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Research Article

Sexual dimorphism in hand anthropometry and second-to-fourth digit ratio among Kanuri ethnic group of Maiduguri Borno State, Nigeria

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Abstract

Information generated from hand dimensions has provided essential data for individual identification, sex determination, ergonomics, population variation studies, forensics, etc. This has necessitated the characterization of hand proportions from additional human groups to broaden the landscape of hand anthropometry within Nigeria and beyond. The aim of this study is to determine sexual dimorphism in some hand dimensions and digit ratio among Kanuri tribe in Maiduguri, Borno state Nigeria. A total of four hundred and five (405) subjects (203 males and 202 females) were recruited for this study, aged 17-30 years from the College of Nursing and Midwifery and College of Health and Technology Maiduguri. Parameters collected were: hand length (HL), palm length (PL), hand breadth (HB), palm breadth (PB), 2D and 4D lengths using a palm print scanner (HP Deskjet 1515 model). The data were compared between groups using student's t-test, SPSS version 22.0 software was used for statistical analyses, and $P < 0.05$ was set as the level of significance. Data analyzed showed that Kanuri males had higher ($p < 0.001$) mean hand dimension values compared to their female counterparts. However, the Kanuri females had higher ($p < 0.001$) mean 2D:4D ratio values compared to their male counterparts. There was sexual dimorphism in hand dimensions and the second-to-fourth digit ratio of Kanuri tribe, which could be useful for the determination of sex, forensic, and criminal situations when a hand is detected in mass disasters such as car accidents, homicide, suicide, etc. Also provide more insight into biological variation with the inclusion of this group.

1. Introduction

Sex determination is often considered as one of the simplest tasks in forensic investigation when the whole body is available as the genitalia can directly suggest the sex of the individual and wide varieties of primates [1, 2]. The issue of sex discrimination can be very complicated in cases of intersex, bodies in an advanced state of putrefaction, mutilated, fragmentary and skeletal remains in which it is common to recover dismembered and peripheral parts of the body [3]. Forensic anthropologists can use various anthropometric techniques to determine sex and ethnicity from such dismembered body parts.

The human hand is among the most frequently used and versatile parts of the human body. Hand dimensions vary in different age, sex, races, and ethnic groups and this may be attributed to biological and environmental factors. It's also of great scientific importance to investigators in the fields of anthropometry, forensic pathology, orthopedic surgery, ergonomics, and legal sciences [4, 5]. The importance of morphometric and skeletal examination of hand and foot dimensions in identification was mentioned previously [6, 7]. Studies using hand measurements for sex determination have been performed in several races [8, 9]. Sexual dimorphism in the hand dimensions was reported by [10] among the students of Ahmadu Bello University Zaria, Nigeria, Numan et al [11] conducted a study on major ethnic groups in Nigeria namely, Hausa, Igbo and Yoruba, they reported significantly higher values in males than their females. In other countries [12], among the upper Egyptians [3], among the population of Udaipur district of Rajasthan [5], among the students of department of forensic medicine and clinical toxicology college of medicine, Ajouf university, the population of North Saudi Arabia [13], among the population of Haryana State, North India.

The digit ratio is the ratio between the lengths of different digits or fingers. The second-to-fourth digit ratio (2D:4D) is the ratio of the length of the second digit (index finger) as measured from the bottom crease to the tip of the finger to the ratio of the length of the fourth digit (ring finger) which varies due to exposure to intrauterine androgen [14, 15].

In Nigeria, investigators are interested in studying sexual dimorphism of 2D:4D ratio within and between ethnic groups and populations [16–18]. Low 2D:4D were important for high sprinting speed endurance and hand grip strength [19, 20]. Manning et al. (2000) reported in their study the second-to-fourth-digit ratio is lower in men than women and varies greatly between ethnic groups [21]. A number of studies have similarly shown the correlation between the second to fourth-digit ratio and fraternal birth order [22, 23].

2. Materials and Methods

2.1. Study Location

Kanuri is a large ethnic group of Borno State, situated in the North-East region of Nigeria. Maiduguri which is locally called 'Yerwa' is the capital, Borno State is located between latitudes 10° and 14° N and longitudes 11° 13′ and 14° 45′E, bordered by Republics of Niger to the North, Chad to the North-East and Cameroon to the East. Kanuri subject was determined using questionnaire, grandfather, grandmother from both parents and father and mother of the subject are Kanuri by tribe, the Kanuri subjects who gave informed consent to participated were included in the study.

2.2. Sample size

The study was carried out among randomly selected healthy individuals of ages between 17-30years. The sample size for the study was determined using the sample formular by Naing et al., 2006.

$$n = \frac{z^2 \times pq}{d^2}$$

Where;
n= Minimum sample size
Z= Standard normal deviation 1.96 at 95% confidence level
P= Proportion of the target population 50% (0.5)
Q= 1-P, 1-0.5= 0.5
D= Sample error which is 5% (0.05)

$$n = \frac{1.96^2 \times 0.5 \times 0.5}{0.05^2}$$

n= 384
A total of four hundred and five (405) subjects (203 males and 202 females) were recruited for this study. The study was conducted in College of Nursing and Midwifery and College of Health and Technology Maiduguri Borno State, Nigeria.

2.3. Anthropometric methodology

The individuals used were apparently healthy without any hand deformities, good representatives of the tribe and who gave informed consent. Hand dimension: subject was asked to place both hands on Hp Deskjet 1515 connected to laptop both hands were scanned and saved on the laptop, CorelDraw X3 was used for hand measurement in centimeter. The hand dimensions were as follows:

i. **Hand length:** Hand length measurement was taken as straight line from distal crease of the wrist joint to tip of the middle finger.
ii. **Hand breadth:** Hand breadth measurement was taken as straight line from most medial set point to most lateral set point including thumb finger.
iii. **Palm length:** Palm length measurement was taken as straight line from distal crease of the wrist joint to distal metacarpophalangeal crease of middle finger.
iv. **Palm breadth:** Palm breadth measurement taken as straight line from most medial to most lateral excluding the thumb finger.
v. **2D:** 2D measurement was taken the distance between the tip of the index finger and distal metacarpophalangeal of the index finger.
vi. **4D:** 4D measurement was taken the distance between the tip of the ring finger and distal metacarpophalangeal crease of the ring finger.

2.4. Ethical approval

Ethical approval for the study was obtained from Ahmadu Bello University Committee on Use of Human Subject for Research with ethical clearance number ABUCUHSR/2018/003. Also, data were obtained under informed consent.

2.5. Statistical analysis

The data were compared between groups using student's t-test, SPSS version 22.0 software was used for statistical analyses and P<0.05 was set as level of significance.

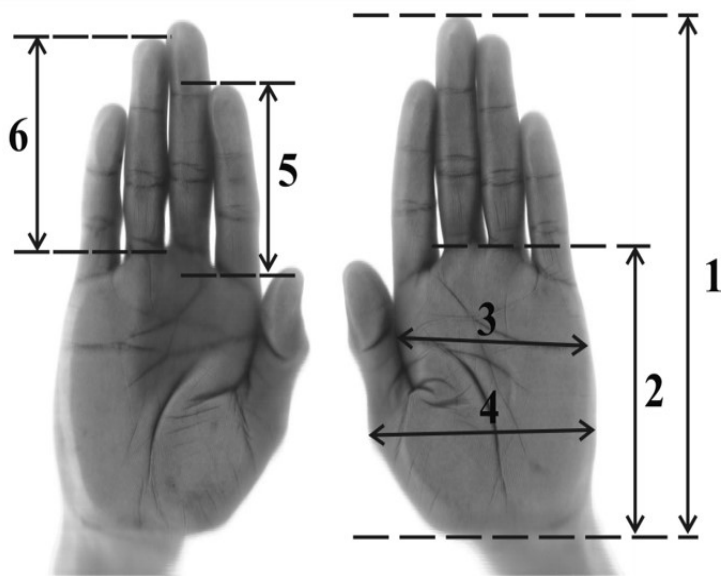

Figure 1: 1.Hand length 2. Palm length, 3. Hand breadth, 4. Maximum hand breadth, 5. 2D length 6. 4D length

3. Results

Table 1 shows the mean, minimum and maximum for both sexes. Right hand length and left-hand length in male subjects had a mean value of 19.19 ± 0.91 cm, 19.25 ± 0.91 cm while in females had a mean value of 18.11 ± 1.03 cm, 18.16 ± 1.03 cm.

Hand dimensions, right palm length, right hand breadth, right palm breadth, left palm length, left hand breadth and left palm breadth mean value in males was 11.02 ± 0.59 cm, 9.97 ± 0.59 cm, 8.06 ± 0.56 cm, 11.06 ± 0.58 cm, 9.90 ± 0.58 cm and 7.98 ± 0.54 cm respectively while in females was 10.41 ± 0.62 cm, 9.16 ± 0.65 cm, 7.36 ± 0.57 cm, 10.44 ± 0.61 cm, 9.07 ± 0.64 cm and 7.28 ± 0.57 cm respectively.

Table 1: Descriptive statistic of all Variables for Kanuri ethnic group according to sex

Variables	Females(n=202) Mean±SD	Minimum	Maximum	Males (n=203) Mean±SD	Minimum	Maximum
RHL (cm)	18.11±1.03	14.94	21.59	19.19±0.91	16.57	21.59
RPL (cm)	10.41±0.62	8.85	12.45	11.02±0.59	9.11	12.42
RHB (cm	9.16±0.65	7.27	11.27	9.97±0.59	8.40	11.53
RPB (cm)	7.36±0.57	6.03	9.11	8.06±0.56	6.62	10.48
LHL (cm)	18.16±1.03	15.07	21.42	19.25±0.91	16.71	21.59
LPL (cm)	10.44±0.61	9.04	12.40	11.06±0.58	9.36	12.41
LHB (cm)	9.07±0.64	6.67	11.20	9.90±0.58	8.52	11.66
LPB (cm)	7.28±0.57	6.16	9.15	7.98±0.54	6.57	9.94

RHL= Right hand length, RPL= Right palm length, RHB= right hand breadth, RPB= right palm breadth, LHL= left hand length, LPL= left palm length, LHB= left hand breadth and LPB= left palm breadth.

Table 2 and 3 shows comparing between the males and females Kanuri ethnic group, when independent sample t-test was performed, the results from the study showed that the males had significantly higher mean values in the hand dimensions than their female counterparts and these values were statistically significant (p <0.005). Considering the length in the same sex, the second digit was less than the fourth digit in both sexes.

Table 2: Sexual Dimorphism of hand dimensions in Kanuri Subjects

Variables	Females (n=202) Mean±SD	Males(n=203) Mean±SD	t-value	p-value
Right Hand Length (cm)	18.11±1.03	19.19±0.91	-11.17	<0.001
Right Palm Length (cm)	10.41±0.62	11.02±0.59	-10.15	<0.001
Right Hand Breath (cm)	9.16±0.65	9.97±0.59	-13.03	<0.001
Right Palm Breath (cm)	7.36±0.57	8.06±0.56	-12.46	<0.001
Left Hand Length (cm)	18.16±1.03	19.25±0.91	-11.33	<0.001
Left Palm Length (cm)	10.44±0.60	11.06±0.58	-10.54	<0.001
Left Hand Breath (cm)	9.07±0.64	9.90±0.58	-13.71	<0.001
Left Palm Breath (cm)	7.28±0.57	7.98±0.54	-12.67	<0.001

SD= Standard Deviation, n= number of sample size, p<0.05 show statistically significant

Table 3: Sexual Dimorphism of digit length in Kanuri Subjects

Variables	Females (n=202) Mean±SD	Males(n=203) Mean±SD	t-value	p-value
Right 2D (cm)	6.66±0.48	6.99±0.47	-7.00	<0.001
Right 4D (cm)	7.12±0.52	7.57±0.49	-9.13	<0.001
Left 2D (cm)	6.70±0.51	7.04±0.45	-7.15	<0.001
Left 4D (cm)	7.14±0.54	7.60±0.46	-9.25	<0.001

2D=second digit, 4D fourth digit, SD= Standard Deviation, n= number of sample size, p <0.05 show statistically significant

Figure 2 shows right and left 2D:4D ratio when compared between male and female Kanuri, the result shows sexually dimorphic with the females of Kanuri having significantly higher digit ratio compared to their male's counterpart in right and left hands.

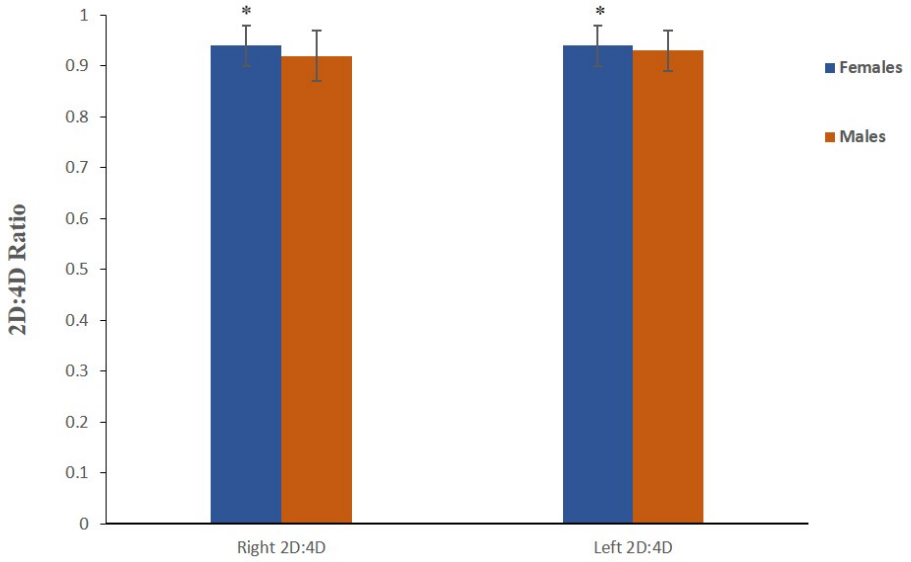

Figure 2: Comparison of anthropometric variables of 2D:4D (right 2D:4D and left 2D:4D) between males and females of Kanuri ethnic group

4. Discussion

Different hand anthropometric studies in the past have been carried out to compare within and between populations using sliding caliper [8, 9, 11]. However, as the world advance in technology there is paucity study reported using a scanner to determine hand anthropometric amongst the population and due to increase in insecurity in the country and man-made disaster in the North-East. The present study was carried out to determine hand anthropometric among the large ethnic group of Borno State, North-East Nigeria.

It was observed in this study the mean value of hand and palm length is higher in left hand side than right hand for both male and female Kanuri and is accordance to earlier study reported by Nur-Atirah and Khairulmazidah [24]. Whereas other studies reported, their mean values are higher on the right hand than left hand in both sex [3, 25, 26]. In addition, the mean values of these variables from our study were similar to those reported by researchers [8, 12]. Even though hand dimensions mean values from this study are longer than previous studies [3, 9, 25]. Sexual dimorphism from this study was observed where female Kanuri hand dimensions are consistently smaller than those of male Kanuri and these significant difference between male and female Kanuri were in concordance with the previous studies [8, 9, 12, 25, 27]. The significant differences in hand dimensions observed in this study between Kanuri males and their female counterparts in both hands could be further explained as part of genetic factors, level of physical activities, nutrition etc [28, 29].

From both hands the finger length from the present study showed that the second digit length was shorter than the fourth digit length in females, whereas in males index and ring finger length tend to be almost equal in left hand. Also, the index and ring fingers are longer in males than females Kanuri and is statistically significant, differences in finger length from our study agrees with the findings from [30].

Index to ring finger ratio (2D:4D) is the most strongly dimorphic of all human digit ratio combinations [31]. In this study, 2D:4D ratio has been found to be sexually dimorphic with females of Kanuri ethnicity having significantly higher digit ratio compared to their male's counterpart in both hands and this trait had earlier been reported by several authors [15–18, 20]. However, our digit ratio values were lower than some authors 2D:4D values Mahrous et al [5]. In addition, differences among gender based on size and shape was reported by Tarsem [4].

5. Conclusion

Sex determination and sexual dimorphism were established in this study using hand dimensions and second-to-fourth digit ratio among Kanuri tribe, which could be useful for the determination of sex, forensic, and criminal situations when a hand is detected in mass disasters such as car accidents, homicide, suicide, etc. This study provides more insight into biological variation with the inclusion of this ethnic group.

Article Information

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