CHEILOSCOPY AND DERMATOGLYPHICS AS TOOLS FOR PERSONAL IDENTIFICATION: AN URBAN NIGERIAN POPULATION STUDY

Samson Taiwo Fakorede[1], Khalid Olajide Adekoya[1], Utom-Obong Udom Akpan[2], Glory Etta[1], Bola Oboh[1]

[1]Genetics Research Group, Department of Cell Biology and Genetics, Faculty of Science, University of Lagos, Nigeria.

[2]Anatomy Programme, College of Health Sciences, Bowen University, Iwo, Osun State, Nigeria.

Corresponding author: S. Taiwo Fakorede, PhD; Email: tfakorede@unilag.edu.ng

Submit Date 2025-02-17
Revise Date 2025-05-17
Accept Date 2025-05-25

ABSTRACT

Background: Fingerprint and lip print patterns are two distinct biometric identifiers used for human identification in forensic science and security applications. Lip print patterns (Cheiloscopy), albeit supplementary in applications, can be combined with fingerprint patterns (dermatoglyphics) to enhance the accuracy of identification. The present study aimed to evaluate lip print and fingerprint patterns as tools for gender identification in the Nigerian population. **Materials and Methods:** We obtained fingerprints and lip prints from 150 randomly selected individuals with no signs of mouth lesions or damaged thumbs. Fingerprint patterns were determined by analyzing the configuration of the skin ridges, while lip print classification was done using the established Suzuki and Tsuchihashi systems. The data were then analyzed using Chi-square, correlation, and descriptive analyses. **Results:** Our results revealed that on the right thumb, males have a higher prevalence of the arch pattern (62.7%) compared to females (50.7%), while females exhibit a higher percentage of the loop pattern (32.0%) than males (17.3%). On the left thumb, however, males again show a higher percentage of the arch pattern (56.0%) compared to females (41.3%). The loop pattern is similar in both genders, though slightly higher in females (32.0%) than in males (28.0%). The most prevalent lip pattern among males and females was intersected, with 38.7% and 28.0% prevalence, respectively. Lip print pattern was statistically associated with gender ($P<0.001$). However, no significant association exists between male and female participants' fingerprint and lip print patterns. **Conclusion:** These findings have practical implications for forensic investigations, providing a basis for the use of fingerprint and lip print patterns for gender identification in the Nigerian population.

KEYWORDS: Forensics, fingerprint, lip prints, Tsuchihashi classification, Nigeria.

INTRODUCTION

The distinguishing differences in the sizes and shapes of individuals of the same species are termed sexual dimorphism. Human sex identification is crucial in forensic research and legal medicine (**Chaves et al., 2024**). In crime scene investigations, determining the sex of the suspect/victim is regarded as the first level of identification (**Chavan & Kumar, 2020**). Besides DNA profiling techniques, various biometric features can be used in forensic investigation to distinguish the sex of the individual(s) collected at a crime scene. Such biometric features include fingerprint ridge density, fingerprint pattern intensity index, fingerprint ridge characteristics (minutiae), and fingerprint pattern type (**Gutiérrez and Rivaldería, 2021**). Additionally, fingerprint and lip print patterns are crucial biometric tools for sex identification in forensic investigations (**Gazge et al., 2018; Kataria et al., 2020; Sharma et al., 2009**).

Fingerprint patterns are distinct for each individual, even in identical twins (**Gazge et al., 2018**). Fingerprints are widely used for identification since the ridge patterns, after development, do not change throughout the lifetime of each individual (**Sánchez-Andrés et al., 2018**). Many findings have shown that fingerprints are essential techniques for sex identification (**Hsiao et al., 2022; Kaur & Dhall, 2024; Sharma et al., 2021**). Fingerprints can be obtained from various sources such as pen, paper, glass, firearms, knives, or currency notes for forensic analysis (**Badiye et al., 2022**). Lip prints, on the other hand, are the wrinkle lines and deep furrows found between the outer skin and the inner labial mucosa of the human

lips (**Sivapathasundharam et al., 2001**). Lip print can be identified six weeks into pregnancy. It does not change throughout life once developed and is unique to individuals. Hence, it is used as an investigative tool in human identification (**Ahmed et al., 2018; Ayuba et al., 2019; Timsinha & Kar, 2019**).

Personal identification is necessary for unknown persons in cases such as homicide, suicide, accidents, and other forms of disaster. It is also essential for missing persons and culprits to hide their identity (**Saraswathi et al., 2009**). The invention of fingerprint analysis for discriminatory purposes has been the only reliable means of human identification in the past century (**Sharma et al., 2009**). Cheiloscopy (a type of forensic investigation that involves identifying someone by their lip traces), forensic odontology (the application of dental principles to legal issues) and dermatoglyphics (the use of fingerprints) have been researched by several authors to determine the sex of unknown persons or in cases involving questioned identity (**Anu et al., 2020; Tandon et al., 2017**). Furthermore, estimates of sex have been carried out in various populations using different skeletal/body parts, including the skulls in Japanese (**Ogawa et al., 2013**), mandibles among Brazilian and South African populations (**Franklin et al., 2008; Lopez-Capp et al., 2018**), and ear morphology and morphometry in Nigerians (**Fakorede et al., 2021; Gaya & Yahaya, 2019; Osunwoke et al., 2018**).

Various population studies have shown that lip print is a reliable tool for sex identification (**Ayuba et al., 2019; Pelin et al., 2019; Thermadam et al., 2020**). Furthermore, lip print patterns are hereditary, showing similarities between parents, children, and siblings (**Šimović et al., 2016**). Like fingerprints, the morphology of lip prints is unique in all individuals and is influenced by race and ethnicity (**Jaber et al., 2023; Loganadan et al., 2019.** At a crime scene, lip prints can be collected from surfaces such as windows, doors, cigarette butts, cups, glasses, and paintings, serving as valuable forensic evidence (**Kumar & Kaur, 2023**). Hence, lip print, like fingerprints, is a tool for forensic research and medico-legal investigation due to its variability among persons, race, and gender. This study examined sexual dimorphism and the correlation between fingerprint and lip print patterns in Nigerian adults for forensic identification purposes.

MATERIALS AND METHODS

Ethics clearance and participant sampling

The Health Research Ethics Committee (HREC), College of Medicine, University of Lagos approved the study (CMUL/HREC/07/21/892). The sampling was conducted at three locations - Ikotun, Alimosho; Lagos University Teaching Hospital (LUTH), Idi-Araba; and the University of Lagos, Akoka, all in the cosmopolitan state of Lagos, Nigeria. One hundred fifty (150) participants comprising 75 females and 75 males in the 18-50 age group, participated in the study. Only individuals with healthy upper and lower lips and thumbs free from injuries were considered for the study, while those with lesions/scars/deformities were excluded.

Collection of fingerprint and lip prints

Fingerprints of the respective participant's right and left thumbs were captured using the Secugen Hamster Plus fingerprint scanner (SecuGen Corporation, California, USA) after thoroughly cleaning them with a cotton swab. Lip print impressions were collected using the glue area of cellophane tape stuck to an individual lip after a single stroke of a coloured frosted lipstick was applied and rubbed evenly on the vermillion border. The lip print impression was transferred to a white sheet and the line and furrow patterns observed with aid of a magnifying lens. Individual fingerprints and lip prints were code-named for easy identification and proper matching.

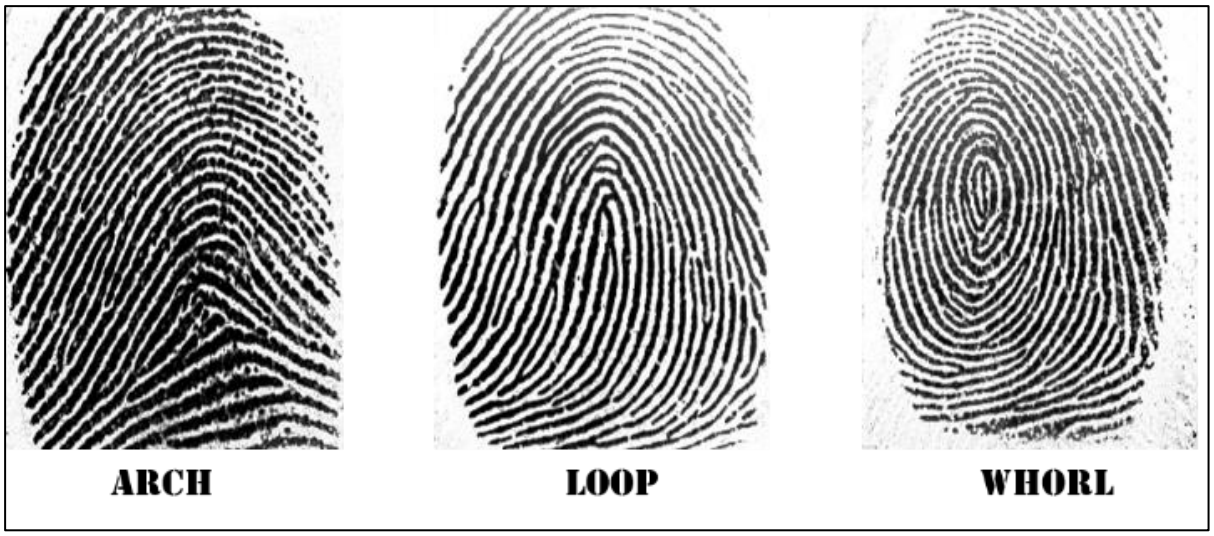

Figure 1: Fingerprint patterns of some of the participants showing the three types of fingerprint patterns

Figure 2: Lip print patterns (adapted from **Šimović et al., 2016**)

Classification of fingerprint and lip print patterns

Fingerprints were classified into arches, loops and whorls according to Henry's system of classification (**Henry, 1900**), while lip prints were classified according to the Suzuki and Tsuchihashi model described by Šimović et al. (**2016**) as shown in Figure 2.

Statistical analysis

Fingerprint and lip print data obtained were subjected to descriptive statistical analysis. Descriptive statistics was used for summarizing data Chi-square and correlation analyses were performed to evaluate the association of gender with fingerprint and lip print patterns. Statistical analyses were performed by IBM SPSS and Microsoft Excel. A *p*-value less than 0.05 was considered statistically significant.

RESULTS

Seventy-five (75) males and females each were sampled for the study, totaling 150 participants. The participants were aged 18-48 years (27.9 ± 0.732). Table 1 shows the distribution of various fingerprint patterns on the study participants' right and left thumbs. The distribution of fingerprint patterns differs significantly between males and females for both thumbs. The most common fingerprint pattern in the right thumb of males is the arch (62.7%), followed by the loop (17.3%) and then the whorl (20.0%). In females, the most common pattern in the right thumb is also the arch (50.7%), but the loop is more frequent (32.0%) than in males. The whorl is observed in

17.3% of females. On the left thumb, the most common fingerprint pattern of males is the arch (56.0%), followed by the loop (28.0%) and then the whorl (16.0%). In females, the loop is the most common pattern in the left thumb (32.0%), followed closely by the arch (41.3%). The whorl is seen in 26.7% of females. There was a significant difference *(P<0.001*) in the distribution of fingerprint patterns between the right and left thumbs, with the arch pattern predominating.

Table 1: Distribution and association of the different fingerprint patterns on the right and left thumbs of study participants

	Right Thumb			Left Thumb		
Gender	Arch	Loop	Whorl	Arch	Loop	Whorl
Male (n = 75)	47 (62.7%)	13 (17.3%)	15 (20.0%)	42 (56.0%)	21 (28.0%)	12 (16.0%)
Female (n = 75)	38 (50.7%)	24 (32.0%)	13 (17.3%)	31 (41.3%)	24 (32.0%)	20 (26.7%)
	Test of association: $\chi^2 = 37.56$, *P<0.001*			Test of association: $\chi^2 = 17.56$, *P<0.001*		

The most prevalent lip print pattern among the male and female participants was the intersected (33.3%) as depicted in Figure 3, followed jointly by the branched and reticular (20.0%), vertical (10.7%), partial length (8.7%), while the least common was the undetermined pattern (7.3%). Similarly, males and females had intersected lip patterns as the most common, with 38.7% and 28.0% prevalence, respectively. While the partial length lip print pattern (4.0%) was the least observed among the male participants, it was the undetermined pattern (6.7%) among females. Lip print pattern was statistically associated with gender (*P<0.001*).

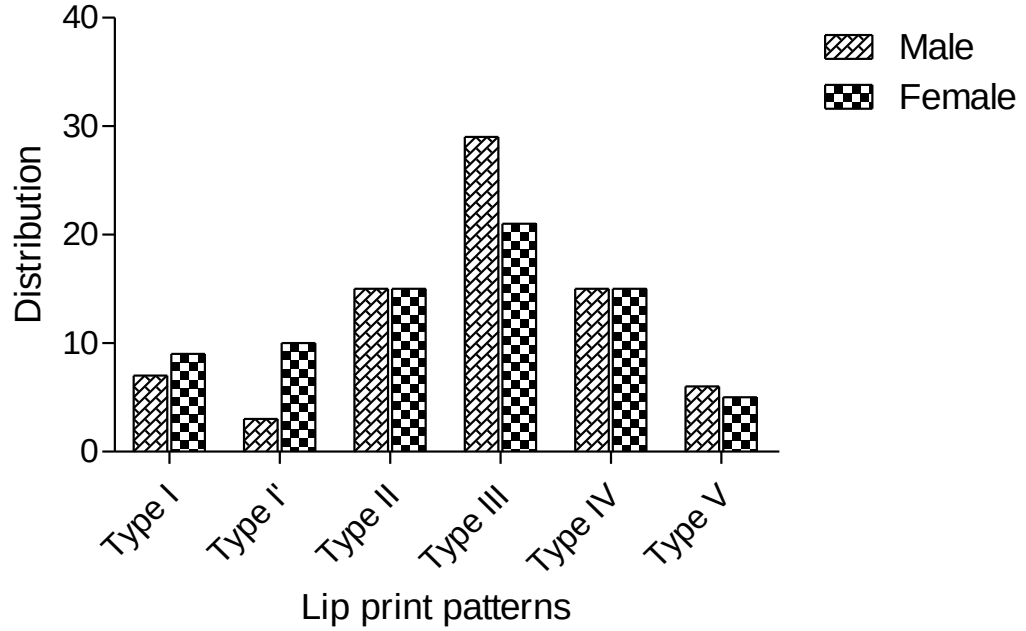

Figure 3: Distribution of lip print patterns among study participants

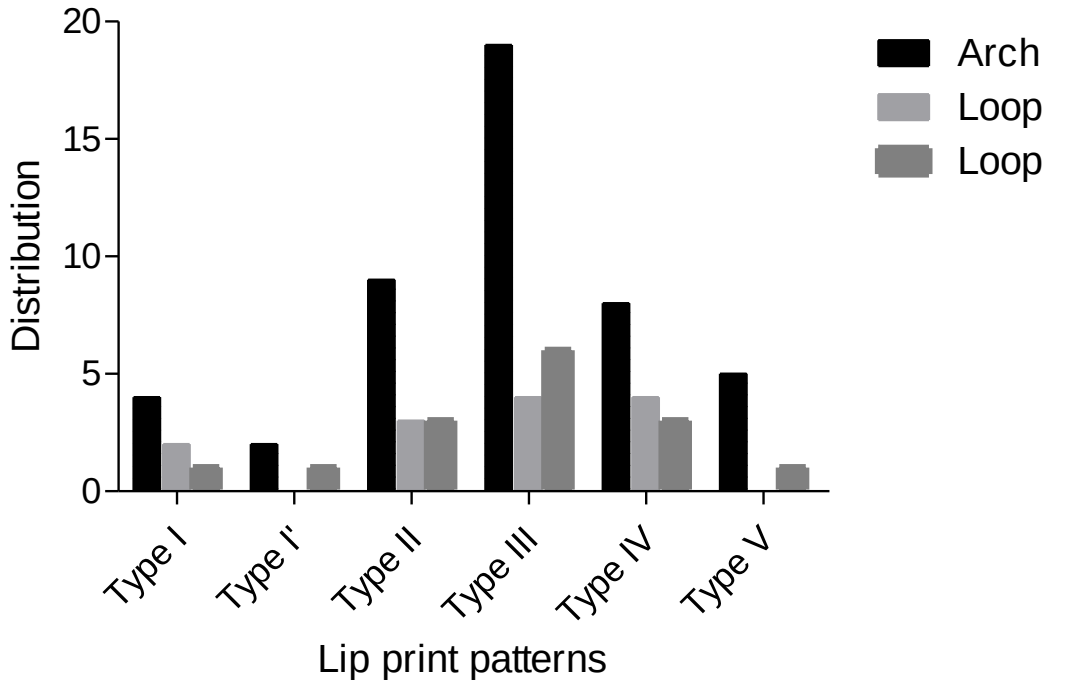

Figure 4: Association of lip prints with fingerprint patterns in males

Figure 4 illustrates the relationship between male participants' lip prints and fingerprint patterns. The arch fingerprint pattern was the most observed among all the lip print patterns. This was reported in 29 (38.9%) of the total 75 participants. The Type I lip print pattern was observed in 7 of 75 male participants. The distribution of fingerprint patterns among these seven was 4 (57.1%) arch, 2 (28.6%) and 1 (14.3%) whorl. Three individuals had the Type I' lip print pattern with 2 (2 (66.7%) associated with arch fingerprint pattern and 1 (33.3%) with whorl. Out of the 29 individuals with the Type III lip print pattern among males, 19 (65.5%) were associated with the arch fingerprint pattern, 4 (13.8%) with the loop pattern, and 6 (20.7%) were associated with the whorl pattern.

The branched lip print pattern (Type II) was seen in 15 male participants; 9 (60%) had the arch fingerprint pattern, while 3 (20%) each were associated with the loop and whorl patterns. Fifteen (15) males were found to have the Type IV lip print pattern. Out of these, 8 (53.3%) were associated with the arch fingerprint, 4 (26.7%) were associated with the loop fingerprints, and 3 (20.0%) were associated with the whorl pattern. The loop fingerprint pattern was not found among the six individuals with the Type V (undetermined) lip print pattern. In contrast, the associations of this lip print pattern with the arch and whorl were 5 (83.3%) and 1 (16.7%), respectively. The differences in the distribution of lip print and fingerprint patterns of male participants were not statistically significant ($P>0.05$).

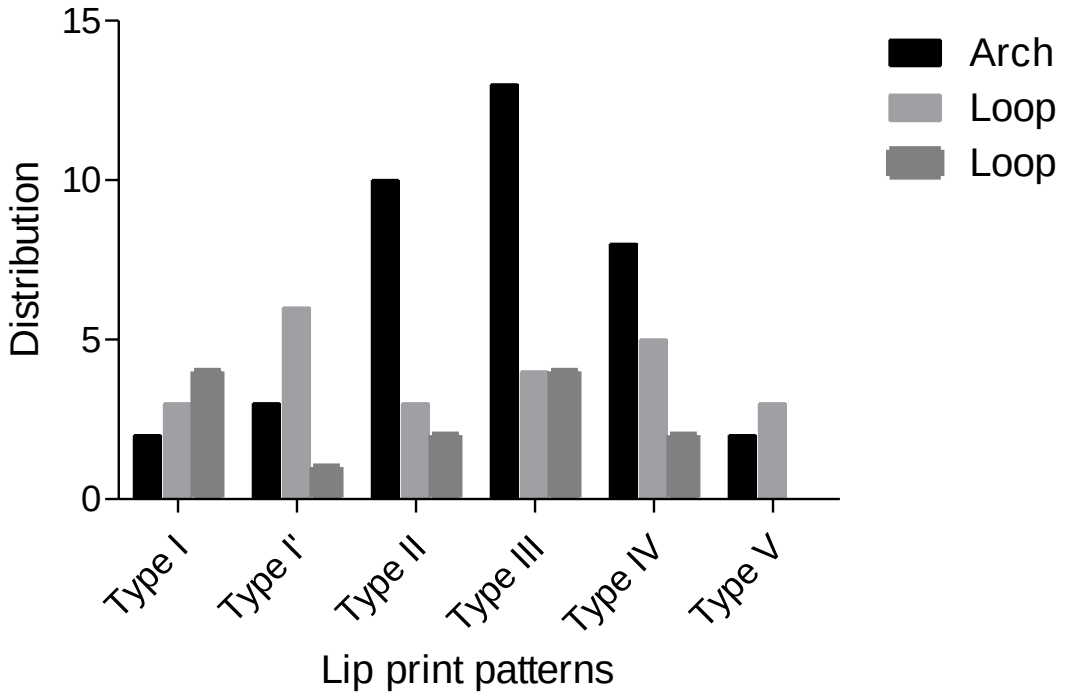

Figure 5: Association of lip prints with fingerprint patterns in females

Figure 5 shows the association of lip print and fingerprint patterns of the female participants. Nine female participants had the Type I lip print pattern, out of which 2 (22.2%) were associated with the arch fingerprint pattern, 3 (33.3%) were associated with the loop fingerprint and 4 (44.5%) were associated with the whorl pattern of a fingerprint. A total of 10 participants among the females possessed the Type I' lip print. Out of these, 3 (30%) were associated with the arch fingerprint pattern, while 6 (60%) and 1 (10%) were found associated with the loop and whorl fingerprint patterns, respectively. The Type II lip print pattern was seen in 15 female participants; 10 (66.7%) of these had the arch fingerprint pattern, 3 (20.0%) were associated with the loop, and 2 (13.3%) had the whorl fingerprint patterns.

The Type III lip print pattern was recorded among 21 females, out of which 13 (62%) were associated with arch fingerprint patterns, and 4 (19%) were associated with both loop and whorl patterns. The Type IV \pattern was observed in 15 female participants. Eight (53.3%) of these were associated with the arch fingerprint pattern, 5 (33.3%) were associated with the loop pattern and 2 (13.4%) with the whorl. Among the five female participants with the Type V lip print pattern, 2 (40%) were associated with the arch fingerprint pattern, 3 (60%) with loop and none with the whorl pattern. The differences in the distribution of lip print patterns among fingerprints of the female participants were not statistically significant (*P>0.05*).

DISCUSSION

The distinctively patterned furrows and grooves on a human lip, as well as the ridges of the fingerprint, have each been described in various research. Cheiloscopy (human identification based on lip prints/wrinkles) and dermatoglyphics (the scientific study of fingerprints) play crucial roles in personal identification and trace evidence analysis. These two fields continue to draw the attention of crime scene investigators during forensic investigations because lip print and fingerprint patterns are unique in individuals (**Multani et al., 2014**). It is believed that antemortem fingerprints or lip prints of individuals are comparable with the post-mortem for personal identification, provided that those prints are not affected in the corpse (**Loganadan et al., 2019; Mahmoud et al., 2020; Prasad & Vanishree, 2011**). Another advantage of cheiloscopy is that DNA can be recovered from lip print for forensic analysis (**Prabhu et al., 2013**).

The present study examined the sexual dimorphism of fingerprint patterns of the right and left thumbs, as well as the distribution of lip

print patterns among the Nigerian population. The selected fingers are most commonly used in biometric data capturing and are most encountered during a forensic investigation (**Priyadharshini et al., 2022**). The overall fingerprint patterns indicated the predominance of the arch pattern on the right and left thumbs of both genders, followed by the loop and whorl patterns among males and the whorl and loop among females among females. The distributions of fingerprint patterns were found to be statistically significant gender-wise. The predominance of the arch fingerprint pattern among the study participants agrees with the findings of Akpan et al. (**2024**), who reported a significantly higher prevalence of arch patterns among females. The distribution of lip print patterns among males and females showed that the Type III pattern is the most frequent in both genders, while the Type V pattern was the least common. This agrees with the findings of Saraswathi et al. (**2009**), who stated that the lip print's intersecting pattern (Type III) was more common in males and females. A similar observation was reported by Baral et al. (**2020**).

In addition, there are more males than females with intersecting lip print patterns, and the number of females with other lip print patterns, such as Type I, Type II and Type IV, is more than the number of males. This also agrees with a study by Sharma et al. (**2009**), who concluded that Type I and Type I' lip patterns were the most common in females and that Type IV was seen mostly in males. In contrast, these findings are at variance with other studies. For instance, Sandhu et al. (**2017**) reported that the branched groove lip print pattern is the most prevalent in the population of Sriganganagar district, India. Similarly, the branched pattern was the most common among students of Kathmandu University, Nepal (**Karki, 2012**). These findings suggest that lip print patterns vary considerably in different populations and geographically. Studies of twins have also revealed that heredity influences lip prints (**Braga et al., 2020; Thakur et al., 2017**). Age and seasons may also have impacts on lip print patterns.

The predominant lip print pattern in both male and female gender was the Type III (intersected) pattern with 38.7% and 28.0% prevalence, respectively, and the lip print patterns of males and females were significantly different *($P<0.001$)* as reported by other authors (**Ahmed et al., 2018; Negi and Negi, 2016; Okeke et al., 2020; Šimović et al., 2016**), indicating that lip print patterns are suitable for gender identification. Several studies have reported the prevalence of different lip print patterns in other populations. Mahmoud et al. (**2020**) reported the prevalence of the Type III pattern in the upper right section of Sudanese males and females' lips. Additionally, a study by Abdel Aziz et al. (**2016**) showed that Type III lip print pattern was the most prevalent among Malaysian males (41.7%) and Egyptian females (46.7%). Other studies in which the intersected lip print pattern predominance has been reported among males and females include Multani et al. (**2014**) and Kumaran et al. (**2017**). Nevertheless, in a South Indian population study, Priyadharshini et al. (**2022**) reported the Type II (branched) lip print pattern as the most common females and Types II and III (incomplete vertical and intersected) among males. Okeke et al. (**2020**) also reported vertical and reticular lip patterns as the most frequent among Igbo females and males.

The study further assessed the association of fingerprints with lip print patterns for gender identification. We did not, however, find significant associations between fingerprints and lip prints among the sampled males and females. This is in accordance with the findings of Nandan et al. (**2015**) and Baral et al. (**2020**). Nevertheless, we observed that the predominant arch fingerprint was associated with the predominant intersected lip print pattern in both genders, which agrees with the findings by Adamu and colleagues (**2013**), who reported an association between predominant fingerprint and lip print patterns among Nigerians. These findings highlight that the association of fingerprint and lip print patterns could serve as a potent tool for gender identification in criminal investigations.

Human identification is a crucial and challenging task in forensic investigation. Consequently, the use of cheiloscopy in human identification can be highly important. The most critical features of lip prints are their distinctiveness and uniqueness, which are similar to fingerprints and can be utilized for future criminal investigations. The study of lip print patterns has significant drawbacks. Sometimes, the prints collected at a crime scene may be subpar, making interpretation challenging. Additionally, standardization of the process of obtaining and evaluating lip print patterns is still lacking. Thus, variable

techniques can impact the findings from various sources. However, there is still promise for developing new forensic science approaches because lip prints may be helpful in DNA analysis. The secretions from lip prints, mainly latent prints, may provide material for DNA research, further providing crucial information for criminal investigations.

CONCLUSIONS

Lip prints and fingerprints have long been employed as supplementary tools for personal identification in forensic investigations due to their uniqueness to individuals. The findings from the present study offer valuable insights into how fingerprint and lip print patterns differ among individuals, with practical implications for forensic investigations, providing a basis for the use of fingerprint and lip print patterns for gender identification in the Nigerian population.

REFERENCES

Abdel Aziz MH, Badr El-Dine FM, Saeed NM. 2016. Regression equations for sex and population detection using the lip print pattern among Egyptian and Malaysian adult. *J Forensic Leg Med*., **44**: 103-110.

Adamu LH, Taura MG, Sadeeq AA, Asuku AY, Datti S, Abdu IT. 2013. The influence of season of birth on the pattern of lip prints in Nigeria. *Bayero J Pure Appl Sci*., **6(2)**: 6-9.

Ahmed SA, Salem HE, Fawzy MM. 2018. Forensic dissection of lip print as an investigative tool in a mixed Egyptian population. *Alex J Med*., **54(3)**: 235-239.

Akpan UOU, Amusa OD, Ojo JH, Fakorede ST, Adebajo OA, Balogun O A, ... & Olajide K. 2024. Linkage Group and Segregation Analyses of Fingerprint and Foot Patterns in the Yoruba, Igbo and Ibibio Populations of Nigeria. Int J Agri Biosci., **13(3)**: 429-438.

Anu V, Lokeswari P, Madhumitra S, Lavanya S, Lavanya C, Madhumitha K. 2020. Significance of cheiloscopy and dermatoglyphics in sex determination. *Indian J Forensic Med Toxicol*., **14(3)**: 741-744.

Ayuba JT, Echoru I, Ssempijja F, Ann ML, Edgar F, Buhari M. 2019. Sexual dimorphism in the lip print pattern and size among Ugandan, Kenyan and Somali population. *Forensic Sci Int: Reports*., **1**: 100012, https://doi.org/10.1016/j.fsir.2019.100012 .

Badiye A, Landge S, Thakare S, Kushwaha SS, Kapoor N. Forensic Applications of Simple (Handheld) Microscope. In: Shukla RK, Kapoor N, Badiye A, editors. *Forensic Microscopy*, CRC Press; 2022, p. 57-71, https://doi.org/10.4324/9781003120995

Baral R, Silwal G, Yadav DK, Koju S, Maharjan N, Bajracharya D. 2020. Patterns of Lip Print and Fingerprint in Gender Identification: A Cross-sectional Study. *J BP Koirala Institute Health Sci*., **3(2)**: 18-22.

Braga S, Pereira ML, Sampaio-Maia B, Caldas IM. 2020. Characterization of lip prints in a Portuguese twins' population. *J Forensic Odontostomatol*., **38(2)**: 40-46.

Chavan VA, Kumar R. 2020. Exploring the Potential of Ridge Density as a Measure of Sex Identification. *J Forensic Res*., **11(5)**: 1-6.

Chaves T, Azevedo Á, Caldas IM. 2024. Cheiloscopy in sex estimation: a systematic review. **Forensic Sci Med Pathol**., **20(1)**: 280-292.

Fakorede ST, Adekoya KO, Fasakin TP, Odufisan JO, Oboh B. 2021. Ear morphology and morphometry as potential forensic tools for identification of the Hausa, Igbo and Yoruba populations of Nigeria. *Bull Natl Res Cent*. **45**: 1-9.

Franklin D, O'Higgins P, Oxnard CE, Dadour I. 2008. Discriminant function sexing of the mandible of indigenous South Africans. *Forensic Sci Int*., **179(1)**: 84.e1-5.

Gaya AA, Yahaya AI. 2019. Sub-Saharan human morphological variations in the external ear (pinna): a potential tool for human identification. *EC Clin Exp Anat*., **2**: 175-184.

Gazge NM Pachipulus B, Chandra P, Malligere SB, Govindraju P, Pawar Y. 2018. Assessment of reliability of cheiloscopy and dactyloscopy in human identification by digital method: A cross-sectional study. *Int J Forensic Odontol*., **3**: 72-79.

Gutiérrez RE and Rivaldería MN. 2021. Dermatoglyphics in forensic identification in the XXI Century. *Eur J Anat*., **25(S2)**:193-208.

Henry ER. Classification and Uses of Finger Prints, 4th ed., London: Georges Routledge; 1900

Hsiao CT, Lin CY, Wang PS, Wu YT. 2022.

Application of convolutional neural network for fingerprint-based prediction of gender, finger position, and height. *Entropy*., **24(4)**: 475, https://doi.org/10.3390/e24040475

Jaber M, Varma SR, Hassan M, Hadi K, Khamis A. 2023. Assessment of lip print (cheiloscopy) patterns and its use for personal identification and crime investigation: A systematic review and Meta-Analysis. *J Int Dent Med Res*., **16(1)**: 331-339.

Karki RK. 2012. Lip prints: an identification aid. *Kathmandu Univ Med J*., **10(38)**: 55-57.

Kataria AP, Konidena A, Puri G, Patil DJ, Gupta R. 2020. Reliability of digitized cheiloscopy, dactyloscopy and combination approach for gender identification–A comparative study. *J Indian Acad Oral Med Radiol*., **32(1)**: 9-16.

Kaur J, Dhall M. 2024. Epidermal ridge sweat pore density: A forensic approach to sex determination. Forensic Sci Int: Reports., **10**: 100378, https://doi.org/10.1016/j.fsir.2024.100378.

Kumar R, Kaur J. 2023. The Role of Cheiloscopy in Forensic Science.J Ophthalmol Eye Care., **5(1)**:101.

Kumaran S, Kumar L, Patel S. 2017. Correlation between finger print and lip print pattern in Gujarati population. *Medico-Legal Update*., **17(1)**: 217-221.

Loganadan S, Dardjan M, Murniati N, Oscandar F, Malinda Y, et al. 2019. Preliminary Research: Description of Lip Print Patterns in Children and their parents among Deutero-Malay Population in Indonesia. *Int J Dent*., **2**: 1-6.

Lopez-Capp TT, Rynn C, Wilkinson C, Paiva LA, Michel-Crosato E, Biazevic MG. 2018. Sexing the cranium from the foramen magnum using discriminant analysis in a Brazilian sample. *Brazilian Dent J*., **29(6)**: 592-598.

Mahmoud NF, Afify MM, Elbendary RN, Shokry DA. 2020. Variations in morphological patterns of lip prints as evidence in racial and sexual discrimination. *J Forensic Res.*, **11(1)**: 2-7.

Multani S, Thombre V, Thombre A, Surana P. 2014. Assessment of lip print patterns and its use for personal identification among the populations of Rajnandgaon, Chhattisgarh, India. *J Int Soc Prev Community Dent*., **4**:170-174.

Nandan SRK, Bandaru BK, Santosh ABR, Thankappan P, Chundru NSV, Amudala R. 2015. A study on association and correlation of lip and fingerprint pattern analysis for gender identification. *J NTR Univ Heal Sci*., **4(3)**: 176-181.

Negi A, Negi A. 2016. The connecting link! Lip prints and fingerprints. *J Forensic Dent Sci*., **8**: 177-178.

Ogawa Y, Imaizumi K, Miyasaka S, Yoshino M. 2013. Discriminant functions for sex estimation of modern Japanese skulls. *J Forensic Leg Med*., **20(4)**: 234-238.

Okeke CM, Ann O, Ukoha UU, Dimkpa U, Enemuo I. 2020. The study of sexual dimorphism in lip print patterns among igbos in anambra state of nigeria: a cross-sectional study. *J Adv Oral Res*., **11(2)**: 240-244.

Osunwoke EA, Vidona WB, Atulegwu GC. 2018. Anthropometric study on the anatomical variation of the external ear amongst Port Harcourt students, Nigeria. *Int J Anat Var*., **11(4)**: 143-146.

Pelin C, Oktem H, Kurkcuoglu A, Olmus H. 2019. Lip Print Characteristics in Anatolian Population: Baskent University Sample. *Open Access Lib J*., **6(1)**: 1-10.

Prabhu RV, Dinkar A, Prabhu V. 2013. Digital method for lip print analysis: A new approach. *J Forensic Dent Sci*., **5**: 96-105.

Prasad P, Vanishree. 2011. A comparison of lip prints between Aryans-Dravidians and Mongols. *Indian J Dent Res*., **22(5)**: 664-668.

Priyadharshini R, Rajmohan M, Prasad H, Srichinthu KK, Loganathan M, Sivanandham S. 2022. Distribution and association of lip print pattern, finger print pattern and ABO blood groups in relation to gender and family among South Indian population. *Oral Maxillofac Pathol J*., **13(2)**: 10110-10114.

Sánchez-Andrés A, Barea JA, Rivaldería N, Alonso-Rodríguez C, Gutiérrez-Redomero E. 2018. Impact of aging on fingerprint ridge density: Anthropometry and forensic implications in sex inference. *Science & Justice*., **58(5)**: 323-334.

Sandhu H, Verma P, Padda S, Raj SS. 2017. Frequency and correlation of lip prints, fingerprints and ABO blood groups in

population of Sriganganagar District, Rajasthan. *Acta Med Acad*., **46(2)**: 105-115.

Saraswathi T, Mishra G, Ranganathan K. 2009. Study of lip prints. *J Forensic Dent Sci*., **1(1)**: 28-31.

Sharma P, Saxena S, Rathod V. 2009. Comparative reliability of cheiloscopy and palatoscopy in human identification. *Indian J Dent Res*., **20(4)**: 453-457.

Sharma S, Shrestha R, Krishan K, Kanchan T. 2021. Sex estimation from fingerprint ridge density. A review of literature. *Acta Biomed*., **92(5)**, https://doi.org/10.23750%2Fabm.v92i5.11471.

Šimović M, Pavusk I, Muhasilovic S, et al. 2016. Morphologic Patterns of Lip Prints in a Sample of Croatian Population. *Acta Stomatol Croat*., **50**: 122-127.

Sivapathasundharam B, Prakash PA, Sivakumar G. 2001. Lip prints (cheiloscopy*). Indian J Dent Res*., **12(4)**: 234-237.

Tandon A, Srivastava A, Jaiswal R, Patidar M, Khare A. 2017. Estimation of gender using cheiloscopy and dermatoglyphics. *Natl J Maxillofac Surg*., **8(2)**: 102-105.

Thakur BGB, Puri N, Bansal R, Yadav S, Sharma RK. 2017. A Comparative Study of Lip Prints Patterns in Monozygotic and Dizygotic Twins. *Int J Res Med Sci*., **5**: 2144-2149.

Thermadam TP, Chatra L, Ahsan A. 2020. Cheiloscopy in gender determination: A study on 2112 individuals. *J Family Med Prim Care*., **9(3)**: 1386-1390.

Timsinha S, Kar SM. 2019. A study on distribution and gender wise predilection of lip print pattern. Asian J Med Sci., **10(4)**: 170-174.