A Study of Inherited Lip Prints Patterns Among the Family Members

Ms. AMRUTHA SURESH[1], Ms. STINY SABU[2]

[1] Ms. AMRUTHA SURESH, M.Sc Criminology and Forensic Science, Department of Computer Science Engineering, sureshamrutha23@gmail.com, 6282545338, Dr. MGR UNIVERSITY, Chennai, India

[2] Ms. STINY SABU, Assistant Professor, Centre of Excellence in Digital Forensic, Chennai, Tamil Nadu, India.

Abstract - Like fingerprints, every individual's lip print has a distinct pattern which varies significantly among family members. These patterns, formed as a result of wrinkles and grooves present on the lips are referred to as "Lip prints" and its study is termed as cheiloscopy. Due to its unique and permanent nature, lip prints may serve as one of the most valuable physical evidence in forensic investigations. Even though these are unique to each individual, research has indicated that they show a slight degree of resemblance between parents and their offsprings which may be attributed to genetic inheritance. The main objective of this study is to identify and analyse the most predominant lip pattern among the family members and to prove the link between lip prints and genetic inheritance. In this study, lip prints of 50 families, residing in Chennai were collected using photography method instead of using the old conventional lipstick method, and classified using the Suzuki and Tsuchihashi classification system. The result indicated, the most predominant pattern among the study population to be Type-III pattern (42.0% each) among the upper lips and lower lips. Both the lip print pattern of father and mother exhibits the similar kind of inheritance.

***Key Words*:** Cheiloscopy, inherited, lip prints, grooves, wrinkles, genetics

1. INTRODUCTION

Lip prints are a combination of the Greek words "*cheilos*," meaning "lips," and "*skopein*," meaning "to see." When the inner labial mucosa and outside layer of skin merge, also known as the vermillion border, they often form lines and fissures that show up as wrinkles and grooves generating patterns. Also known as cheiloscopic patterns, are unique to each individual [2] and hence these have been identified as a unique identifier like fingerprints [1]. Because of these variances, each lip print is unique. The Suzuki and Tsuchihashi categorization method is used to categorize these patterns[3].

In forensic investigations, like fingerprints, lip prints left on skin, glasses, and clothing can be used as trace evidence. Their unique characteristics make them more important for personal identification and criminal investigations[4]. In genetic research, inherited lip print patterns can be studied better to understand the major role of genetics in dermatoglyphic traits; by examining variations in lip print patterns among various populations and families, this study also advances forensic anthropology.

Studying lip prints among family members can reveal whether genetic factors influence these hereditary patterns, which can help forensic scientists to predict or to confirm the familial relationships of individuals during investigations. These helps to understand how genetic variations influence physical traits within populations and can contribute to understanding human diversity and evolution, especially in isolated or distinct populations. If patterns are found to be hereditary, familial lip print information databases can be incorporated for quicker identification[5].

The study endeavors to determine the unknown genetic components of family members' lip print patterns. It seeks to determine whether genetic influences shape lip print similarities within families, enhance understanding of their uniqueness, and evaluate their applicability in forensic science, genetics, and anthropology, filling a critical gap in cheiloscopic research.

2. METHODOLOGY

2.1 Aim

The primary aim of the study is to assess the hereditary trends in the lip print patterns among Chennai based family members

2.2 Ethical consideration

Every family member's written consent was obtained, and in case of a minor, the consent was obtained from their parents. The study ensures confidentiality and anonymity for all the participants. All the lip print data's were stored securely to prevent unauthorized access.

2.3 Materials and Methods

2.3.1 Sample criteria

This research focuses on both quantitative (visual) and qualitative (statistical) research methodology to analyze and explore hereditary traits and uniqueness on the families who live in the Chennai population. The lip prints are obtained from 50 families from both the parents and their offspring consisting of 200 individuals. Minimum size of the family is of four members with Father, Mother, and two children (son or daughter). All healthy individuals with no genetic diseases are selected. To ensure the accuracy of the prints Individuals with any kind of disease, inflammation, or abnormalities/deformities, such as any kind of cut marks, cleft lips, or any scars around the lips were not considered[6].

2.3.2 Sample collection

Sample collection was done using a non-invasive photographic technique from a total of 50 family members based on inclusion criteria. In order to ensure the natural grooves and patterns of the lip prints, participants were asked to stand in a a relaxed stance with the lips closed. The lips were cleaned gently to remove any external debris before photography. Samsung A35 smartphone camera, with a 50 MP sensor was used to capture high-resolution photographs of the lips for cheiloscopic analysis. To maintain consistency, the camera was maintained at a constant distance of 10-15 cm from the subject's lips in natural lighting conditions. Later, the lip print images were transferred to a digital storage system and coded for anonymity.

2.3.3 Lip print Classification

Each lip was divided into two sections, namely the upper lip print pattern and the lower lip print pattern. The classification of the lip print patterns was done using the Suzuki and Tsuchihashi classification system it is most widely accepted classification system based on the groove formation. The Suzuki and Tsuchihashi classification system [7] as follows:

Type I— Complete vertical grooves

Type I' — Partial vertical grooves

Type II— Branched grooves

Type III— Intersected grooves

Type IV— Reticular grooves

Type V— Undetermined or irregular pattern

2.3.4 Data analysis

The Statistical Package for the Social Sciences software [SPSS] version 20 was used to analyze the collected data and also to look for similarities and inheritance by comparing the lip print patterns of family members. A chi-square test was used to determine if the lip print patterns indicate substantial inheritance within the families after the frequency and percentage of each type of pattern were computed using SPSS[8].

3. RESULT

3.1 Interpretation of the Frequency distribution

3.1.1 Upper lip pattern

The upper lip pattern's frequency distribution is seen in Table 1. In the research group, Type IV is the most common upper lip print pattern (48%), especially for mothers and fathers. Type III predominates in S2 (52%), and it is the second most common (42%). In general, type I is uncommon (2.5%), absent in fathers, and primarily observed in children. Type I and Type II are minority patterns, while Type III and Type IV are mixed in both S1 and S2. Type I and Type V patterns are not present in the upper lip print pattern.

Table 1. Frequency Distribution of upper lip pattern

	Type I'	Type II	Type III	Type IV	Total
Father	0	3	19	28	50
Mother	1	2	20	27	50
S1	2	6	19	23	50
S2	2	4	26	18	50
Total	5	15	84	96	200

3.1.2 Lower lip pattern

The frequency distribution of the lower lip print pattern is seen in Table 2. The most prevalent lower lip print pattern is Type III (42%). The second most common pattern (27%) is Type II, which is more common in youngsters (S1 and S2). The upper lip is

where type I' is most frequently observed (2.5%). Only two examples (one in Father and one in S1) exhibit this pattern, making Type I very uncommon (1%). While parents exhibit more Type III and Type IV, children exhibit Type I and Type II.

Table 2. Frequency Distribution of lower lip pattern

	Type I	Type I'	Type II	Type III	Type IV	Total
Father	1	4	7	25	13	50
Mother	0	7	14	20	9	50
S1	1	10	15	22	2	50
S2	0	10	18	17	5	50
Total	2	31	54	84	29	200

3.2 Percentage wise distribution

The overall distribution of the frequency of the upper and lower lip print patterns is displayed in Table 3. At 42.0% each, Type III is the most evenly distributed across the upper and lower lips. Type IV is substantially less prevalent on the lower lip (14.5%) than it is on the upper lip (48.0%). Compared to the upper lip, Type II and Type I' are much more prevalent in the lower lip. With the exception of a little 1.0% presence on the lower lip, Type I is not present. The study population does not have Type V in either lip.

Table 3. Total Distribution – Upper vs. Lower

Pattern type	Upper Lip (%)	Lower Lip (%)
Type I	0.0%	1.0%
Type I'	2.5%	15.5%
Type II	7.5%	27.0%
Type III	42.0%	42.0%
Type IV	48.0%	14.5%
Type V	0.0%	0.0%
Total	100%	100%

3.3 Inheritance Analysis

Based on the tables from 4 to 11, the distribution patterns of upper and lower lip types in children (S1 and S2) exhibit notable similarities to their parental lip print types.

3.3.1 Inheritance from Father

Table 4. Distribution of S1 upper lip type based on Father's upper lip type

Father's upper lip type	S1: Type I'	S1: Type II	S1: Type III	S1: Type IV	Total
Type II	0 (0.0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	3 (100.0%)
Type III	2 (10.5%)	1 (5.3%)	9 (47.4%)	7 (36.8%)	19 (100.0%)
Type IV	0 (0.0%)	4 (14.3%)	9 (32.1%)	15 (53.6%)	28 (100.0%)
Total	2 (4.0%)	6 (12.0%)	19 (38.0%)	23 (46.0%)	50 (100.0%)

Table 5. Distribution of S1 lower lip type based on Father's lower lip type

Father's lower lip type	S1: Type I	S1: Type I'	S1: Type II	S1: Type III	S1:Type IV	Total
Type I	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Type I'	0 (0.0%)	1 (25.0%)	0 (0.0%)	2 (50.0%)	1 (25.0%)	4 (100.0%)
Type II	0 (0.0%)	1 (14.3%)	5 (71.4%)	1 (14.3%)	0 (0.0%)	7 (100.0%)
Type III	0 (0.0%)	3 (12.0%)	8 (32.0%)	14 (56.0%)	0 (0.0%)	25 (100.0%)
Type IV	0 (0.0%)	5 (38.5%)	2 (15.4%)	5 (38.5%)	1 (7.7%)	13 (100.0%)
Total	1 (2.0%)	10 (20.0%)	15 (30.0%)	22 (44.0%)	2 (4.0%)	50 (100.0%)

Table 6. Distribution of S2 upper lip type based on Father's upper lip type

Father's upper lip type	S1: Type I'	S1: Type II	S1: Type III	S1: Type IV	Total
Type II	0 (0.0%)	2 (66.7%)	1 (33.3%)	0 (0.0%)	3 (100.0%)
Type III	0 (0.0%)	1 (5.3%)	11 (57.9%)	7 (36.8%)	19 (100.0%)
Type IV	2 (7.1%)	1 (3.6%)	14 (50.0%)	11 (39.3%)	28 (100.0%)
Total	2 (4.0%)	4 (8.0%)	26 (52.0%)	18 (36.0%)	50 (100.0%)

Table 7. Distribution of S2 lower lip type based on Father's lower lip type

Father's lower lip type	S2: Type I'	S2: Type II	S2: Type III	S2: Type IV	Total
Type I	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Type I'	3 (75.0%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)
Type II	1 (14.3%)	3 (42.9%)	3 (42.9%)	0 (0.0%)	7 (100.0%)
Type III	2 (8.0%)	10 (40.0%)	9 (36.0%)	4 (16.0%)	25 (100.0%)
Type IV	3 (23.1%)	4 (30.8%)	5 (38.5%)	1 (7.7%)	13 (100.0%)
Total	10 (20.0%)	18 (36.0%)	17 (34.0%)	5 (10.0%)	50 (100.0%)

3.3.2 Inheritance from Mother

Table 8. Distribution of S1 upper lip type based on Mother's upper lip type

Mother's upper lip type	S1: Type I'	S1: Type II	S1: Type III	S1: Type IV	Total
Type I'	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Type II	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	2 (100.0%)
Type III	0 (0.0%)	2 (10.0%)	9 (45.0%)	9 (45.0%)	20 (100.0%)
Type IV	2 (7.4%)	2 (7.4%)	9 (33.3%)	14 (51.9%)	27 (100.0%)
Total	2 (4.0%)	6 (12.0%)	19 (38.0%)	23 (46.0%)	50 (100.0%)

Table 9. Distribution of S1 lower lip type based on Mother's lower lip type

Mother's Lower lip type	S1: Type I	S1: Type I'	S1: Type II	S1: Type III	S1: Type IV	Total
Type I'	1 (14.3%)	3 (42.9%)	1 (14.3%)	1 (14.3%)	1 (14.3%)	7 (100.0%)
Type II	0 (0.0%)	3 (21.4%)	3 (21.4%)	8 (57.1%)	0 (0.0%)	14 (100.0%)
Type III	0 (0.0%)	2 (10.0%)	11 (55.0%)	7 (35.0%)	0 (0.0%)	20 (100.0%)
Type IV	0 (0.0%)	2 (22.2%)	0 (0.0%)	6 (66.7%)	1 (11.1%)	9 (100.0%)
Total	1 (2.0%)	10 (20.0%)	15 (30.0%)	22 (44.0%)	2 (4.0%)	50 (100.0%)

Table 10. Distribution of S2 upper lip type based on Mother's upper lip type

Mother's upper lip type	S2: Type I'	S2: Type II	S2: Type III	S2: Type IV	Total
Type I'	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Type II	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	2 (100.0%)
Type III	1 (5.0%)	1 (5.0%)	12 (60.0%)	6 (30.0%)	20 (100.0%)
Type IV	0 (0.0%)	3 (11.1%)	13 (48.1%)	11 (40.7%)	27 (100.0%)
Total	2 (4.0%)	4 (8.0%)	26 (52.0%)	18 (36.0%)	50 (100.0%)

Table 11. Distribution of S2 lower lip type based on Mother's lower lip type

Mother's lower lip type	S2: Type I'	S2: Type II	S2: Type III	S2: Type IV	Total
Type I'	3 (42.9%)	2 (28.6%)	2 (28.6%)	0 (0.0%)	7 (100.0%)
Type II	3 (21.4%)	8 (57.1%)	2 (14.3%)	1 (7.1%)	14 (100.0%)
Type III	2 (10.0%)	5 (25.0%)	10 (50.0%)	3 (15.0%)	20 (100.0%)
Type IV	2 (22.2%)	3 (33.3%)	3 (33.3%)	1 (11.1%)	9 (100.0%)
Total	10 (20.0%)	18 (36.0%)	17 (34.0%)	5 (10.0%)	50 (100.0%)

Type III and Type IV upper lip print types are the most common patterns seen in both S1 and S2 offspring. The higher percentage of Type III and Type IV lip print patterns in parents of children with Type IV upper lip print patterns indicates a stronger pattern inheritance from parents to their children. The finding also shows that there is a small percentage of Type I' and Type II lip print types in the offspring; therefore, they are less commonly inherited. Type III and Type IV dominated the children's lower lip print pattern once more. Similarly, children were more likely to receive Type III and IV, the lower lip print types, from their parents. Type I and Type I' lip prints were less prevalent, which would suggest that they are less

prevalent. The findings indicate that the lip print type of both parents exhibits a comparable kind of inheritance, even if both parents contribute to the lip print morphology. However, the maternal influence indicates that it plays a more major role in defining the kinds of S2 lip prints, particularly those of Type III and Type IV patterns.

Limitations

- The study sample size was relatively small, which consisted of only 50 families.
- Since photography technique has been adopted for this study, high-resolution images are necessary to capture good details of the lip print pattern to prevent shadow and glare. Also, uniformity in distance, angle, and positioning during photography should be maintained.
- External factors such as lip dryness, the presence of any kind of cosmetics, etc. Can affect the clarity of the lip prints in the photographs.

4. ACKNOWLEDGEMENTS

I would like to express our sincere gratitude to all those who contributed to the successful completion of this research work. First and foremost, we extend our heartfelt thanks to Dr. M.G.R. Educational and Research Institute, Chennai, for providing us with the necessary infrastructure and academic environment to carry out this project.

I deeply thankful to Ms. Stiny sabu, Assistant Professor, Centre of Excellence in Digital Forensics, for her invaluable guidance, continuous support, and insightful feedback throughout the research. Her expertise and mentorship were instrumental in shaping the direction and quality of this work.

I also extend our appreciation to our colleagues and peers who provided constructive suggestions and moral support throughout this journey. Special thanks to the faculty of the Department of Computer Science Engineering for their encouragement and academic assistance.

5. CONCLUSION

This study set out to explore the relationship between genetic inheritance and the characteristics of lip print patterns. By systematically analyzing participants from various families within the Chennai population, the study provides valuable insights to the field of forensic science. The analysis revealed that Type III was the most prevalent pattern among the study group for the upper lips (42.0%), while Type IV was dominant in the lower lip category (48.0%). Lip prints of children, particularly S2, exhibited notable similarities to their parents lip print patterns. In S2's upper lips, the Type III and Type IV patterns were primarily inherited, reflecting the distribution observed in their parents. Furthermore, among the research groups, Type III was the pattern that appeared in the lower lip the most frequently. Although both parents play a role in the inheritance of lip print traits, there was a more pronounced maternal influence on the lip print characteristics of S2. The findings indicate a consistent inheritance of lip print features from parents to their children, suggesting that lip prints may serve as a valuable biomarker for both forensic and familial identification.

6. REFERENCE

[1] J. Chandrakala, G. Suganya, T. S. Yadava, V. Doddawad, J. Nagarathna, and M. Kalavathi, “Lip print patterns: Similarities among the parents and their children,” Journal of Oral and Maxillofacial Pathology, vol. 26, no. 1, p. 134, Jan. 2022, doi: 10.4103/jomfp.jomfp_194_21.

[2] P. Ghalaut, S. Bhagwath, and S. Saxena, “An Assessment Of Inheritance Pattern Of Lip Prints In North Indian Population,” Indian Journal of Dental Sciences, vol. 5, no. 1, Mar. 2013, https://doi.org/10.260843578

[3] S. Patel, I. Paul, M. S. Astekar, G. Ramesh, and S. G, “A study of lip prints in relation to gender, family and blood group,” International Journal of Oral and Maxillofacial Pathology, vol. 1, no. 1, pp. 4–7, Dec. 2010, https://doi.org/215617765

[4] M. Astekar, V. Kumar, P. Kaur, N. Singh, G. Sidhu, and A. Devi, “The study of inheritance analysis and evaluation of lip prints in individuals,” Journal of Forensic Dental Sciences, vol. 7, no. 1, p. 49, Jan. 2015, doi: 10.4103/0975-1475.150309.

[5] N. Vezhavendhan, P. Vendhan, and Gs. Kumar, “A study of lip prints among Pondicherry population,” Journal of Forensic Dental Sciences, vol. 4, no. 2, p. 84, Jan. 2012, doi: 10.4103/0975-1475.109894.

[6] G. Mishra, K. Ranganathan, and T. Saraswathi, “Study of lip prints,” Journal of Forensic Dental Sciences, vol. 1, no. 1, p. 28, Jan. 2009, doi: 10.4103/0974-2948.50885.

[7] P. Sharma, S. Saxena, and V. Rathod, "Cheiloscopy: The study of lip prints in sex identification," Journal of Forensic Dental Sciences, vol. 1, no. 1, p. 24, Jan. 2009, doi: 10.4103/0974-2948.50884.

[8] K. Ramalingam, F. Rehman, S. Sethuraman, M. Kinra, G. Lalawat, and A. Pandey, "Cheiloscopy for Sex Determination: a study," Universal Research Journal of Dentistry, vol. 4, no. 1, p. 48, Jan. 2014, doi: 10.4103/2249-9725.127078.

[9] A. Yadav, R. Gaikwad, A. Jain, and S. Jajoo, "Lip prints as a genetic marker in inheritance of cleft lip and palate: A case–control study," Journal of Cleft Lip Palate and Craniofacial Anomalies, vol. 4, no. 3, p. 38, Jan. 2017, doi: 10.4103/jclpca.jclpca_85_17.

[10] T. A. Anai et al., "Classification and identification of individuals using analysis lip prints," journal-article, Jun. 2022. [Online]. Available: https://doi.org/10.25130/tjds.10.1.1

[11] M. Moshfeghi, P. Iranparvar, H. Mortazavi, and N. Nasrabadi, "Study of lip print patterns distribution and their stability in Time Pass," Journal of Iranian Medical Council, Nov. 2023, doi: 10.18502/jimc.v7i1.14222.

[12]] S. Timsinha and S. M. Kar, "A study on distribution and gender wise predilection of lip print pattern," Asian Journal of Medical Sciences, vol. 10, no. 4, pp. 61–65, Jun. 2019, doi: 10.3126/ajms.v10i4.23881.

[13] A. A. T. I. A. Iqbal Khalil Ur Rehman ,. Nayella Nijat Bangesh ,. Qurrat Ul Ain ,. Farrukh, "Hereditary resemblances of lip prints among the members of biological families," DOAJ (DOAJ: Directory of Open Access Journals), Sep. 2022, [Online]. Available: https://doaj.org/article/95498bc3c7f541a9ba8c468a7aeb539c

[14] S. S, "A Study of Lip Print Pattern Identification on the Population of Delhi," Journal of Forensic Research and Crime Studies, vol. 6, no. 1, Sep. 2021, doi: 10.17303/jfrc.2021.6.104.

[15] B. Anand, S. Kumar, and M. S. Sankhla, "The morphological study of lip print pattern & identify the genetic variation of family members," International Journal of Medical Toxicology & Legal Medicine, vol. 24, no. 3and4, pp. 24–29, Jan. 2021, doi: 10.5958/0974-4614.2021.00052.8.

[16] N. MSugatha, N. R. J. Jacquiline, and N. M. T. Khan, "Cheiloscopy - a tool for identification in twins," Indian Journal of Forensic Medicine & Toxicology, vol. 16, no. 1, pp. 41–46, Nov. 2021, doi: 10.37506/ijfmt.v16i1.17412.

[17] L. Kumar, N. Kumar, S. Alam, and B. Singh, "Forensic Anthropology-LIP print pattern in North Indians," Journal of Punjab Academy of Forensic Medicine & Toxicology, vol. 17, no. 2, p. 72, Jan. 2017, doi: 10.5958/0974-083x.2017.00015.2.

[18] M. R. Sangam, P. K, R. R. Bokan, V. G, A. Kaur, and R. Deka, "Distribution and uniqueness in the pattern of lip prints," Cureus, Feb. 2024, doi: 10.7759/cureus.53692.

[19] R. Prabhu, A. Dinkar, and V. Prabhu, "Digital method for lip print analysis: A New approach," Journal of Forensic Dental Sciences, vol. 5, no. 2, p. 96, Jan. 2013, doi: 10.4103/0975-1475.119772.

[20] T. A. C. Marquina, S. V. Mondalgo, H. Arbildo-Vega, C. A. Farje-Gallardo, and F. T. Coronel-Zubiate, "Comparison of Cheiloscopic Characteristics between Generations: Similarities and Divergences between Parents and Children," Cuadernos De Medicina Forense, vol. 27, no. 27(2), pp. 81–92, Jan. 2024, doi: 10.59457/cmf.2024.27.02.org01.