Morphological Variation of Lip Patterns among Nepali Adults

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ABSTRACT

Background

Lip patterns are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of the human lip between the inner labial mucosa and the outer skin. Lip patterns are said to be unchangeable and unique.

Objective

To determine predominant lip patterns found among the Nepali population and to evaluate whether any sex difference exists.

Method

This study included 411 healthy adult Nepali comprising 215 males and 196 females in the age group of 18-27 years. The data was collected using an automated mode Canon EOS 3000D 18MP camera with an 18-55 mm lens. Lip patterns were then divided into four quadrants using Suzuki and Tsuchihashi's classification system.

Result

Lip pattern Type I (29.56%) was found to be the most common lip pattern in the study population. Sex-wise, Type I was the most common pattern with a prevalence of 28.72% in males and 30.48% in females. Applying the Chi-square test, a statistically significant difference (p 0.05) was not achieved in all the quadrants.

Conclusion

There is a marked variation observed between the findings of the present study when compared to previous Nepali studies. Being insignificant to sex differences, lip patterns should not be used as a useful resource in forensic casework for sex discrimination.

KEY WORDS

Cheiloscopy, Identification, Lip pattern, Nepal, Sexual dimorphism

INTRODUCTION

For centuries, lip patterns or lip patterns have been studied and observed through a practice known as cheiloscopy (Greek: cheilos- lips, skopein- to observe).[1] French criminologist Edmund Locard conducted the earliest recorded study of lip patterns, focusing on identifying criminals based on their lip patterns.[2]

Lip patterns are a unique feature for individuals that have a scope in forensic identification casework.[3,4] Numerous studies have been conducted on this subject in multiple countries, such as those in South America (Brazil), Central Europe (Hungary and Czechoslovakia), Middle East (Iran), and Western Europe (France, Italy, Great Britain, and West Germany). In Poland, research was carried out between 1982-1986 involving 1500 people, resulting in the development of a cohesive system of cheiloscopy for criminal identification.[4] There are six different classifications for lip patterns in the literature.[5] However, Suzuki and Tsuchihashi's classification is considered standard and has been adopted in various studies.[6]

The present study aimed to investigate the prevalence of different lip patterns in a larger cohort of Nepali adults, compare findings with those of previous studies conducted in Nepal, and determine if there is any sexual dimorphism and its applicability in forensic medicine caseworks.

METHODS

Data collection was carried out from January 2022 to March 2022 at the Department of Forensic Medicine of Lumbini Medical College, Palpa, Nepal. All undergraduate medicine students were notified through their class representative of the objectives of the study. The interested students were then asked to come to the Department of Forensic Medicine. Written informed consent of the students was obtained. The present study was approved by the Institutional Review Committee of Lumbini Medical College (IRC-LMC 03-E/021).

Recording of the lip pattern was according to the study conducted by Kapoor et al.[8] A Canon EOS 3000D 18 Mega Pixel camera with an 18-55 mm lens in automatic mode was used to take the photograph of the lips of the consenting students. The camera was fixed to a tripod to minimize the chances of blurring the images. The students were asked to stand in Frankfurt horizontal plane against a white background with their gaze fixed on the horizon. The lips were free of any gloss, chapstick, or lipstick, and were wiped with a wet tissue prior to the photograph. Exclusion criteria for this study included students who had lip abnormalities such as signs of inflammation, presence of ulcers, history of trauma, congenital developmental defects and/or malformations, deformities, surgical scars, or any other such anomalies. Two photographs were taken of each volunteer participant. The image numbers were
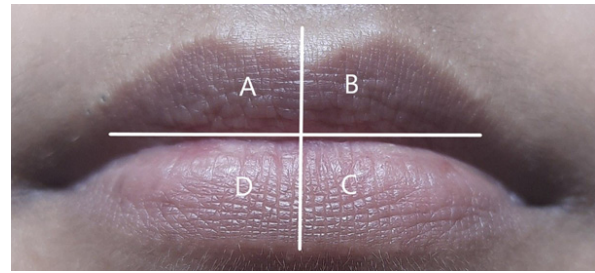

Figure 1. The lips were divided into four quadrants, alphabetically marked as A, B, C, and D.

noted against name, age, and sex on a standard proforma. Subsequently, all the photographs were transferred to a computer and analyzed using the Microsoft Office Picture Manager Program. Kapoor et al. method was utilized in dividing the lips into four quadrants, alphabetically marked as A, B, C, and D (Fig. 1).[8] The lip pattern of each individual was evaluated by two observers. The observers were allowed to zoom the image in and out and also use the brightness and contrast features of the software for a detailed evaluation of the lip pattern. In the case of inter-observer dispute, a third observer examined the lip print and the lip pattern was ascertained.

Suzuki and Tsuchihashi, method of classification was utilized to categorize the lip patterns.[6]

Type I: Clear-cut groove that runs vertically across the lips

Type I': Partial length groove of Type I

Type II: Branched groove (Y-shaped branching pattern)

Type III: Intersected groove (criss-cross pattern)

Type IV: Reticular groove (grooves that form a reticular pattern)

Type V: Others (grooves that do not fall into any of the above categories and cannot be differentiated morphologically/ undetermined)

The data thus obtained were then entered into SPSS v 23. The identity of the student was recorded only in terms of sex in SPSS.

RESULTS

None of the participants in the present study exhibited a consistent lip pattern across all four quadrants. In the present study the predominant pattern was Type I (29.56%) followed by Type I' (19.77%), Type II (18.37%), Type IV (16.24%), Type III (13.75%), and Type V (2.31%) for both men and women (Table 1). Sex wise too, Type I was the most common lip pattern with a prevalence of 28.72% in men and 30.48% in women (Table 2). The predominant pattern in men was Type I followed by Type I', Type II, Type III, Type IV, and Type V. However, in women the predominant pattern was Type I followed by Type IV, Type I' Type II, Type III, and Type V.

Table 1. Percentage distribution of the lip pattern in the Nepali population (n=411).

Lip pattern types	All quadrants (A+B+C+D) N%
Long vertical (Type I)	486 (29.56%)
Short vertical (Type I')	325 (19.77%)
Branched (Type II)	302 (18.37%)
Intersecting (Type III)	226 (13.75%)
Reticulate (Type IV)	267 (16.24%)
Mixed/Indefinite (Type V)	38 (02.31%)
Total	1644 (100%)

Table 2. Distribution of lip patterns among men and women (n = 411).

Lip pattern types	Distribution		
	Men	Women	Total
Long vertical (Type I)	247 (28.72%)	239 (30.48%)	486 (29.56%)
Short vertical (Type I')	172 (20%)	153 (19.52%)	325 (19.77%)
Branched (Type II)	164 (19.07%)	138 (17.60%)	302 (18.37%)
Intersecting (Type III)	159 (18.49%)	67 (8.55%)	226 (13.75%)
Reticulate (Type IV)	89 (10.35%)	178 (22.70%)	267 (16.24%)
Mixed/Indefinite (Type V)	29 (3.37%)	9 (1.15%)	38 (02.31%)
Total	860 (100%)	784 (100%)	1644 (100%)

Table 3. Quadrant wise distribution of lip patterns in men and women (n = 411).

Pattern type	Men				Women			
	A	B	C	D	A	B	C	D
Long vertical (Type I)	57 (13.87%)	57 (13.87%)	65 (15.82%)	68 (16.46%)	36 (8.76%)	35 (8.47%)	86 (21.03)	82 (19.85%)
Short vertical (Type I')	25 (6.08%)	24 (5.84%)	61 (14.91%)	62 (15.09%)	26 (6.33%)	30 (7.30%)	48 (11.74%)	49 (11.86%)
Branched (Type II)	65 (15.82%)	63 (15.33%)	19 (4.62%)	17 (4.12%)	52 (12.65%)	53 (12.90%)	16 (3.89%)	17 (4.12%)
Intersecting (Type III)	40 (9.73%)	43 (10.46%)	38 (9.20%)	38 (9.20%)	16 (3.89%)	17 (4.12)	16 (3.89%)	18 (4.38%)
Reticulate (Type IV)	18 (4.38%)	19 (4.62%)	26 (6.36%)	26 (6.36%)	62 (15.09%)	57 (13.87%)	30 (7.30)	29 (7.02%)
Mixed / Indefinite (Type V)	10 (2.43%)	9 (2.19%)	4 (0.97%)	6 (1.45%)	4 (0.97%)	4 (0.97%)	0	1 (0.24%)

Table 4. Summary of results of the statistical analysis by quadrant and sex for lip patterns.

Quadrant	Pearson Chi-Square Value	df	p-value	Minimum Expected Count	N of Valid Cases
Upper right	42.476	5	<0.001	6.68	411
Upper left	11.081	5	.050	2.38	411
Lower right	19.139	5	.002	2.86	411
Lower left	44.252	5	<0.001	6.62	411

In men, the order of appearance of lip patterns was Type I (28.72%) > Type I' (20%) > Type II (19.07%) > Type III (18.49%) > Type IV (10.35%) > Type V (3.37%). In women, the order of appearance of the lip pattern was Type I (30.48%) > Type IV (22.7%) > Type I' (19.52%) > Type II (17.60%) > Type III (8.55%) > Type V (1.15%). The predominant pattern in quadrant A was Type II (28.5%) > Type I (22.6%) > Type IV (19.5%) > Type III (13.6%) > Type I' (12.4%) > Type V (3.4%) in that order. In quadrant B, the predominant pattern was Type II (28.2%) > Type I (22.4%) > Type IV (18.5%) > Type III (14.6%) > Type I' (13.1%) > Type V (3.2%) in that order (Table 3). In quadrant C, the most predominant pattern was Type I (36.7%) > Type I' (26.5%) > Type IV (13.6%) > Type III (13.1%) > Type II (8.5%) > Type V (1.5%). In quadrant D, the predominant pattern was Type I (36.5%) > Type I' (27%) > Type III (13.6%) > Type IV (13.4%) > Type II (8.3%) > Type V (1.2%).

The Pearson Chi-Square test is significant for all quadrants, indicating a statistically significant association between sex and pattern type (Table 4). Overall, the results suggest sexual dimorphism in lip patterns, particularly in the lower left quadrant. The minimum expected count is reported for each chi-square test to allow assessment of the test's validity based on the assumption of adequate cell frequencies. When the minimum expected count falls below 5, the validity of the chi-square test is compromised, and the statistical significance should be interpreted with caution.

DISCUSSION

Lip patterns are believed to be unique and sexually dimorphic. Many researchers across various disciplines like forensic medicine, anatomy, and dentistry have attempted to study lip patterns for their sexually dimorphic nature and explored their role in sex identification. Some researchers have come up with their own unique way of examining lip patterns for sex differentiation. Topczydło et al., compared three different methods for sex differentiation from lip patterns where they used the Vahanwala method as the first method, assessment of the mid-section of the lower lip as the second method, and their own method as the third method and found out that their method was superior among the three methods.[9,10] A review of articles on lip patterns published from 1982 to 2019, which synthesized qualitative data, found that the accuracy of sexual dimorphism determined by cheiloscopy ranged from 52.7% to 93.5%.[11] The authors concluded that the determination of sex from cheiloscopy using the current methods had limited value and should not be used in forensic practice.[11]

Table 5. Summary of the findings of previous Nepali studies on lip patterns.

Author	Sample size	Predominant pattern		
		Male	Female	Overall
Karki[12]	♂75, ♀75	Type I and Type I'	Type II	Type II
Ghimire et al.[15]	♂100, ♀100	Type I > Type II > Type I' > Type III > Type IV > Type V	Type I > Type II > Type I' > Type IV > Type III > Type V	Type I > Type II > Type I' > Type IV > Type III > Type V
Karn et al.[17]	♂75, ♀75	Type I > Type I' > Type II/V > Type IV > Type III	Type II > Type I > Type I' > Type III > Type IV	Type I > Type II > Type I' > Type III/IV >Type V
Timsinha et al.[16]	♂50, ♀50	Type II > Type I' > Type I > Type III	Type II > Type I' > Type IV > Type I > Type III	Type II > Type I' > Type I > Type IV > Type III
Gurung et al.[13]	♂141, ♀64	Type I > Type II > Type III > Type I' > Type IV > Type V	Type I > Type II > Type I' > Type III/ IV >Type V	Type I > Type II > Type III > Type I' > Type IV > Type V
Baral et al.[18]	♂75, ♀75	Type III > Type IV > Type II > Type I > Type V	Type I > Type III > Type IV > Type II > Type V	Type III > Type I > Type IV > Type II > Type V
Makaju et al.[14]	♂120, ♀120	Type I' > Type I > Type III > Type II/IV	Type I > Type I' > Type II > Type III > Type IV	Type I > Type I' > Type II > Type III > Type IV
Present study	♂215, ♀196	Type I > Type I' > Type II > Type III > Type IV > Type V	Type I > Type IV > Type I' > Type II > Type III > Type V	Type I > Type I' > Type II > Type IV > Type III > Type V

Almost all studies on sex determination from the lip pattern studied the predominant pattern in both men and women and made the assumption of sex determination based on that predominant pattern. This method cannot be reliable because the predominant pattern is not precise across studies. For example, Vahanwala et al., concluded that Type I, Type I', and Type II are predominant in females in their study conducted in India in a sample of 30 females and 20 males aged between 19-29 years.[10] However, in our study these types were predominant in the male population. An exact lip print pattern of predominance is not observed across previously conducted Nepali studies (Table 5).[12-18]

Kapoor et al. study among the Marathi population in India concluded that lip patterns could be used for sex differentiation based on the results of statistical analysis (Chi-square test, Kappa value and likelihood).[8] Similarly, another study from India predicted the sex with the predominant pattern and reported an accuracy of 81.7% to 84.7%.[19] However, a low Kappa value was observed by Kaul et al. with sex prediction accuracy of 17.4% to 35.4%.[20] In another study from India, the authors did not find any statistically significant difference among the male and female lip patterns using the Chi-square test, but significant difference was observed when the Z-score value was calculated.[21]

In another study conducted by Abdel et al., the authors studied the predominant lip pattern across the four quadrants of the lips among Egyptian and Malaysian populations where they used a linear regression equation for sex and ethnicity and concluded that the precision was between 65% and 93.3%.[22]

Lip patterns are crucial in forensic medicine as they can help identify individuals in criminal cases. Lip patterns are often considered unique and accurate, making them suitable for matching suspects with existing evidence. The study conducted reveals a considerable variation in lip patterns of Nepali population compared to previous studies, providing the forensic laboratory and investigators with data to identify and compare lip patterns found in forensic evidence. However, the study's statistical analysis indicates that there is no significant difference between males and females' lip patterns in Nepali populations. Therefore, this finding may suggest that lip patterns may not be a useful factor in determining sex within this particular population. Overall, this research provides helpful insights for forensic science, contributing to the identification of suspects and evidential support in forensic casework.

CONCLUSION

In the present study, lip pattern Type I (29.56%) and Type V (2.31%) were found to be the most and least common among Nepali young adults, respectively. In men, the order of appearance of the lip patterns was Type I > Type I' > Type II > Type III > Type IV > Type V. However, in women, the order was Type I > Type IV > Type I' > Type II > Type III > Type V. The statistical analysis indicates that caution is warranted in interpreting the test results due to low expected cell counts (less than 5 in some cases). This violates an assumption of the chi-square test, potentially rendering it unreliable and leading to p-values that may not accurately reflect the true statistical significance of the relationships observed. The present study highlights the limited value of lip pattern for the determination of sex in the Nepali population.

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