

Heritable Behaviour of Dermal Configurations of Toes in Relation to Sex

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Introduction

The genetic particularities of dermatoglyphic traits, though obscure, stand a chance of being enriched by future researches. Several approaches suggested by various workers to demonstrate the transmission of dermatoglyphic traits through family trees, have been found to be of value and have made us aware of the fact that the offspring do not necessarily conform to genetic expectations and show deviations from their parents. The present work is an attempt to bring into light the heritable inter-sex deviations, if any, among the pattern-types of parents and their offspring.

As compared to other dermatoglyphic areas, the toes have been virtually neglected; perhaps the main reason of the toe dermatoglyphics having received so little attention is the difficulty in securing complete and decipherable prints.

Material and methods

The present material is constituted of 96 families, each representing two generations. The total number of individuals comprising these families are 557, out of which 192 belong to the first and 365 229 (males and 136 females) to the second generation.

The material is drawn from the ethnically homogeneous population of Kashmiri Muslims and each individual is represented by bilateral toe prints.

The methods followed for formulating the toe prints and for analysing the sample are those described by Cummins and Midlo (1943).

Results

The occurrence and non-occurrence of pattern-types in a particular parental combination could be interpreted under three probable conditions:

1. The offspring following the parental lines, i.e. carrying the same number of patterns as shown by their respective parental combination. This condition could

further be stated in two ways, the parents showing upper and lower limit of the patterns in a parental combination.¹

2. Offspring falling within the parental range, i.e. carrying the same number of pattern-types in between the two extremes of a particular parental combination; e.g., in the parental combination 2×7 whorls, the offspring bearing three, four, five and six whorls on their toes are considered within the parental range.

3. Offspring falling off the parental range could further be stated under two probable conditions, i.e. offspring falling off towards the upper limit and the lower limit of the parental combination.

Combination 2×7 whorls. 3 families

M	Ab	—	1	2	—	1	1	1	—	1	7
	Pc	—	14.3	28.5	—	14.3	14.3	14.3	—	14.3	100.0
F	Ab	—	—	—	4	—	1	—	—	—	5
	Pc	—	—	—	80.0	—	20.0	—	—	—	100.0
T	Ab	—	1	2	4	1	2	1	—	1	12
	Pc	—	8.3	16.7	33.3	8.3	16.7	8.3	—	8.3	99.9

M = male offspring, F = female offspring and T = total number of offspring

The inheritance of toe configurations in relation to sex, i.e. relationship between the parents and their offspring belonging to the same sex or vice-versa, is exhibited in Tabs. 1, 2 and 3 for whorls, loops and arches respectively.

Whorls

In order to assess the influence of the same sex parents on their offspring, the list of parents having more whorls or falling on the upper limit line of parental combinations is given in Tab. 1.

The parental combinations of a varied number of whorls have been appropriated for the above table and parents bearing equal number of whorls, i.e. 1×1 whorl, 2×2 whorls etc. have not been included in this table. Thus, the relationship between the same sex parents and the same sex offspring could be inferred from the fact that when a father has more whorls that trend is shown by male and female offspring.

The sex of the parents and of their offspring is represented by M and F; the former stands for male and the latter for female, while T represents their total.

From the above table it could be noticed that the overall influence of the same sex parents on the same sex offspring is somewhat less marked. The incidence of carrying more whorls, among the various parental combination, is higher in male (63.3%) than in female (36.7%) parents.

The total numbers, of male and female offspring occurring in all the parental combinations are 180 and 121 respectively. The male offspring following upper limit

¹ A typical parental combination. The methodologies were developed by the Author (Bali, 1964)

Tab. 1. Heritable behaviour of whorls in relation to sex

S. N.	Parental combination	Parents showing upper limit line			Offspring following upper limit line			Offspring following lower limit line			Offspring falling within and off the range		
		M	F	T	M	F	T	M	F	T	M	F	T
1	0 × 1 whorls	3	2	5	4	1	5	8	1	9	5	1	6
2	0 × 2	1	1	2	2	—	2	1	2	3	1	1	2
3	0 × 3	2	—	2	1	1	2	—	—	—	4	1	5
4	0 × 4	3	—	3	2	—	2	—	1	1	—	—	—
5	0 × 5	2	2	4	1	1	2	1	—	1	7	3	10
6	0 × 6	1	—	1	—	—	—	—	—	—	3	—	3
7	1 × 2	1	2	3	—	2	2	4	—	4	3	6	9
8	1 × 3	2	1	3	1	1	2	1	3	4	5	4	9
9	1 × 4	1	4	5	1	1	2	1	2	3	6	3	9
10	1 × 5	1	—	1	—	—	—	—	—	—	4	2	6
11	1 × 6	1	1	2	—	2	2	—	—	—	3	6	9
12	1 × 7	—	1	1	—	1	1	—	—	—	3	1	4
13	1 × 8	1	—	1	—	—	—	—	—	—	4	3	7
14	2 × 3	4	3	7	2	1	3	4	3	7	7	5	12
15	2 × 4	5	—	5	1	1	2	5	3	8	4	3	7
16	2 × 5	3	1	4	2	2	4	2	1	3	3	4	7
17	2 × 6	—	2	2	—	1	1	1	1	2	5	2	7
18	2 × 7	2	1	3	—	—	—	2	—	2	5	5	10
19	2 × 8	1	—	1	—	—	—	—	—	—	2	1	3
20	3 × 4	—	2	2	—	—	—	1	—	1	2	3	5
21	3 × 6	5	—	5	3	—	3	4	2	6	7	3	10
22	3 × 7	1	—	1	1	1	2	—	1	1	2	1	3
23	3 × 8	1	—	1	—	—	—	—	1	1	2	2	4
24	4 × 5	1	1	2	—	—	—	2	—	2	2	3	5
25	4 × 6	2	2	4	1	3	4	—	1	1	5	4	9
26	4 × 7	—	1	1	1	—	1	—	—	—	1	1	2
27	4 × 9	—	1	1	—	—	—	1	—	1	2	1	3
28	5 × 6	—	—	—	—	—	—	1	—	1	2	2	4
29	5 × 7	2	—	2	—	—	—	3	—	3	2	2	4
30	5 × 8	2	—	2	2	—	2	1	1	2	4	4	8
31	6 × 7	1	—	1	—	—	—	—	—	—	3	—	3
32	6 × 8	1	—	1	—	—	—	—	—	—	1	2	3
33	7 × 8	—	1	1	—	—	—	1	—	1	2	—	2
Total		50	29	79	25	19	44	44	23	67	111	79	190
P.C.		63.3	36.7	100.0	13.9	15.7	14.6	24.4	19.0	22.2	61.7	65.3	63.1

M = male, F = female, T = total

Tab. 2. Heritable behaviour of loops in relation to sex

S. N.	Parental combination	Parents showing upper limit line			Offspring following upper limit line			Offspring following lower limit line			Offspring falling within and off the range		
		M	F	T	M	F	T	M	T	T	M	F	T
1	1 × 2 loops	2	—	2	1	1	2	2	—	2	—	5	5
2	1 × 4	2	1	3	2	—	2	1	1	2	1	5	6
3	1 × 5	1	1	2	1	—	1	—	—	—	3	3	6
4	1 × 6	1	2	3	—	1	1	—	1	1	5	4	9
5	1 × 7	2	—	2	—	—	—	—	—	—	5	3	8
6	1 × 8	1	—	1	—	1	1	1	—	1	3	—	3
7	2 × 3	1	1	2	—	—	—	2	—	2	1	1	2
8	2 × 4	3	1	4	—	—	—	3	1	4	6	6	12
9	2 × 5	—	1	1	—	—	—	1	—	1	2	2	4
10	2 × 6	1	1	2	—	—	—	1	1	2	4	3	7
11	2 × 7	2	1	3	—	—	—	—	2	2	3	4	7
12	2 × 10	—	1	1	—	—	—	—	—	—	3	—	3
13	3 × 4	2	3	5	2	2	4	1	—	1	6	4	10
14	3 × 5	1	2	3	1	—	1	—	1	1	4	4	8
15	3 × 6	—	2	2	1	—	1	—	1	1	4	3	7
16	3 × 7	1	1	2	—	1	1	1	—	1	3	1	4
17	3 × 8	2	3	5	1	—	1	1	1	2	10	8	18
18	3 × 9	1	—	1	—	—	—	1	—	1	2	1	3
19	4 × 5	3	2	5	2	—	2	3	2	5	5	7	12
20	4 × 6	2	2	4	2	1	3	1	2	3	5	2	7
21	4 × 7	4	1	5	—	1	1	1	1	2	9	6	15
22	4 × 8	1	—	1	1	—	1	—	—	—	2	—	2
23	4 × 9	1	—	1	—	1	1	—	—	—	2	2	4
24	5 × 6	1	3	4	3	—	3	4	2	6	9	3	12
25	5 × 7	2	4	6	3	—	3	—	1	1	10	6	16
26	5 × 8	—	2	2	—	1	1	1	—	1	3	2	5
27	5 × 9	—	2	2	—	—	—	—	1	1	7	2	9
28	6 × 7	1	1	2	1	1	2	—	1	1	4	3	7
29	6 × 8	—	1	1	1	—	1	1	—	1	3	—	3
30	6 × 9	1	—	1	—	—	—	—	1	1	2	—	2
31	7 × 8	1	—	1	—	—	—	—	1	1	1	1	2
32	7 × 9	—	2	2	—	1	1	—	—	—	3	2	5
Total		40	41	81	22	12	34	26	21	47	128	92	220
P.C.		49.2	50.6	100.0	12.5	8.0	11.3	14.8	16.8	15.6	72.7	75.2	73.0

M = male, F = female and T = total

line of their parents are 13.9% and the female offspring 14.6%. Thus the female offspring exhibit higher incidence of whorls than the male offspring and fall closer to their fathers than to their mothers. Similarly the collective behaviour of the offspring following the lower limit line of different parental combinations is noted both in male (24.4%) as well as in female (14.0%) offspring; and 61.7% of male and 65.3% of female offspring either fall within the parental range or off the range.

Loops

Tab. 2 lists all parents carrying the varied number of loops in their combinations. Let us explain it more fully: those parents occurring on the upper limit line of the combination are considered in the above table. This is done with a view for assessing the effect of those parents only who bear a higher number of loops than those having an equal number of loops, thereby expressing the equal influence on their offspring, a condition which is not desired here. Hence, the parents carrying a higher number of loops in all the parental combinations are dealt collectively and their influence on the behaviour of the male and female offspring is noted separately.

It could be seen from the above table that both male (49.3%) and female (50.6%) parents show almost the same incidence in their occurrence on the upper limit line. Among the male offspring 12.5% of them follow the upper limit line of the parental combinations and 8.0% of the female offspring follow the same line, while lower limit line is followed by a higher number of female (16.8%) than male (14.8%) offspring. There hardly appears any relationship between the sex of the parents and their offspring as to the distribution of loops among their toes is concerned.

Arches

The behaviour of arches among the parents and their offspring is given sex-wise, in Tab. 3. The parental combinations showing varied number of arches among two sexes are added, and their overall influence on either sex offspring is noted separately.

Out of ninety-six families seventy-six were found with varied number of arches, and the number of parental combinations in case of arches is twenty. It could be seen from the above table that 36.5% of male and 63.5% of the female parents show upper limit line, in other words female parents show higher incidence of arches. Among their offspring 19.7% of male and 18.7% of female offspring follow the upper limit line of combinations. It appears that male offspring fall closer to their mothers than to their fathers. Similarly, offspring following the lower limit line of parental combinations, show 30.8% of male and 30.2% of female offspring occurring on this line. Thus it could be said that male offspring show higher incidence in following their parental lines, irrespective of the sex of their parents or there appears no sex linkage in this trait. The rest of the offspring fall within and off the parental range.

Tab. 3. Heritable behaviour of arches in relation to sex

S. N.	Parental combination	Parents showing upper limit line			Offspring following upper limit line			Offspring following lower limit line			Offspring falling within and off the range		
		M	F	T	M	F	T	M	T	T	M	F	T
1	0 × 1 arches	6	7	13	7	4	11	12	7	19	11	4	15
2	0 × 2	6	7	13	12	3	15	13	5	18	8	3	11
3	0 × 3	4	5	9	2	—	2	13	4	17	9	9	18
4	0 × 4	—	3	3	1	1	2	2	—	2	4	6	10
5	0 × 5	—	1	1	—	—	—	—	—	—	3	—	3
6	0 × 7	—	1	1	—	—	—	—	—	—	1	2	3
7	1 × 2	3	5	8	3	5	8	3	4	7	8	3	11
8	1 × 3	—	4	4	2	—	2	2	—	2	6	4	10
9	1 × 4	1	1	2	2	—	2	1	—	1	5	—	5
10	1 × 5	—	3	3	—	—	—	2	2	4	3	5	8
11	1 × 7	1	1	2	1	—	1	—	1	1	5	3	8
12	2 × 3	1	1	2	2	1	3	—	—	—	2	2	4
13	2 × 4	1	2	3	2	2	4	2	—	2	3	2	5
14	2 × 5	—	1	1	—	—	—	—	1	1	1	1	2
15	2 × 6	—	1	1	—	—	—	—	1	1	4	—	4
16	2 × 7	1	1	2	—	—	—	—	1	1	4	1	5
17	2 × 4	—	2	2	—	1	1	—	2	2	3	1	4
18	3 × 6	1	—	1	—	—	—	1	—	1	1	1	2
19	3 × 7	1	1	2	—	—	—	1	1	2	2	2	4
20	5 × 6	1	—	1	—	1	1	1	—	1	2	—	2
Total		27	47	74	34	18	52	53	29	82	85	49	134
P.C.		36.5	63.5	100.0	19.7	18.7	19.4	30.8	30.2	30.6	49.4	51.0	50.0

M = male, F = female and T = total

Summary

The sex-wise distribution of whorls among the offspring of various parental combinations reveals that the over-all influence of the parents on the same sex offspring is somewhat less marked. A similar tendency is noticed in case of loops and arches. There hardly seems to exist any relationship between the sex of the parents and their offspring regarding the distribution of pattern-types.

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RIASSUNTO

La distribuzione per sesso dei vortici nei figli di varie combinazioni parentali rivela che l'influenza generale dei genitori sui figli dello stesso sesso è alquanto inferiore alla norma. Una tendenza simile è stata notata nel caso delle anse e degli archi. Appare difficile che esista un qualsiasi rapporto fra il sesso dei genitori e i loro figli rispetto alla distribuzione dei tipi di figure.

RÉSUMÉ

La distribution d'après le sexe des tourbillons, des boucles et des arches chez les fils de différentes combinaisons parentales révèle une diminution de l'influence générale des parents sur les fils du même sexe. Il est difficile qu'il existe un rapport quelconque entre le sexe des parents et leur fils, en ce qui concerne la distribution des types de dessin.

ZUSAMMENFASSUNG

Die Beobachtung der Verteilung der Wirbel auf die Töchter und Söhne bei verschiedentlicher Elternkombination zeigt, dass im allgemeinen der Einfluss der Eltern auf die gleichgeschlechtlichen Kinder dabei viel niedriger als in der Norm ist. Eine ähnliche Tendenz wurde auch bei den Schleifen und Bögen beobachtet. Bezüglich der Verteilung der verschiedenen Hautlinienfiguren erscheint schwerlich irgendein Verhältnis zwischen dem Geschlecht der Eltern und dem der Kinder zu bestehen.