

## PALMAR CREASES AND HANDEDNESS IN HAUSAS OF NORTHERN NIGERIA: A CROSS-SECTIONAL STUDY

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### ABSTRACT

Dermatoglyphics have been widely studied in relation to chromosomal aberrations and other genetic makeup and was shown to vary across different ethnic populations. This is also true for handedness. We undertook this cross-sectional study to estimate the prevalence of normal and abnormal palmar creases, and handedness in seemingly normal individuals among the Hausa ethnic group of northern Nigeria. Four hundred and sixty-two ( $n=462$ ) participants were randomly recruited, comprising of 243 males and 219 females. SPSS (Version 21) was used to analyze the data. For association, Fischer's exact test was used and  $P<0.05$  was considered statistically significant. The results showed Normal palmar crease to be the most prevalent (about 89% on both palms) followed by Simian palmar crease (7.8% on the right palms and 8.2% on the left palms) then Suwon crease (2.2% on the right, 1.7% on the left palms) and Sydney crease (1.5% on the right, 1.1% on the left palms). The latter showed no manifestations in the females. For handedness, right handedness was more prevalent (89.6%), followed by left handedness (10.2%) and ambidextrous was least (0.2%); only a single case was seen. Association between handedness with palm creases (right palm  $P=0.403$ , left palm  $P=0.786$ ); gender with palm creases (right palm  $P=0.055$ , left palm  $P=0.165$ ); and gender with handedness ( $P=0.489$ ) were not statistically significant. This study estimated the prevalence of palmar creases and handedness in Hausa ethnic group, confirming anthropologic variability of different populations.

**Keywords:** Anthropometry, dermatoglyphics, dexterity, phenotype.

### INTRODUCTION

#### Palmar Creases

Dermatoglyphics have for several decades been employed as a diagnostic indicator to certain medical conditions, where unusual patterns have been shown to correlate with some genetic disorders (Than *et al.*, 1998; Nazarabadi *et al.*, 2007). Thus they are occasionally considered as preliminary prognostic tools in seemingly normal infants in whom cryptic impairments maybe suspected to in later in life (Nazarabadi *et al.*, 2007). Palmar creases are classified into normal and abnormal, with the latter further sub-classified into Simian, Suwon and Sydney (Park *et al.*, 2010). Presence of abnormal creases or epidermal ridges strongly indicate a number of medical disorders such as mental disorders (Stevenson *et al.*, 1997; Van, 2000), Down, Turner and Klinefelter syndromes (Kava *et al.*, 2004), fetal alcoholic syndrome (Jones *et al.*, 2006), and are useful in anthropologic studies (Park *et al.*, 2010). Dermatoglyphic features such as palmar creases begin to develop at about the end of second trimester and remain unchanged throughout life (Lakshmi &Thenmozhi, 2014). Typically, palmar crease variants are classified based on connection between the three major creases—radial longitudinal (I), proximal transverse (II), and distal transverse crease (III)—which slope from the angle near the metacarpo-phalangeal joint of the index finger. Borbolla *et al.*, and Kamali's studies (as cited by Sharma & Sharma, 2011) suggested that the palmar crease is termed normal when none of the transverse creases traverses entirely from the radial border to the ulnar border of the palm. Infrequently, these creases merge to signify a different thing.

The fusion of I and II resulting in a single palmar crease which extends wholly the palm is termed Simian crease. However, Sydney crease occurs when both transverse creases (I and II) are present, but only one of them completely go across the palm. Suwon crease is formed when a single crease, formed by the merging of the two major transverse creases with an accessory proximal transverse crease, extends across the palm (Sharma & Sharma, 2011). They are classified more clearly in the work of Park *et al* (2010) as: Normal (when II and III do not meet), Simian (when II and III meet to cross the palm), and Suwon (when II and III meet, accompanied by accessory II), and Sydney (when II and III meet, accompanied by accessory III) (See Figure I)

Nevertheless, presence of abnormal palmar creases do not necessarily connotes abnormality in genetic property or other anthropologic characteristics and can be present in apparently normal individuals. They also vary across different ethnic groups and communities as reported in the other previous studies (Sharma and Sharma, 2011; Taura *et al.*, 2014)

### **Handedness**

The instinctive tendency to use either hands effortlessly and predominantly than the other. Those that can utilize both on an almost equal proportion are broadly classified as ambidextrous. The preferential usage of either the left or the right hand had been shown to be a potential determinant of child's cognitive development (Heilman, 2005). Left handedness was linked with cognitive advantage (McManus, 2002), whereas other studies linked it to cognitive disadvantage (Resch *et al.*, 1997) and being left handed is often considered a disadvantage. However in the recent work of David *et al.* (2009), it was reported that mixed-handers (those with no hand preference) were the most disadvantaged.

Handedness was also widely studied in different fields ranging from economics (Denny & O'Sullivan 2007), anthropology (Ramadhani *et al.*, 2006), medicine and psychology (David *et al.*, 2009) and several theories have been propounded as to why handedness differentials exist. Dietrich *et al.* (2003) suggested that asymmetry of the vestibular cortex strongly correlated with the direction of handedness. Other studies linked left handedness to prenatal exposure to certain hormones (Titus-Ernstoff, 2003) or ultrasound (Salvesen, 2011), or children who suffered from severe bacterial meningitis (Ramadhani *et al.*, 2006) or in female with early neurologic slur (Miller *et al.*, 2005) or even as a result of being born by an older mother (Bailey & Mckeever, 2004). However, a more reason why we considered to study handedness in relation to palmar crease was that several studies have suggested that it shows a complex pattern of inheritance (McManus, 2002), where genetics might be the major determining factor (Hepper *et al.*, 2005). Although there are other studies that looked at palmar creases in Nigeria across ethnic groups and communities (Oyinbo&Fawehinmi, 2008; Adetona *et al.*, 2012) and more closely the comparative study of palmar creases between epileptic and healthy subjects among Hausas of Northern Nigeria by Taura *et al.* (2014), there is no specific study which had singled out Hausas for prevalence studies of variant palmar creases, handedness and their associations in the seemingly normal population.

## **METHODOLOGY**

### **Settings**

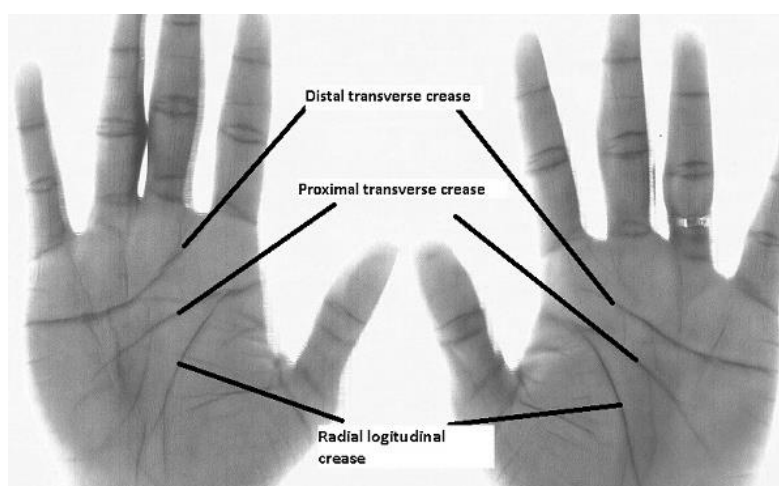
The study was carried out in Zaria located in the North-western Nigerian state of Kaduna in 2012. It is one of the famous Hausa capital cities dating back to centuries. The majority of the dwellers are Hausas. The enrolled participants were randomly drawn from randomly selected

three secondary schools – Alhudahuda College, Islamic Trust of Nigeria (ITN) Schools and Barewa College – all spread across the city.

## Subjects and Materials

In determining the sample size to achieve 2.0% precision, especially for the predicted most prevalent variables (Normal palmar crease and Right handedness), we needed about 457 subjects in estimating prevalence for Normal creases and right handers which may be about 95% respectively (Holder, 1997; Taura et al., 2014) (using Sample Size Calculator for Prevalence Studies Naing et al., 2006). Overall, the total of four hundred and sixty-two ( $n = 462$ ) participants aged between 14 and 26 were randomly selected from the aforementioned schools. The study did not discriminate for any type of palmar creases or handedness.

Preceding palmar studies such as that of Park et al. (2010) used ink to obtain palm print. This study used digital scanner (HP Deskjet 1050 J410 model) connected to Laptop computer to scan and print subjects' both palms on A4 papers, and classification into either Normal, Simian, Suwon or Sydney were based on Park et al. (2010) palm analysis (See Fig 1) Furthermore, handedness was assessed using the Oldfield's Edinburgh Handed Inventory (Oldfield, 1971). From the Inventory, R scores  $< -40$  was Left Handed; R  $> +40$ , Right Handers; whereas R score between  $-40$  and  $+40$  was Ambidextrous.



**Figure 1. The three major palmar creases: Radial longitudinal (I), Proximal transverse (II), and Distal transverse (III) (sample scanned with permission)**

## Data Analyses

Palmar creases and handedness prevalence were presented using percentages. Statistical association between handedness and palm creases; gender with palm creases; and handedness with gender were established using Fischer's exact test. SPSS (Version 21) was used in carrying out all analyses and  $P < 0.05$  was considered statistically significant.

## Ethical Considerations

The entry criteria were; both parents (father and mother) of the participant are ethnically Hausas, absence of no palmar abnormality and consent by signing the approved informed consent form from the Research Ethics Committee of Ahmadu Bello University by the

participants. In addition to their individual consents, parental assent were sought for those below the age of 18 and approval obtained from the schools' authorities.

## RESULTS

88.5% of the individuals presented with Normal crease on their right palms (86.4% males and 90.9% females) whereas 89% presented it on the left palm (87.2% males and 90.9% females). For abnormal creases, Simian crease showed higher prevalence. 7.8% of the sample presented with it on their right palms (8.6% males and 6.8% females); 8.2% on their left palms (9.1% males and 7.3% females). Suwon crease showed a more equal distribution across gender: 2.2% presented with it on their right palms (2.1% males and 2.3% females) whereas on the left palms, 1.7% presented with it (1.6% males and 1.8% females). In the population, we were 95% it would be between 1% and 3% for both palms and gender. Lastly the least prevalent palm crease, Sydney crease was not found in either palms among the females. It was only recorded among the male subjects, where 1.5% presented with it (2.9% males and 0% females) and 1.1% had it on their left palms (2.1% males and 0% females). We were 95% sure it would be between 0% and 3% on the right palm and 0% and 2% on the left palms (Table 1).

In the case of handedness, 89.6% were right handers (88.9% males, 90.4% females), which would be between 87% and 92% in the population (95% CI). 10.2% were left handers (11.1% males, 9.1% females), which would be between 7% and 13% in the population (95% CI). The least handedness was ambidextrous. About 1% was ambidextrous (95% CI: 0% males, 0.5% females). (See Table 1).

Association between palmar creases on either hand and handedness were not statistically significant (See Table 2).

**Table 1. Prevalence and relationship of palmar crease, handedness and gender**

Palm Crease	Gender		(95% CI)	PValue <sup>a</sup>
	Male n (%)	Female n (%)		
<b>Right Palm</b>				
Normal	210 (86.4)	199 (90.9)	(86.0, 91.0)	0.055
Simian	21 (8.6)	15 (6.8)	(5.0, 10.0)	
Suwon	5 (2.1)	5 (2.3)	(1.0, 3.0)	
Sydney	7 (2.9)	7 (2.9)	(0.0, 3.0)	
<b>Left Palm</b>				
Normal	212 (87.2)	199 (90.9)	(86.0, 92.0)	0.165
Simian	22 (9.1)	16 (7.3)	(6.0, 11.0)	
Suwon	4 (1.6)	4 (1.8)	1.0, 3.0)	
Sydney	5 (2.1)	0 (0.0)	(0.0, 2.0)	
<b>Handedness</b>				
Right handed	216 (88.9)	198 (90.4)	(87.0, 92.0)	0.489
Left handed	27 (11.1)	20 (9.1)	(7.0, 13.0)	
Ambidextrous	0 (0.0)	1 (0.5)	(0.0, 1.0)	

<sup>a</sup>Fisher's exact test

**Table 2. Relationship between handedness with palmar crease using Fischer's Test**

		Handedness			PValue <sup>a</sup>
		Right Handers n (%)	Left Handers n (%)	Ambidextrous n (%)	
<b>Right Palm Crease</b>	Normal	369 (89.1)	39 (83.0)	1 (100)	0.403
	Simian	31 (7.5)	5 (10.6)	-	
	Suwon	8 (1.9)	2 (4.3)	-	
	Sydney	6 (1.4)	1 (2.1)	-	
<b>Left Palm Crease</b>	Normal	369 (89.1)	41 (87.2)	1 (100)	0.786
	Simian	33 (8.0)	5 (10.6)	-	
	Suwon	7 (1.7)	1 (2.1)	-	
	Sydney	5 (1.12)	-	-	

<sup>a</sup>Fisher's exact test

## DISCUSSION

Palm creases have been closely related to numeral aberration of chromosomes (Chung *et al.*, 2000) but then occurrence of abnormal palm creases in seemingly normal individuals have been reported in other studies (Sharma and Sharma, 2011; Taura *et al.*, 2014). Still, previous prevalence studies carried out in different populations have shown diverse occurrences of palm creases. In Nigerian Ijaw, Simian crease prevalence was found to be 4.1% (Oyinbo and Fawehinmi, 2009), 14.4% in Central Indian population, 2.8% in Germans, 2.5% in Iranians, 11.2% in Koreans and as high as 34.7% in Pygmies population (Sharma and Sharma, 2011), and about 8% in Hausas according to our result. The variation seen proved that palm creases was invaluable in exploring inter-ethnic variability in anthropometry, in addition to its diagnostic relevance. Normal crease among Hausas could be as low as 86% and as high as 92%, which agrees with earlier studies by Taura *et al.* (2014); a comparative study (between normal and epileptic persons) done among Hausas. For abnormal creases, Simian could range from 5% to 11%, slightly disagreeing with the study by Taura *et al.* (2014) where the latter reported 2.8%. The divergence could be that this study had a higher sample size (462) as against the earlier study by Taura *et al.* (109 'normal' comparison group) and possibly also due to differing means of classifying the creases. Another closely related study carried out in Nigeria, among Ijaw ethnic group, by Oyinbo and Fawehinmi (2009) showed Simian creases to be higher in the females than in males. This was in agreement with this study (Table 1). Suwon Crease could be between 1% to 3%, and Sydney from 0% to 2%. Curiously, Sydney crease type did not feature in any of the female palm studied. This was in sharp contrast to the work of Sharma and Sharma (2011) which reported it – Sydney crease – being more common among the females than among the males, but in apt agreement with the work of Oyinbo and Fawehinmi (2009) which also reported no case of Sydney creases in the female subjects of Nigerian Ijaw.

Moreover, association between the gender with palmar creases; and gender with handedness were all not statistically significant (Table 1 and 2). All these agreed with earlier studies (Sharma and Sharma, 2011; Oyinbo and Fawehinmi, 2009). This study also validated the Park *et al.* (2010) palmar crease analysis as a valuable anthropometric tool for palmar crease classification.

On the other hand, handedness reported in this study was consistent with many previous researches. Ambidextrous was the least, where only 1 person, a female, presented with it. Left handers could be from 7% to 13%, which was in consonance with earlier reports (Ruebeck *et al.*, 2007; McManus *et al.*, 2010; Sinha *et al.*, 2012). It also followed a pattern of males being more left handed (11.1%) compared to females (8.7%). This agreed with an earlier work done by Johnston *et al.* (2009). Traditionally, right handedness was considered a norm, whereas left handedness and to a lesser extent ambidextrous were considered aberrations. Their associations with palm creases were not statistically significant (Table 2). Inferentially, all the discrepancies observed confirmed the position of Nazarabadi *et al.* (2007), that genetic, environmental and ethno-historical factors act in congruence to determine the variability of a specific population, hence the lack of uniform prevalence. However, interestingly, in the case of Down syndrome, its effect often overrides any other factors and cause manifestation of its peculiar dermatoglyphic pattern of a single crease across the palm (Oyinbo and Fawehinmi, 2009). Similarly, prevalence of handedness seems to follow a similar pattern across the world, regardless of geography or ethnicity.

This study took advantage of palm crease study being cost-effective and noninvasive (Caplan, 1990). In controlling for possible bias/confounders, standard checklist for classification based on Park *et al.* (2010) was already at hand prior to carrying out the study, and a sample calculator was used in determining the sample size which would fairly and reasonably represent the population under study. We however noted that this study was not without its limitation. Despite having a high precision ( $d = 0.02$ ) for the most prevalent variables (Normal palmar creases and Right handers) precision for other variables were relatively lower, nearly precision ( $d$ ) of about 0.028 for the other variables even though having lower prevalence. Therefore sample size used was this study's major limitations followed by how the palmar creases were categorized (using Park *et al.*, 2010 classification) which may not necessarily be the same for other studies, thereby making it incomparable to studies that did not used same categorization method.

In future, a more specified large sample studies could be carried to establish correlations between variable anthropological variables.

## CONCLUSIONS

This study reported that Normal palm crease is the most prevalent among seemingly normal population of Hausa ethnic group followed by Simian palm crease then Suwon palm crease. Sydney palm crease was least, and no female presented with it in either palms. Likewise handedness; right handedness was the most prevalent followed by left handedness and the least was ambidextrous. Association between gender and palm creases; gender and handedness; handedness and palm creases were all not statistically significant.

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