Original Research

ANALYTICAL STUDY ON DISTRIBUTION & GENDER PREDILECTION OF LIP PRINT PATTERN

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ABSTRACT
Fingerprint evidence is undoubtedly the most reliable and acceptable evidence till date in the court of law. But now a days, lip print patterns play an important role in identification of criminals especially when such obtained from crime scene related to sexual assaults. Lip print pattern can be collected from accused to compare with lip print evidences found in crime scene to straight-line the investigation. Due to the immense potential of lip prints as an effective method of identification an attempt has been made in the present work to analyse & classify the different types of lip prints in the study population. This study was conducted to determine the most common pattern in six quadrants of lip to evaluate variations in lip prints between males and females. The samples collected form 100 individuals which include 50 male and 50 female within age group of 19-30 years. Lip print patterns were obtained using lipstick and adhesive tape. The quadrant wise variation in lip print helps to establish identity even in partial evidences obtained from crime scene and for sex differentiation among population.

Keywords: Chelioscopy, Lip Print Pattern, Identification, Sexual Differentiation.

INTRODUCTION
Identification is vital as that every individual has a unique set of features.[1] Personal identification is a very important part during the investigation of an unidentified body in a mass disaster, or for distinguishing missing person and also during criminal suspects.[2] Forensic odontology plays a crucial role in this situation for proper identification. DNA profiling is considered the gold standard method for identification in forensicodeology.[2] But this method is very expensive and time consuming. Lip print, fingerprint and ABO blood group study are the most commonly used methods for identification. These methods are very important because they remain unchanged throughout life.
Individual elements of vermilion ozone patterns contribute to the uniqueness of lip prints and help in individual identification.[3] Sulci labiorum are the wrinkles and grooves on labial mucosa and it forms a characteristic pattern, called lip prints.[4]

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 25-04-2026
Date Acceptance: 02-05-2026
Date of Publication: 03-06-2026

The edges of the lips have sebaceous glands with sweet glands in between, therefore, secretions of oil and moisture enable the development of 'latent' or persistent lip prints.[5] The study of those wrinkles or grooves present on the red part or the vermilion border of the human lip is known as Chelioscopy.
This term Chelioscopy is derived from Greek word 'chelios' meaning 'lips' and 'skopein' meaning 'see'.[3] The wrinkles and grooves which are visible on lips have been named by Tsuchihashi as 'sulci labiorum rubrorum'.[4] According to a French doctoral thesis, lip print patterns appear to be genotypically determined, unchanged from birth i.e. as early as the sixth week of intrauterine life to death.[6] Even the lip pattern of twins is unique to each individual.[7] So, lip print analysis is considered as a vital tool for personal identification. Lip prints can be identified at a crime scene on items such as buds of cigarettes, glass of window, cushion & beddings, cups, glasses, napkins and clothes may therefore be collected and further analysed to give crucial evidence as like fingerprints, there are no two people with identical lip prints.[8,9] Thus, visible or latent lip prints discovered at a crime scene can be developed, documented, and compared with the prints of suspects to identify the accused.[10] As a result, it is reasonable to believe that lip prints can be included as forensic odontology as a valid tool for

interest of identification for person indulged in criminal activity.[11]

The statistical relation of lip prints in the present study will be valuable for the identification and also when conducting autopsies on unknown or unidentified bodies or when only mutilated or fragmentary remains of head and face are retrieved. The results of the present study will be useful for Forensic experts, police personnel and other law enforcement agencies to collect evidences in crime scene investigation where lip print can narrow down the investigation.

MATERIAL AND METHODS

The present study was carried out in the Department of Forensic Medicine & Toxicology, Ruxmaniben Deepchand Gardi Medical College, Ujjain, (M.P.). This study was conducted in compliance with the protocol of the Institutional Ethical Research Committee (IERC). The subjects of this study selected from the out-patient department, R.D. Gardi Medical College 100 subjects which include 50 male and 50 female within age group of 19-30 years. All the subjects were briefed about the purpose of the study and voluntary written informed consent was obtained from each of them before taking the samples. For this cross-sectional study, we used lipstick - cellophane tape method for recording lip prints.

Inclusion Criteria: Only healthy individuals free from deformities of lips or face were included in the study.

Exclusion Criteria: Subjects having deformity like permanent scars or have any disease related lips, lacerations, scars, any congenital deformities of the lip (i.e., cleft lip, lip pits etc) were not included as part of the study.

The material used for this study is Dark brown or a dark red/orange colored, non-glossy, non-metallic lipstick, Cellophane tape, wet wipes tissue paper (for wiping color), A4 size unglazed white paper, Proforma for recording lip prints, magnifying lens, scissor, pencil and pen.

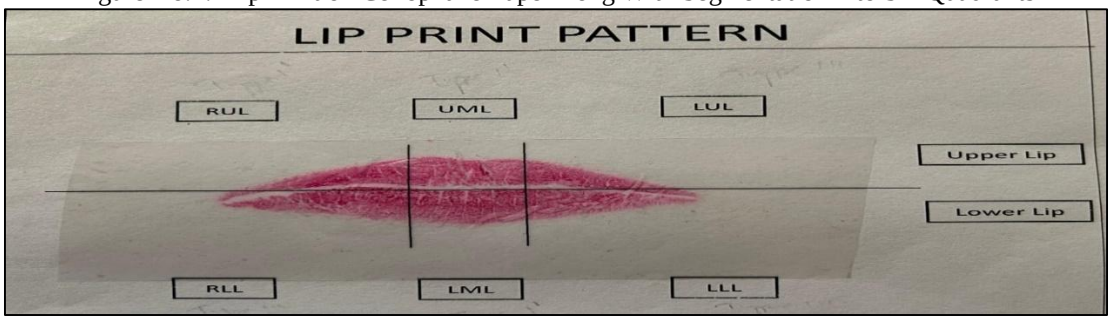
METHODOLOGY

For the recording of lip prints, individuals were asked to sit on a chair comfortably in a relaxed position. The upper and lower lips of the individual were cleaned with tissue paper before the procedure. The lipstick was applied gently on slightly separated the lips and then the subjects were asked to rub their lips for equal spreading of lipstick. Cellophane tape was applied from the right side to the left side covering the entire length and breadth of upper and lower lips from the glued side very carefully so that it cannot be smudged. This cello tape was carefully removed and then applied on to the white unglazed paper sheet. The lip prints were examined carefully using a magnifying glass in bright light to identify the type of lip print. To eliminate the inter-examiner bias, all the samples are taken by a single researcher and analyzed. This procedure of collection was similar to what was used by Sharma et al. [12]

Topographically the lips were divided into six quadrants by making two perpendicular parallel lines and one horizontal line. Two vertical perpendicular parallel lines passes from both the sides of the frenulum leaving middle 10-15 mm of both upper & lower lip and the horizontal line divides the upper lip from the lower lip.

Therefore, each lip print was divided into the following six quadrant; Right Upper Quadrant (RUQ) or Right Upper Lip(RUL), Middle Upper Quadrant (MUQ) or Upper Middle Lip(UML), Left Upper Quadrant (LUQ) or Left Upper Lip(LUL), Right Lower Quadrant (RLQ) or Right lower Lip(RLL), Middle Lower Quadrant (MLQ) or Lower Middle Lip(LML) and Left Lower Quadrant (LLQ) or Left Lower Lip(LLL) as shown in (FIGURE NO. 1)

Figure No.1. Lip Print on Cellophane Tape Along With Segmentation into Six Quadrants



The lip prints were observed by using magnifying lens and were categorized into particular type depending upon the predominant pattern. The classifications are very useful to divide the lip prints into different category and limited the range for any investigating process. Various classification systems were given by researchers over the period of time, among them the most accepted classifications of Suzuki and Tsuchihashi is used for sex determination.

Each lip pattern was determined as per the following classification given by Suzuki and Tsuchihashi (1971).

Type-I: Clear cut grooves vertically across the lip.

Type-I': Similar to type-I, the grooves are straight but the disappear halfway, do not cover the whole lip.
Type-II: The grooves forked in their way (branched), Y-shaped pattern.
Type-III: The grooves intersect (intersecting), crisscross pattern.
Type-IV: The grooves are reticular, typical checked pattern, and fence like
Type-V: The grooves do not fall in any of the types from I to IV (undetermined).

OBSERVATIONS AND RESULTS

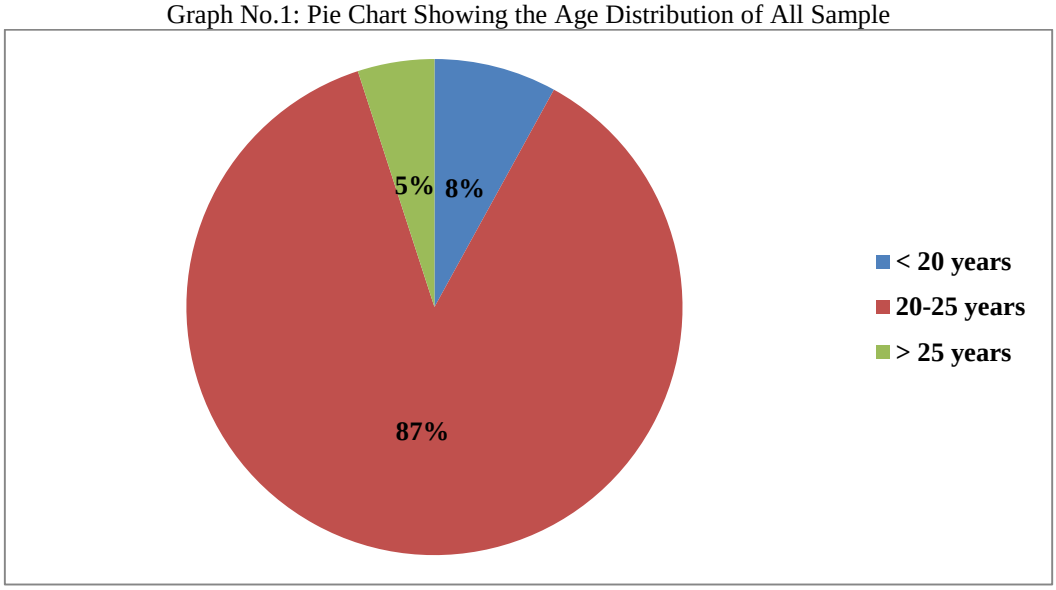
TABLE NO. 1 illustrates a perfectly balanced gender distribution among the sample group, with an equal number of males and females. Both genders are represented by 50 individuals, each making up 50% of the total population.

Table No.1: Showing the Gender Distribution of All Sample

Gender distribution	Frequency	Percentage
Males	50	50%
Females	50	50%
Total	100	100%

The majority of participants, 87 individuals (87%), are in the 20-25 years age group, indicating that most of the group consists of young adults. A smaller portion, 8 individuals (8%), are under 20 years old, and only 5 individuals (5%) are over 25 years as shown in (GRAPH NO. 1)

Graph No.1: Pie Chart Showing the Age Distribution of All Sample



(TABLE NO. 2) presents the gender distribution across different types in the right, middle, and left upper lip quadrants, along with the associated p-values, indicating statistical significance.
Right Upper Quadrant: In this quadrant, the distribution of types of lip print shows some variation between males and females. The most common type among males is TYPE II (26.0%), while females predominantly have TYPE I and TYPE I' (both 28.0%). The p-value of 0.037 suggests that the gender difference in this quadrant is statistically significant.
Middle Upper Quadrant: For this quadrant, the most frequent type among both males (36.0%) and females (51.0%) is TYPE IV. However, the p-value of 0.197 indicates that the difference in distribution between males and females is not statistically significant in this quadrant.
Left Upper Quadran: In the left upper quadrant, males most commonly exhibit TYPE II (30.0%), while females show a higher occurrence (22.0%) of TYPE I and TYPE V. The p-value of 0.011 signifies a statistically significant difference in the distribution of types between males and females in this quadrant.

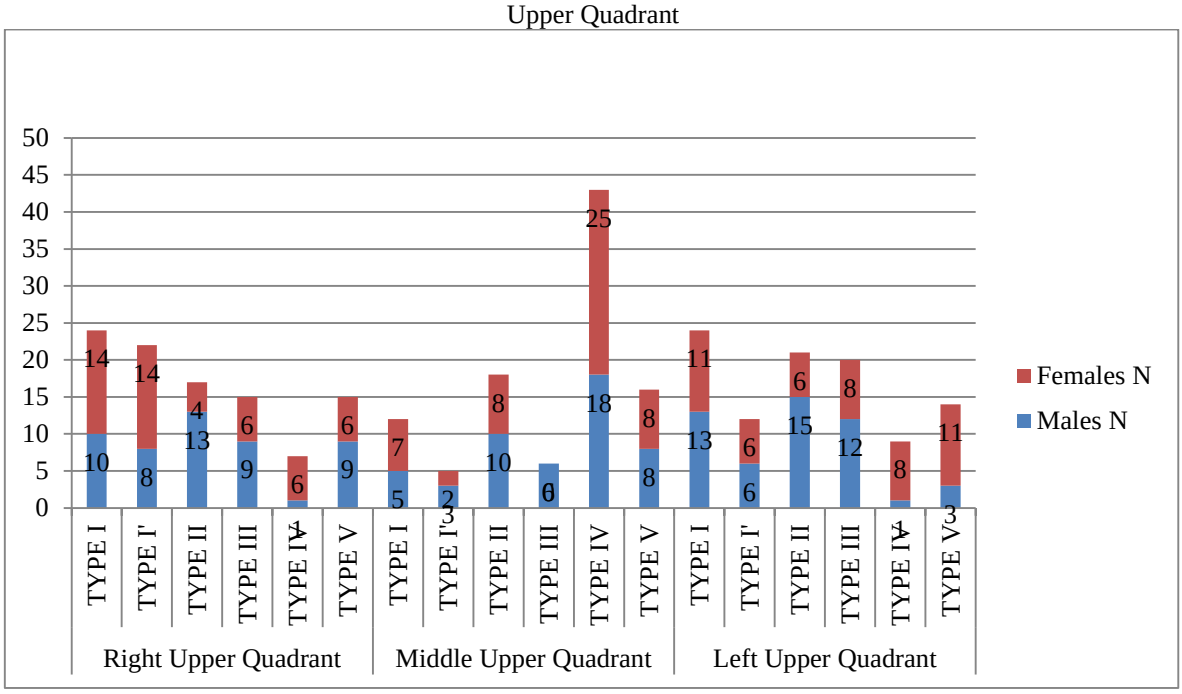
Table No. 2: Showing Statistical Description of All the Lip Print Pattern between Male and Female in Upper Lip Quadrant

Upper lip Quadrants		Gender Distribution				P value
		Male		Female		
		N	N %	N	N %	
Right Upper Quadrant	TYPE I	10	20.0%	14	28.0%	**0.037***

	TYPE I'	8	16.0%	14	28.0%	
	TYPE II	13	26.0%	4	8.0%	
	TYPE III	9	18.0%	6	12.0%	
	TYPE IV	1	2.0%	6	12.0%	
	TYPE V	9	18.0%	6	12.0%	
Middle Upper Quadrant	TYPE I	5	10.0%	7	14.0%	0.197
	TYPE I'	3	6.0%	2	4.0%	
	TYPE II	10	20.0%	8	16.0%	
	TYPE III	6	12.0%	0	0.0%	
	TYPE IV	18	36.0%	25	51.0%	
	TYPE V	8	16.0%	8	16.0%	
Left Upper Quadrant	TYPE I	13	26.0%	11	22.0%	**0.011***
	TYPE I'	6	12.0%	6	12.0%	
	TYPE II	15	30.0%	6	12.0%	
	TYPE III	12	24.0%	8	16.0%	
	TYPE IV	1	2.0%	8	16.0%	
	TYPE V	3	6.0%	11	22.0%	

Overall, the analysis reveals significant gender differences in the distribution of types in the right and left upper lip quadrants but not in the middle upper quadrant as shown in (GRAPH NO. 2)

Graph No. 2: Comparison of All the Lip Print Pattern between Male and Female in Right, Middle and Left Upper Quadrant



As shown in (TABLE NO. 3) In Right Lower Quadrant: Both males and females show the highest prevalence of TYPE I (22.0% for both genders) and TYPE III (22.0% for both genders). However, males show a significantly higher frequency of TYPE II (48.0%) compared to females (18.0%). The p-value of 0.004 indicates a statistically significant gender difference in the distribution of types in this quadrant.

Middle Lower Quadrant: In this quadrant, males most frequently exhibit TYPE I (42.0%) and TYPE IV (30.0%), whereas females display a more balanced distribution among TYPE I (26.0%), TYPE II (24.0%), and TYPE V (18.0%). The p-value of 0.036 suggests a statistically significant difference in type distribution between genders in this quadrant.

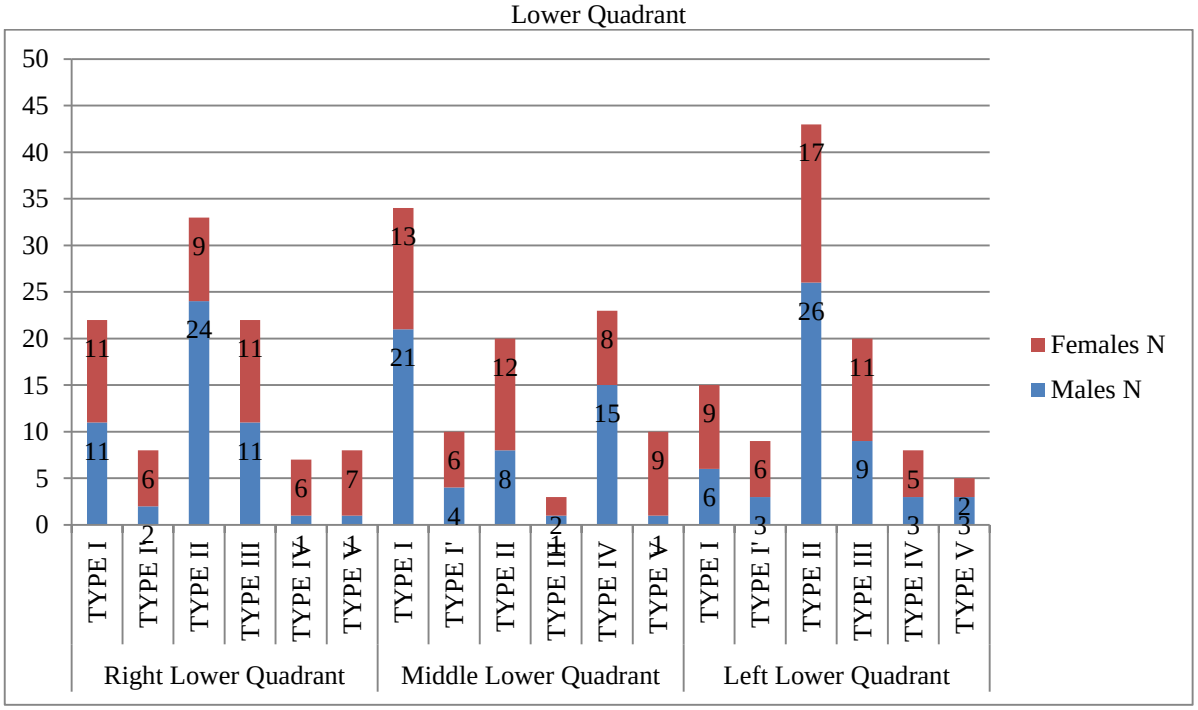
Left Lower Quadrant: The most common type among males is TYPE II (52.0%), while among females, TYPE II is also prevalent but at a lower frequency (34.0%). The distribution of other types is relatively balanced between both the genders. The p-value of 0.496 indicates no statistically significant gender difference in this quadrant.

Table No.3: Showing Statistical Description Of All The Lip Print Pattern Between Male And Female In Lower Lip Quadrant With Corresponding P-Values Indicating Statistical Significance.

Lower lip Quadrants		Gender Distribution				P value
		Male		Female		
		N	N %	N	N %	
Right Lower Quadrant	TYPE I	11	22.0%	11	22.0%	**0.004***
	TYPE I'	2	4.0%	6	12.0%	
	TYPE II	24	48.0%	9	18.0%	
	TYPE III	11	22.0%	11	22.0%	
	TYPE IV	1	2.0%	6	12.0%	
	TYPE V	1	2.0%	7	14.0%	
Middle Lower Quadrant	TYPE I	21	42.0%	13	26.0%	**0.036***
	TYPE I'	4	8.0%	6	12.0%	
	TYPE II	8	16.0%	12	24.0%	
	TYPE III	1	2.0%	2	4.0%	
	TYPE IV	15	30.0%	8	16.0%	
	TYPE V	1	2.0%	9	18.0%	
Left Lower Quadrant	TYPE I	6	12.0%	9	18.0%	0.496
	TYPE I'	3	6.0%	6	12.0%	
	TYPE II	26	52.0%	17	34.0%	
	TYPE III	9	18.0%	11	22.0%	
	TYPE IV	3	6.0%	5	10.0%	
	TYPE V	3	6.0%	2	4.0%	

Overall, the analysis highlights significant gender differences in the right and middle lower lip quadrants, with no significant difference observed in the left lower quadrant as shown in (GRAPH NO. 3)

Graph No. 3: Comparison of All the Lip Print Pattern between Male and Female In Right, Middle And Left Lower Quadrant



DISCUSSION

Lip print is very important tool like fingerprint for personal identification and sex determination in any criminal investigation cases. Presence of lip print in any crime site can give evidence related to the suspect and also give information about the number of person's present at the crime scene [13, 14].

The present study was conducted in the Department of Forensic Medicine & Toxicology, R. D. Gardi Medical College, Ujjain (M.P.) and it has been compared with other similar studies carried out in different parts of the world to bring out the similarities and differences. Different study gives different opinion about the lip print pattern among

both the sexes. In the present study the lip print was taken to identify the commonest type of lip print pattern in male as well in female quadrant wise. In our study, we tried to analyze the lip print patterns among 100 individuals of central Indian (M.P.) origin.

On Comparison of the distribution of lip prints in the right upper quadrant (RUQ) of lips in both genders-

In this study of lip prints of the right upper quadrant (RUQ) on 50 males, Type II was seen in maximum numbers (26%) of males while in cases of females (50), Type I & Type I' lip print was seen in maximum that is 28% of female population. Similar pattern to the present study was observed by Sunil et al. [15] Ghimire et al. [16] found that a Type I pattern was seen in 62% of males and 32% of females in the right upper quadrant. Earlier Augustine et al [17] found it in 37.75% of males and 35.93% of females whereas in a study by Mathew SA et al [18] in males, Type I is present in the maximum population i.e. in 48% of total males while females had type IV lip print in 44% of total females. Type II pattern was most common in the right upper quadrant among females and males in study conducted by Deepa Jatti et al [19]

On Comparison of the distribution of lip prints in the left upper quadrant (LUQ) of lips in both genders-

In this study the lip prints of left upper quadrant (LUQ) Type II was seen in maximum numbers (30%) of males while in cases of females, type I & type IV (22%) followed by type V (16%) lip print was seen in maximum of total female population, Similar findings seen in study of Mathew SA et al [18] where females had Type IV lip print in 44% of the total female population while Type I was present in the maximum population i.e. in 48% of total males. In study of Sunil et al [15] had type II lip print in 25% of male population similar to that of present study.

On Comparison of the distribution of lip prints in the right lower quadrant (RLQ) of lips in both genders-

Type II was seen in maximum numbers (48%) of males similar to that of Sunil et al **[15]** while in cases of females Type I & Type III lip print was seen in maximum that is 22% of female population similar to that Ghimire et al [16] and Mathew SA et al [18] noted that females had Type I lip print in 68% of the total female population.

On Comparison of the distribution of lip prints in the left lower quadrant (LLQ) of lips in both genders-

In the present study Type II was seen in maximum numbers (52%) of males similar to that of Sunil et al [15] and maximum numbers (34%) of females which shows variations with study of Ghimire et al [16] and Augustine et al [17] where type III & type I respectively is present in maximum population of females.

On Comparison of the distribution of lip prints in the middle upper quadrant (MUQ) and middle lower quadrant (MLQ) of lips in both genders-

It is not uncommon to find partial lip prints at the scene of crime. Centre portion of the lip has special importance, as it is more likely to be found at the scene of crime and hence, has to be studied separately. In our study, we divided the lip into six portions to study them separately for sexual dimorphism. In the upper middle quadrant, the most common pattern among both males and female was Type IV (Reticular pattern). While in the lower middle quadrant, the most common lip print pattern which was found was Type I in both males and females which has similar findings with the study conducted by Kautilya D V et al. [20], however these findings differ with the findings of Augustine et al. [17]

This sexual dimorphism showed excellent statistical significance in the right upper quadrant (p= 0.037) and left upper quadrant (p= 0.011) with that of right lower quadrant (p= 0.004) However, the findings which were noted for the middle upper quadrant were insignificant statistically in upper lip, but it is statistical significance in middle lower quadrant (p= 0.036) in lower lip. Based on the lip print patterns, only the outer portions of the lip can be effectively used for sex determination.

CONCLUSION

The present study reveals that, there was no similarity in the lip print pattern of one individual with that of the other individual. The lip print pattern varies between the same age group people as well as among the population of same region as well as same sex. From the observation it can be concluded that lip print can be used as a key tool in sexual dimorphism and it can be useful for the forensic investigator to investigate any criminal cases.

Acknowledgement

The authors are thankful to all participants who took part in this strenuous study.

Conflict of interest: Nil

Source of Funding: "This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors".

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How to cite this article: Lokesh Kumar Sharma, Mohit Shrivastava, Ashish Kumar Vishwakarma, ANALYTICAL STUDY ON DISTRIBUTION & GENDER PREDILECTION OF LIP PRINT PATTERN, Asian J. Med. Res. Health Sci., 2026; 4 (2):-615-621.
Source of Support: Nil, Conflicts of Interest: None declared.