous group the total morbidity ranged from 5.42% (Bharathar) to 13.11% (Pallar). In non-consanguineous Pallar morbid conditions were not observed in the sampled population. The percentage of morbid conditions were observed to be above 5% in consanguineous group whereas it was below 5% in non-consanguineous group except Paravan (6.16%). Morbidity among consanguineous was more in four communities except Paravans and it was absent in non-consanguineous Pallars. Severity of morbid conditions range from handicap, diseases and to deaths at different stages of life. Diseases is due to missense mutations in genomes which may be lethal, less deleterious, neutral or beneficial [45]. Blood related unions are also associated with morbid conditions like tuberculosis, diabetes and kidney problems, cardiac and physical, sensory and mental complaints [37].

## CONCLUSIONS

Occurrence of hereditary diseases was found to be a major issue and one of a cause is thought to be consanguineous unions. Analysis on the effects of consanguinity among the progenies of consanguineous and non-consanguineous unions in 5 selected SC communities of Kanyakumari District is also an evidence. Mortality and morbid conditions among consanguineous unions of the selected population were found more than non-consanguineous. More 2C unions may be an indication of decreasing trend of consanguineous unions but fertility mean was also found more among consanguineous couples which may be due to reproductive compensation. Educating the public to avoid blood unions in order to stop birth with recessive disorders is very essential.

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