Brief Communication

Lip Prints: A Statistical Study of Morphological Patterns to Determine Sex Differences among Brahmins and Yadavs of the Bundelkhand Region of Uttar Pradesh, India

بصمات الشفاه: دراسة إحصائية للنماذج المورفولوجية لتحديد الفروق بين الجنسين لدى Brahmins و Yadavs في منطقة Bundelkhand في ولاية أوتار براديش، الهند

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Abstract

Like fingerprints, lip prints are considered distinctive to an individual. A lip print found at the crime scene can help reveal the identity of the persons involved. The present study focuses on the differentiation of lip prints according to sex and studies the distribution of lip print patterns in various communities of the Bundelkhand region of Uttar Pradesh, India.

A total of 400 samples of lip prints were collected from males and females of age group 18-24 years, belonging to Brahmins and Yadavs from the Bundelkhand region of Uttar Pradesh.

The most prevalent was Type I lip print in Brahmin males and Type II in Brahmin females, whereas Type III pattern was the most common in Yadav males and females. When Lip patterns were statistically evaluated based on the sex differences in Brahmins, Type II and I patterns may help in sex determination. Whereas, when the data is compared between males and females of Yadavs, Type III lip print had high predominance in comparison to other patterns but may not help in sex determination.

المستخلص

تعد بصمات الشفاه مميزة للأفراد كما هي بصمات الأصابع، ويمكن لبصمات الشفاه الموجودة في مسرح الجريمة أن تساعد في الكشف عن هوية الأشخاص المتورطين. وتركز الدراسة الحالية على التمييز بين بصمات الشفاه وفقاً للجنس ودراسة توزيع أنماط بصمات الشفاه في مجتمعات مختلفة في منطقة بونديلخاند في ولاية أوتار براديش بالهند.

أجريت الدراسة على ما مجموعه ٤٠٠ عينة من بصمات الشفاه من الذكور والإناث من الفئة العمرية بين ١٨-٢٤ سنة، والذين ينتمون إلى البراهمة و Yadavs من منطقة بونديلخاند في ولاية أوتار براديش.

وكان الأكثر انتشاراً هو بصمات الشفاه من النوع الأول لدى الذكور من البراهمة والنوع الثاني لدى إناث البراهمة، في حين كان نمط النوع الثالث هو الأكثر شيوعًا لدى الذكور والإناث من Yadavs. عندما تم تقييم أنماط الشفاه من الناحية الإحصائية على أساس الفروق بين الجنسين في البراهمة وجد أن أنماط النوع الأول والثاني يمكن أن تساعد في تحديد الجنس. وحيث أنه عند مقارنة البيانات بين الذكور والإناث من Yadavs فإن بصمات الشفاه من النوع الثالث لها غلبة عالية مقارنة بأنماط أخرى ولكنها قد لا تساعد في تحديد الجنس.

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1. Introduction

Cheiloscopy is the study of the prints formed by the lines present on the red part of human lips, which are called grooves or furrows [1] [2]. These grooves or furrows are present at the middle region of the exterior skin and interior skin.

The lip prints of each human are unique. Like DNA fingerprinting and Dactylography, the study of lip prints is an important aspect of forensics. Cheiloscopy is, therefore, a valid tool that can be used to determine the sex of an individual or their identity. It is possible to identify lip patterns in an individual as early as the sixth week of intrauterine life. Thereafter, lip patterns rarely change, even after injury [3]. Lip prints are unique to an individual and can be used to establish the identity of a person, as they remain unchanged over time.

The system of ridges and furrows on the red part of the lips was first described by anthropologist Fischer in 1902. The use of lip prints to establish identity was first recommended by Edmond Locard in 1932. In 1961, the first study on lip prints was carried out by Dr. Martin Santos in Hungary.

At that time, the applicability of lip prints in criminal investigations had been proven. In 1971, Kajuo Suzuki and Yasuo Tsuchihashi carried out more research work on the individuality and heredity of lip prints [4].

Several studies were conducted by researchers from India or other countries focusing on different aspects of lip prints. These included stability, sex determination, and various morphological patterns among different population groups [5].

The present study investigated morphological patterns of lip prints to determine sex differences among Brahmins and Yadavs of the Bundelkhand region of Uttar Pradesh in India. The objective of the study was to lay down a method to establish identity on the basis of a questioned lip print.

2. Materials and Methods

The present study was conducted in 400 students ($n = 200$ males and $n = 200$ females) of Bundelkhand University. They belonged to Brahmin and Yadav communities of the Bundelkhand region. Their age ranged from 18-24 years. The subjects were informed of the impetus of the study and written consent was taken from them prior to the study. The criteria for exclusion included the presence of any inflammation, allergic reactions to lipsticks or development anomaly on the lips,

In the present study, the researchers used the method of Bajpai et al. (2011) to collect lip prints [6]. Materials used in this study are shown in Figure-1. Based on the method, each participant was made to sit in a relaxed position and their lips were thoroughly inspected for any deformities, scars or abnormalities.

Dark red colored long-lasting lip stick was used to obtain clear lip prints. The lips were cleaned with moisturizer and cotton and dried. A single coating of lipstick was then applied onto the lips of the subject and left for 3 min. The impressions of the lips were taken by rolling or spreading

Figure 1- *Material used for the Collection of Lip Prints.*

the glued portion of cellophane tape over lips. An equal amount of pressure was applied over the complete area of the lips by using the index finger. The cellophane tape was then gently lifted and spread onto specified papers. Care was taken to avoid any wrinkles and air bubbles. The tape method was used for lifting the lip prints as to procure the specific shape of the lips without minimal smudging of the lipstick. White hard paper was used to take the impressions of the lips (Figure-2). Three prints were taken from each person to make sure that we had at least one complete print sufficient for examination and identification of various areas of the lip.

Briefly, each lip print was divided into four quadrants, vertically across the Philtrum and horizontally from left Labial Commissure to right Labial Commissure.

Type I: Clear-cut grooves that run across the entire lip

Type I': Similar to type I, but do not cover the entire lip

Type II: Branched grooves

Type III: Intersected grooves

Type IV: Reticular grooves

Type V: Grooves that do not fall into any of the above categories and cannot be differentiated morphologically [4, 7].

Prints present in each quadrant were classified according to Suzuki (1970) [4] and Tsuchihashi (1974) [7]. In cases where there were two dominant patterns, the first dominant pattern was considered (Figure-3)

Statistical Analysis: Chi-square test was used for the statistical analysis. It is a method of evaluating the goodness of fit between a set of observed values and those expected theoretically.

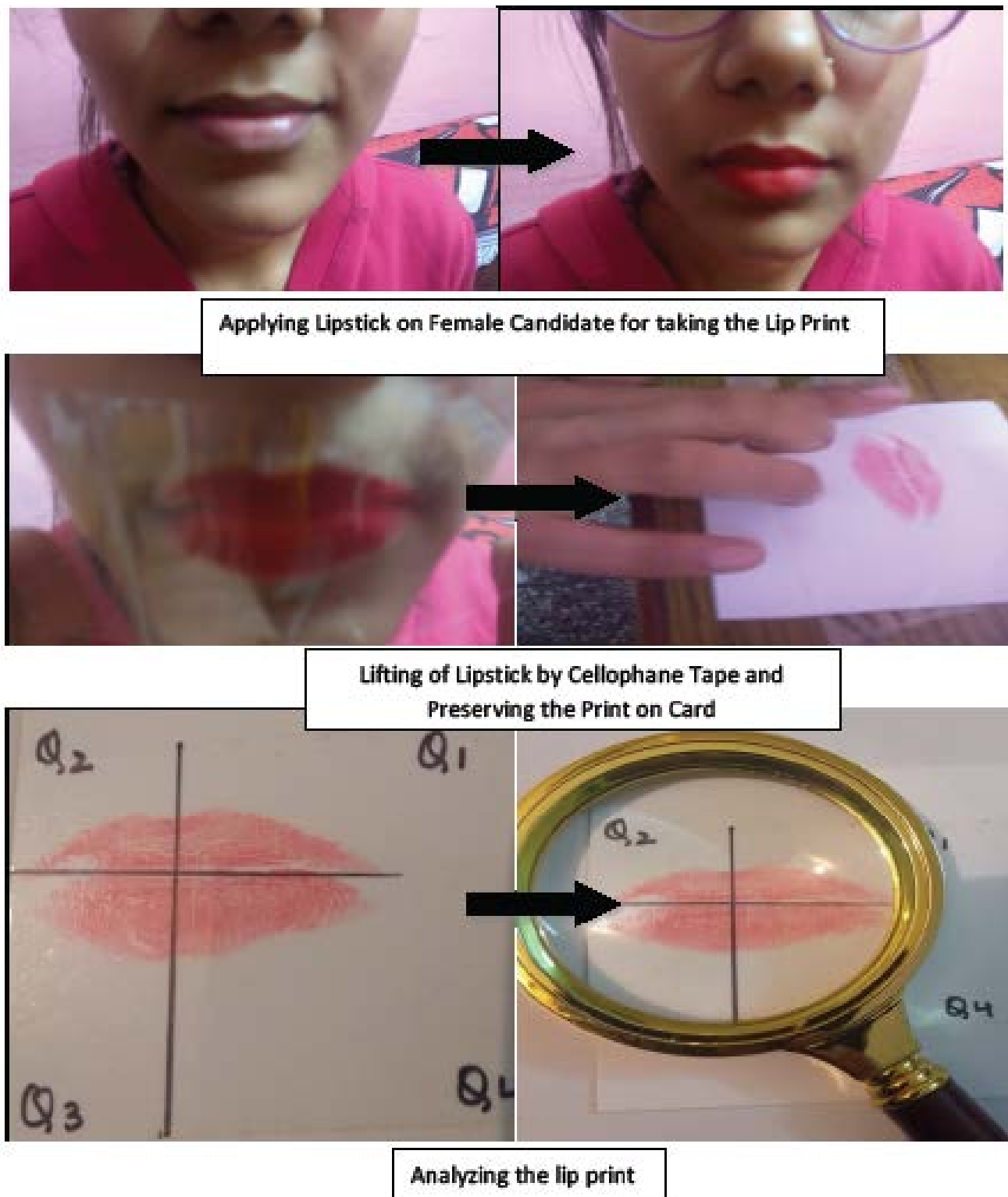Our null hypothesis (H_0) was that there is no association

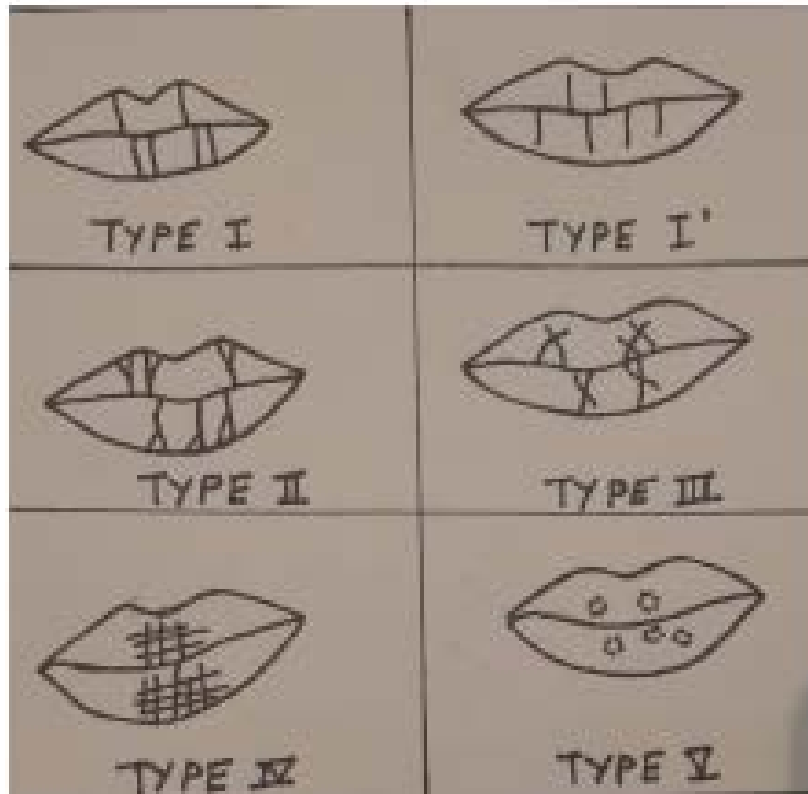**Figure 2-** *Methodology for the analysis of the lip prints.*

Figure 3- *Classification of lip prints*.

between the gender of both the communities (Brahmin and Yadav) and the type of lip print pattern.

Where as our alternate hypothesis (HA) stated that there is an association between the gender of both the communities (Brahmin and Yadav) and the type of lip print pattern.

3. Results

In this study, an effort was made to investigate the quadrants of lip prints of 400 subjects of Brahmin and Yadav communities (200 males: 83 Brahmins and 117 Yadavs, 200 females: 95 Brahmins and 104 Yadavs) from the Bundelkhand region of Uttar Pradesh.

It was observed that in the Brahmin community, the number of Type I pattern in males was 51, followed by

Type I'($n = 8$). Type II was 6, type III was 7, type IV was 11 and type V was 0 (Table-1).

The total number of Type I pattern in females of the Brahmin community was 6, followed by Type I' ($n = 2$). Type II was 64, Type III was 11, Type IV was 12 and Type V was 0 (Table-1).

In Brahmin males, Type I lip patterns are the most predominant with an average of 51%, succeeded by Type IV, I', III, II and V in a descending order with an average of 11%, 8%, 7%, 6% and 0%, respectively. Whereas, Type II patterns with an average of 64% were the most predominant in Brahmin females followed by Type IV, III, I, I' and V in descending order with an average of 12%, 11%, 6%, 2% and 0%, respectively.

Table 1- *Distribution of lip print patterns among Brahmins community (n=178)*

		Lip Patterns					Total
		Type I	Type I'	Type II	Type III	Type IV	
Gender	Male	51	8	6	7	11	83
	Female	6	2	64	11	12	95
Total		57	10	70	18	23	178

In the Yadav community, the total number of Type I pattern observed in males was 10, followed by Type I' (*n* = 1). Type II was 21 followed by Type III (*n* = 48), Type IV (*n* = 36) and Type V (*n* = 1) (Table-3).

Whereas, the total number of Type I pattern in females of the Yadav community was 3, followed by Type I' (*n* = 2). Type II was 20 followed by type III (n = 47), type IV (n = 30) and Type V (*n* = 0) (Table-3).

In males of the Yadav community, Type III lip patterns were most predominant with an average of 48%, succeeded by Type IV, II, I, I' and V in a descending order with an average of 36%, 21%, 10%, 1% and 1%, respectively. Whereas, Type III patterns with an average of 47% were most predominant in Yadav females followed by Type IV, II, I, I' and V in descending order with an average of 30%, 20%, 3%, 2% and 0%, respectively.

We used Pearson chi-square to determine thesignificance of the association between the two variables i.e. the gender of the Brahmin community and the type of lip pattern. This relationship turned out to be statistically significant. The asymptotic significance (2-sided) i.e. 0.000 was less than 0.05. This resulted in the rejection of null hypothesis and accept once of the alternate hypothesis, as shown in Table-3.

The association between the two variables, gender and the type of lip print pattern in yadav community was statistically insignificant. The asymptotic significance (2-sided) i.e. 0.462 was greater than 0.05. This accepts the null hypothesis and rejects the alternate hypothesis (Table-4).

Therefore, both sexes of the Brahmin community showed different lip patterns with a statistically significant difference ($p < 0.05$), which helped in the differentiation of the gender. Whereas, the sex determination of the Yadav community was statistically insignificant ($p < 0.05$), as shown in Table-4.

4. Discussion

Table 2- *Distribution of lip print patterns among Yadav community (n=222).*

		Lip Patterns						Total
		Type I	Type I'	Type II	Type III	Type IV	Type V	
Gender	Male	10	1	21	48	36	1	117
	Female	3	2	20	47	33	0	105
Total		13	3	41	95	69	1	222

Table 3- *Calculation of Chi-Square statistics to test the value of significance for lip print patterns (in Brahmins).*

	Value	Dfa	Asymp. Sig. (2-sided)
Pearson Chi-Square	87.705[a]	4	0.000
Likelihood Ratio	100.733	4	0.000
Linear-by-Linear Association	34.272	1	0.000

[a] *1 cells (10.0%) have expected count less than 5. The minimum expected count is 4.66.*

Table 4- *Calculation of Chi-Square statistics to test the value of significance for lip print patterns (sex wise in Yadavs).*

	Value	Dfa	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.633[a]	5	0.462
Likelihood Ratio	5.219	5	0.390
Linear-by-Linear Association	.831	1	0.362

[a] *4 cells (33.3%) have expected count less than 5. The minimum expected count is .47.*

Cheiloscopy is an important identification tool used in forensic investigation. Determination of an individual's identity by using this forensic technique is warranted in many cases. With the advancement of various scientific technologies, human identification has become a paramount importance to society to unveil the truth behind crimes. The use of lip prints still exists, with some limitations. The lip prints can be used for revealing personal identity, as they get registered easily on glasses, clothing, cutlery, cigarette butts, and tissue paper and even on skin. If an individual's gender is known, it would be easy to shortlist the array of suspects with a motive [8, 9]. In the period from 1968 to 1971, two Japanese scientists, Kajuo Suzuki and Yasuo Tsuchihashi (1970), studied lip prints of 1,364 persons. Based on their research, the disposition of these lines on the red part of human lips were unique for each human being and also showed recovery after infection/inflammation [4]. According to literature, some researchers worked extensively on lip prints and proved that lip prints show gender differences that can aid in personal identification. Different methods have been evolved to trace the lip prints to aid in criminal investigations. Khanna et al. [10] established the uniqueness of lip prints and to look out for any new character which aids in personal identification. The statistical calculation after study estimated that simple bifurcation is more prominent in the upper lip (56%) and simple bottom bifurcation is prominent in the lower lip (68%). However, calculation shows that a line like (I) feature is most prevalent when both upper and lower lips were taken into account (44%). After a detailed study of lip prints samples, a new character "A Bar" denoted as "x" was found in all the quadrants with a frequency of 14% and 16%, respectively. Nagral et al. (2014) positively identified individuals on the basis of lip prints. Type I, I', and II patterns were the most commonly seen among females; whereas, Type III and IV lip patterns were the most predominant among males [11]. A study on the effect of age changes on lip print pattern and its reliability in sex determination was done by Randhava et al. [12]. Their study determined the most common lip patterns in a north Indian population and evaluated whether sex differentiation was possible on the basis of lip prints. They also attempted to ascertain if

there is any co-relation between age and its effect on lip pattern. A total of 600 subjects, 289 males and 311 females were selected and divided into three age groups. Statistical analysis showed a very highly significant difference for different lip patterns ($p < 0.0001$) in males and females in group 2 and no significant difference in group 1 and group 3. The most predominant pattern in the entire study population was Type I (32.33%).

Shivaramu et al. [13] observed that the majority of individuals had Type I' lip prints, followed by Type I and Type V. On the other hand, majority of females had Type II lip prints, followed by Type I', and Type IV [13]. Sharma et al. (2015) showed that the most prevalent pattern in Rajasthani population was found to be Type IV, followed by Type I, Type V, Type III, Type I with Type II being the least prevalent. Chi-square test revealed that no statistically significant differences were found among male and female individuals [14]. Bijjargi et al. (2015), determined the predominant lip pattern and compared amongst Kodavas, Keralites, & Tibetans race groups [15]. Type I patterns were predominant in Kodavas, males showed Type IV and females Type I. Type II patterns predominantly seen in Keralans, Type IV in males and Type II in females. Type III patterns predominantly seen in Tibetans, Type V in males and Type III in females. [15]

Vijay et al. [16] showed that the Type I pattern is the most predominant one followed by Type III, Type II and Type V on the upper lip and Type IV pattern on the lower lip in females. In males, Type II pattern was the most predominant in both lips followed by Type III and Type V on the upper lip, and Type IV and Type I pattern on the lower lip. Gupta et al. [17] reported that the intersected type of pattern was the most commonly seen pattern in females

and the branched type of pattern in males. Reticular pattern (Type IV) was the least common type of pattern in both males and females. In a study between 2 populations (Kerala and Manipuri), Koneru et al. [18] reported that Type 1 pattern was predominant in the Kerala population, which is consistent with the present study. They also found no potential difference between two populations.

Contrary to these studies, where mostly the work is done on racial population for sex determination, not much work is done on different communities in India. Thus, the area of our research is targeted on the Brahmin and Yadav communities of the Bundelkhand region of Uttar Pradesh.

5. Conclusion

The present work shows that the most common lip pattern in Brahmin males is Type I and in Brahmin females Type II, whereas Type III pattern is the most common in Yadav males and females. When Lip patterns are statistically evaluated based on the sex differences in Brahmins, Type II and I patterns may help in sex determination. Whereas, when the data was compared between males and females of Yadavs, Type III lip print had high preponderance in comparison to other patterns, therefore, it may not help in sex determination.

This study concludes that lip patterns can be used for community differentiation, sex determination and also in personal recognition and that it can be conducive extensively to criminal investigation. Examining lip patterns should be detailed with a large number of samples of different communities to generate important data which may help in the personal identification as well as communities differentiation.

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Conflict of interest statement

The authors have no conflicts of interest to disclose.

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