Determination of Whorl Pattern amongst the Hausa People in the Federal Capital Territory, Nigeria

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Abstract
Dermatoglyphic patterns can reveal a lot about genetic and population diversity, but there's still a gap in our knowledge about whorl fingerprint patterns among the Hausa people. This study set out to explore how these whorl patterns are distributed by sex within the Hausa ethnic group living in the Federal Capital Territory (FCT) of Nigeria. We used a cross-sectional design to gather high-resolution digital fingerprints from 150 Hausa adults in the FCT. The patterns were analyzed using AutoCAD® and categorized according to standard dermatoglyphic types. We calculated the frequencies by digit and sex, employing chi-square analyses for statistical comparisons. The findings indicated that whorl patterns were more common among Hausa males, particularly in the index (26.7%) and middle fingers (23.3–30.0%), compared to females (index: 14.8–20.4%; middle: 13.0–14.3%). The little fingers showed lower frequencies, with significant differences between the sexes. Overall, Hausa males in the FCT displayed a higher prevalence of whorl fingerprint patterns than females, especially in the central digits. This sexual dimorphism might be influenced by both genetic and developmental factors, which could have important implications for forensic and anthropological studies.

Keywords: dermatoglyphics, fingerprint, whorl pattern, Hausa, sexual dimorphism, Nigeria

Introduction
Dermatoglyphics, the study of skin ridge patterns on fingers, palms, toes, and soles, offers valuable insights into genetic variation, population dynamics, and forensic identification (Cummins & Midlo, 1961). These ridge patterns—established during early intrauterine life—remain unchanged throughout an individual's lifetime and express both hereditary and environmental influences (Kanchan *et al*., 2021).

Among the major fingerprint types, whorl patterns are particularly useful for population studies due to their intermediate frequency and variability (Holt, 1968; Henry, 1900). Dermatoglyphic research since 2020 has reinforced the importance of whorl and ridge-count patterns in reflecting genetic and developmental influences. Dare *et al.* (2021) showed in a Nigerian student sample that whorl frequencies, pattern intensity index, and ridge counts vary significantly by sex—consistent with sexual dimorphism in fingerprint traits While substantial data exist for some Nigerian ethnic groups, the Hausa,

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one of Nigeria's largest ethnic minorities remain understudied in this context. Given the Hausa's considerable cultural, demographic, and historic presence in Nigeria and West Africa, population-specific dermatoglyphic data are needed for comprehensive anthropological mapping, as well as potential medical and forensic applications.

This study aims to fill this knowledge gap by analyzing the distribution of whorl patterns among the Hausa of FCT, exploring possible sex-based differences, and comparing findings with established dermatoglyphic literature.

Materials and Methods

Study Design and Setting

A descriptive cross-sectional study was conducted among adult Hausa residents in the Federal Capital Territory (FCT), Nigeria. Ethical approval was obtained from the Nile University Health Research Ethics Committee (FHREC/2024/01/65/11-03-24). All participants provided informed verbal consent, in line with the Declaration of Helsinki.

Participants

Participants were 150 self-identified Hausa adults (age ≥18 years), made up of 75 males and 75 females, residing in the FCT. Exclusion criteria included visible hand deformities, skin diseases, or previous finger injuries.

Data Collection

Fingertip prints were obtained using an HP Scanjet G3110 flatbed scanner at high resolution. Participants washed and dried their hands before scanning. All ten fingers were scanned individually; images were anonymized and coded.

Pattern Analysis

Fingerprint patterns were analyzed using AutoCAD® and classified into loops, whorls, and arches, following standard principles (Henry, 1900). Only whorl pattern frequencies are presented herein.

Statistical Analysis

Data were analyzed using IBM SPSS v29. Frequencies and percentages of whorl patterns by digit and sex were computed. Associations were evaluated using the chi-square test; $p < .05$ denoted significance.

Study Design and Setting

A descriptive cross-sectional study was conducted among adult Hausa residents in the Federal Capital Territory (FCT), Nigeria. Ethical approval was obtained from the Nile University Health Research Ethics Committee (FHREC/2024/01/65/11-03-24). All participants gave their informed verbal consent, adhering to the Declaration of Helsinki.

Participants

The study included 150 self-identified Hausa adults, with an equal split of males and females, all aged 18 and over, living in the FCT. Exclusion criteria included visible hand deformities, skin diseases, or previous finger injuries.

Data Collection

Fingertip prints were obtained using an HP Scanjet G3110 flatbed scanner at high resolution. Participants washed and dried their hands before scanning. All ten fingers were scanned individually; images were anonymized and coded.

Pattern Analysis

Fingerprint patterns were analyzed using AutoCAD® and classified into loops, whorls, and arches, following standard principles (Henry, 1900). Only whorl pattern frequencies are presented herein.

Results

Table 1: Frequency (%) of whorl patterns by digit and sex

Finger	Male (n =75)	Female (n = 75)	Difference (Male - Female)
Index (R)	26.7	20.4	+6.3
Index (L)	26.7	14.8	+11.9
Middle (R)	30.0	14.3	+15.7
Middle (L)	23.3	13.0	+10.3
Ring (R)	20.0	16.7	+3.3
Ring (L)	16.7	16.7	0.0
Little (R)	10.0	11.1	-1.1
Little (L)	16.7	5.6	+11.1

Table 1 illustrates the percentage frequency of whorl patterns categorized by digit and sex. The analysis of whorl fingerprint patterns among Hausa participants highlights a distinct sexual dimorphism. Males tend to show a higher overall frequency of whorl patterns across most digits when compared to females.

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The index and middle fingers stand out with the highest prevalence of whorl patterns in both sexes, particularly among males, where the rates peak at 30.0% for the right middle finger and 26.7% for both index fingers. On the other hand, females exhibit a lower overall prevalence, with the right index finger (20.4%) showing the highest occurrence. The little fingers have the lowest frequencies, especially among females (5.6% on the left, 11.1% on the right), in contrast to males (16.7% on the left, 10.0% on the right).

The results indicate statistically significant gender differences in the Middle (Right), Index (Left), and Little (Left) fingers ($p<0.05$), while no significant differences were found in the Ring fingers (both hands), Little (Right), and Index (Right) fingers ($p>0.05$). These findings emphasize a consistent trend of higher whorl occurrences in the central digits (index and middle fingers) and a notable gender gap, particularly in the middle and index fingers.

Discussion

This study highlights a clear difference in fingerprint whorl patterns between males and females among Hausa adults in the Federal Capital Territory (FCT), Nigeria. In line with previous research conducted in Africa and around the world (Kanchan *et al*., 2021; Anthony *et al*., 2023), it was found that males had a notably higher occurrence of whorl patterns, especially in the central digits—the index and middle fingers. The right middle finger had the highest prevalence among males at 30.0%, while the left index and left little fingers also showed significant gender differences ($p < 0.05$). These findings reinforce the idea that both polygenic inheritance and prenatal hormonal influences play a role in shaping dermatoglyphic traits (Schaumann & Alter, 1976; Babler, 1991).

In general, females exhibited lower frequencies, with the right index finger showing the highest occurrence at 20.4%. The little fingers had the lowest frequencies for both genders, especially among females, which aligns with the known variability in ridge pattern development across different fingers (Cummins & Midlo, 1961). The absence of significant differences in the ring fingers and right little finger ($p > 0.05$) indicates that sexual dimorphism in whorl patterns is specific to certain digits, reflecting the intricate genetic and developmental influences during embryogenesis (Meier *et al*., 2013).

Although there is limited direct comparisons with other Nigerian ethnic groups, the prevalence seen in Hausa males matches reported patterns among Yoruba and Igbo populations (Anthony et al., 2023). The strengths of this study include a thorough digit-wise analysis and strong methodology; however, the moderate sample size and the lack of genetic or environmental covariates are limitations. These findingsoffervaluable baseline data that enhance our understanding of intra-ethnic dermatoglyphic diversity and support the application of fingerprint pattern analysis in forensic and anthropological studies in Nigeria (Gutiérrez-Redomero *et al*., 2011;

Conclusion

This research sheds light on the important gender differences in the frequency and specific distribution of whorl fingerprint patterns among Hausa adults in FCT, Nigeria. It turns out that males have a notably higher prevalence of these patterns in their right middle, left index, and left little fingers, while the other fingers don’t show any significant gender differences. These initial findings enhance our understanding of dermatoglyphics and anthropology related to the Hausa population, highlighting the need to factor in digit-specific patterns in forensic and population studies. For future research, it would be beneficial to include larger, genetically diverse groups and consider environmental factors to gain a deeper insight into what influences dermatoglyphic variation.

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