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RESEACH ARTICLE

COMPARISON OF ASYMMETRY OF THUMBPRINTS PATTERNS AND PALM PRINTS VARIABLES IN MALES AND FEMALES HAUSA ETHNIC GROUP OF KANO AND ZARIA, NIGERIA

Affan Usman[1]* and Aliyu Jaafar[2],

[1]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Umaru Musa Yar'adua University, Katsina, Katsina State, Nigeria
[2]Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, Ahmadu Bello University, Zaria, Nigeria

Abstract

Background: Dermatoglyphic features due to its permanency, genetic influence as well as number of easily observable and measurable characters may be considered one of the most suitable parameters for population variability and have been used extensively to characterize differentiate human populations, hence, are highly suitable for studying population variation. **Materials and Methods:** A total of 600 subjects comprising of 300 participants from two Hausa metropolis (Kano and Zaria) with 1:1 male to female ratio participated. Ink method was used to capture Thumbprints and Palm prints. Chi-square was used to determine the association between the variables. **Results:** The result of the study showed no statistical significant differences in frequency distribution of thumbprint pattern in the Hausa population. Similarly, in male participant no statistical significant difference in the frequency distribution among the two Hausa state. However, a statistically significant difference (Z= -2.05, P= 0.04) was observed in the frequency distribution of the left and right thumbprint pattern of the middle finger in the female of Kano state. With regards to palmer creases type no statistical significant differences between the frequency distribution of the right and left hand in both male and female of the two metropolis. A significant difference (t= -2.18, P=0.03) was observed in the mean of triradii angles (adt angle) of the left and right palmer angles in male Hausa Ethnic Group of Kano State. However, no such differences occur in the females of the two Hausa metropolis. **Conclusion:** The study reveals the potential of thumbprint asymmetry in sex differences among Hausa ethnic group in Kano and Zaria, Nigeria.

Keywords: Thumbprint, Palm prints, Asymmetry, Hausa Ethnic Group, Kano, Zaria

INTRODUCTION

Dermatoglyphics is the study of dermal ridges on the balls of finger, palm of hand and sole of the feet, and provides a myriad of genetic information which are pointer to inherited genetic diseases (Reddy and Reddy, 2006; Muralidhar *et al.*, 2011). Studies have shown that dermatoglyphics is used in establishing ethnic differences, genetic inheritance and population studies respectively (Harich *et al.*, 2002; Karmakar *et al.*, 2006; Danborno and Garba, 2007).

Fingerprints have ridge characteristics that allow for efficient classification and examination which often leads to the identification or elimination of suspects involved in a crime. So, fingerprints are the most and infallible means of personal identification in forensic investigations and trials (Kapoor and Badiye, 2015; Deepa *et al.*, 2021;). This has led to its wide use in the fields of forensic science, medicine, biological anthropology, ethnology and population genetics for their capabilities to identify racial and ethnic differences, gender, individuals as well as congenital malformations (Eboh, 2012).

* Corresponding Author: Affan Usman,
Tel: +2348034409926
E-mail: usman.affan@umyu.edu.ng

Palm prints provide a vast source of identification that can be used in a number of important fields, such as biometrics (Kong *et al.,* 2009), dermatoglyphics (Qiao *et al.,* 2005), and forensic science (Ashbaugh, 1991). The general flow of skin, its pattern configuration, and minutiae formation, all contribute towards making the palm print a unique identification metric (Ashbaugh, 1999). However, many palm print identification systems are based on features, such as minutiae, ridge flow, singular points, and flexion creases which are formed during embryological development (Zhang, 2010). Therefore, an understanding of palm print morphogenesis, that is, of palmar friction ridge skin development, is necessary when discussing palm print identification.

The presence of asymmetry between normally symmetric, bilateral traits has been studied using dermatoglyphic patterns (Palmer and Strobeck, 1986; Parsons, 1992). Excessive asymmetry between the dermatoglyphic patterns of the left and right hands may signify relatively unstable genetic control during embryogenesis (Naugler and Ludman, 1996), which, in turn, may contribute to the development of malformations.

In recent decades a large body of biological research has developed around the concept of fluctuating asymmetry (FA), which has been defined as random differences between the right (R) and left (L) sides of a morphological trait (Valen, 1962; A. O. Yusuf et al, 2019). When the distribution of the right minus left (RL) differences in a population sample approximates a normal curve with a mean of zero or close to zero, the variance of the distributions of R-L difference is a measure of FA (Valen, 1962; Saha *et al*., 2003). FA has been regarded by many researchers as primarily being an expression of environmental 'noise' (Arrieta *et al.,* 1993; Martin *et al*., 1982) disrupting the fidelity of the genetic 'signal'. However, genetic factors may also have a weak link to FA in finger ridge counts (Martin *et al*., 1982) and *a-b* ridge counts (Arrieta *et al.,* 1993). It has been proposed that the degree of fluctuation asymmetry in an organism reflects the developmental instability of that organism (Markow and Wandler, 1986; Livshits, and Kobylianski, 1987; Danborno and Garba, 2007).

The Hausa ethnic group is one of Nigeria's largest ethnic groups, but data on their human biology is scarce. The present study intends to describe asymmetry of Thumbprints Patterns and Palm Prints variables of Hausa Ethnic Group from Kano and Zaria, Nigeria.

MATERIALS AND METHODS

Study Location and Population

The study was conducted in the two Hausa cities of Kano and Zaria metropolis, which belong to north-western part of Nigeria. Data was collected from participants after informed verbal consent was obtained from those who were willing to participate in the survey, using a stamp pad, printer's duplicating ink, microscopic slide, methylated spirit, cotton wool and white plain sheets of paper.

Sampling Technique

A total of six hundred (600) participants were selected using systematic random sampling method with a sex ratio of 1:1.

Sample Size Determination

The sample size for this study was 600 subjects comprising both male and female considering the minimum sample size of 384 which was calculated using a formula below:

$$n = \frac{Z^2 \quad pq}{d^2}$$

Where n= desire sample size

Z= standard normal deviation 1.96 at 95% confidence level q= 1 – p, d= degree of precision usually set at 0.05, p= proportion =0.5 (50%)

Geography of the study area

Hausa people are concentrated mainly in North-west Nigeria and in adjoining Southern part of Niger republic. This area is mostly semiarid grassland or savanna, dotted with cities surrounded by farming communities. The cities of the region- Kano, Sokoto, Zaria, and Katsina, for exampleare among the greatest commercial centers of sub-sahara Africa (Africa south of the Sahara desert).

Hausa people are also found in othercountries of West Africa like Cameroon, Togo, Chad, Benin, Burkina Faso, and Ghana.

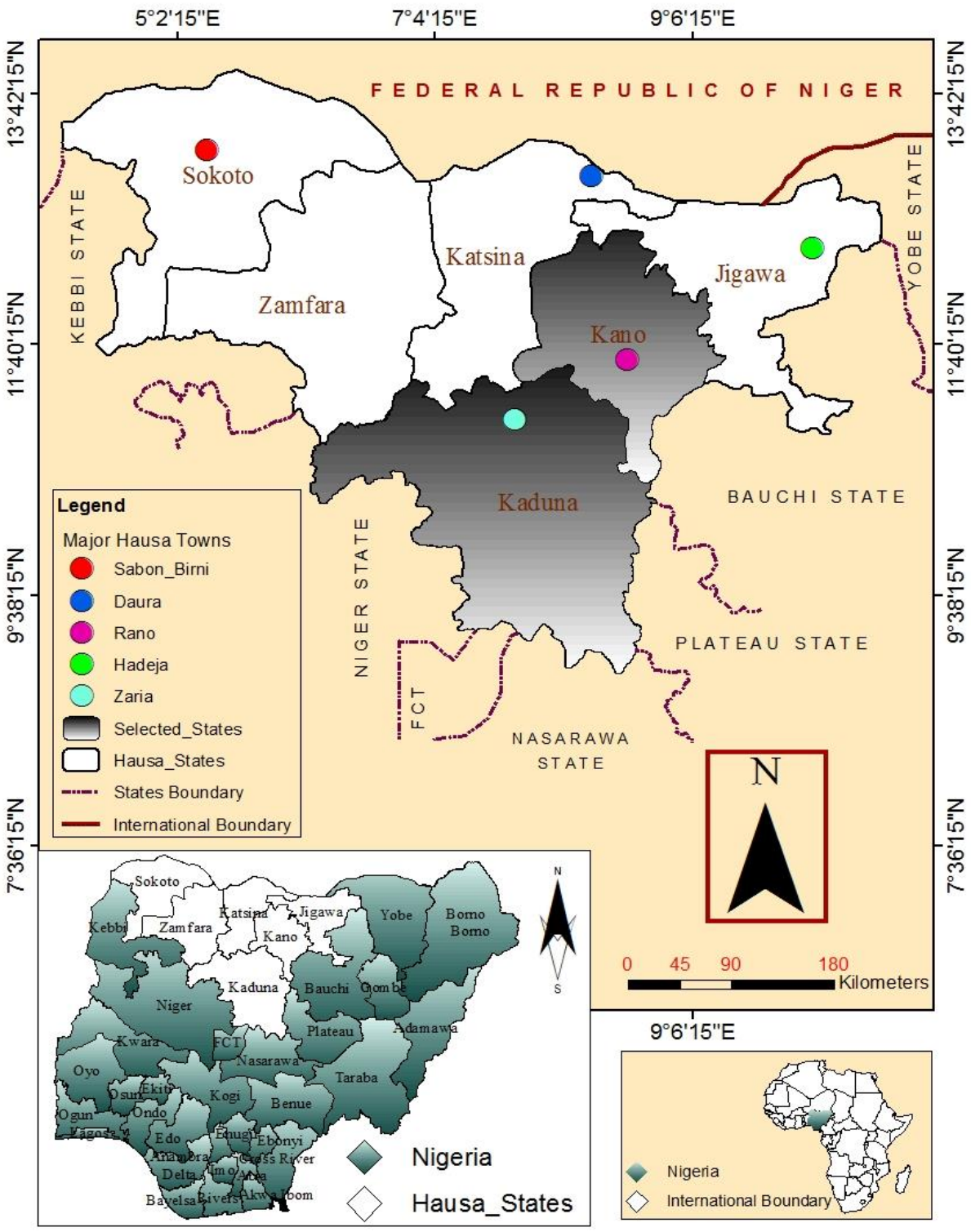

Figure 1: Map of Hausa states showing the two study area (above): Map of Nigeria showing the states where Hausa people mostly found (below). **Source:** Geographic and information systems (GIS)

Anthropometry

Finger print collection: The subjects were asked to wash and dry their hands and a traditional method of touching the ink pad with the tip of the finger and making imprint on a white sheet of paper was used in collecting the fingerprint and the patterns were studied and recorded accordingly (Champed *et al*., 2004).

Palm print: In this research work an offline method of palm print acquisition was employed, in which the palm print data was collected or captured from a non-digital source. Instead, the reference palm print was collected by printing with an ink on to a white paper sheet (Champed *et al*., 2004). The subjects were asked to sit in a relax position, wash and dry their hands. A small quantity of ink was applied over the palm of the subject by simply pressing their palm on the provided stamp pad, the cupped region of the palm was smeared thoroughly and uniformly. A sheet of paper was kept at the edge of the table. The palm was **imprinted** on the sheet of paper, taking care that the cupped regions of the palm **were** printed properly by pressing the dorsum of the palm of the subject. Care was taken to avoid any wrinkles and air bubbles. Then**, the palm prints were studied carefully using a** magnifying glass in bright light**, and** parameters such as palm **crease** type and triradii angles (ATD, ADT**, and DAT)** were obtained from the palm print.

Ethical Clearance

Ethical clearance was obtained from research ethics committee Ahmadu Bello University Teaching Hospital, Zaria. Nigeria. Batch number ABUTH/HREC/M22/2014.

Statistical Analyses

Data were expressed as frequency/percentages. Chi-square test was used to test for association between qualitative variables.The analyses were carried out using the Statistical Package for Service Solution (SPSS version 22, IBM, corp, New York). A $p<0.05$ was deemed statistically significant.

RESULTS

The frequency distribution of thumbprint pattern showed no statistical significant difference in the Hausas population (Table 1). Similarly, in male participants, no statistical significant difference in the frequency distribution among the two Hausa state (Table 2). However, a statistically significant difference ($Z= -2.05$, $P= 0.04$) was observed in the frequency distribution of the left and right thumbprint pattern of the middle finger in the female of Kano state (Table 3). With regards to palmer creases type no statistical significant difference between the frequency distribution of the right and left hand in both male and female of the two study population (Fig. 2 and 3). From Figure 3, a statistical significant differences ($t= -2.18$, $P=0.03$) was observed in the mean of adt angle of the left and right palmer angles in male Hausa ethnic group of Kano State. However, no such differences occur in the females of the two Hausa state (Fig. 4).

DISCUSSION

Dermatoglyphics has application in establishing ethnic differences, genetic inheritance and population studies respectively (Danborno and Garba, 2007; Harich *et al.,* 2002; Karmakar *et al.,* 2006). The skin ridge are never duplicated in two persons even in monozygous twins but similarities have been found in the same ethnic groups and variation noted in different ethnic groups and races (Danknierjer, 1947; Harrich *et al.,* 2002). The Hausa ethnic group is one of Nigeria's largest ethnic groups, but data on their human biology is scarce. The present study intends to describe the nature of finger and palm dermatoglyphics pattern of the two Hausa states.

The presence of asymmetry between normally symmetric, bilateral traits has been studied using dermatoglyphic patterns (Palmer and Strobeck, 1986; Parsons, 1992). Excessive asymmetry between the dermatoglyphic patterns of the left and right hands may signify relatively unstable genetic control during embryogenesis (Naugler and Ludman, 1996), which, in turn, may contribute to the development of malformations.

Table ١: Comparison of frequency distribution of thumbprints of left and right digit in among Hausas of Kano and Zaria (n=600)

		Kano		Zaria		
		Side		Side		
Digits	Pattern	Right (%)	Left (%)	Right (%)	Left (%)	Total
I	Loops	128 (85.3)	132 (88)	115 (77)	127 (85)	502 (761)
	Whorls	142 (94.6)	136 (90.6)	160 (107)	144 (96.3)	582 (388.5)
	Arches	30 (20)	32 (21.3)	24 (16)	28 (18.7)	114 (76)
II	Loops	171 (114)	159 (106)	128 (85.6)	134 (89.6)	592 (295.2)
	Whorls	94 (62.6)	93 (62)	132 (88.3)	118 (79.0)	437 (291.9)
	Arches	35 (23.4)	48 (32)	20 (26.1)	47 (31.4)	150 (113)
III	Loops	213 (136)	199 (132.7)	183 (122.4)	176 (117.7)	771 (508.8)
	Whorls	55 (36.7)	60 (40.0)	81 (54.2)	87 (58.2)	283 (189.1)
	Arches	32 (21.4)	41 (27.3)	35 (23.4)	36 (24.1)	144 (96.2)
IV	Loops	178 (118.7)	192 (127.6)	149 (59.6)	167 (111.7)	686 (417.6)
	Whorls	273 (63.3)	78 (52.0)	135 (90.3)	111 (74.2)	597 (279.8)
	Arches	27 (18)	30 (20.0)	15 (10.1)	21 (14.0)	83 (62.1)
V	Loops	221 (147.3)	233 (155.3)	187 (125.1)	207 (138.5)	848 (566.2)
	Whorls	63 (42.0)	47 (31.4)	97 (64.8)	78 (52.2)	285 (169.2)
	Arches	16 (10.7)	20 (13.3)	15 (10.0)	14 (9.3)	65 (43.3)

Table ٢: Comparison of frequency distribution of thumbprints of left and right digit of male participants among Hausas of Kano and Zaria (n=600)

		Kano		Zaria		
		Side		Side		
Digits	Pattern	Right n = 300 (%)	Left n = 300 (%)	Right n = 300 (%)	Left n = 300 (%)	Total
I	Loops	57 (38)	70 (46.7)	55 (36.7)	67 (44.7)	249 (166.1)
	Whorls	80 (53.3)	68 (45.3)	84 (56.0)	69 (46.0)	301 (200.6)
	Arches	13 (8.7)	12 (8.0)	11 (7.3)	14 (9.3)	50 (33.3)
II	Loops	84 (56.0)	84 (56.0)	67 (44.7)	78 (52.0)	313 (208.7)
	Whorls	50 (33.3)	46 (30.7)	65 (43.3)	48 (32.0)	209 (139.3)
	Arches	16 (10.7)	20 (13.3)	18 (12.0)	24 (16.0)	78 (52)
III	Loops	104 (63.3)	105 (70.0)	94 (62.7)	91 (60.7)	394 (256.7)
	Whorls	30 (20.0)	33 (22.0)	38 (25.3)	40 (26.7)	141 (94)
	Arches	16 (10.7)	12 (8.0)	18 (12.0)	19 (12.7)	65 (43.4)
IV	Loops	91 (60.7)	98 (65.3)	77 (51.3)	82 (54.7)	348 (232)
	Whorls	48 (32.0)	42 (28.0)	69 (46.0)	56 (37.3)	215 (143.3)
	Arches	11 (7.3)	10 (6.7)	4 (2.7)	12 (8.0)	37 (24.7)
V	Loops	110 (73.3)	122 (81.3)	94 (62.7)	106 (70.7)	432 (288)
	Whorls	34 (22.7)	22 (14.7)	50 (33.3)	36 (24.0)	142 (94.7)
	Arches	6 (4.0)	6 (4.0)	6 (4.0)	8 (5.3)	26 (17.3)

Table ٣: Comparison of frequency distribution of thumbprints of left and right digit of female participants among Hausas of Kano and Zaria (n = 600)

		Kano		Zaria		
		Side		Side		
Digits	Pattern	Right (%)	Left (%)	Right (%)	Left (%)	Total
I	Loops	71 (47.3)	62 (41.3)	60 (40.3)	60 (40.3)	253 (169.2)
	Whorls	62 (41.3)	68 (45.3)	76 (51.0)	75 (50.3)	281 (187.9)
	Arches	17 (11.3)	20 (13.3)	13 (8.7)	14 (9.4)	64 (42.7)
II	Loops	87 (58.0)	75 (50.0)	61 (40.9)	56 (37.6)	279 (186)
	Whorls	44 (29.3)	47 (31.3)	67 (45.0)	70 (47.0)	228 (137.0)
	Arches	19 (12.7)	28 (18.7)	21 (14.1)	23 (15.4)	91 (60.9)
III*	Loops	109 (72.7)	94 (62.7)	89 (59.7)	85 (57.0)	377 (252.1)
	Whorls	25 (16.7)	27 (18.0)	43 (28.9)	47 (31.5)	142 (95.1)
	Arches	16 (10.7)	29 (19.0)	17 (11.4)	17 (11.4)	79 (52.5)
IV	Loops	87 (58.0)	94 (62.7)	72 (48.3)	85 (57.0)	338 (226)
	Whorls	47 (31.3)	36 (24.0)	66 (44.3)	55 (36.9)	204 (136.5)
	Arches	16 (10.7)	20 (13.3)	11 (7.4)	9 (6.0)	56 (37.4)
V	Loops	111 (74.0)	111 (74.0)	93 (62.4)	101 (67.8)	416 (278.2)
	Whorls	29 (19.3)	25 (16.7)	47 (31.5)	42 (28.2)	143 (95.7)
	Arches	10 (6.7)	14 (9.3)	9 (6.0)	6 (4.0)	39 (26.0)

*p< 0.05 for Hausas of Kano State

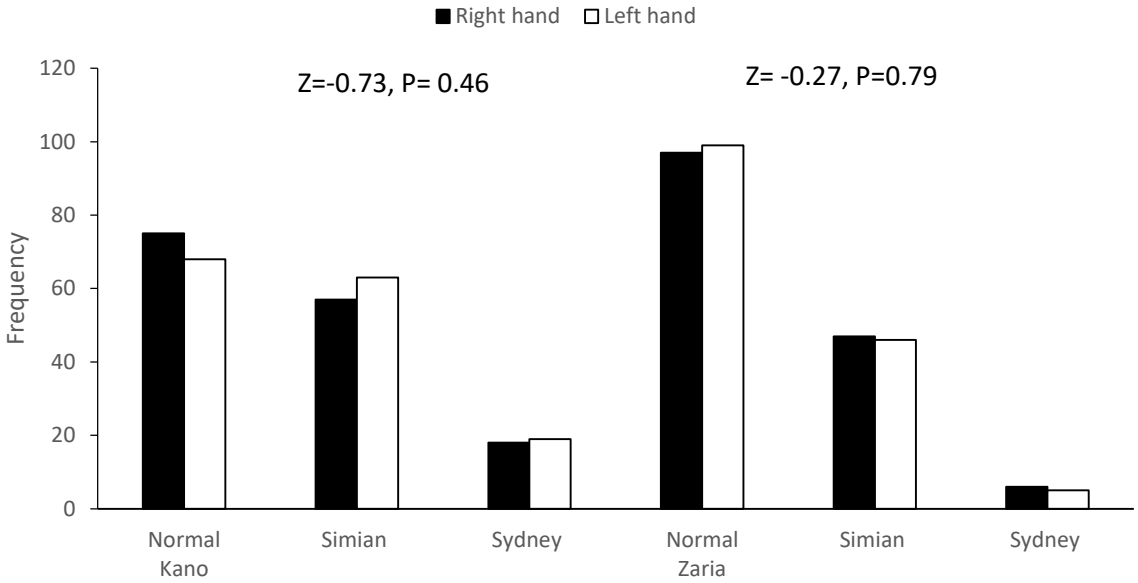

Figure 2: Asymmetry in palmer crease of male participants between Hausa ethnic group of Kano and Zaria

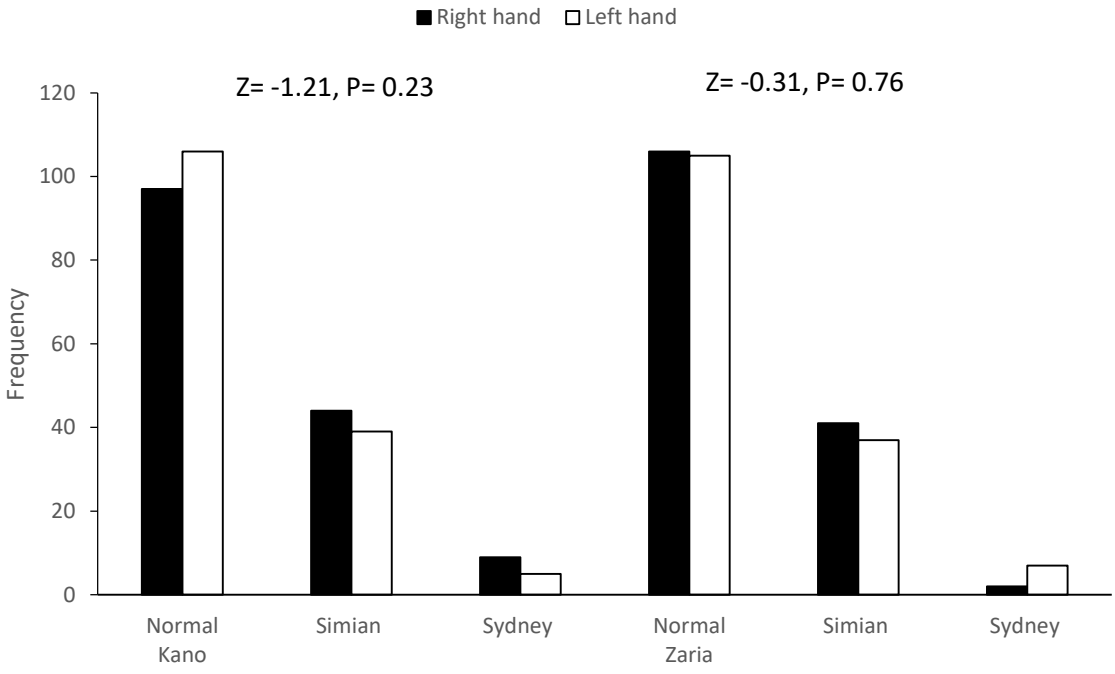

Figure 3: Asymmetry in palmer crease of female participants between Hausa ethnic group of Kano and Zaria

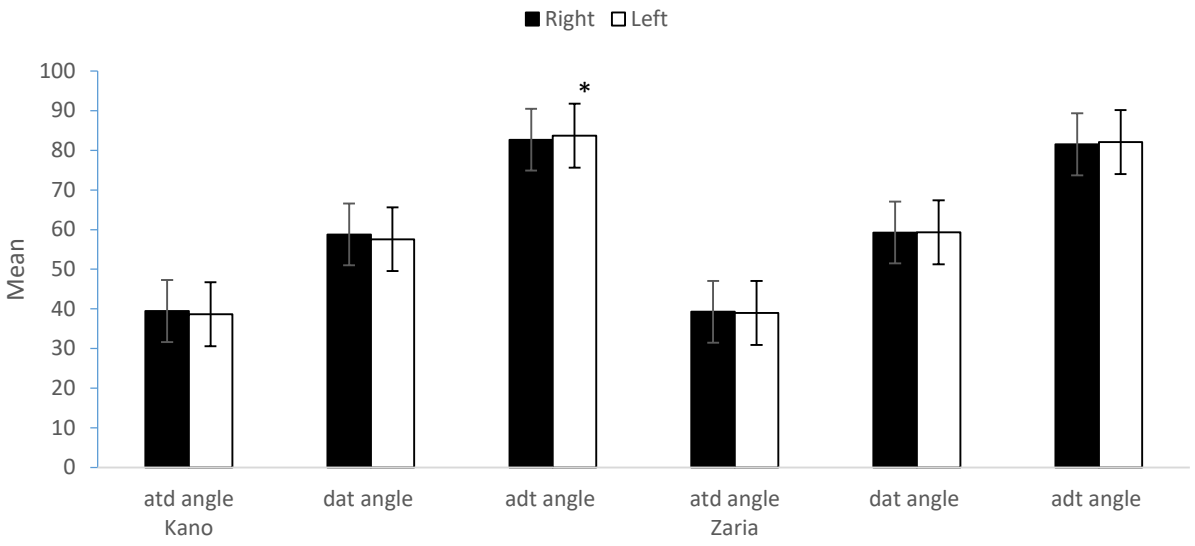

Figure 4: Asymmetry in palmer angles of male participants between Hausa ethnic group of Kano and Zaria. *P < 0.05

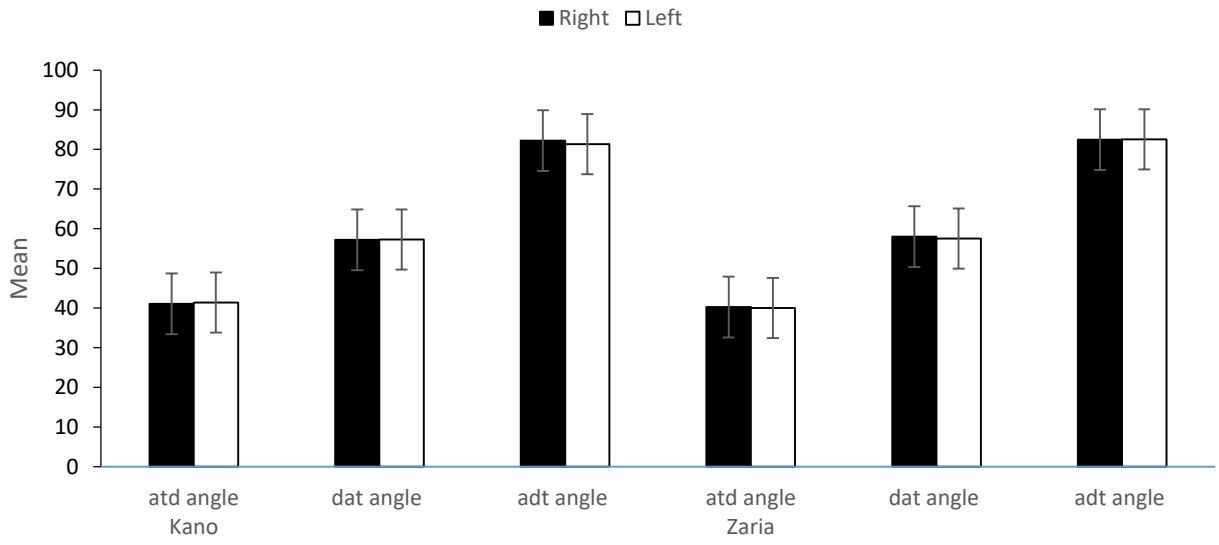

Figure 5: Asymmetry in palmer angles of female participants between Hausa ethnic group of Kano and Zaria

The frequency of the digital print patterns of all the studied subjects among Hausa ethnic group in Kano and Zaria metropolis, Nigeria, was inconsistent with the findings of previous researchers in Nigeria and in other parts of the world (Cummins H. 1926; Umana et al 2013). The percentage frequency for both hands showed that the loop pattern had the highest frequency in both genders for both cities, followed by the whorl pattern; and the arch pattern was least prevalent, except for digit I where whorls pattern happened to have high percentage frequency for both cities in both hands. as shown in Tables 1.

The total percentages of fingerprints patterns for all 10 fingers in Hausa ethnic group subjects from both Kano and Zaria metropolis were found to be: loop, 65.7%; whorl, 28.5%; and arch, 3.4% respectively. For male subjects, the total percentages of patterns for all 10 fingerprints were:

loop, 63.2%; whorl, 27.8%; and arch, 6.3% respectively. For female subjects, the total percentages of patterns for all 10 fingerprints were: loop, 59.1%; whorl, 32.0%; and arch, 6.8% respectively. These findings revealed that the two studied cities (Kano and Zaria) had similar characteristics in fingerprints patterns in the form of loop>whorl>arch; although the values for each group differs. These similarities in the findings of these two groups are possibly an indication of their common ancestry. These percentages for the fingerprint patterns were consistent with reports by Odokuma et al 2005, among students in Delta, by Osunwoke et al 2008 among the Okrika and Ikwere ethnic groups, by Umana et al 2013 in Abuth Zaria, by Danborno and Garba 2007 among the Hausa ethnic group of Nigeria, who all reported a higher percentage of the loop pattern. The work of Biswas 2011 among the Indian population, and of Etta et al 2014 among the Cross river people, however, reported the highest frequency of the whorl pattern, followed by the loop pattern.

With regards to palmer creases type no statistical significant differences between the frequency distribution of the right and left hand in both male and female of the two cities (figure 2 and 3). However, it was documented that dermoglyphics of sexual dimorphism in 372 male and 208 females of Israelis showed that in finger traits, females presented a lessened degree of bimanual asymmetry. At the same time it is known that these distinctions may be equalized or even reversed in some populations (Schauman and Alter, 1976). The reverse trend is what was observed in the present study which is just justifying the use of dermatoglyphic as marker for differentiation between different ethnic groups.

Asymmetry of the tri-radii angles of both hands in both cities were investigated in the studied subjects. The tri-radii angles investigated were tri-radii atd, dat and adt angles. The findings from the study showed that tri-radii atd, dat and adt angles had similar mean values of for the right and left hands. The mean values for the three tri-radii angles were all<90° (acute angles). The works of Khairnar et al, (2012), of Navgire et al, 2013 and of Chaudhari et al 2015 have all reported mean tri-radii angles values of similar range.

Asymmetry of the tri-radii adt angle results showed significant ($p<0.05$) higher mean values only in males of Kano with no statistical significant differences in tri-radii atd and dat angle compared with male subjects Zaria with no statistical significant difference in tri-radii atd, dat and adt angle respectively. The tri-radii atd, dat and adt angle, however, showed no statistical significant difference among the female subjects of the two studied population. These findings showed that the two studied population have similar tri-radii characteristics, suggesting a possible common ancestry.

Conclusion

From the present study, the fingerprint patterns of Hausa ethnic group followed a particular pattern of percentage frequency, which is loop>whorl>arch, which implies similarities among the studied population. Gender differences were observed among the studied subjests. The tri-radii atd, dat and adt angles of the subjects revealed mean acute angles for all the two studied population in the order atd<dat<adt angle. The study reveals the potential of thumbprint asymmetry in sex differences among Hausa ethnic group in Kano and Zaria, Nigeria.

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Author's contribution

The majority of the work was completed by AU, who also wrote the article, design and revise the book's final draught, and AJ helped by suggesting certain crucial changes to make the work flawless. The final text was created and approved by all contributors.

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