

A Finger Dermatoglyphics of the New Zealand-Samoans

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Fingerprints of 100 New Zealand-Samoan males and 93 females have been analyzed. Whorls are more numerous in fingerprint females (65.6%) than in males (55.6%). The index of pattern intensity displays a higher value in females (16.49) than in males (15.48). The bimanual differences both in males and females are not statistically significant for the occurrence of patterns on the digits of the right and left hands. Also the difference between both sexes for the occurrence of patterns is not statistically significant. Incidences of actual symmetry on homologous digits represented 78.2% in males and 85.8% in females. The mean total ridge counts showed 175.7 ± 54.6 ($M \pm SD$) in males and 171.6 ± 49.8 ($M \pm SD$) in females, respectively. Conclusively, this study shows that the New Zealand-Samoans are closely related to the Mongoloids in quantitative dermatoglyphics.

Polynesian dermatoglyphics has been examined according to different populations. Studies have been made of Polynesian Samoans (Suzuki, 1961; Shima, 1963) and New Zealand-Maori (Veale and Adams, 1965; Cho, 1998). From previous articles, we see that the Polynesians have the highest whorl frequencies and relatively low frequencies of loops and arches.

Dermatoglyphics of the New Zealand-Samoans has not been reported previously for anthropological research. In the present paper, the various characteristics of finger dermatoglyphics of the New Zealand-Samoans are quantitatively described.

Materials and Methods

The samples consist of 193 New Zealand-Samoans, 100 males and 93 females, supplied by Fingerprint Section, Auckland Central Police Station, New Zealand. The fingerprints were impressed in ink and personal records except sex were not provided.

The methods used in analysing, formulating and interpreting the fingerprint patterns were those described by Cummins and Midlo (1961). The classification of the fingerprint pattern types is modified from the Henry system (Henry, 1900). Lateral pocket loops, twin loops, central pockets and accidentals were counted as whorls. Radial and ulnar loops were counted separately. Together with plain and tented arches, other forms which simulate diminutive loops were classified as arches.

The frequencies of pattern types, the pattern indices and the total ridge count (TRC) have been examined

for males and females. Computed chance symmetry and actual symmetry of finger pattern types are compared in percentages for males and females.

Results

Percentages of the fingerprint pattern types on different digits separately, as well as on both hands, are listed in Table 1 for males and Table 2 for females, respectively.

It has been observed that whorls (55.6%) are more abundant than loops (43.6%) in males (Tables 1 and 3). Females exhibit a much higher frequency of whorls (65.6%) and lower frequency of loops (33.7%) (Tables 2 and 3). The frequency of ulnar loops (42.8%) and arches (0.8%) are higher in males than in females, who show them as 33.2% and 0.7%, respectively. Radial loops are absent in the third and fifth digits of both hands for males and females. Simple whorls are nearly twice as lateral pockets, central pockets, twin loops and accidentals combined in males and thrice in females (Tables 1 and 2). Distribution of the finger pattern types exhibits statistically insignificant variations ($P > 0.05$) between both sexes (Table 3).

The mean values of Dankmeijer's index, pattern intensity index (PII) and Furuhashi's index exhibit 1.32, 15.99 and 156.59 in the total samples in order, respectively (Table 3). The PIIs (15.99) are within the Mongoloid range and other high whorl populations (Table 4). Incidences of chance and actual symmetry represent 55.3% and 82.0% in the total samples in order, respectively (Table 5).

The variation of the TRC for males ranged from 33 to 380 ridges but for females from 70 to 268 ridges. Mean ridge count for each individual displays 15.1 in

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Table 1. Frequencies (%) of the fingerprint pattern types in the New Zealand-Samoan males (N=100)

Digit	Side	Arches		Loops		Whorls			Accidental
		Plain	Tented	Ulnar	Radial	Simple	Lateral pocket + Twin loop	Central pocket	
I	R	-	-	27.0	-	36.0	36.0	-	1.0
	L	1.0	-	35.0	-	20.0	43.0	1.0	-
	R+L	0.5	-	31.0	-	28.0	39.5	0.5	0.5
II	R	1.0	1.0	27.0	6.0	48.0	16.0	1.0	-
	L	1.0	-	34.0	1.0	37.0	25.0	1.0	1.0
	R+L	1.0	0.5	30.5	3.5	42.5	20.5	1.0	0.5
III	R	1.0	1.0	55.0	-	33.0	10.0	-	-
	L	2.0	-	52.0	-	25.0	18.0	3.0	-
	R+L	1.5	0.5	53.5	-	29.0	14.0	1.5	-
IV	R	-	-	21.0	1.0	71.0	2.0	4.0	1.0
	L	-	-	39.0	-	43.0	14.0	4.0	-
	R+L	-	-	30.0	0.5	57.0	8.0	4.0	0.5
V	R	-	-	67.0	-	27.0	5.0	1.0	-
	L	-	-	71.0	-	13.0	12.0	4.0	-
	R+L	-	-	69.0	-	20.0	8.5	2.5	-
All digits	R	0.4	0.4	39.4	1.4	43.0	13.8	1.2	0.4
	L	0.8	-	46.2	0.2	27.6	22.4	2.6	0.2
	R+L	0.6	0.2	42.8	0.8	35.3	18.1	1.9	0.3

males and 13.0 in females for loops, and 20.7 commonly in both sexes for whorls. The highest means are those for digits I of right hands in males and digits I of left hands in females. The lowest ridge count occurs on digits V of right hands in males and digits V of left hands in females, respectively (Table 6).

Discussion

For Polynesians the features of predominance are whorls and a great reduction of arches. Shima (1963) reported that the whorl frequencies are 80.5% (N=38, M+F) in full Polynesians and 70.4% (N=83, M+F) in Polynesian-European hybrids from Maupiti Island, Central Polynesia. Veale and Adams (1965) presented a paper about the relative frequencies of the different fingerprint patterns in three samples of Maori. The whorl percentage is very high, being 77.1% in 65 males and 68.6% in 86 females for near full Maori. The whorl percentages for the two samples of criminals were somewhat lower and it was reasonably certain that

these samples contain a greater admixture of European ancestry (Burrige, 1983). However, it is evident that Polynesian-European hybrids possess a low whorl percentage compared with pure Polynesians. It is noticeable that the whorl percentages of the present samples are close to the Mongoloid values and the pattern frequencies are different from the latest Maori (Cho, 1998).

The pattern frequencies vary to some degree with race, sex and side. Asians have a higher frequency of whorls than Europeans and Americans. In most ethnic groups, with some exceptions, whorl frequency is greater in males than in females. The general rule is not accordant to the samples whose females exceed males in whorl frequency (Tables 1, 2 and 4). As for the relative frequencies of whorls and loops in the New Zealand-Samoans, whorls are more frequent in right than in left hands; accordingly, loops are less frequent in right than in left hands. Such trends agree with the general rule (Cummins and Midlo, 1961).

As might be expected from the general reduction in

Table 2. Frequencies (%) of the fingerprint pattern types in New Zealand-Samoans females (N=93)

Digit	Side	Arches		Loops		Whorls			Accidental
		Plain	Tented	Ulnar	Radial	Simple	Lateral pocket + Twin loop	Central pocket	
I	R	1.1	-	12.9	-	51.6	33.3	1.1	-
	L	-	-	17.2	1.1	46.2	34.4	1.1	-
	R+L	0.5	-	15.1	0.5	48.9	33.9	1.1	-
II	R	1.1	-	23.7	-	59.1	15.1	1.1	-
	L	-	1.1	24.7	3.2	54.8	12.9	3.2	-
	R+L	0.5	0.5	24.2	1.6	57.0	14.0	2.2	-
III	R	1.1	-	48.4	-	41.9	6.5	2.2	-
	L	2.2	1.1	37.6	-	40.9	17.2	1.1	-
	R+L	1.6	0.5	43.0	-	41.4	11.9	1.6	-
IV	R	-	-	24.7	-	68.8	5.4	1.1	-
	L	-	-	35.5	-	58.1	4.3	2.2	-
	R+L	-	-	30.1	-	63.5	4.8	1.6	-
V	R	-	-	50.5	-	40.9	5.4	3.2	-
	L	-	-	57.0	-	31.2	11.8	-	-
	R+L	-	-	53.8	-	36.0	8.6	1.6	-
All digits	R	0.6	-	32.0	-	52.5	13.1	1.7	-
	L	0.4	0.4	34.4	0.9	46.2	16.1	1.5	-
	R+L	0.5	0.2	33.2	0.5	49.4	14.6	1.6	-

Table 3. Frequencies (%) and indices of the fingerprint pattern types in New Zealand-Samoan males and females

Sex	N	Frequency of pattern types			Index of pattern intensity ¹	Dankmeijer's index ²	Furuhata's index ³
		Arches	Loops	Whorls			
M	100	0.8 [*]	43.6 ^{**}	55.6 ^{***}	15.48	1.44	127.52
F	93	0.7	33.7 ^{**}	65.6 ^{***}	16.49	1.07	194.66
M+F	193	0.8	38.7	60.6	15.99	1.32	156.59

* **, *** P > 0.05
¹(2 × % whorls + 1 × % loops) ÷ 10
²(% arches ÷ % whorls) × 100
³(% whorls ÷ % loops) × 100

the frequencies of loops, radial loops are rare (0.7%) and they make 1.8% of the total loops. But then, the samples confirm to correspond with the general rule that radial loops predominate on the index digits (75.8%) in both sexes. And, also the percentages of radial loops are slightly higher in males (0.8%) than in females (0.5%) as shown in Tables 1 and 2. The values correspond with the ordinary rules (Srivastava, 1963; Tiwari and Chattopadhyay, 1967; Jantz et al., 1969; Cho, 1990; Cho, 1998).

The whorl percentages of the present samples are similar with those of Suzuki (1961) and Shima (1963) for the Samoans (P>0.05). Arches predominate rather on the middle fingers than index fingers of the general rule.

The PII, arch/whorl index of Dankmeijer and whorl/loop index of Furuata are used for an affinity of races. The values of three indices belong to the Mongoloid range: the standard values are 14 or more for the PII, 10 or less for Dankmeijer's index and 70 or more for Furuata's index. Among three indices, the PII might be considered to be very useful for racial distinction. The distributions of PII present a contrast to those of most populations in examination of the separate sex (Tables 3 and 4).

The bimanual symmetry in the fingerprint pattern types is examined from the chance symmetry which has been calculated by multiplying the percentages of incidence, and the actual symmetry. The percentage of the symmetry actually examined is found to be

Table 4. Comparison of fingerprint pattern frequencies (%) in the Mongoloids and other high whorl populations

Population	Sex	N	Frequency of pattern types			Pattern intensity index	Authors
			Arches	Loops	Whorls		
Samoans (Polynesia)	M	43	0.2	39.1	60.7	16.05	Suzuki (1961)
	F	82	-	41.9	58.8	15.95	
	M	157	0.8	40.8	58.3	15.74	Shima (1963)
	F	153	1.4	42.0	56.6	15.52	
Samoans (New Zealand)	M	100	0.8	43.6	55.6	15.48	Present study
	F	93	0.7	33.7	65.6	16.49	
Maori (New Zealand)	M	65	0.3	22.6	77.1	17.68	Veale and Adams (1965)
	F	86	0.5	30.9	68.6	16.81	
	M	104	2.1	50.6	47.3	14.52	Cho (1998)
	F	98	1.1	43.9	55.0	15.39	
Melanesians (Ellice Island)	M	45	0.5	27.5	72.0	17.15	Veale and Adams (1968)
	F	67	2.0	33.2	64.9	16.30	
Melanesians (W. Nakanai of New Britain)	M	257	1.7	46.8	51.5	14.98	Mavalwala et al. (1963)
	F	64	4.1	50.5	46.0	14.24	
W. Arnhem Land Aborigines (Australia)	M	82	0.9	38.0	60.9	15.98	Macintosh (1952)
Kalumburu Mission Aborigines (Australia)	M	44	0.5	35.1	64.3	16.37	Rao (1964)
	F	40	2.0	33.0	64.8	16.26	
Yuendumu Settlement Aborigines (Australia)	M	61	1.3	48.0	50.7	14.94	Rao (1965)
	M+F	44	2.0	55.0	43.4	14.18	
Mongolians (Mongolia)	M	613	2.3	43.7	54.0	15.17	Hisakichi (1939)
	M	336	2.8	54.5	42.8	14.01	
	F	192	6.9	53.7	39.4	13.25	
Tibetans (Refugees in India)	M	156	0.8	39.0	60.2	16.00	Tiwari and Chattopadhyay (1967)
	F	150	2.2	49.1	48.7	14.70	
Tharus (India)	M	90	4.4	54.0	41.6	13.70*	Srivastava (1963)
	F	91	3.6	56.2	40.2	13.65*	
Chinese (China)	M+F	300	1.4	47.7	50.7	14.91	Dankmeijer (1938)
Koreans (South Korea)	M	250	2.7	42.8	54.5	14.70*	Cho (1990)
	F	250	4.6	49.3	46.1	14.01*	

*Observed value

Table 5. Incidences of bimanual symmetry in the fingerprint pattern types in New Zealand-Samoan males and females (%)

Sex	N	Symmetry	Digits (R+L)					Average(%)
			I	II	III	IV	V	
M	100	Chance	56.2	53.2	37.4	56.2	57.1	52.0
		Actual	78.0	82.0	77.0	78.0	76.0	78.2
F	93	Chance	72.6	60.4	48.1	57.4	54.4	58.6
		Actual	90.3	85.0	85.0	80.7	88.2	85.8
M+F	193	Chance	64.4	56.8	42.8	56.8	55.8	55.3
		Actual	84.2	83.5	81.0	79.4	82.1	82.0

greater than that of computed chance symmetry. The values obtained from the present samples are in accordance with general rules and any anthropological difference is not found (Table 5).

The total frequency of homologous finger patterns is within from 74.4% to 82.1% in a number of different races (Cummins and Midlo, 1961). The influence of symmetry on the incidence of the finger patterns is a general morphological phenomenon which is not affected by sex or race (Dankmeijer and Renes, 1938). Frequency of obligatory symmetry on 10 digits from the present samples presents 12% in all whorl combinations and 1.0% in all loop combinations for males, and 33.3% and 0.3% for females, respectively. It is noted that all arch combinations is not at all observed in both sexes. The mean actual percentage (23.3%) of obligatory symmetry from 10 digits of the total samples is a bit higher than those (20.2%) of the Maori (Cho, 1998). All loop combinations may be most frequent in Caucasians due largely to high loop occurrences.

For the mean ridge count on different digits from the present samples, males display higher values in right hands and lower values in left hands but females show lower values in right hands and higher values in left hands. In general, the mean ridge count is higher in the right than in left hands and the TRC is higher in males than in females (Glanville, 1969; Jantz et al., 1969; Mi and Rashad, 1977; Hwang, 1985). The present samples demonstrate one of the populations that show the greatest ridge counts (Srivastava, 1965; Basu and Namboodiri, 1971).

The mean ridge count has been calculated for 125 fingers of males and females separately. In males, the value for arches is zero, for loops 15.06 and for

whorls 20.66; in females zero, 12.98 and 20.72 in order, respectively. The values of the present Samoans are slightly higher than those of Caucasians (Preus and Fraser, 1972).

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Table 6. Mean ridge counts on individual fingers of New Zealand-Samoan males and females

Digit	Males (N=100, mean±SD)		Females (N=93, mean±SD)	
	Right	Left	Right	Left
I	22.7± 6.1	19.6± 5.9	18.5± 5.0	20.5± 5.3
II	17.0± 6.3	15.9± 5.6	15.5± 5.0	15.9± 4.8
III	16.5± 5.8	16.5± 5.5	16.7± 5.8	16.5± 5.1
IV	18.2± 4.9	19.1± 5.0	18.6± 5.5	18.9± 4.4
V	14.6± 5.1	15.1± 4.3	15.8± 4.4	14.8± 4.6
I-V	88.9±28.2	86.8±26.4	85.0±25.7	86.6±24.1
TRC (R+L)	175.7±54.6*		171.6±49.8*	

*P>0.05

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