

# Palm Patterns and Pigmentation in a Cherokee Indian Population

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## SUMMARY

Hand prints, estimates of degrees of skin pigmentation and percentages of Cherokee ancestry of 700 Indian pupils attending the Cherokee, North Carolina school were analyzed. The pupils are of mixed Cherokee-White origin. The average proportion of Cherokee ancestry is approximately 60%, the percentages being significantly higher in upper than in lower grades.

The frequencies of palmar patterns are similar to those recorded for other North American tribes. Frequencies of patterns in each of three palmar areas show significant associations with degrees of pigmentation, the highest association occurring between light pigmentation and accessory triradii in distal interdigital areas.

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This report is concerned with an investigation of data obtained from pupils at the Cherokee Indian school in Cherokee, North Carolina. The objectives of the investigation were to determine the frequencies of variations in dermatoglyphics and skin pigmentation and associations between them, and to explore possible causes for such associations.

## Material and Methods

The school population at Cherokee admirably fulfills the requirements for such a study. The tribal council has kept a record of proportions of Cherokee ancestry for every Indian on the reservation. These records go back as many as seven generations and each teacher has a record of their pupils. The only exceptions are a few White children whose parents live in the village of Cherokee. There is no evidence of Negro ancestry. Most of their White ancestors are of Scotch-Irish and English stock.

Data were obtained from 700 pupils, including almost all of those in the first eight grades and several in high school. Data included an estimate of the degree of skin pigmentation (five categories were employed), hand prints and percentages of Cherokee ancestry. Estimates of skin pigmentation were made in each instance prior to taking hand prints and finding the degree of Cherokee ancestry.

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## Findings

## ANCESTRY AND PIGMENTATION

Judgment as to shade of skin pigmentation on the basis of appearance is a subjective evaluation and should be tested for correlations with other types of evaluation in order to determine its reliability. One should expect a significant but not complete correlation between degrees of pigmentation and percentages of Cherokee ancestry, if ratings of pigmentation are very reliable. Such a test was made on 649 pupils. The subjects were grouped into eight classes with respect to ancestry, the class means varying from 6.25% to 93.75% Cherokee ancestry. They had previously been grouped into five categories with respect to degree of pigmentation, from the lightest (no. 1) to the darkest (no. 5). Thus the test included forty categories. A statistically significant correlation coefficient of  $+0.681$  was obtained. The mean percentage of Cherokee ancestry was  $59.71 \pm 1.087$ , and the mean rating of pigmentation was  $2.805 \pm 0.052$ .

The next step was to determine whether pupils in the first four grades differed from those in the upper grades with respect both to ancestry and shade of skin color. The results of these tests are listed in Tab. I. Pupils in the upper grades have

Tab. I. Comparisons between Cherokee pupils in different grades

<i>a) In respect to percentage of Cherokee ancestry</i>			
	<i>N</i>	Cherokee ancestry	Difference
Upper grades	323	$65.06 \pm 1.450$	
Four lower grades	345	$55.58 \pm 1.481$	$9.48 \pm 2.072$
<i>b) In respect to degree of pigmentation</i>			
	<i>N</i>	Degree of pigmentation	Difference
Upper grades	332	$3.057 \pm 0.056$	
Four lower grades	358	$2.544 \pm 0.095$	$0.573 \pm 0.110$

significantly higher percentages of Cherokee ancestry and darker shades of pigmentation than do those in the first four grades. These observations indicate a fairly rapid rate of change towards reduction in the proportion of Cherokee ancestry.

Hand prints were analyzed for the incidence of patterns on hypothenar, thenar/first interdigital and distal interdigital palmar areas. Tests were made for associations between each of these dermatoglyphic variations with degree of pigmentations.

## HYPOTHENAR

Patterns occur more frequently among Whites than among American Indians in this region of the palm (Tab. II). The percentage observed among the pupils is higher than among American Indians and lower than among Whites (Tab. III). Pupils having patterns in this area have pigmentation ratings below means for the entire samples. The difference in mean percentages is statistically significant (Tab. VI).

Tab. II. Palmar patterns in American Indians and Whites

Investigator	N	Population	Comparative frequencies		
			Hypothenar	Thenar/first	Distals II, III and IV
Newman, 1960	420	Maya Indians (Yucatan)	14.2	45.8	
Steggerda et al, 1936	224	Maya Indians	12.3	48.7	9.2
Neel et al, 1964	76	Xavante Indians (Brazil)	12.0	49.5	
Rife, 1968	146	Seminole Indians (USA)	9.9	18.4	11.2
Rife (Present study)	659	Cherokee Indians (USA)	17.5	23.3	12.8
Pons, 1956	342	Whites (Spain)	26.2	9.8	18.6
Cummins and Midlo, 1926	150	Whites (USA)	37.0	12.5	19.2
Steggerda et al, 1936	150	Whites (USA)	32.7	11.9	17.7

Tab. III. Hypothenar pattern frequencies in Cherokee pupils

[N = 359 ♂ and 337 ♀]

Sex	Side	No. of patterns	Percentage of persons	Percentage of palms
♂	R	22	6.12	3.06
	L	23	6.40	3.20
	R+L	25	6.96	6.96
	R	20	5.93	2.96
	L	29	8.08	4.04
	R+L	50	14.83	14.83
Totals		169	24.28	17.51

## THENAR/FIRST INTERDIGITAL

American Indians are noted for relatively high frequencies of patterns in this area. In general these frequencies are higher among South and Central American than among North American tribes. Frequencies among Whites average well below those of all tribes which have been studied, including those in North America.

Cherokee pupils having patterns in the thenar/first interdigital area also have a higher mean for degree of skin pigmentation than does the entire pupil sample. Differences between the means are highly significant (Tables II, IV, VI).

**Tab. IV. Thenar/first interdigital pattern frequencies in Cherokee pupils**  
[ $N = 363 \text{ ♂}$  and  $337 \text{ ♀}$ ]

Sex	Side	No. of patterns	Percentage of persons	Percentage of palms
♂	R	7	1.92	0.96
	L	67	18.45	9.22
	R+L	50	13.77	13.77
	R	6	1.78	0.89
	L	45	13.32	6.66
	R+L	52	15.43	15.43
Totals		227	32.42	23.35

#### DISTAL INTERDIGITAL AREAS

Patterns which occur in interdigital area II almost always result from an accessory triradius, whereas those in areas III and IV may result either from accessory triradii or from configurations associated with main lines emerging from triradii *c* and *d*. *D* symbolizes a pattern arising from an accessory triradius, whereas *L* symbolizes those originating from main lines arising from triradii *c* and *d*. *L* patterns are associated with the transverseness of palmar ridges rather than with accessory triradii. It is not uncommon for *L* and *D* patterns to occur simultaneously in interdigital IV.

There is a high correlation between the occurrence of accessory triradii in interdigital areas II, III, and IV. This correlation has been observed in all populations which have been investigated (Pons, 1956; Bansal and Rife, 1962). Previous studies had suggested dominance of accessory triradii in area II (Weinand, 1937). Later work indicated that *D* patterns in area II do not conform to simple dominance, but that if *D* patterns and distinct vestiges in any or all of areas II, III, and IV are assumed to result from the same dominant gene, the data do conform to dominance with high penetrance. Expressivity varies from accessory triradii on one or more areas of both palms to a distinct vestige (*V*) on a single area of one palm.

A total of 120 pupils have *D* or *V* configurations in the distal interdigital areas. Among these, 35 have *D* or *V* in two different interdigital areas: 5 of them in areas III and IV, and 30 in areas II and IV. Among the latter, 27 pupils have patterns or vestiges in area II of right palms and area IV of left palms (Tab. V).

It is for the foregoing reasons that patterns in areas II, III, and IV are con-

**Tab. V. *D* and *V* pattern frequencies in interdigital areas II, III, and IV in Cherokee pupils**  
 [*N* = 358 ♂ and 328 ♀]

Area	Sex	Side			Total
		R	L	R+L	
II	♂	9	3	0	12
II	♀	4	0	0	4
III	♂	4	2	0	6
III	♀	0	0	0	0
IV	♂	3	20	10	33
IV	♀	4	14	11	29
II R and IV L					
II and IV	♂		7		7
II and IV	♀		2		2
II R + L and IV L					
II and IV	♂		3		3
II and IV	♀		4		4
II R and IV R + L					
II and IV	♂		5		5
II and IV	♀		6		6
Other combinations II and IV					
II and IV	♂		3		3
II and IV	♀		1		1
All combinations III and IV					
III and IV	♂		3		3
III and IV	♀		1		1
Combinations II, III, and IV					
II, III, IV	♂		0		0
II, III, IV	♀		1		1
<b>Totals</b>					
Sex	Persons with patterns	Percentage of persons		Percentage of palms	
♂	71	19.83		14.38	
♀	49	14.90		8.99	
♂ + ♀	120	17.49		12.82	

sidered together in Tab. V. Only *D* and *V* configurations are included. Frequencies of *D* patterns are relatively high in Negroes, intermediate in Whites and low in American Indians. Inspection of Tab. VI reveals that Cherokee pupils with *D* and *V* configurations also have lighter shades of skin pigmentation than does the entire sample. The difference in means is highly significant.

Tab. VI. Pigmentation and patterns in palmar areas

Area	No. of pupils	Mean degree of pigmentation	Difference <sup>a</sup>
Hypothenar	167	2.50 ± 0.108	0.305 ± 0.119
Thenar/first interdigital	220	3.11 ± 0.090	0.308 ± 0.104
Distal interdigital	118	2.29 ± 0.116	0.515 ± 0.125

<sup>a</sup> As compared with the mean degree of pigmentation of the entire sample (2.805 ± 0.052).

### Associations between Pigmentations and Palm Patterns

A highly significant association was found between the incidence of accessory triradii in distal interdigital areas and lightness of pigmentation. Linkage could result in such an association. The incidence of accessory triradii in distal palmar areas is significantly lower among all American Indian tribes that have been investigated than among populations of European origin. Under these circumstances the observed association between lightness of pigmentation and incidence of accessory triradii in distal palmar areas would be expected in populations of mixed Indian-White origin. The degree of association should diminish in successive generations until approximate equilibrium is attained. If not linked these associations should disappear within a few generations, whereas if linked they would persist longer (Rife, 1954).

Less significant associations were found between degrees of pigmentation and the occurrence of patterns in hypothenar and thenar/first interdigital areas. Patterns in the hypothenar areas are associated with lighter degrees of pigmentation, whereas those in the thenar/first interdigital area are associated with darker degrees of pigmentation. Here again, the trait associations are of the types expected prior to the attainment of equilibrium (Tab. II).

The observation that significant associations occur between degrees of pigmentation and frequencies of patterns in each palmar area suggests that hybridization has been so recent that such associations are still apparent even though linkage may not be involved. Highly significant differences in the degree of association between heritable variations within populations of recent hybrid origins would be expected if some of the variables involve linkage and others do not. The highly significant association between lightness of pigmentation and pattern frequencies in distal interdigital areas as compared with associations of lesser significance in hypothenar and thenar/first interdigital areas suggests linkage between genes responsible for pigmentation and patterns in distal interdigital areas. But the observed differences in degree of association are of insufficient magnitude to be sure that they may not result from chance fluctuations. Thus the data neither rule out nor confirm the possibility of linkage between genes responsible for dark pigmentation in American Indians and accessory triradii in distal areas of the palm.

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## RIASSUNTO

Sono stati analizzati i dermatoglifi palmari, il grado di pigmentazione cutanea e la percentuale di ascendenza Cherokee in 700 scolari della scuola Cherokee nello stato della North Carolina. Si tratta di scolari di origine mista, Cherokee-Bianca. L'ascendenza Cherokee è di circa 60% in media, e significativamente più elevata nelle classi scolastiche superiori che in quelle inferiori.

I disegni palmari presentano frequenze simili a quelle di altre tribù nordamericane. Le frequenze dei disegni su tre aree palmari sono significativamente associate al grado di pigmentazione, l'associazione più elevata risultando quella fra pigmentazione lieve e triradi accessori nelle aree interdigitali distali.

## RÉSUMÉ

Les empreintes palmaires, le degré de pigmentation et le pourcentage d'ascendance Cherokee ont été analysés chez 700 écoliers de l'école Cherokee de l'Etat de la North Carolina, d'origine mixte, Cherokee-Blanche. L'ascendance Cherokee est d'environ 60% en moyenne, et significativement plus élevée dans les classes scolaires supérieures.

Les figures palmaires présentent des fréquences très proches de celles d'autres tribus nordaméricaines. Les fréquences des figures sur trois aires palmaires sont significativement associées au degré de pigmentation, l'association la plus élevée étant celle entre pigmentation légère et triradii accessoires sur les aires interdigitales distales.

ZUSAMMENFASSUNG

Handflächenzeichnung, Pigmentierungsgrad und Anteil der Cherokee-Azpendenz wurden bei 700 Kindern der Cherokee-Schule im Staate North Carolina untersucht. Die Schüler sind Mischlinge aus Cherokee und Weissen. Die Cherokee-Azpendenz beträgt im Durchschnitt 60% und ist in den höheren Schulklassen wesentlich stärker als in den unteren.

Die Frequenzen der Handflächenzeichnung sind ähnlich wie bei anderen nordamerikanischen Volksstämmen. Für drei Handflächenzonen besteht eine interessante Assoziation zwischen Handleistenzeichnung und Pigmentierung. Die stärkste Assoziation fand man zwischen leichter Pigmentierung und überschüssigen Triadien in der distalen Zwischenfingergegend.

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