# A Study in Dermatoglyphic Correlation in Related Individuals

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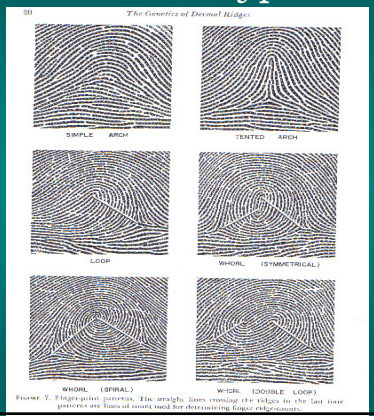
## Dermatoglyphics

- Dermatoglyphics is a term that describes the study of dermal ridges specifically those on the fingers, hands, and feet
- This is a study of dermatoglyphics,
  - It evaluates similarities based on heritability
  - It compares correlations in nuclear and extended families to unrelated individuals

## Anthropology in Dermatoglyphics

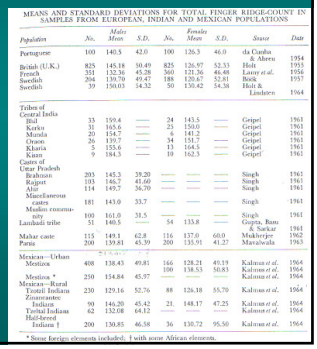
- Fingerprints are less susceptible to genetic drift.
- Fingerprints are unalterable after birth.
- Dermatoglyphic studies are highly objective, reducing personal error.
- Because the ridges are polygenic traits.
- Due to the ridges being fixed once they are expressed.
- This is because the results are based on calculations, not opinion.

## Pattern Types




## Anthropology in Dermatoglyphics

- Dermatoglyphics can be used to study world wide populations.
- In terms of :
  - Heritability
  - Developmental selection
  - Geographic variation


MEANS AND STANDARD DEVIATIONS FOR TOTAL FINGER RIDGE-COUNT IN SAMPLES FROM EUROPEAN, INDIAN AND MEXICAN POPULATIONS

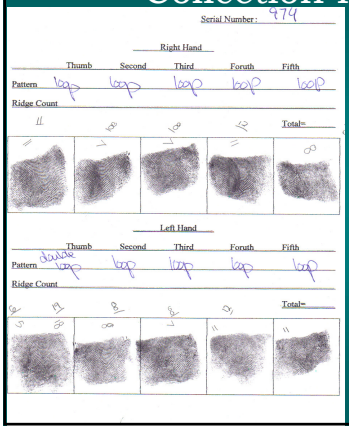
| Population | Male No. | Male Mean | Male S.D. | Female No. | Female Mean | Female S.D. | Source | Date |
|---|---|---|---|---|---|---|---|---|
| Portuguese | 100 | 140.5 | 42.0 | 100 | 126.3 | 46.0 | da Cunha & Abreu | 1954 |
| British (U.K.) | 825 | 145.18 | 50.49 | 825 | 126.97 | 52.33 | Holt | 1955 |
| French | 351 | 132.36 | 45.28 | 360 | 121.36 | 46.48 | Lamy et al. | 1956 |
| Swedish | 204 | 139.70 | 49.47 | 188 | 120.67 | 52.81 | Böök | 1957 |
| Swedish | 39 | 150.03 | 34.32 | 50 | 130.42 | 54.38 | Holt & Lindsten | 1964 |
| Tribes of Central India | | | | | | | | |
| Bhil | 33 | 159.4 | — | 24 | 143.5 | — | Geipel | 1961 |
| Korku | 31 | 165.6 | — | 25 | 150.0 | — | Geipel | 1961 |
| Munda | 20 | 154.7 | — | 6 | 141.2 | — | Geipel | 1961 |
| Oraon | 26 | 139.7 | — | 24 | 151.7 | — | Geipel | 1961 |
| Kharia | 5 | 155.6 | — | 13 | 164.3 | — | Geipel | 1961 |
| Kaur | 9 | 184.3 | — | 10 | 162.3 | — | Geipel | 1961 |
| Caste of Uttar Pradesh | | | | | | | | |
| Brahmin | 203 | 145.3 | 39.20 | — | — | — | Singh | 1961 |
| Rajput | 105 | 146.7 | 41.60 | — | — | — | Singh | 1961 |
| Ahir | 114 | 149.7 | 36.70 | — | — | — | Singh | 1961 |
| Miscellaneous castes | 181 | 143.0 | 33.7 | — | — | — | Singh | 1961 |
| Muslim community | 103 | 161.0 | 31.5 | — | — | — | Singh | 1961 |
| Lambadi tribe | 51 | 140.5 | — | 54 | 133.8 | — | Gupta, Basu & Sarkar | 1961 |
| Mahar caste | 113 | 149.3 | 62.8 | 116 | 137.0 | 60.0 | Mukherjee | 1962 |
| Paraiyan | 200 | 139.83 | 45.39 | 200 | 133.91 | 41.27 | Mavalwala | 1963 |
| Mexican—Urban Mestizo | 408 | 138.43 | 49.81 | 166 | 128.21 | 49.19 | Kalmus et al. | 1964 |
| | | | | 100 | 138.53 | 50.83 | Kalmus et al. | 1964 |
| Mestizo * | 250 | 154.84 | 45.97 | — | — | — | Kalmus et al. | 1964 |
| Mexican—Rural Totoli Indians | 230 | 129.16 | 52.76 | 88 | 126.38 | 55.70 | Kalmus et al. | 1964 |
| Zinacantec Indians | 90 | 146.20 | 45.42 | 21 | 148.17 | 47.25 | Kalmus et al. | 1964 |
| Tzotal Indians | 62 | 132.08 | 64.12 | — | — | — | Kalmus et al. | 1964 |
| Half-breed Indians † | 200 | 130.85 | 46.58 | 36 | 130.72 | 95.50 | Kalmus et al. | 1964 |

* Some foreign elements included. † with some African elements.

## Institutional Review Board

- To be approved by the IRB the study had to:
  - Adhere to the guidelines of the ethical treatment of human subjects
  - Go through an application process, to assure the safety of the participants

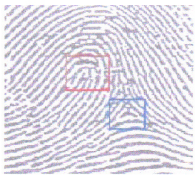
# Collection Process

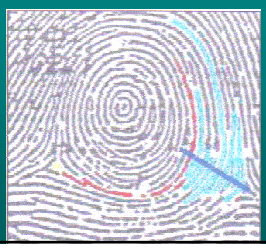



- The participants were part of four groups:
  - Families 1-3
  - An unrelated control
- All ten finger were printed using:
  - Archival ink
  - Acid free ID cards
  - A rolling technique
- All individuals received a serial number to assure confidentiality.

# Total Ridge Count

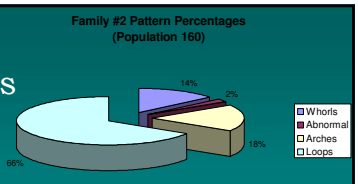
- A ridge count is the number of ridges along a straight line.
  - Starts at the delta
  - Stops at the center of the pattern
- A TRC is derived by adding the counts from all ten fingers

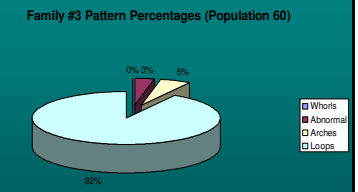

A Loop Pattern



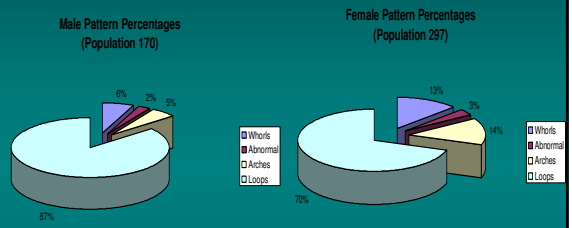
# Pattern Frequencies

- Family 2 most closely correspond with Harold Cummins' percentages
  - Loops 70%
  - Whorls 20%
- Family 3 was least like the expected percentages
  - Arches 5%
  - Unique 5%




# Pattern Frequencies




- It is expected that males will have a higher percentage of whorls than females.
- The study found this to be untrue, possibly due to the difference in male and female populations.

# Correlations

- As a complete population the families were a good fit to theoretical values
- Family 1 was most like the theoretical values
- Family 3 was the least similar

| Degree of relationship | Number of Pairs used | Observed coefficient | Relative coefficient |
|---|---|---|---|
| Midparent - Child | 7 | 0.75043 | 0.71 |
| Mother - Child | 7 | 0.431939 | 0.50 |
| Father - Child | 14 | 0.392316 | 0.50 |
| Sibling-Sibling | 19 | -0.07934 | 0.50 |

# Chi-square test: observed-observed

| Family comparison | X2 Value | Sample size | Significance Level |
|---|---|---|---|
| Family 1 & 2 | 14.3 | 359 | 0.01 |
| Family 1 & 3 | 9.44 | 262 | 0.05 |
| Family 2 & 3 | 22.8 | 217 | 0.01 |

- This test was used to find the goodness of association among the families
- Each family was tested against the others
- The frequencies were found to be statistically significant

## Chi-square test: observed-expected

- This test was used to show goodness of fit
- It was done by testing the complete population against the expected frequencies
- Results showed that the study was significantly different from the expected values

**X2 value =11.21**

**Significant at p=0.05**

## Conclusions

- By comparing the data to proven correlations and pattern frequencies the study shows heritability and variation among the families through:
  - Correlations
  - Chi-square tests
- Supporting the hypothesis, that related individual's fingerprint ridge counts are more similar than an unrelated individual's

## Thank You!


- To all the participants who let me bother them over the holidays.
- To Dr. Jen Rehg who listened to me vent and helped an idea become a reality.
- To the SIUE Anthropology department for their help.
- To Steve for reading over all the drafts and listening to all the rehearsals. Thank you for everything!


Pictures came form Holt 1968, Cummins 1961, and www.poliecensw.com/info/fingeprints/finger07.html