OPEN ACCESS
Saudi Journal of Biomedical Research
Abbreviated Key Title: Saudi J Biomed Res
ISSN 2518-3214 (Print) |ISSN 2518-3222 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Individual Uniqueness of Cheiloscopy among Ikwerre Indigenes of Rivers State

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DOI: 10.36348/sjbr.2022.v07i04.005 | **Received:** 26.01.2022 | **Accepted:** 02.03.2022 | **Published:** 11.04.2022

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Abstract

Background: Personal identification remains the primary goal of every forensic investigation. In the present study, lip print was considered as a tool in personal identification as well as establishing ethnic differences.
Materials and Methods: The study involved 300 randomly selected subjects (72 males and 78 females) from the Ikwerre ethnic group in Rivers State Nigeria. A 500 watts Solar powered HPG 3110 Photo scanner was used to capture the lip print of the subjects. The lip was divided into four (4) quadrants and five (5) lip types were identified in each quadrant (Type I, I', II, III, IV and V). Descriptive statistics (frequency) was done to determine the distribution of the lip print patterns, while chi-square test was done to determine the association between sex and cheiloscopy.
Results and Discussion: In the upper left quadrant; Type I [53 (35.33%)] was the most occurring pattern, followed by II [28 (18.67%)], Type I' [27 (18.00%)], Type IV [22 (14.67%)] and Type III [20 (13.33%)]. In the upper right quadrant; Type III [44 (29.33%)] was the most occurring pattern, followed by Type II [33 (22.00%)], Type I' [24 (16.00%)], Type IV [20 (13.33%)], Type I [17 (11.33%)] and Type V [12 (8.00%)]. For the lower left quadrant; Type IV [42 (28.00%)] was predominant, followed by Type I' [35 (23.33%)], Type II [28 (18.67%)], Type III [24 (16.00%)], Type I [16 (10.67%)] and Type V [5 (3.33%)]. While in the lower right quadrant; Type I [36 (24.00%)] occurred most, followed by Type IV [33 (22.00%)], Type III [30 (20.00%)], Type II [23 (15.33%)], Type I' [22 (14.67%)] and Type V [6 (4.00%)]. Except in the lower right quadrant, sexual dimorphism was observed in all quadrants; upper right quadrant (X^2 = 21.75; *P*-value = 0.001), upper left quadrant (X^2 = 22.60; *P* = <0.01) and lower left quadrant (X^2 = 20.15; *P*-value = 0.001). The most occurring pattern for the population was type I [122 (20.3%)], followed by III [118 (19.7%)], while the least was type V [23 (3.8%)]. Type III [Male (M) = 64 (22.2%); Female (F) = 54 (17.3%)] and V [M = 13 (4.5%); F = 10 (3.2%)] were predominant in male subjects. While Type I [M = 54 (18.8%); F = 68 (21.8%)], I' [M = 50 (17.4%); F = 58 (18.6%)], II [M = 51 (17.7%); F = 61 (19.6%)], and IV [M = 56 (19.4%); F = 61 (19.6%)] were predominant in female subjects. Differences in the distribution of various types between male and female subjects were not statistically significant at $p < 0.05$.
Conclusion: Lip print was observed to be unique among individuals and also sexually dimorphic when considered according to quadrants. This finding will serve as a useful tool in forensic investigations.
Keywords: Cheiloscopy, Tsuchihashi, Lip print, Personal identification, sexual dimorphism.

INTRODUCTION

The uniqueness of humans spans from the simplest to the most complex structure. Structural differences exist due to the differences in our genetic makeup and markup. This therefore explains why drugs are formulated considering the molecular variations in human DNA. Disputes as well as crime in recent times are solved at the molecular (DNA) level. However, the high cost and unavailability of DNA diagnostic and forensic techniques especially in developing countries has made it necessary for techniques considered

unpopular such as cheiloscopy to be adopted [1, 2]. Scientist leverage on the uniqueness of lip patterns, especially when other identification methods or resources involved are not available.

It is possible to identify the lip pattern of an individual as early as the sixth week of intrauterine life, which does not change throughout life time [3]. Lip patterns are so unique and consistent, that it can recover and resume its groove pattern [2], after trauma, inflammation, and disease conditions capable of inflicting structural damages such as herpes [4]. Cheiloscopy first recognized and mentioned by R. Fischer (an anthropologist) in 1902 [5]. It deals with the identification of humans based on characteristic pattern of elevations and depressions in the transition zones (between the inner labial mucosa and the outer skin) of the lip. They are otherwise described as lines, fissures (wrinkles and grooves) seen on human lips [6].

Crime perpetrators often wear overalls, with gloves covering the hands and masks for the face, with the lips usually kept open for communication. This makes it difficult for their finger prints to be obtained at crime scenes. However, traces of lip prints are typically seen on cutleries, crockery items and tip of cigarettes. They can also be found in atypically places such as the surface of windows, walls, doors, glass cups, paintings, doors, and plastic bags etc [5]. They are most likely to appear in scene of murder, rape and burglaries [7].

Authors such as (Suzuki and Tsuchihashi [8]; Warren [9]; kasprzak [5]; Williams [10]; Ball [11]) recommended the use of lip prints for the identification of persons.

Williams [10] and Suzuki and Tsuchihashi [8], found individual specificity in the morphology of lip patterns. They demonstrated that even in identical twins, no two lips have the same pattern, although their characteristics may be inherited from either parent. Hence the possibility of using lip print patterns in the identification of persons.

Between the year 1985-1997, cheiloscopic techniques were employed in 85 cases (65 burglary cases, 15 cases of homicide and 5 cases of assault). Positive identifications were made in 34 of the 85 cases, which is a useful average when compared to other forensic techniques [5]. A decade long study (2000-2010) by Indian scientists were also positive when it comes to specificity, sex estimation, using lip print patterns among different Indian populations [2].

Embryologically, the upper and lower lip is derived from the maxillary and mandibular (1st pharyngeal arch), as well as the medial and lateral nasal prominences [12, 13]. Histologically, it is predominantly skeletal muscles. Each lip consists of an external surface lined by the skin, and an internal surface lined by mucous membrane, having stratified squamous epithelium. A transitional zone (often called vermillion) is found between the two layers [14].

Anatomically, the lip; upper (labium superioris) and lower (labium inferioris) is a visible part of the mouth in humans and many animals. They are soft, movable, and serve as the opening for food intake and in the articulation of sound and speech production. They are tactile and sensory in humans, and could be so erogenous especially during kissing [15]. The lips mostly consist of skin outwardly, the orbicularis muscle, labial glands, and mucosa internally. [16] The upper and the lower lips are connected to each other at the corners of the mouth by the labial commissures. While they are separated from the cheeks by the nasolabial folds. [15] The upper lip is innervated by the infraorbital nerve, a branch of the maxillary branch of the trigeminal nerve. While the lower lip is innervated by the mental nerve, a branch of the mandibular branch of the trigeminal nerve. The lip is supplied by the superior and inferior labial branches of the facial artery [15].

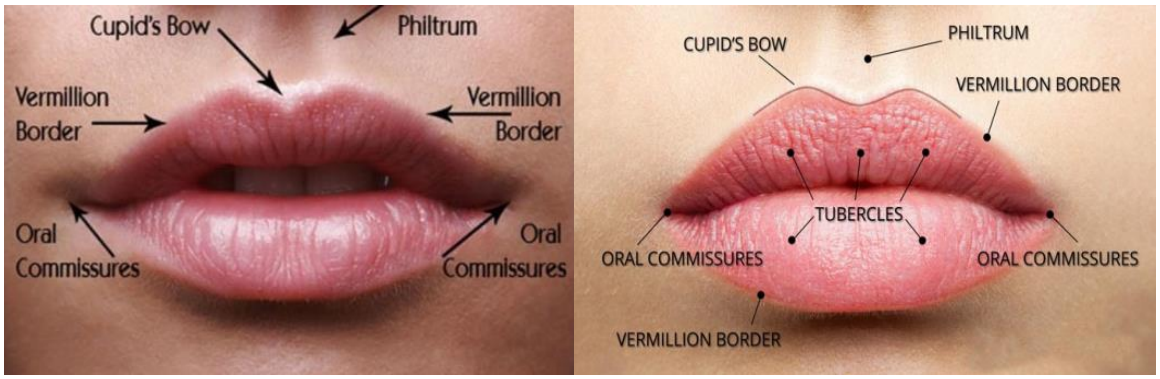


Figure 1: Surface anatomy of the lips adopted from www.rejuvent.com

Classification of lip prints

Various attempts have been made to classify lip prints. These classification makes it possible to analyze and make inference from lip prints when the need arises, usually during crime resolution [2].

Santos [17] divided wrinkles and grooves into (1) simple [straight line (R-1), a curve (C-2), angular (A-3) or sinusoidal (S-4) forms] and (2) compound (2 or 3 branches as well as irregular patterns). He also considered thickness [thin (seen amongst Europeans), medium (about 8 - 10mm with rounded pink zones, which is characteristic of the general population), thick or very big lips (found in Negros, usually with inverted labial strings) and mixed types (common among Asians] and commissures (horizontal, flat and elevated).

Suzuki and Tsuhihashi [8] classified the lip into six (6) types according to the shape and course of grooves. Type I, I', II – V.

Renaud [18] classified the lips dividing the upper lip into right and left halves denoted with capital (R and L), and the groves according to their forms in small letters, while this is reversed for the lower lips.

Kasprzak [5] classified the lips considering only the middle lower part (10mm wide) and distinguished 23 predominant individual characteristic patterns. The patterns with continuous lines that runs across are said to be linear "L", bifurcate "R" if bifurcated patterns are more and "S" if reticular. Pattern are said to be undetermined "N" when they are mixed with no particular pattern being significantly more in number.

A number of authors (Augustine *et al.,* [4]; Saraswathi *et al.,* [19]; Rashmi *et al.,* [20]; Kumar *et al.,* [21]; Jain *et al.,* [22]; Ishaq *et al.,* [7]; Nagrale *et al.,* [6]; Nazir *et al.,* [23]; Chimurkar *et al.,* [24]) studied the uniqueness of lip prints and found population specific patterns and individual uniqueness. They did not find any two individuals to have similar lip print patterns. Lip print patterns were also found to be sexually dimorphic. Similarities and sex specific differences were also observed. Edibamode *et al.,* [25] found uniqueness in lip prints irrespective of tribe, culture and race.

Considering the high cost of DNA analysis and the technical know-how, it has become necessary to provide an affordable alternative to forensic investigations. The study was therefore carried out to determine individual uniqueness and sexual dimorphism in lip print types among the Ikwerre ethnic group in Nigeria.

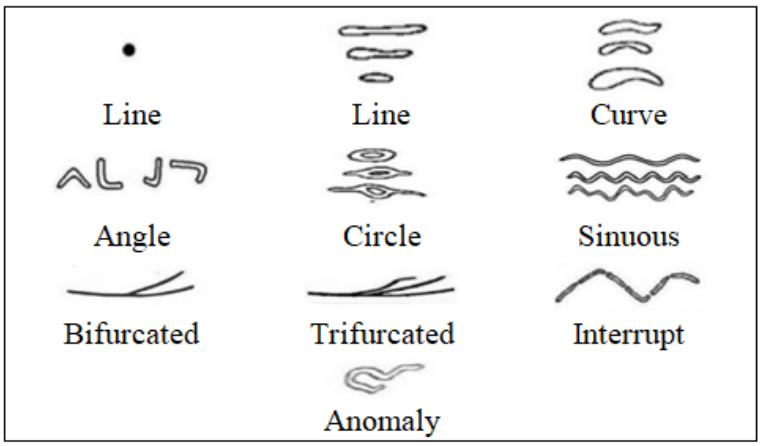
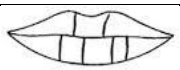
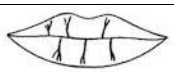


Figure 2: Santos classification of lip prints

Lip print	Sketch	Type/ Description
		Type I Long Vertical
		Type I' Short Vertical
		Type II Branched

		Type III Intersecting
		Type IV Reticulate
		Type V Indefinite/ Mixed

Figure 3: Suzuki and Tsuchihashi's classification

Type	Description	Type	Description
a	Complete vertical	f	Incomplete intersecting
b	Incomplete vertical	g	Reticulated
c	Complete bifurcated	h	In the form of sword
d	Incomplete bifurcated	i	Horizontal
e	Complete intersecting	j	Other types

Figure 4: Renaud's classification of lip prints

SN	Type of features	Graphic symbol	SN	Type of features	Graphic symbol
1	An eye		13	A clothing bottom bifurcation	
2	A hook		14	A delta-like opening	
3	A bridge		15	A simple opening	
4	A line		16	A clothing top bifurcation	
5	A dot		17	A pentagonal arrangement	
6	A rectangle-like		18	A branch-like top bifurcation	
7	A triangle-like		19	A star-like bifurcation	
8	A group of dots		20	A fence	
9	A simple top bifurcation		21	A branch-like bottom bifurcation	
10	A simple bottom bifurcation		22	A double fence	
11	A double eye		23	A hexagonal arrangement	
12	Crossing lines				

Figure 5: Kasprzak's classification of lip prints

MATERIALS AND METHODS

It was a descriptive cross-sectional study, involving 150 randomly selected males (72) and females (78) of the Ikwerre ethnic group. The subjects were briefed concerning the details of the study and only those who gave their consent were involved in the study. Sample size was determined using Cochran [26].

Selection Criteria

The following considerations were made before selecting subjects:

1. Individual who are of Ikwerre ethnic origin by both parents up to the second generation.
2. Individuals with no congenital lip anomaly or cleft palate.
3. Individuals who have not had plastic surgery, lip implants / injections.

Procedure

Subjects who met the inclusion criteria were made to sit upright in a relaxed comfortable position. The lips of every individual were first cleaned with face wipes before they were asked to place it close to, but not directly on the photo scanner. HPG 3110 Photo scanner (powered by a 500watts Solar Power Inverter) connected to Hp ProBook 5320m Laptop (using the USB cable) was used to capture the lip print of the subjects. The captured prints were displayed on the laptop screen. They were later imported into Corel Draw version 13.0, magnified and divided into four quadrants (upper left, upper right, lower left and lower right). The prints in each quadrant was observed and classified according to Tsuchihashi [27].

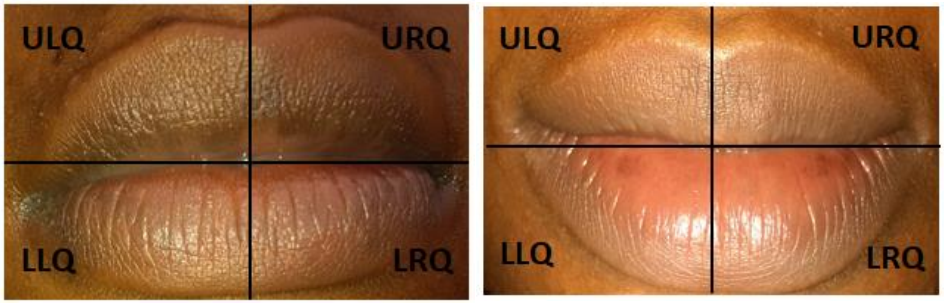


Figure 7: Lip print of subjects divided into four quadrants

***ULQ** = Upper Left Quadrant, **URQ** = Upper Right Quadrant, **LLQ** = Lower Left Quadrant, **LRQ** = Lower Right Quadrant.*

DATA ANALYSIS

The data was analyzed using the Statistical Package for the Social Sciences version 25.0 (SPSS) and Microsoft Excel 2019 edition. Chi-square analysis was carried out to determine sex associated relationship between lip print patterns. *Z*-test was used to determine the association between each lip print type in both sexes.

Significance level was set at 95% confidence interval, therefore $P < 0.05$ was considered significant.

RESULTS

Data from the randomly selected 150 subjects (72 males and 78 females) were analyzed and results presented in Figure 1 and Table 1 & 2. The distribution of each lip pattern was presented in frequency and proportion (percentage) [Table 1], while chi-square analysis to determine the association between sex and lip pattern was presented in Table 2.

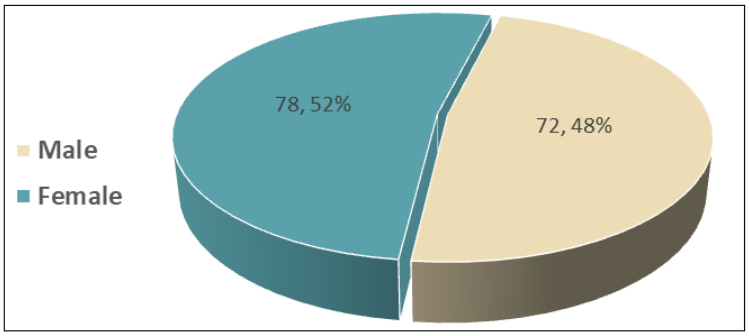


Figure 6: Pie chart showing the distribution of the subjects

Table 1: Distribution of lip patterns according to quadrant

Tsuchihashi's type	Sex		N (%)
	Male (%)	Female (%)	
Upper left quadrant			
I	32 (44.4)	21 (26.9)	53 (35.3)
I'	2 (2.8)	25 (32.1)	27 (18.0)
II	14 (19.4)	14 (18.0)	28 (18.7)
III	11 (15.3)	9 (11.5)	20 (13.3)
IV	13 (18.1)	9 (11.5)	22 (14.7)
Upper right quadrant			
I	4 (5.6)	13 (16.7)	17 (11.3)
I'	12 (16.7)	12 (15.4)	24 (16.0)
II	16 (22.2)	17 (21.8)	33 (22.0)
III	31 (43.1)	13 (16.7)	44 (29.3)
IV	3 (4.7)	17 (21.8)	20 (13.3)
V	6 (8.3)	6 (7.7)	12 (8.0)
Lower left quadrant			
I	3 (4.2)	13 (16.7)	16 (10.7)
I'	26 (36.1)	9 (11.5)	35 (23.3)
II	11 (15.3)	17 (21.8)	28 (18.7)

III	8 (11.1)	16 (20.5)	24 (16.0)
IV	20 (27.8)	22 (28.2)	42 (28.0)
V	4 (5.6)	1 (1.3)	5 (3.3)
Lower right quadrant			
I	15 (20.8)	21 (26.9)	36 (24.0)
I'	10 (13.9)	12 (15.4)	22 (14.7)
II	10 (13.9)	13 (16.7)	23 (15.3)
III	14 (19.4)	16 (20.2)	30 (20.0)
IV	20 (27.8)	13 (16.7)	33 (22.0)
V	3 (4.2)	3 (3.9)	6 (4.0)

Type I=*Vertical, comprising of complete (end to end) longitudinal fissures/patterns.* ***Type I'***=*Incomplete longitudinal fissures.* ***Type II***=*Branching Y shaped pattern.* ***Type III***=*Criss-cross pattern.* ***Type IV***= *Reticular, fence like.* ***Type V***=*Undetermined.*

Table 2: Distribution and test of association of lip print patterns of the subjects according to sex

Quadrant	*Sex*	**Tsuchihashi's *type***						*N (%)*	X^2	*P-value*
		I (%)	*I' (%)*	*II (%)*	*III (%)*	*IV (%)*	*V (%)*			
Lower left	M	3 (18.8)	26 (74.3)	11 (39.3)	8 (33.3)	20 (47.6)	4 (80.0)	72 (100)	20.147	**0.001***
	F	13 (81.3)	9 (25.7)	17 (60.7)	16 (66.7)	22 (52.4)	1 (20.0)	78 (100)		
Lower right	M	15 (41.7)	10 (45.5)	10 (43.5)	14 (46.7)	20 (60.6)	3 (50.0)	72 (100)	2.956	0.71
	F	21 (58.3)	12 (54.5)	13 (56.5)	16 (53.3)	13 (39.4)	3 (50.0)	78 (100)		
Upper left	M	32 (60.4)	2 (7.4)	14 (50.0)	11 (55.0)	13 (59.1)	-	72 (100)	22.599	**<0.01***
	F	21 (39.6)	25 (92.6)	14 (50.0)	9 (45.0)	9 (40.9)	-	78 (100)		
Upper right	M	4 (23.5)	12 (50.0)	16 (48.5)	31 (70.5)	3 (15.0)	6 (50.0)	72 (100)	21.753	**0.001***
	F	13 (76.5)	12 (50.0)	17 (51.5)	13 (29.5)	17 (85.0)	6 (50.0)	78 (100)		

** = Significant at p < 0.05,* ***M*** *= Male,* ***F*** *= Female,* ***Type I***=*Vertical, comprising of complete (end to end) longitudinal fissures/patterns.* ***Type I'***=*Incomplete longitudinal fissures.* ***Type II***=*Branching Y shaped pattern.* ***Type III***=*Criss-cross pattern.* ***Type IV***= *Reticular, fence like.* ***Type V***=*Undetermined.*

Table 3: Distribution and test of association of specific lip print pattern of the subjects according to sex

Sex	**Type**	**Quadrants**				**N (%)**	**Z-test**	
		ULQ (%)	**URQ (%)**	**LLQ (%)**	**LRQ (%)**		***z***	***P*-value**
M	I	32 (59.3)	4 (7.4)	3 (5.6)	15 (27.8)	54 (18.8)	-0.49	0.62
F		21 (30.9)	13 (19.1)	13 (19.1)	21 (30.9)	68 (21.8)		
M	I'	2 (4.0)	12 (24.0)	26 (52.0)	10 (20.0)	50 (17.4)	-0.33	0.74
F		25 (43.1)	12 (20.7)	9 (15.5)	12 (20.7)	58 (18.6)		
M	II	14 (27.5)	16 (31.4)	11 (21.6)	10 (19.6)	51 (17.7)	-1.45	0.15
F		14 (23.0)	17 (27.9)	17 (27.9)	13 (21.3)	61 (19.6)		
M	III	11 (17.3)	31 (48.4)	8 (12.5)	14 (21.9)	64 (22.2)	0.46	0.64
F		9 (16.7)	13 (24.1)	16 (29.6)	16 (29.6)	54 (17.3)		
M	IV	13 (23.2)	3 (5.4)	20 (35.7)	20 (35.7)	56 (19.4)	-0.26	0.80
F		9 (14.8)	17 (27.9)	22 (36.1)	13 (21.3)	61 (19.6)		
M	V	-	6 (46.2)	4 (30.8)	3 (23.1)	13 (4.5)	0.59	0.56
F		-	6 (60.0)	1 (10.0)	3 (30.0)	10 (3.2)		

** = Significant at p < 0.05,* ***M*** *= Male,* ***F*** *= Female,* ***Type I***=*Vertical, comprising of complete (end to end) longitudinal fissures/patterns.* ***Type I'***=*Incomplete longitudinal fissures.* ***Type II***=*Branching Y shaped pattern.* ***Type III***=*Criss-cross pattern.* ***Type IV***= *Reticular, fence like.* ***Type V***=*Undetermined,* ***ULQ*** *= Upper Left Quadrant,* ***URQ*** *= Upper Right Quadrant,* ***LLQ*** *= Lower Left Quadrant,* ***LRQ*** *= Lower Right Quadrant*

In Table 1, the distribution of the subjects according lip pattern following Tsuchihashi's classification was presented. The result showed that in the upper left quadrant, the most common pattern for male subjects was Type I [2 (44.4%)], followed by II [14 (19.4%)], while the least was I' [2 (2.8%)]. When compared to females, the most common pattern was Type I' [25 (32.1%)], followed by I [21 (26.9%)], with Type III and IV having the same as well as the least values; 9 (11.4%). In the population, the predominant pattern was Type I [53 (35.3%)], while the least was Type III [20 (13.3%)].

In the upper right quadrant, males had higher distribution of III [31 (43.1%)], followed by Type II [16 (22.2%)], while the least pattern was Type IV [3

(4.7%)]. Females have more of Type II and IV which was equally distributed [17 (21.8%)], followed by I and III distributed equally [13 (16.7%)], while the least occurring pattern was Type V [6 (7.7%)]. The predominant pattern in the population was Type III [44 (29.3%), while the least was Type V (8.0%).

In the lower left quadrant, the predominant pattern for males is Type I' [26 (36.1%)], followed by Type IV [20 (27.8%)], while the least occurring pattern is Type V [4 (5.6%)]. For females, Type IV [22 (28.2%)] was predominant, followed by Type II [17 (21.8%)], while Type V [1 (1.3%)] was the least. Type IV [42 (28.0%)] was the predominant pattern for the population, while Type V [5 (3.3%] was the least occurring pattern.

In the lower right quadrant, male subjects had more of Type IV [20 (27.8%)], followed by Type I [15 (20.8%)], while the least was Type V [3 (4.2%)]. Female subjects had more of Type I [21 (26.9%)], followed by Type III [16 (20.2%)], while the least was Type V [3 (3.9%)]. For both sexes, the predominant pattern was Type I [36 (24.0%)], followed by Type IV [33 (22.0%)] and Type V [6 (4.0%)] as the least pattern.

In Table 2, sex differences in lip patterns was determined using Chi-square, significant difference was observed in the upper right quadrant (X^2 = 21.75; P = 0.001), upper left quadrant (X^2 = 22.60; P < 0.01), lower left quadrant (X^2 = 20.15; P = 0.001), while significant difference was not observed in the lower right quadrant (X^2 = 2.96; P = 0.71).

The most predominant pattern in the general population is Type I [122 (20.3%)], followed by Type III [118 (19.7%)], while the least occurring pattern is Type V [23 (3.8%)]. Type III [64 (22.2%)] was predominant in male subjects, while Type V [13 (4.5%)] was the least occurring pattern. Type I [68 (21.8%)], was predominant in females, while Type V [10 (3.2%)] was the least occurring pattern. Differences in the distribution of various types between male and female subjects were not statistically significant at P < 0.05 (Table 3).

DISCUSSION

The principle of exchange which is the basis of forensic analysis formulated by Edmond Locard states that every contact leaves a trace [28]. The trace could be in the form of hair, fiber, pieces of clothing, blood and footprint. Lip print have proven to be one of the useful contacts that could leave a trace for forensic analysis.

In the present study, careful examination of lip print pattern from the individuals studied, revealed that no two individuals have the same pattern and proportion of lip print types in all quadrants. Lip print type occurred naturally in diverse combinations, like the typical mathematical permutation and combination where no two numbers repeats in a series. It was also observed that every individual has more than one pattern in each quadrant [4] reported that the patterns of lip prints occurred in diverse combinations. Hence no two individuals have the same pattern. Saraswathi *et al.*, [19], also observed that no individual had a single type of lip print pattern in all four compartments and no two or more individuals had a similar type of lip print pattern.

Generally, for the study population, Type I was the most predominant, followed by Type III, while Type V was the least. When the lip was divided into four quadrants, Type I was the predominant type in the upper left quadrant, Type III (upper right quadrant), Type IV (lower left quadrant) and Type I (lower right quadrant).

Differences in lip prints between males and females were observed. The most predominant pattern in the upper left quadrant was Type I (male) and I' (female). In the upper right quadrant, Type III (male) and II & IV (female). Type I'(male) and IV (female) in the lower left quadrant. While it was Type IV (male) and I (female) in the lower right quadrant. Edibamode *et al.*, [25] found the most common lip print for males in the upper left right quadrants to be Type I while Type II was the most common in the lower left and right quadrants. While in females it was Type III for the upper left quadrant, Type II for the upper right and lower left quadrants and Type I for the lower right quadrant in a population of University of Port Harcourt students. Bharathi *et al.*, [29], found the most predominant lip print pattern in the upper right quadrant to be Type IV and I in male and female subjects respectively. Type II (males) and V (females) in the upper left quadrant. Type I (males) and IV (females) in the lower right quadrant. While Type II (female) was predominant in the lower left quadrant. While Bharathi *et al.*, [29] also found the most predominant lip print pattern in the upper right quadrant to be Type I (females). Type II (males) in the upper left quadrant. Type I (males) in the lower right quadrant. Type II (females) in the lower left quadrant. Other authors (Kaul *et al.*, [30]; Nagalaxmi *et al.*, [31]; Sultana *et al.*, [3]; Prabhath *et al.*, [32] made similar findings; observing differences in predominant lip print types in different quadrants in male and female subjects. None of these authors found the same pattern to be predominant in both sex in all quadrants.

In the current study, the lower left, upper right and left quadrants were statistically significant when compared between male and female subjects, while the lower right quadrant did not show any statistical significance between sex. Vijay *et al.*, [33] divided the lips into six (6) portions and found significant difference in the outer four portions of the lip between male and female subjects, while the middle portion did

not show significance. Gondivkar *et al.*, [34], Narang *et al.*, [35], Karki [36], Vijay *et al* [33], Kinra *et al.*, [37] and Nazir *et al.*, [23] also reported sexual dimorphism in lip print patterns.

CONCLUSION

This study has been able to establish the uniqueness of lip print patterns for the Ikwerre ethnic group. The study has also established sexual dimorphism in the distribution of lip print patterns according to quadrants. The most occurring pattern for the population was type I followed by type II, while the least was type V. The study will therefore be relevant in forensic science and anthropology for crime resolution and ethnic studies.

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