

# Sexual Dimorphism, Inbreeding Effects And Bilateral Variation Of Finger Dermatoglyphic Ridge Counts In Ansari Muslim Population Of Nandigram In West Bengal

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## Abstract

A systematic study of inbreeding effects on finger dermatoglyphic ridge counts among the Ansari Muslims in rural areas of Nandigram in West Bengal portrays some significant results. The distribution of total and absolute finger ridge counts (TFRC and AFRC respectively) show wide range of variation in inbred and non-inbred series of both the sexes. The rise of mean (studied both right and left sides combined as well as separately), increase of bilateral correlation and decline of bilateral asymmetry (examined both sides separately) of dermatoglyphic ridge counts in male and female samples due to inbreeding are observed. The study further records the sexual dimorphism in distribution and inbreeding effects on these traits. This investigation also attempts to throw some light on genetics of these traits. In frequency distributions, clear modes suggest that at least a few major genes (homozygous) clearly segregate on inbreeding with lowering of heterozygotes in antimodes. The results of the present study also conform to some earlier reports from different populations.

## INTRODUCTION

Inbreeding is broadly defined as the mating of individuals who have one or more common ancestors (<sub>1,2</sub>). But more precisely, it is the genetical consequence of consanguineous mating. It is generally assumed that the consanguineous marriage occurs in low frequency in a large population compared to a small, isolated population (<sub>3</sub>).

Inbreeding effects on the genetics of quantitative traits are examined in respect of anthropometric, dermatoglyphic, skin colour, blood pressure and menarcheal age etc. The permanence and matchlessness of dermatoglyphic patterns on each anatomical area of an individual is well established (<sub>4</sub>). The genetic basis of the dermatoglyphic patterns and their sizes has also been worked out by various authors through familial correlations and patterns of frequency distributions (<sub>5,6,7,8</sub>). The most common effect of inbreeding studied in human populations is change of the value of mean of the character. In this way, the direction of the recessive characters could be discovered. The inbreeding effects on quantitative characters can be examined by the study of the frequency distributions. The Indian studies on inbreeding effects on physical and physiological measurements have demonstrated that most useful genetical analysis of

quantitative traits in relation to inbreeding is frequency distribution. The influence of additive genes is easily observed only in the frequency distribution. The appearance of bimodality of a number of traits - triradial number and ridge counts on fingers (<sub>9,10,11,12,13,14,15</sub>) suggest a limited number of additive genes for the traits. The consistency of the positions of modes and antimodes indicates the presence of a few common genes for those traits rather than of many genes. The non-additive genes for a quantitative variation can be detected both in the change of means and in that of frequency distributions. The effects of a few additive genes on the other hand, can be deciphered from the tendency to bimodality or trimodality. The hypothesis of multifactorial inheritance of these traits has to reckon with the observed facts and it can be assumed that at least a few major genes clearly segregate on inbreeding. Inbreeding effects on finger and palmar dermatoglyphic traits recorded in different population in different parts of the world, outside India were, in Jewish populations (<sub>16</sub>) and in the populations of Gredos mountain range of Spain (<sub>17</sub>).

Estimation of inbreeding effects on dermatoglyphs is an important measure of quantitative variation in human population. The present analysis of inbreeding effects on the

ridge counts of finger dermatoglyphic patterns is undertaken to throw some light in these aspects.

## **MATERIALS AND METHODS**

This study among the Ansari Muslim population in the rural part of the Purba Medinipur district in West Bengal was designed to further examine the inbreeding effects on finger dermatoglyphic ridge counts (total and absolute finger ridge counts, TFRC and AFRC respectively). The population represents a common gene pool, be characterized by endogamy, has a small marriage distance and gene flow is absent or negligible. The population has prevalence of marriage between cousins. The population includes adequate number of closely related consanguineous couples, their inbred offspring and non-consanguineous individuals as control group belonging to same gene pool and in the population and precise relationships between individuals could be traced up to at least the third generation.

Firstly, the socio-economic and genetical backgrounds of the inbred and non-inbred samples have been controlled as far as possible. This was achieved by collecting data from inbred offspring of cousin marriages and their non-inbred cousins and/or relatives. Data were collected through systematic field surveys from the both inbred (male 34 and female 36) and non-bred sections (male 65 and female 82) of the Ansari Muslim population (total number of individuals is 217) at Nandigram in the district of Purba Medinipur in West Bengal. It has been carefully observed whether any other consanguineous marriages took place or not in any previous generation(s) and also simultaneously within same generation in both the paternal and maternal lineages, i.e. bilaterally. These were checked and verified through pedigrees / bilateral genealogies at least up to three generations. In this sample, first cousin and second cousin marriages were recorded as 94.12% and 5.88% among the parents of male inbreds respectively. In female section, 94.44% and 5.56% of inbreds were observed to be the offspring of first and second cousin marriages respectively. However, no significant difference between the different kinds of inbreds was observed in respect of ridge counts in either sex. So the two subsamples of different kinds of inbreds were pooled together to consider them as the inbreds as a whole in both the sexes for this present study.

Rolled prints were taken of fingertips, using printer's black ink and the data were read and analysed for the most part utilizing the conventional methods (18192021). The finger prints were analysed taking new approaches of dermatoglyphic

nomenclature (19202122). Frequency distributions, mean (M), and standard errors (Se) of total ridge count (TFRC) and absolute ridge count (AFRC) on fingers were calculated with respect to all comparable series such as non-inbred and inbreds, in both left and right sides, separately as well as in combined ways. Test of significant difference (Student t test) between inbreds and non-inbreds and between the sides and bilateral correlations have also been done wherever required. Fluctuating asymmetry (FA) and directional asymmetry (DA) of the finger ridge counts were measured respectively as the absolute and signed value of difference between the right (R) and left (L) sides (23). The data are being presented in the following tables and figures.

## **RESULTS**

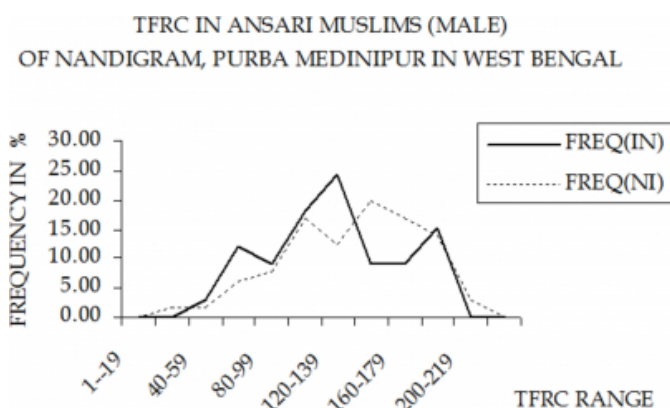
Frequencies of TFRC in the inbred sample (figure 1) of the Ansari Muslims of Nandigram in West Bengal appear to show a trimodal distribution with two antimodes where the frequencies of inbreds are much less compared to that of the non-inbreds. In Ansari Muslim males, there is a trimodality in frequency distribution of TFRC in the inbred sample and in Ansari Muslim females (figure 2), the trimodality can be traced in the hump in the lower side of the distribution. Quantitative values are higher in inbreds compared to the non-inbreds in frequency distribution of TFRC of both the sexes of Ansari Muslims (figure 1 and 2). However, in Ansari Muslim males, inbreds have lower quantitative value at antimode. A clear bimodality can be observed in the frequency distribution of absolute finger ridge count (AFRC) of these samples of both the sexes in Ansari Muslims (figure 3 and 4). However, in both the sexes, one can trace a third peak in the distribution of quantitative values at the lower end.

Figures 1-4: Frequency distribution of TFRC and AFRC (both sides combined) among the Figure 5: Ansari Muslim (Male and Female) Inbred and Non-Inbred series

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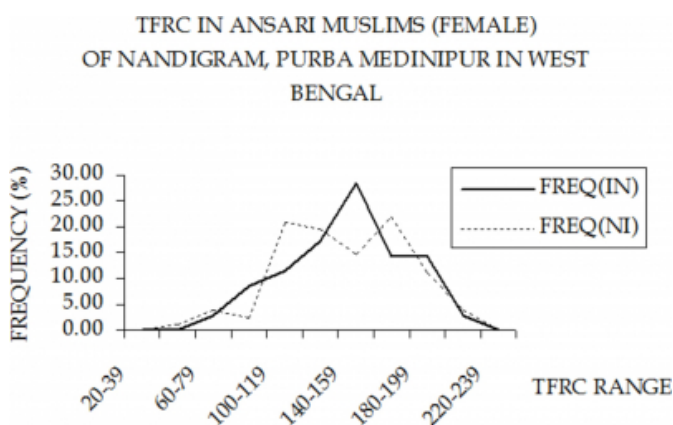
**Figure 1**

Figure 1: the Ansari Muslim (Male) Inbred and Non-Inbred series



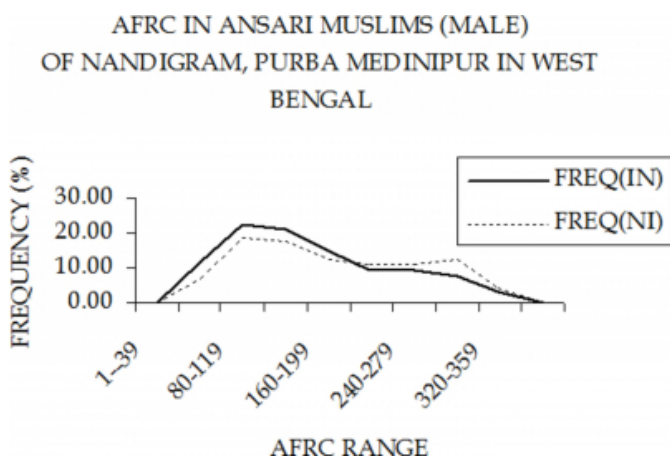
**Figure 2**

Figure 2: the Ansari Muslim (Female) Inbred and Non-Inbred series



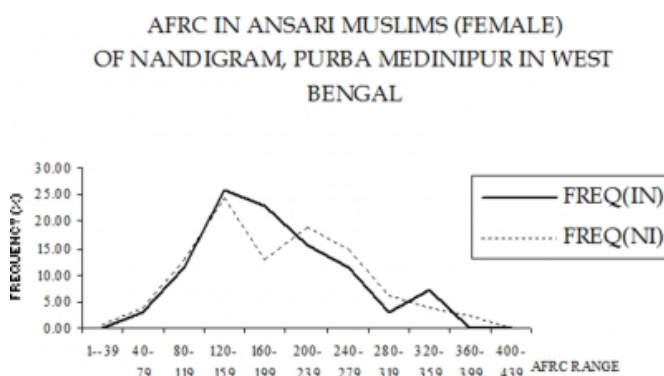
**Figure 3**

Figure 3: Ansari Muslim (Male) Inbred and Non-Inbred series



**Figure 4**

Figure 4: among the Ansari Muslim (Female) Inbred and Non-Inbred series



Ansari Muslims show bimodality with an antimode between quantitative values of 200-239 of AFRC in males and 280 and 319 of AFRC in the females (figure 4). Thus, it appears that frequency distribution of TFRC and AFRC show a clear trend of variation in the inbred samples compared to the non-inbreds. The effects of a few additive genes on the other hand, can be deciphered from the tendency to bimodality or trimodality. The segregation and rise of homozygosity in one hand and decline of heterozygosity on the other are depicted through the modes and antimodes in frequency distributions of the ridge counts respectively due to inbreeding.

**Figure 5**

Table 1 : Tri-radial number and ridge counts of dermatoglyphic patterns on fingers (both left and right sides combined) among the inbred and non-inbred series of Ansari Muslim samples.

SL. NO.	SEX	N	VARIABLES	INBRED	NON - NBRED	t
				MEAN ± Se	MEAN ± Se	
1	MALE	IN = 34	TFRC	206.88 ± 5.17	125.50 ± 6.87	2.15*
		NI = 65	AFRC	198.60 ± 7.94	164.65 ± 13.73	2.14*
2	FEMALE	IN = 36	TFRC	142.81 ± 5.43	133.73 ± 2.97	1.71
		NI = 82	AFRC	189.19 ± 11.88	182.16 ± 6.97	0.51

Se = Standard Error. Level of significance \*p<0.05.

**Figure 6**

SEX	N	TRAIT	TYPES	LEFT	RIGHT	t	SIG. (P<)	FA	DA	Correlation Coefficient left and right sides
				MEAN ± Se	MEAN ± Se			BETWEEN TWO SIDES	BETWEEN TWO SIDES	
MALE	IN = 34 NI = 65	TFRC	INBRED	103.20±1.97	103.68±3.37	-0.21	NS	0.48±0.84	-1.79±1.38	0.923****
			NON - NBRED	63.65±3.54	61.85±3.46	0.362	NS	10.48±1.92	1.85±1.92	0.870
		AFRC	INBRED	100.78±4.36	97.82±4.40	0.479	NS	12.94±1.66	-0.41±2.81	0.942**
			NON - NBRED	82.53±6.63	82.12±7.16	0.042	NS	22.54±2.43	-0.97±3.70	0.920**
FEMALE	IN = 36 NI = 82	TFRC	INBRED	70.50±3.09	72.30±2.81	-0.432	NS	11.53±1.48	1.81±2.36	0.686**
			NON - NBRED	66.11±1.84	67.62±1.58	-0.695	NS	12.36±1.05	1.51±1.72	0.498**
		AFRC	INBRED	93.47±6.32	96.72±6.13	-0.256	NS	16.18±1.25	0.38±2.19	0.852**
			NON - NBRED	90.89±3.62	91.27±3.68	-0.073	NS	16.26±2.52	2.29±3.71	0.823**

Se = Standard Error. Level of significance \*\*\*\* p<0.001, \*\* p<0.01, \* p<0.05.

FA = Fluctuating asymmetry; DA = Directional asymmetry

Tables 1 and 2 present the results of mean ( $\pm$ se) total finger ridge count (TFRC) and absolute ridge counts (AFRC) of both left and right sides combined respectively in inbred and non-inbred series of male and female samples from the endogamous Ansari Muslims. Trends of consistent rise of mean TFRC and AFRC are observed among the male inbred series compared to their respective non-inbred counterparts when recorded for both left and right sides combined (table1) and also for two sides separately (table2). The difference of mean between inbred and non-inbred series with respect to the TFRC and AFRC in males is noted to be more or less significant ( $p < 0.05$ ). In case of females, similar trend of excess mean TFRC and AFRC in inbred sections compared to the non-inbred counterparts is also observed.

Table 2 : Ridge counts of dermatoglyphic patterns on fingers and their asymmetries (left and right sides) among the inbred and non-inbred series of Ansari Muslim samples.

In table 2, consistent trends higher mean TFRC and AFRC are observed in inbred samples of both the sexes in comparison with the non-inbred sections when the left and right sides were studied separately. In most of the occasions, it is observed that both the ridge counts are higher in left hands in males and in right sides among the females. The difference of mean TFRC and AFRC between the two sides in both the sexes of inbreds and non-inbreds are not statistically significant. However, the results of fluctuating as well as directional asymmetry ( $_{23}$ ) indicate a clear trend of decline of asymmetry of the ridge counts between the left and right sides in inbreds compared to higher asymmetry in non-inbreds of both the sexes.

Table 2 also exhibits the results of bilateral correlation of TFRC and AFRC between the left and right sides. Higher Pearson's correlation coefficients for TFRC and AFRC in inbreds compared to the non-inbreds in both the sexes further indicate that correlation of ridge counts between the two sides increase due to inbreeding. Moreover, bilateral correlation coefficients of finger dermatoglyphic ridge counts in inbred series are noted to be higher in males compared to females. So from these facts, it is evident that, due to inbreeding, asymmetry with respect to finger dermatoglyphic ridge counts fall, which is more pronounced in males compared to the females.

## **DISCUSSION**

This paper contributes further knowledge about inbreeding effects on finger dermatoglyphic ridge counts, TFRC and

AFRC indicating pattern size. Studies on inbreeding effects on finger and palmar dermatoglyphic traits recorded in different population in different parts of the world outside India are rather few. The suggestion of recessive genes with positive effects is also supported by Emery's (1970) estimates of about nine percent non-additive component of TFRC in the British data (-). The study of frequency distributions in the inbred series appears to serve as substitute for the segregation analysis of the trait. The distributions of these traits invariably show an antimode or reduced frequency of some intermediate values in the inbred series, which must be the phenotypic manifestations of heterozygotes. Therefore, the antimodes may represent the heterozygotes (of additive genes), which would decline in frequency on inbreeding. The antimode suggests the heterozygotes for finger ridge count shifts towards the lower value ( $_{910}$ ). This indicates about a larger frequency of positive additive alleles than that of negative additive alleles for finger ridge count. These results conform to the hypothesis of a small number of major genes for fingerprint patterns with considerable additive effects of the involved alleles and a small average dominance of alleles having negative or reduction effects on pattern size. This is illustrated by the appearance of bimodality in the inbred distributions of the dermatoglyphic traits, total and absolute ridge counts on fingers (TFRC and AFRC) in the Ansari Muslim samples with a few minor exceptions.

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**Figure 7**

Table 3 : Triradial number and ridge counts of dermatoglyphic patterns on fingers (both left and right sides combined) among the inbred and non-inbred series of different samples (previous studies).

SL. NO.	POPULATION	N	VARIABLES	INBRED	NON-INBRED
				MEAN ± Se	MEAN ± Se
1	Telagas of Kharagpur, West Bengal	IN = 21	TFRC	169.29 ± 11.50	162.54 ± 9.24
		NI = 28	AFRC	231.14 ± 24.40	208.32 ± 18.48
2	Pokanati Reddies of Tirupati, Andhra Pradesh	IN = 79	TFRC	157.20 ± 4.50	132.50 ± 2.10
		NI = 157	AFRC	219.60 ± 12.41	195.20 ± 7.32
3	Malas of Chittoor, Andhra Pradesh	IN = 49	TFRC	130.80 ± 2.56	124.40 ± 1.12
		NI = 132	AFRC	235.70 ± 8.75	210.20 ± 4.35
4	Reddies of Chittoor, Andhra Pradesh	IN = 44	TFRC	143.00 ± 5.20	122.30 ± 1.50
		NI = 324	AFRC	207.30 ± 7.20	194.35 ± 2.95
5	Sheik Sunni Muslims of Burdwan, West Bengal (1 <sup>st</sup> Series)	IN = 54	TFRC	142.00 ± 4.54	135.50 ± 3.00
		NI = 71	AFRC	212.00 ± 11.00	198.70 ± 8.75
6	Sheik Sunni Muslims of Burdwan, West Bengal (2 <sup>nd</sup> Series)	IN = 46	TFRC	151.00 ± 6.80	149.12 ± 5.84
		NI = 51	AFRC	202.30 ± 13.20	200.51 ± 11.88
7	Qureshi Muslims of Aligarh, Uttar Pradesh	IN = 280	TFRC	163.00 ± 4.57	145.00 ± 3.85
		NI = 76	AFRC	223.00 ± 10.58	207.30 ± 11.20

Se = Standard Error. Level of significance \*\*\*\* p<0.001; \*\* p<0.01; \* p<0.05; p<0.05.

[SOURCES : 1. Datta Banik, 2008 (25); 2, 3. Mukherjee et al. 1980ab (910); 4. Sabarni and Mukherjee, 1975 (32); 5. Mukherjee, A. 1985 (13), 1990 (14); 6. Datta Banik, 2008 (25); 7. Badaruddoza, 1992 (26); Mukherjee et al. 1996 (27). (Reference numbers are given in parentheses).]

**Figure 8**

Table 4 : Triradial number and ridge counts of dermatoglyphic patterns on fingers (both left and right sides combined) among the inbred and non-inbred series of different samples (previous studies).

SL. NO.	POPULATION	N	VARIABLES	INBRED	NON-INBRED
				MEAN ± Se	MEAN ± Se
1	Telagas of Kharagpur, West Bengal	IN = 26	TFRC	155.62 ± 8.93	132.16 ± 5.97
		NI = 36	AFRC	207.97 ± 20.48	161.87 ± 13.84
2	Pokanati Reddies of Tirupati, Andhra Pradesh	IN = 62	TFRC	162.00 ± 8.72	141.00 ± 6.71
		NI = 73	AFRC	237.00 ± 10.12	216.20 ± 8.31
3	Reddies of Chittoor, Andhra Pradesh	IN = 22	TFRC	151.00 ± 3.91	127.20 ± 1.12
		NI = 184	AFRC	222.70 ± 8.70	192.78 ± 1.76
4	Qureshi Muslims of Aligarh, Uttar Pradesh	IN = 290	TFRC	172.00 ± 4.84	165.00 ± 3.97
		NI = 80	AFRC	231.00 ± 7.85	221.00 ± 8.21

Se = Standard Error.

[SOURCES : 1. Datta Banik, 2008 (25); 2, 3. Mukherjee et al. 1980ab (910); Sabarni and Mukherjee, 1975 (32); 4. Badaruddoza, 1992 (26); Mukherjee et al. 1996 (27). (Reference numbers are given in parentheses).]

In the previous studies among both the sexes of Pokanati

Reddy population of Andhra Pradesh (24) among the Telagas of Kharagpur (25), Qureshi Muslims of Aligarh (26,27) and in Sunni Muslim male samples (series 1 (14) and series 2 (25)) of Burdwan, clear bimodality in frequency distributions and rise of mean TFRC and AFRC in inbreds in comparison with the non-inbreds were observed in both the sexes (tables 3 and 4). Thus, it appears that frequency distribution of TFRC and AFRC show a clear trend of variation in the inbred samples compared to the non-inbreds. These results further strengthen the hypothesis of some average recessiveness for the ridge counts on fingers. The hypothesis has, of course, to be considered in the light of heritability studies on this character (28,29,30,31), which strongly indicate additive alleles at a few loci. The absence of significant changes of means on inbreeding does not also seriously contradict that conclusion. This agrees with the earlier observations in other series of data (1126). The increase of bilateral correlations as well as the decline of asymmetry between sides are related to the rise of homozygosity of the alleles for finger dermatoglyphic ridge counts due to inbreeding as recorded in the present context further conform to the results of the previous study undertaken among the Seik-Sunni Muslims in West Bengal (14). Thus the results of the present study largely clarify the nature and mechanism of genetic effects of inbreeding on dermatoglyphs and quantitative biological variation in man. They also provide new insights for designing future investigations.

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