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Original Research Article

AGE-RELATED VARIATIONS IN LIP PRINT PATTERNS: A CHEILOSCOPIC STUDY IN A SUBURBAN POPULATION OF DAKSHINA KANNADA DISTRICT

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ABSTRACT

Background: Cheiloscopy, the study of lip print patterns, has emerged as a useful adjunct in forensic identification due to the unique and relatively stable nature of lip groove patterns. Although several studies have evaluated the distribution of lip print patterns, limited research has focused on age-related variations in these patterns. The present study aimed to evaluate the distribution of lip print patterns across different age groups in a suburban population of Dakshina Kannada district.

Materials and Methods: A cross-sectional study was conducted on 300 individuals aged 12–60 years residing in a suburban region of Dakshina Kannada district. The study population was categorized into three age groups: 12–20 years, 21–40 years, and 41–60 years. Lip prints were recorded using the cellophane tape method after applying lipstick and were analyzed using the Suzuki and Tsuchihashi classification. Data were analyzed using SPSS software, and the Chi-square test was used to assess the association between age groups and lip print patterns.

Results: Among the five lip print patterns identified, Type I pattern was the most predominant (32.0%), followed by Type V (20.7%), Type IV (16.3%), Type II (15.7%), and Type III (15.3%). Age-wise analysis showed that Type I pattern was more common in the younger age group (44.8%), while Type III and Type V patterns were relatively more frequent in the older age group. However, statistical analysis showed no significant association between age group and lip print pattern distribution ($\chi^2 = 12.84$, $p = 0.118$).

Conclusion: The findings of this study indicate that lip print patterns remain largely stable across different age groups, supporting their potential use as a supplementary tool for personal identification in forensic investigations.

Keywords: Cheiloscopy; Lip prints; Age-related variation; Suzuki and Tsuchihashi classification; Dakshina Kannada.

INTRODUCTION

Forensic identification relies on unique biological characteristics that remain relatively stable over time. Although conventional techniques such as fingerprint analysis, dental records, and DNA profiling are widely used, additional methods are often required when primary identifiers are unavailable or degraded. Cheiloscopy, the study of lip prints, has emerged as a supplementary forensic tool based on the analysis of grooves and furrows present on the vermilion border of the lips.[1]

Lip prints consist of characteristic lines and fissures that form distinct patterns. These patterns develop early during intrauterine life and are believed to remain relatively stable throughout an individual's lifetime, making them useful in forensic identification.[2] Lip impressions may be left on surfaces such as glasses, cigarette butts, clothing, and

cutlery at crime scenes, thereby providing valuable trace evidence for investigation.[3] Because of these characteristics, cheiloscopy has been increasingly explored as an adjunct technique in personal identification.

Most cheiloscopic studies have focused on identifying the predominant lip print patterns within populations and evaluating their usefulness in sex determination.[4,5] However, comparatively fewer studies have investigated the influence of age on lip print pattern distribution. Age-related changes in the perioral region, including reduced tissue elasticity, alterations in muscular tone, and environmental influences, may affect the appearance and prominence of lip grooves over time.[6] These physiological changes could potentially influence the visibility or distribution of lip print patterns.

Previous investigations examining age-related variation in lip prints have reported inconsistent findings. While some studies suggest that lip print patterns remain relatively constant across age groups, others have observed differences in pattern predominance in older individuals.[7] Such variations highlight the need for further population-based studies to better understand the relationship between age and lip print morphology.

In India, limited research has specifically evaluated age-wise variation in lip print patterns, particularly in regional populations. Therefore, the present study was conducted with an aim to assess the distribution of lip print patterns across different age groups in a suburban population of Dakshina Kannada District and to evaluate their potential forensic significance.

MATERIALS AND METHODS

Study Design and Setting: The present study was a descriptive cross-sectional observational study conducted under the department of Anatomy in collaboration with department of Forensic Medicine, in a suburban population of Dakshina Kannada District, Karnataka, India. The study was carried out over a period of two years and aimed to evaluate age-related variations in lip print patterns using cheiloscopic analysis. Dakshina Kannada district represents a diverse population with varying socio-demographic characteristics, making it suitable for assessing pattern distribution across different age groups.

Study Population and Sample Size: The study population comprised 300 individuals residing in suburban areas of Dakshina Kannada District. Participants were selected from the general population and included both males and females between the ages of 12 and 60 years. The entire study population was divided into three age groups for analysis: Group I included individuals aged 12–20 years, Group II included individuals aged 21–40 years, and Group III included individuals aged 41–60 years. Each age group included approximately equal representation to facilitate age-wise comparison of lip print patterns. Individuals selected for the study were healthy volunteers without any congenital deformities or pathological conditions affecting the lips.

Inclusion and Exclusion Criteria

Healthy individuals within the specified age range who were willing to participate in the study were included after obtaining informed consent. Participants with congenital lip deformities such as cleft lip, individuals with a history of trauma, inflammation, or surgical procedures involving the lips, and those with known hypersensitivity to lipstick were excluded from the study to prevent distortion of lip print patterns. Individuals undergoing orthodontic treatment or with active lesions on the lips were also excluded to ensure accurate recording of lip grooves.

Collection of Lip Prints: Lip prints were recorded using a standardized method to ensure consistency. The materials used for recording lip prints included dark red colored lipstick, a lipstick brush, cellophane tape, scissors, white bond paper, and a magnifying lens for examination. Before recording the prints, the lips of each participant were examined for any deformities, lesions, or inflammatory conditions. The lips were then cleaned gently using cotton moistened with water to remove debris or cosmetic residues.

A thin and uniform layer of dark red lipstick was applied on the participant's lips using a lip brush, starting from the midline and extending laterally to cover the entire vermilion border. Participants were asked to rub their lips together gently to ensure even distribution of the lipstick. The lipstick was allowed to dry for approximately two minutes. Subsequently, a strip of transparent cellophane tape was carefully placed over the lips in the normal resting position and pressed gently to obtain the lip impression. The tape was then removed and immediately affixed onto a sheet of white bond paper to create a permanent record of the lip print. In cases where the impression appeared smudged or unclear, the procedure was repeated to obtain a clear and distinct print.

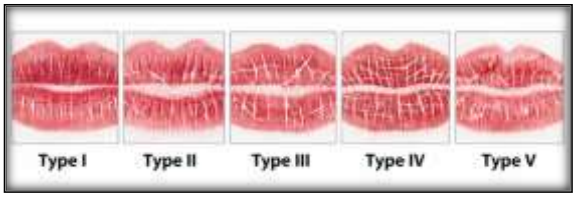

Figure 1: Representative Lip Print Patterns According to Suzuki and Tsuchihashi Classification.

Classification of Lip Print Patterns: The recorded lip prints were examined using a magnifying lens, and the patterns were classified according to the Suzuki and Tsuchihashi classification system [8]. This classification categorizes lip prints into five primary types based on the arrangement of grooves. Type I consists of clear vertical grooves running across the entire lip, while Type I′ represents partial vertical grooves. Type II includes branched grooves, Type III consists of intersecting grooves, Type IV represents

reticular patterns, and Type V includes undetermined patterns that do not fit into the other categories. In the present study, the predominant groove pattern observed in the middle portion of the lip impression was used for classification, as this area is most commonly available in trace evidence encountered at crime scenes [Figure 1].

Data Recording and Statistical Analysis: All observations were recorded in a master data sheet prepared using Microsoft Excel. The frequency distribution of lip print patterns was calculated for the entire study population as well as for each age group. Age-wise comparison of lip print patterns was performed to identify possible variations in pattern distribution among the three age groups. Statistical analysis was performed using SPSS software version 22. Descriptive statistics were used to summarize the distribution of lip print patterns, and the Chi-square test was applied to determine whether there was any statistically significant association between age groups and lip print patterns. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee prior to the commencement of the research. Written informed consent was obtained from all participants prior to the collection of lip prints. For participants below 18 years of age, consent was obtained from the head of the institution or guardian as appropriate. Participants were informed about the purpose of the study and assured that the information collected would be used only for research purposes while maintaining confidentiality.

RESULTS

A total of 300 participants were included in the study. The study population was almost evenly distributed across the three age groups. The 21–40 year age group constituted the largest proportion (33.7%, n=101), followed closely by the 12–20 year group (33.3%, n=100) and the 41–60 year group (33.0%, n=99). This relatively balanced distribution allowed meaningful comparison of lip print patterns across different age groups [Table 1 and Figure 2].

Table 1: Age Distribution of Study Participants.

Age Group (years)	Frequency	%
12–20	100	33.3
21–40	101	33.7
41–60	99	33.0

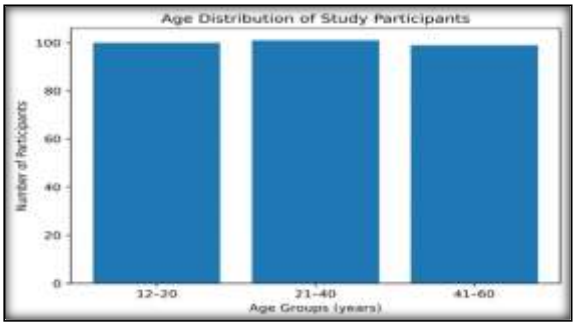

Figure 2: Bar chart showing the distribution of the study population across three age groups (12–20, 21–40, and 41–60 years).

Among the five types of lip print patterns identified, Type I was the most predominant pattern, observed in 96 individuals (32.0%). This was followed by Type V pattern in 62 individuals (20.7%). The remaining patterns included Type IV in 49 individuals (16.3%), Type II in 47 individuals (15.7%), and Type III in 46 individuals (15.3%). These findings indicate that vertical groove patterns (Type I) were the most common in the studied population [Table 2 and Figure 3].

Table 2: Overall Distribution of Lip Print Patterns in the Study Population.

Lip Print Pattern	Frequency	%
Type I	96	32.0
Type II	47	15.7
Type III	46	15.3
Type IV	49	16.3
Type V	62	20.7

Lip print patterns were classified according to the Suzuki and Tsuchihashi classification: Type I – complete vertical grooves; Type II – branched grooves; Type III – intersecting grooves; Type IV – reticular pattern; Type V – undetermined pattern.

Type I pattern was most frequently observed in the youngest age group (12–20 years), accounting for 44.8% of Type I cases, followed by 33.3% in the 21–40 year group and 21.9% in the 41–60 year group, suggesting a decreasing trend with increasing age. In contrast, Type III and Type V patterns showed relatively higher proportions in the older age group (41–60 years), contributing 43.5% and 41.9% of their respective cases. Type IV pattern was most common in the 21–40 year age group (46.9%), whereas Type II pattern showed a relatively even distribution between the younger and older groups (36.2% each). However, statistical analysis using the Chi-square test demonstrated no significant association between age group and lip print pattern distribution (χ^2 = 12.84, df = 8, p = 0.118) [Table 3, Figure 4 and Figure 5].

Table 3: Age-wise Distribution of Lip Print Patterns.

Lip Print Pattern	12–20 yrs (n=100)	21–40 yrs (n=101)	41–60 yrs (n=99)	Test value
	Frequency (%)			
Type I (n=96)	43 (44.8%)	32 (33.3%)	21 (21.9%)	Chi-square = 12.84, df = 8, p = 0.118
Type II (n=47)	17 (36.2%)	13 (27.7%)	17 (36.2%)	
Type III (n=46)	11 (23.9%)	15 (32.6%)	20 (43.5%)	
Type IV (n=49)	11 (22.4%)	23 (46.9%)	15 (30.6%)	
Type V (n=62)	18 (29.0%)	18 (29.0%)	26 (41.9%)	

df – degrees of freedom.

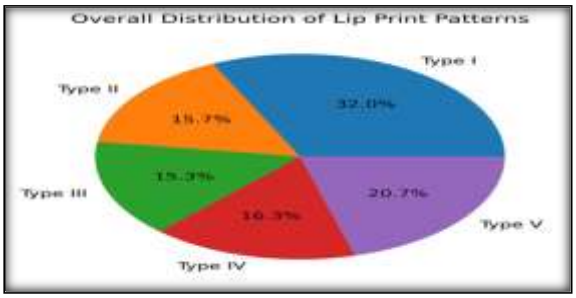

Figure 3: Pie chart illustrating the prevalence of lip print patterns (Types I–V) among the study population.

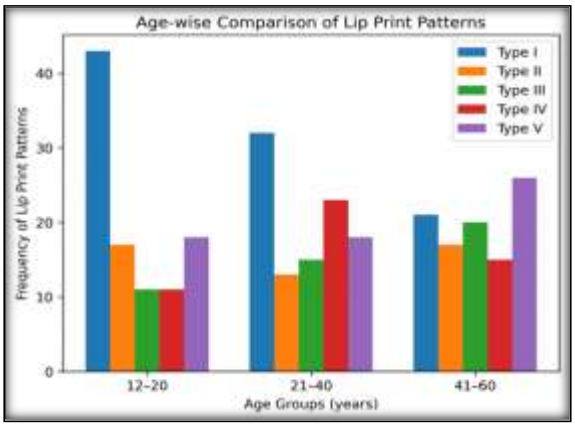

Figure 4: Clustered bar graph depicting the frequency of different lip print patterns across the three age groups.

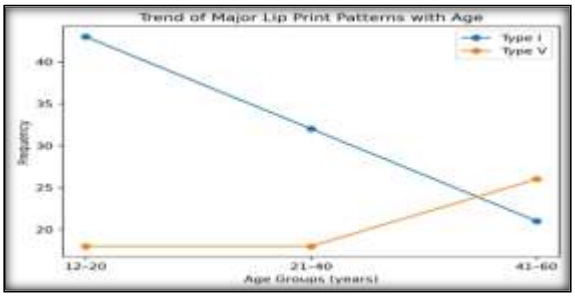

Figure 5: Line graph demonstrating the decreasing trend of Type I patterns and the increasing trend of Type V patterns with advancing age.

DISCUSSION

Cheiloscopy has gained recognition as a supplementary method for personal identification in forensic investigations due to the distinctive and relatively stable patterns of grooves present on the vermilion border of the lips.[9] The present study aimed to evaluate age-related variations in lip print patterns in a suburban population of Dakshina Kannada district and to determine whether advancing age influences the distribution of cheiloscopic patterns. The study population was almost evenly distributed across three age groups, namely 12–20 years (33.3%), 21–40 years (33.7%), and 41–60 years (33.0%). Such balanced representation of participants allowed meaningful comparison of lip print patterns across different age categories.[10,11]

The overall distribution of lip print patterns in the present study revealed that Type I pattern was the most predominant (32.0%), followed by Type V (20.7%), Type IV (16.3%), Type II (15.7%), and Type III (15.3%). The predominance of Type I pattern observed in the present study is consistent with findings reported in several previous investigations conducted in Indian populations.[12-15] Vahanwala et al., reported Type I as the most common lip print pattern in a Mumbai population, particularly among females.[12] Misra et al., also observed Type I as the predominant pattern in their study on individuals from Uttar Pradesh.[13] Similarly, Sandhu et al., reported Type I as the most frequent pattern in a Punjabi population,[14] while Randhawa et al., in a large population-based study involving 600 individuals, also found Type I pattern to be predominant across different age groups.[15] The consistent predominance of Type I pattern in several Indian studies such as Tiwari et al., and Chawla et al., suggests that vertical groove patterns may represent a common morphological characteristic among populations in the region.[16,17]

However, variation in the predominant lip print pattern has also been reported in different geographical and ethnic groups. Sivapathasundaram et al., reported Type III pattern as the most common in an Indo-Dravidian population,[18] while Augustine et al., found Type III patterns to be more frequent in certain lip segments in their study population.[19] Prabhu et al., using digital image analysis techniques, reported Type V patterns as the predominant type in their study.[20] These variations indicate that lip print pattern distribution may be influenced by genetic background, environmental factors, and methodological differences in recording or analyzing lip prints. Differences in sample size, population characteristics, and classification methods may also contribute to the variability observed across studies.[21,22]

Age-wise analysis demonstrated that Type I pattern was most frequently observed in the youngest age group (12–20 years), accounting for 44.8% of Type I cases, whereas its proportion gradually decreased

with increasing age, reaching 21.9% in the 41–60 year age group. In contrast, Type III and Type V patterns showed relatively higher proportions in the older age group, accounting for 43.5% and 41.9% respectively of their respective cases. Type IV pattern was most commonly observed in the 21–40 year age group (46.9%). These observations suggest a gradual shift in the relative frequency of certain patterns across age groups, which may be associated with morphological changes in the lip surface with advancing age.[23-25]

Despite these observable trends, statistical analysis revealed no significant association between age group and lip print pattern distribution ($\chi^2 = 12.84$, df = 8, p = 0.118). This indicates that although minor variations in pattern frequency may occur, the fundamental configuration of lip grooves remains largely stable across different age groups. The findings therefore support the concept proposed in earlier cheiloscopic studies by Tekinera et al., Sarkar et al., and Multani et al., that lip print patterns are largely permanent and remain unchanged throughout life.[26-28]

Similar observations have been reported in several previous studies. Saraswathi et al., concluded that lip print patterns remain stable over time and that age does not significantly influence the overall pattern configuration.[29] Sandhu et al., also reported that lip print patterns did not show statistically significant variation among different age groups.[14] Patel et al., in a study examining lip prints over a period of time, observed that lip print patterns remained unchanged during follow-up examinations, further supporting the concept of pattern stability.[30] The stability of lip print patterns may be explained by the fact that lip grooves develop during early intrauterine life and persist throughout life, similar to dermatoglyphic patterns.[31]

Nevertheless, certain studies have suggested that age-related physiological changes may influence the appearance or clarity of lip grooves. Randhawa et al., reported that advancing age may influence lip print patterns due to reduced tonicity of the lip musculature and changes in elasticity of the vermilion border.[15] Age-related reduction in collagen content, decreased muscle tone of the orbicularis oris muscle, and environmental exposure such as sunlight, smoking, or habitual lip movements may contribute to subtle alterations in lip surface morphology.[32] These physiological changes could explain the relatively higher frequency of intersecting or irregular patterns such as Type III and Type V observed in the older age group in the present study.[33]

Limitations: The present study was conducted on a limited sample from a single suburban population in Dakshina Kannada district, which may restrict the generalizability of the findings to other populations. Lip print analysis was performed using conventional visual examination rather than advanced digital imaging techniques, which may provide greater accuracy. Additionally, longitudinal assessment of lip prints over time was not performed to evaluate temporal stability.

CONCLUSION

The present study evaluated the distribution of lip print patterns across different age groups in a suburban population of Dakshina Kannada district using the Suzuki and Tsuchihashi classification. Type I pattern was the most predominant pattern observed in the overall population, followed by Type V and Type IV patterns. Although certain patterns such as Type I were more common in younger individuals and Type III and Type V patterns appeared relatively more frequent in older age groups, statistical analysis did not demonstrate a significant association between age and lip print pattern distribution. These findings support the concept that lip print patterns remain largely stable throughout life. Therefore, cheiloscopy can serve as a useful supplementary tool in forensic identification.

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