

A Comparative Study of Muslim Foot of Lower Assam, India

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ABSTRACT An attempt has been made to show the variation of Muslim foot qualitatively and quantitatively as compared with other population groups of Assam. Types of foot, anthropometric characters and interspaces have been considered for this purpose. Co-efficient of divergence has also been calculated to find out the biological distances among groups of Caucasoid and Mongoloid affinities.

INTRODUCTION

In accordance with the different environmental settings as well as genetic make ups the shape, size and structure of the human foot varies from one group to another. Minami (1952) and Schultz (1953) have studied the importance of morphometric variation in the human foot. On the basis of the relative lengths of the first (1) and the second (2) toes, Minami (1952) classified the human foot into three types - T, F and O *i.e.* tibial ($1 > 2$), fibular ($1 < 2$) and transitional ($1 = 2$). Hawkes (1913-14) emphasized that the incidence of longer second toe is genetic in nature. On the other hand Sarkar (1958) opined that the O type of foot in which the first and the second toes are equally long is an inherited trait. He also identified eleven types of interspaces between toes in human foot. Besides these eleven types one more subtype of interspace *i.e.*, Flat base No. 4c, has been added in the present study. Phelps (1952) and Mukherjee and Rao (1975) emphasized that the digital formulae of foot is inherited through autosomal genes in phenotypic expression.

In the present paper an attempt has been made to study the variation of Muslim female foot of Lower Assam on the basis of digital formulae as well as anthropometric measurements in comparison with other population groups, namely, Brahmin, Hira, Ahom, Rabha, Kachari and Mikir of Assam; Santal of West Bengal; Mundari of Bihar; Ao of Nagaland and Khasi

of Meghalaya (erstwhile Assam). Interspaces between the toes in Muslim female foot have also been studied.

MATERIALS AND METHOD

The data were collected from 140 Muslim females who live in and around Greater Guwahati, Lower Assam. The contour tracing method has been applied in the field and the measurements were taken in centimetres and degrees accordingly. The individuals for the study were free from any deformity of the foot.

RESULTS AND DISCUSSION

Digital Formulation

Table 1 represents the percentage distribution of digital formulae of Muslim females of Lower Assam. The frequency of the T type (76.78%) of foot is more than the F (4.28%) and O (18.93%) types. It reveals that T type is slightly high in the left foot than the right foot (81.43% vs 72.14%) whereas F and O types (6.43% vs 2.14% and 21.43% vs 14.43%) are more frequent on the right foot in comparison to the left foot among the Muslim females in bilateral variation. However, the Chi-square test ($\chi^2 = 4.70$, $0.10 > P > 0.05$) did not reveal any significant bilateral differences.

Tables 2 and 3 represent qualitative variation through the frequency distribution of three types of foot among different population in

Table 1: Percentage distribution of different types of digital formulae of Muslim females of Lower Assam

No.	Right			Left			Combined		
	T	F	O	T	F	O	T	F	O
140	101	9	30	114	3	23	215	12	53
%	72.14	6.43	21.43	81.43	2.14	16.43	76.78	4.28	18.93

percentage. Table 2 shows T type of foot of Muslim (76.78%) is higher than Brahmin (72.67%; Nath and Das, 1985), Rabha (72.66%; Das and Ujir, 1959), Khasi (76.6% Das and Ujir, 1961), Ao (76.53%; Nath and Das, 1994) and Onge (70.3%; Pal, 1971) but lower than Santal (83.6%; Pal, 1966), Mundari (83.3%; Sarkar, 1959), Ahom (77.00%; Nath, 1976), Hira (87.62%; Das and Das, 1967), Kachari (87.00%; Nath, 1976) and Mikir (83.5%; Das and Das, 1968). The frequency of O type of foot in Muslim is highest (18.93%, while that of F type is seen lowest (4.28%) among all other groups.

Table 3 reveals that the percentage of homotype TT (57.86%) in Muslim female is

lower while OO (11.43%) is higher among the compared groups. Except Hira (1.9%) and Kachari (2.0%) the frequency of FF type (2.14%) is lower compared with Ahom (10.00%), Brahmin (6.66%), Rabha (11.00%), Ao (12.24%), Onge (15.6%) and Mikir (6.0%). In heterotypes FT (6.42%), OT (12.14%) and TO (7.86%) are found to be higher in percentage compared to tabulated groups whereas OF and FO are totally absent in case of Muslim females.

Chi-square test has been applied for three types of foot of Muslim with different population groups which show statistically significant difference in every cases, except Mundari and

Table 2: Distribution of different types of digital formulae in different population groups

Population	Area	n	Percentage of foot types			Authors
groups			T	F	O	
<i>Australoid</i>						
Santal	W. Bengal	134	83.6	9.0	7.4*	Pal, 1966
Mundari	Bihar	18	83.3	11.1	5.6	Sarkar, 1958
<i>Caucasoid</i>						
Brahmin	Assam	75	72.67	17.34	10.00*	Nath & Das, 1985
Hira	Assam	105	87.62	7.62	4.76*	Das & Das, 1967
Muslim	Assam	140	76.78	4.28	18.93	Present Study
<i>Mongoloid</i>						
Ahom	Assam	100	77.00	18.00	5.00*	Nath, 1976
Rabha	Assam	300	72.66	18.33	9.00*	Das & Ujir, 1959
Ao	Nagaland	49	76.53	16.33	7.14*	Nath & Das, 1994
Kachari	Assam	100	87.00	7.00	6.00*	Nath, 1976
Mikir	Assam	200	83.5	13.3	3.9*	Das & Das, 1968
Khasi	Assam	124	76.6	8.1	15.3	Das & Ujir, 1961
<i>Negrito</i>						
Onge	Little Andaman	64	70.3	23.4	6.3*	Pal, 1971

The present sample has been compared with other population groups using chi-square test. *Statistically significant at 5.0% level. + At present Meghalaya

Table 3: Frequency distribution of homotypes and heterotypes in different populations

Population groups	Homotypes			Heterotypes					
	TT	FF	OO	TF	FT	OT	TO	OF	FO
Muslim	57.86	2.14	11.43	2.14	6.42	12.14	7.86	-	-
Brahmin	73.33	6.66	9.33	4.0	-	4.0	2.66	-	-
Hira	80.9	1.9	0.95	5.7	2.8	2.8	1.9	1.9	0.9
Santal	77.6	6.0	1.5	-	3.0	6.0	3.0	1.5	1.5
Mundari	77.3	11.1	-	-	-	-	11.1	-	-
Onge	59.3	15.6	-	6.3	6.3	3.1	6.3	-	3.1
Ahom	70.00	10.00	2.00	12.00	2.00	-	4.00	-	-
Rabha	63.00	11.00	2.7	3.7	7.0	4.3	4.3	1.7	2.3
Ao	67.35	12.24	2.04	6.12	-	2.04	6.12	2.04	2.04
Kachari	80.0	2.00	-	4.00	2.00	2.00	6.00	4.00	-
Mikir	76.0	6.0	2.0	6.0	6.0	-	1.0	3.0	-
Khasi	69.3	3.3	6.4	1.6	6.4	3.3	6.4	1.6	1.6

Khasi which are statistically non-significant (Table 2).

Anthropometric Characters

Anthropometric measurements and indices of Muslim female foot are shown in table 4. It is revealed that except hallux divergence angle (7.30 ± 0.10 deg vs 7.06 ± 0.11 deg), foot length (22.44 ± 0.11 cm vs 22.42 ± 0.10 cm), foot breadth (8.85 ± 0.04 cm vs 8.79 ± 0.04 cm) and

($\chi^2_3 = 0.1376$, $0.30 > P > 0.50$), foot breadth ($\chi^2_1 = 1.0606$, $0.20 > P > 0.25$), foot index ($\chi^2_1 = 1.7616$, $0.10 > P > 0.05$) and hallux divergence angle ($\chi^2_1 = 0.201$, $0.50 > P > 0.30$) among the Muslim females.

Table 5 shows the quantitative variation in anthropometric characters of Muslim foot in comparison with other population groups. It is observed that the foot length of Muslim female (22.43 cm) is high compared to Rabha (22.00

Table 4: Anthropometric measurements and indices of Muslim female foot of Lower Assam

Character	n	Range	Mean $\pm$ S.E.	S.D.	C.V.
Foot Length (cm)					
Rt. (ac-pt.I)	140	20.6 - 24.9	22.65 ± 0.09	1.11	4.90
Rt. (ac-pt.II)	140	20.2 - 24.8	22.19 ± 0.10	1.21	5.45
Combined		20.2 - 24.9	22.42 ± 0.10	1.16	5.17
Lt. (ac-pt. I)	140	20.1 - 24.6	22.68 ± 0.11	1.26	5.55
Lt. (ac-pt.II)	140	20.0 - 24.3	22.20 ± 0.11	1.34	6.04
Combined		20.0 - 24.6	22.44 ± 0.11	1.28	5.73
Rt + Lt		20.0 - 24.9	22.43 ± 0.11	1.26	5.61
Foot Breadth (cm)					
Rt.	140	7.8 - 9.5	8.79 ± 0.04	0.46	5.23
Lt.	140	7.7 - 9.7	8.85 ± 0.04	0.51	5.76
Rt + Lt		7.7 - 9.7	8.81 ± 0.04	0.49	5.56
Foot Index					
Rt.	140	35.39 - 40.93	38.81 ± 0.11	1.26	3.25
Lt.	140	36.68 - 42.39	39.11 ± 0.13	1.53	3.91
Rt + Lt		35.39 - 42.39	38.98 ± 0.12	1.43	3.67
Hallux Divergence Angle (deg)					
Rt.	140	$4.0^\circ - 10.0^\circ$	7.06 ± 0.11	1.26	17.85
Lt.	140	$4.0^\circ - 10.0^\circ$	7.03 ± 0.10	1.23	17.49
Rt + Lt		$4.0^\circ - 10.0^\circ$	7.11 ± 0.10	1.24	17.44

Rt. = Right, Lt. = Left, ac. = Acropodion, Pt. = Pterion

food index (39.11 ± 0.13 vs 38.81 ± 0.11) are a bit higher in left foot than the right foot.

The χ^2 analysis indicates significant bilateral variation in all the cases, such as, foot length

Table 5: Comparison of anthropometric characters of Muslim female foot with other population groups

Population	Foot length (in cm)	Foot breadth (in cm)	Foot index	H.D. angle (in deg)
Muslim	22.43	8.81	38.98	7.11°
Brahmin	22.60	9.23	39.90	6.85°
Hira	22.63	9.15	40.31	7.27°
Ahom	22.54	9.19	40.81	6.4°
Rabha	22.0	8.7	39.58	6.6°
Ao	23.34	9.21	41.36	6.02°
Kachari	22.52	9.16	41.05	6.3°
Mikir	23.63	9.22	40.92	7.01°
Khasi	21.8	9.4	41.9	7.0°

cm; Das and Ujir, 1959) but low when compared to Brahmin (22.6 cm; Nath and Das, 1985), Ahom and Kachari (22.54 cm and 22.52 cm; Nath, 1976). But the foot breadth of Muslim female (8.81 cm) is low compared to Brahmin (9.23 cm; Nath and Das, 1985) and high compared with Rabha (8.7 cm; Das and Ujir, 1959), Ahom and Kachari (9.19 cm and 9.16 cm; Nath, 1976). On the other hand the foot index of Muslim females (38.98 ± 0.12) is lower than the tabulated racial groups. The hallux divergence angle of Muslim females (7.11 ± 0.10) is lower than Hira (7.27° ; Das and Das, 1967) but higher than Brahmin, Ahom, Kachari and Rabha (6.85° ; Nath and Das, 1985; 6.4° and 6.3° ; Nath, 1976 and 6.3° ; Das and Ujir, 1959, respectively).

Co-efficient of divergence has been calculated, using the method as used by

Najjar (1978), on the basis of anthropometric characters of foot to find out the distance relationship of Muslim females with other population groups, (Fig. 1). The results shows the inter population groups relationship between Brahmin, Hira and Muslim which are Caucasoid and Ahom, Rabha, Ao, Kachari, Mikir and Khasi, which are Mongoloid.

INTERSPACES

The frequency distribution of different interspaces in four inter digital areas of Muslim females is given in table 6. It reveals that type No. 11 (Pointed) is less frequent (0.27%) while the frequency of type No. 7 (U form) is high (8.11%) compared to other types of

Table 6: Percentage frequencies of interspace forms of Muslim female foot of Lower Assam

Type	Right					Left					Total
	I	II	III	IV	Total	I	II	III	IV	Total	
0	0.71	7.85	35.00	50.00	23.39	-	7.85	16.43	21.43	11.43	17.41
1	7.85	12.14	10.00	6.43	9.11	-	23.63	12.86	3.57	8.21	8.66
2	-	17.86	12.14	-	7.50	-	20.71	17.86	-	9.64	8.52
3	-	27.86	-	3.57	7.86	-	12.86	12.14	17.86	10.71	9.28
4a	29.29	-	-	2.14	7.86	20.71	5.00	6.43	2.14	8.57	8.21
4b	18.57	2.14	7.86	-	7.14	19.29	5.00	-	3.57	6.96	7.05
4c	5.71	2.86	2.14	-	2.68	20.00	2.14	2.14	-	6.07	4.38
5	12.14	6.43	3.57	-	5.53	18.57	3.53	-	-	5.54	5.54
6	-	5.71	-	3.57	2.32	-	-	6.43	3.57	2.50	2.41
6a	-	-	-	-	-	-	-	-	5.00	1.25	0.63
6b	-	-	-	3.57	0.89	-	-	-	2.14	0.54	0.71
7	17.14	12.14	5.00	-	8.57	12.86	12.14	13.57	-	9.64	9.11
7a	2.14	-	9.29	-	2.86	-	-	2.14	2.14	1.07	1.96
7b	3.57	-	-	9.29	3.21	5.00	2.14	-	-	1.79	2.50
8	-	-	-	2.14	0.54	-	3.53	-	12.86	4.11	2.32
9	2.86	-	15.00	7.85	6.43	3.57	3.57	10.00	15.71	8.21	7.32
10	-	5.00	-	-	1.25	-	5.00	-	-	1.25	1.25
11	-	-	-	-	-	-	-	-	2.14	0.54	0.27
11a	-	-	-	5.00	1.25	-	-	-	5.00	1.25	1.25
11b	-	-	-	6.43	1.61	-	-	-	2.86	0.71	1.16
Total	99.29	92.14	65.00	50.00	76.61	100.00	92.14	83.57	78.57	87.50	82.58
Absent (Rt + Lt)						0.35	7.85	25.71	35.71		17.41
Present (Rt + Lt)						99.64	92.14	74.28	64.28		82.58

Rt = Right, Lt. = Left

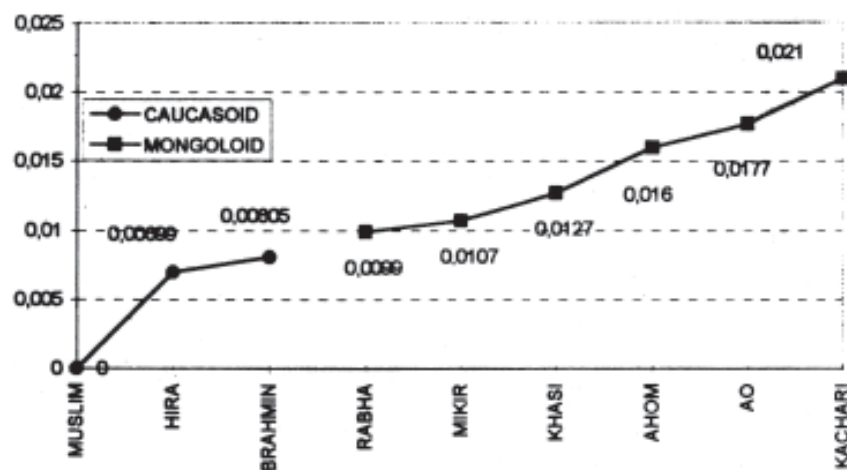


Fig. 1. Biological distances among with Caucasoid and Mongoloid affinities

interspaces. The general order of frequency distribution of presence of interspaces in four inter digital areas is I > II > III > IV (99.64%, 92.14%, 74.28% and 64.28%, respectively), among Muslim females. Similar observations were made among Khasi (Das and Ujir, 1961), Santal (Pal, 1966) and Mikir (Das and Das, 1968).

In the right foot No. 6a (V form - elongated) and No. 11 (Pointed) of interspaces are completely absent. An equal per cent (0.54%) is observed in types No. 8 (Y form) and No. 6b (V form - constricted) in both right and left feet. Type No. 1 (Coalescent) is high (9.11%) in right foot while type No. 3 (Tubular) is high (9.28%) in left foot. Presence of interspaces in four inter digital areas in left foot is high in comparison to the right foot (87.50% vs 76.61%) among the Muslim females. However, among the Muslim females 82.58 per cent of interspaces in four inter digital areas are present while only 17.41 per cent of interspaces are absent in both the right and left feet.

Summing up it is observed that the T type is predominant in both the feet while the homotype OO and heterotype OT are high in percentage compared to other types of foot among the Muslim females of Lower Assam. They are more or less biologically closer to the Hira (0.00699) and Brahmin (0.00805) which are Caucasoid groups than to the Rabha (0.0099), Mikir (0.0107), Khasi (0.0127), Ahom (0.0160), Ao (0.0177) and Kachari (0.0210) which are Mongoloid groups, the results are given in figure 1.

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