

A Quantitative Analysis of Lip Print Patterns as Ethnic Biomarkers in the Ukwuani Population of Nigeria

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ARTICLE INFORMATION	ABSTRACT
Article history: Published: August 2026 Keywords: Morphometric Forensic Anthropology Sexual Dimorphism Lip Print Type Ukwuani	Lip prints, the characteristic grooves on the vermilion border, are considered unique biomarkers. This study aimed to perform a quantitative, morphometric analysis to determine the influence of sex on lip print patterns within the Ukwuani ethnic group of Nigeria, contributing to population-specific forensic data. This cross-sectional study involved 415 Ukwuani volunteers (200 males, 215 females). Lip prints were collected using the lipstick-and-paper technique. Each print was divided into six segments for systematic morphometric analysis. Pattern types in each segment were identified via direct visual inspection with a magnification lens, categorized, and counted. The quantitative data was analyzed using the Chi-square test in SPSS version 21, with statistical significance set at $p < 0.05$. Quantitative analysis revealed no statistically significant difference ($p > 0.05$) in the overall distribution of lip print pattern types between sexes. The Type II pattern was the most prevalent across the cohort. However, measurable trends were identified: Type I patterns occurred with higher frequency in males, while Type III patterns were more commonly observed in females. This morphometric study successfully quantified lip print variation, identifying subtle, population-specific trends within the Ukwuani people. The findings confirm that lip prints serve as viable ethnic biomarkers and demonstrate evidence of sexual dimorphism. This underscores the importance of establishing ethnically specific databases for accurate applications in forensic anthropology and identification.

1. Introduction

Human identification in forensic science relies on a range of biometric techniques, such as odontology, anthropometry, and fingerprint analysis, to determine key characteristics including gender, approximate age, and stature (Vamsi & Krishna, 2011). Among these, the study of lip prints—termed cheiloscopy, from the Greek cheilos (lips) and skopein (to see)—has emerged as a valuable tool for personal identification due to the unique and permanent nature of lip groove patterns (Vats et al., 2011). Although first described by Fischer in 1902, it was Edmond Locard who, in 1932, formally recommended their application in criminalistics (Kasprzak & Leczynska, 2001).

Lip prints left on surfaces such as glass, clothing, or cigarette butts can provide crucial tactical and criminalistic information. They may assist in determining the number of individuals involved in a crime, their sex, habits, and even the use of specific cosmetics (Aggrawal, 2011). Furthermore, the presence of minor salivary and sebaceous glands on the vermilion border means latent prints are common, necessitating careful crime scene examination.

While cheiloscopic research has been conducted globally and within some Nigerian populations, a significant gap exists regarding the Ukwuani ethnic group of Delta State, Nigeria. This study therefore aims to document and analyse the lip print patterns within the Ukwuani population, contributing essential population-specific data to the forensic identification database.

2. Materials and Methods

This descriptive, cross-sectional study was designed to perform a quantitative analysis of lip print patterns as ethnic biomarkers within the Ukwuani population of Delta State, Nigeria. A total of 415 healthy volunteers (200 males, 215 females), aged 15–30 years, were enrolled. Ethnic inclusion was strictly defined, requiring all participants and their preceding three generations to be of confirmed Ukwuani origin.

Individuals with any lip pathology, deformities (e.g., cleft lip, active ulcers, trauma), hypersensitivity to cosmetics, or anatomical lip incompetence were excluded. The study protocol received ethical approval from the Research and Ethics Committee of the Department of Human Anatomy and Cell Biology, Delta State University, Abraka.

The lip print collection protocol followed an established tape-lift method (Verma et al., 2013). Participants' lips were cleaned, and a non-glossy, dark lip liner was applied. After a brief period for setting, a transparent cellophane tape strip was carefully applied

over the lips in a relaxed position and subsequently lifted, transferring the print. The tape was then mounted on white bond paper for permanent preservation and analysis.

For systematic quantitative assessment, each lip print was divided into six anatomical quadrants: three each on the upper and lower lips. Quantitative evaluation focused on the central 10 mm segment of the lower lip, as this region provides the most consistent and reliable trace evidence in forensic contexts (Sivapathasundaram et al., 2001). Lip groove patterns within this study area were classified according to the widely adopted Tsuchihashi system (Type I, I', II, III, IV, V) (Tsuchihashi, 1974). Pattern frequency data from each quadrant were recorded.

All analyses were conducted by two independent researchers using magnification lenses to ensure accuracy and minimize inter-observer bias. The collected frequency data were subjected to statistical analysis using IBM SPSS Statistics, Version 21.0. The Chi-square test was employed to assess for significant associations between pattern type distribution and sex. A p-value of less than 0.05 was considered statistically significant for this quantitative analysis.

3. Results

3.1 The result derived from the study was tabulated below;

In the table, the male and female have different percentage distribution which the highest percentage distribution in males are type I, II and III while in females was type III, II and I in their highest percentage distribution

Table 1: The distribution of the lip print pattern (types) among the Ukwuani subject

Sex	Type I (%)	Type I' (%)	Type II (%)	Type III (%)	Type IV (%)	Type V (%)
Males	32.5%	6.5%	19.0%	19.0%	17.5%	6.0%
Female	22.0%	7.5%	25.0%	36.0%	10.5%	7.0%

In table 2 male had the highest upper lip distribution of type I and III while the female has the highest distribution of type III, III, and I. In the lower lip print distribution male has the highest lip print distribution of type I and III while in the female the highest lip print distribution is the type III, II and I

Table 2: Lip print pattern distribution in the upper and lower lip print segments according to sex

Lip segment	Sex	Type I	Type I'	Type II	Type III	Type IV	Type V
Upper lip	Male	191	39	108	114	111	36
	Female	131	45	146	214	67	42
Lower lip	Male	191	39	108	114	111	36
	Female	137	45	146	211	64	42

The statistically significant difference ($p < 0.05$) obtained in all the quadrants individually and taken together suggests the potential of usage in sex discrimination. The examination of lip print patterns revealed that no two lip prints pattern matched with each other, thus establishing the uniqueness of the lip prints. The Chi-square test applied to test significant differences between males and females for different types of lip patterns in different age groups, showed no significant differences between male and female lip prints pattern.

4. Discussion

Lip prints represent a significant form of trace evidence, frequently encountered on surfaces such as glass, clothing, or cigarette butts at crime scenes (Vahanwala & Parekh, 2000). The development of non-transferring lipsticks and the existence of latent ("persistent") prints, which require specialized powders for visualization, underscore the importance of cheiloscropy—the scientific study of lip prints—in forensic investigation. However, its application requires further standardization in collection and classification methodologies to fully systematize the analysis of unique lip grooves (Tsuchihashi, 1974).

The present study contributes to this standardization by applying the Tsuchihashi classification to quantitatively analyze lip prints within the Ukwuani population. Our results align with established forensic principles, demonstrating sexual dimorphism in lip print patterns. Specifically, the Type I pattern was observed with higher frequency in males, whereas Type III was more prevalent in females, with Type V being the least common overall.

These findings are consistent with prior research across diverse populations. Similar gender-linked distributions have been reported among Japanese (Suzuki & Tsuchihashi, 1971), Romanian (Popa et al., 2013), and North Indian populations (Gupta et al., 2011). Furthermore, the demonstration of sexual dimorphism within the Ukwuani cohort corroborates studies conducted among other Nigerian ethnic groups (Adamu et al., 2013) and reinforces the foundational concept that lip prints are unique to the individual (Abhishek et al., 2014). The reliability of lip prints for identification is further supported by research indicating their persistence and utility even post-mortem (Utsuno et al., 2005).

In conclusion, this study provides quantitative data affirming lip prints as valuable ethnic biomarkers within the Ukwuani population. The identified pattern distributions support the use of cheiloscropy for gender estimation in forensic contexts specific to this group. Future research with larger, multi-ethnic cohorts is recommended to develop robust population-specific databases, enhancing the reliability of lip print analysis in criminal investigations and personal identification.

5. Conclusion

Cheiloscropy is a recognized forensic discipline based on the principle that lip prints are unique to the individual, allowing for positive identification. This study confirms that lip print patterns also function as a valuable secondary indicator for sex determination within the Ukwuani population, though this application has inherent limitations. Our analysis revealed that no single pattern was exclusive to a specific lip quadrant or age group. However, a distinct sexual dimorphism was observed: Type I was the most prevalent pattern overall, while Type III was most common among females.

The lip grooves themselves are permanent and do not change over time. Consequently, while sex differentiation was most discernible in the studied 15–30 year age group, age-related changes in lip size, shape, or surrounding skin do not alter the fundamental groove pattern. These findings affirm the stability of lip prints as biometric markers and support their utility in forensic profiling, particularly when integrated with other identifying characteristics.

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