

The Analysis of the ATD Angle of the Hausa People in the Federal Capital Territory, Nigeria

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Abstract—Quantitative measures of palmar dermatoglyphics, especially the ATD angle, are crucial genetic markers that vary across populations and are important for fields like anthropology, forensics, and biomedicine. Yet, there's a lack of data on the ATD angle among the Hausa people, one of the largest ethnic groups in West Africa. This study aims to quantify the ATD angle in Hausa men and women living in Nigeria's Federal Capital Territory (FCT), providing reference values and exploring differences between the sexes. A cross-sectional sample of 150 Hausa adults (75 males and 75 females, all aged 18 and over) was recruited. For the study, high-resolution palm prints were captured using an HP Scanjet G3110 scanner. The ATD angles formed by connecting the digital triradius "a," the axial triradius "t," and the digital triradius "d" were measured with AutoCAD software. The data was analyzed using SPSS v29, reporting mean values, standard deviations, ranges, and t-tests. The results indicated that the average ATD angle for males was 43° (SD = 4, range = 35–50°), while females had a slightly higher average of 44° (SD = 4, range = 36–52°). The difference between the sexes was not statistically significant ($p > .05$), and both groups showed moderate variability within themselves. The ATD angle values in the Hausa population align closely with global averages, showing minor but non-significant sexual dimorphism. These findings offer valuable normative data for future research in biomedicine, forensics, and population genetics in the region.

Keywords— ATD angle, Dermatoglyphics, Hausa, Palmar prints, Sexual dimorphism, Nigeria.

I. INTRODUCTION

Dermatoglyphics, the fascinating scientific study of the unique patterns found on our fingers, palms, and soles, offers a powerful, non-invasive way to delve into human population diversity, genetic inheritance, and their links to various medical conditions [1],[2]. One particularly insightful measure in this field is the ATD angle. This angle, formed at the axial triradius (t) by lines drawn to the digital triradii "a" (located at the base of the index finger) and "d" (at the base of the little finger), is established during the second trimester of fetal development and remains consistent throughout a person's life.[3],[4]. Changes in the ATD angle have been associated with both ethnogeographic backgrounds and certain developmental or chromosomal disorders, including Down syndrome [5], [3].

The Hausa people are one of the largest and most influential ethnic groups in West Africa, yet there's a surprising lack of dermatoglyphic data specific to them compared to groups like the Yoruba or Igbo [6],[7]. Since quantitative dermatoglyphics can reveal insights into gene-environment interactions, gathering baseline data on the ATD angle within the Hausa population is crucial for anthropological, clinical, and forensic purposes [8], [9].

This study aims to (i) measure the ATD angle in a sample of Hausa adults living in the Federal Capital Territory, and (ii) explore any potential differences between sexes in this trait, ultimately contributing to the regional database of palmar dermatoglyphic standards.

II. MATERIALS AND METHODS

Study Design and Ethical Considerations

A descriptive cross-sectional study was carried out involving Hausa adults aged 18 and older living in the FCT, Nigeria. The Nile University Health Research Ethics Committee approved our study (Approval No. FHREC/2024/01/65/11-03-24). Following the principles of the Helsinki Declaration, all subjects provided their informed consent orally and in writing [10].

Sample

Our sample included 150 healthy, unrelated Hausa adults, with an equal split of 75 males and 75 females. To be included, participants had to self-identify as Hausa and not have any congenital hand abnormalities, significant injuries, or skin conditions affecting their palms.

Dermatoglyphic Print Acquisition

The hands of each participant were scanned using an HP Scanjet G3110 flatbed scanner, set to a resolution of 9000 × 4800 dpi. Before capturing their prints, participants cleaned and dried their hands. Each palmar image was assigned a unique identifier to maintain anonymity.

ATD Angle Measurement

The ATD angle was measured using AutoCAD software (2024 edition). On the palmar images, we marked the positions of triradii "a," "t," and "d," and calculated the angle at "t" formed by the lines "at" and "td," following established dermatoglyphic protocols.^{11,3} Two trained raters independently performed each measurement, and we took the mean values to reduce observer error.

Statistical Analysis

The data obtained was analyzed using IBM SPSS Statistics v29. For each sex, we calculated descriptive statistics, including mean, standard deviation, and range. To compare groups, the Student's t-test was used, considering $p < .05$ as statistically significant.

RESULTS

Sample Characteristics

A total of 150 Hausa adults (75 males, 75 females), ages 18–60 (mean \pm SD: males 28.3 ± 7.2 years, females 27.5 ± 8.1 years), provided analyzable prints.

The mean ATD angle for males is 43° , with a standard deviation of 4° and a range from 35° to 50° . For females, the mean ATD angle is 44° , with the same standard deviation of 4° and a range from 36° to 52° . A t-test comparing the two groups yielded $t(148) = -1.31$ with a p-value of .194, indicating that the difference is not statistically significant.

TABLE 1. Mean, Standard Deviation, and Range of ATD Angles in Hausa Males and Females (n = 75 per group)

Sex	Mean (°)	SD (°)	Range (°)
Males	43	4	35–50
Females	44	4	36–52

Females exhibited a slightly higher mean ATD angle and a marginally broader range than males, while variability within groups (SD) was the same. No significant difference was found between sexes ($p > .05$).

III. DISCUSSION

This study offers important baseline data on the ATD angle within the Hausa population of Nigeria's FCT. The average ATD angles recorded 43° for males and 44° for females—are in line with global averages seen in diverse ethnic groups.[1], [11].[3]. The absence of a significant difference between sexes mirrors findings from other African populations [6], [12]. highlighting the ATD angle as a reliable biometric marker that is specific to different populations.

The moderate variability observed within both sexes aligns with previous studies that emphasize the polygenic and multifactorial nature of palmar ridge patterns [3]. The slightly wider range in females might indicate a greater sensitivity to environmental or genetic influences during development, but more extensive research with larger sample sizes is needed to better understand this pattern.

The clinical and forensic significance of ATD angle measurements is well-established, especially when it comes to identifying specific syndromic traits or assisting with personal identification in areas with limited resources [5],[2],[6]. By creating these reference values tailored to the Hausa population, we can enhance comparative studies and applications in genetic epidemiology. Looking ahead, future research should involve larger multi-center cohorts, longitudinal follow-ups, and explore potential links to medical conditions or genetic markers that are common in the region. However, this study does have its limitations, including a small sample size, a cross-sectional design, and a dependence on self-reported ethnicity. Additionally, factors like environmental and socio-economic

influences, as well as any left-right asymmetry in the ATD angle, were not examined and should definitely be considered in future studies.

IV. CONCLUSION

The ATD angle in Hausa males and females from the FCT shows values that align with broader African and global standards, and there's no notable difference between the sexes. This information provides crucial dermatoglyphic benchmarks specific to the population, which can be used in scientific, forensic, and biomedical fields. It also lays the groundwork for future research in epidemiology and genetics, both in Nigeria and beyond.

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