



Analysis of Gender Dimorphism and their correlation in Lip and Palm Prints - A Cross-Sectional Study

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Table of Content

Table of Content	ii
List of Tables	iv
List of Figures	v
Abstract:	vi
CHAPTER 1	1
INTRODUCTION	1
1.1 INTRODUCTION	1
1.2 CHEILOSCOPY	1
1.3 DEVELOPMENT OF PATTERNS	2
1.4 LIP PRINT CLASSIFICATION SYSTEM	3
1.5 DERMATOGLYPHICS	4
1.6 PALM PRINTS	4
1.7 PALM PRINT DEVELOPMENT	5
1.8 PALM PRINT CLASSIFICATION	6
1.9 SIGNIFIANCE OF THE STUDY	6
1.10 AIMS & OBJECTIVES	7
CHAPTER 2	8
LITERATURE REVIEW	8
CHAPTER 3	14
MATERIALS AND METHODS	14
3.1 Sample Size	14
3.2 Sample Details	14
3.3 Inclusion Criteria	14
3.4 Exclusion Criteria	14
3.5 Research Design	14
3.6 Sample Collection	16
3.7 Materials for Cheiloscopy and Dermatoglyphics	16
3.8 Cheiloscopy	16
3.8.1 Methods of Collecting Cheiloscopic and Dermatoglyphic Patterns	17
3.9 Lip Print Pattern Collection and Analysis	17
3.9.1 Collection of Lip Prints	17

3.9.2 Palm Print Pattern Collection and Analysis	19
3.10 Statistical Analysis	20
CHAPTER 4	21
RESULTS AND DISCUSSION	21
4.0 Introduction	21
4.1 Descriptive Statistical Analysis	21
CHAPTER 5	26
CONCLUSION	26
5.1 Conclusion:	26
5.2 Limitations:	26
REFERENCES	27

List of Tables

Table No 4.1 Descriptive Statistics for Gender Wise Percentage Distribution of Lip prints	21
Table 4.2 Descriptive Statistics for Gender Wise Percentage Distribution of Left and Right Palm prints	22
Table 4.3 Chi-Square Test Results for Correlation between Right Palm Prints and Lip Print Patterns in Females	24
Table 4.4 Chi-Square Test Results for Correlation between Light Palm Prints and Lip Print Patterns in Males	25

List of Figures

Figure 1.1 : Suzuki and Tsuchihashi classification of lip grooves, adapted from (Suzuki, K., & Tsuchihashi, 1971).....	4
Figure 1.2: Classification of Palm Prints According to Wu et al.	6
FIGURE 3.1 Schematic representation of the research design.....	15
Figure 3.2: Materials required for collecting Lip Print Patterns	16
Figure 3.3: Type I of a Male Subject.....	17
Figure 3.4: Type I of a Female Subject.....	17
Figure 3.5: Type II of a Female Subject.....	18
Figure 3.6: Type III of a Female Subject.....	18
Figure 3.7: Type IV of a Female Subject.....	18
Figure 3.8: Category 1 in Right Palm of a Female Subject.....	19
Figure 3.9: Category 2 in Right Palm of a Female Subject	19
Figure 3.10: Category 3 in Left Palm of a Female Subject.....	20
Figure 3.11: Category 4 in Left Palm of a Male Subject.....	20
Figure 3.12: Category 5 in Right Palm of a Male Subject.....	20
Figure 4.1 Gender Wise Percentage Distribution of Lip prints	22
Figure 4.2 Gender Wise Percentage Distribution of Left and Right Palm prints	23

Abstract:

Background: Forensic science uses both lip prints and palm prints for personal identification, as these are unique and do not change in the lifetime of the individual. Although not up to par with fingerprints, palm prints and primary lines in both hands may be helpful when prints are insufficient for gender dimorphism.

Aim: To analyse the predominant pattern of lip prints and palmprints and to identify the correlation between right and left palm print patterns and lip print patterns in females and males.

Materials and Methods: The study involved 100 participants, with 50 males and 50 females, whose lip and palm print patterns were collected. Lip prints were taken by applying lipstick and pressing the lips against paper, following the Suzuki and Tsuchihashi classification. Palm prints were taken using a digital camera, focusing on the primary lines of the thenar, hypothenar regions, and proximal triradius of the second and fifth digits, based on the Wu et al. classification.

Results: The study reported 82% Type I' in females, 76% of males in Type I, the most frequent patterns were Type I' for females and Type I for males. Lip print pattern was not correlated significantly with the right and left palm print patterns for either gender since p-values for both males and females were greater than 0.05.

Conclusion: The use of standard lipsticks for collecting lip print impressions is the most convenient and easiest method. The Chi square test is also the most reliable test for getting the best outcomes in the analysis of palm prints. Personal identification was aided by the significant gender dimorphism and the correlation between palm patterns of females and males that were noted.

Keywords: Correlation, forensic identification, gender dimorphism, lip prints, unique, unchangeable, lipstick, palmprints, primary lines, thenar region, hypothenar region and proximal triradius.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The primary goal of forensic investigations is to identify a person or establish their identity. Personal identification is primarily the responsibility of the police and is relatively easier in the case of living people. In forensic science, the existence or lack of distinctive traits establishes the identify of living or deceased people. In forensic investigations, it is a crucial factor. This can be accomplished using the idea that each person's morphological and genetic traits are unique. As the frequency of mass murders, accidents, and disasters rises, the identification procedure is become increasingly challenging. When establishing a person's identity, factors including sex, height, age, race, fingerprints, DNA profile, anthropometric measures, scars, birthmarks, and so forth are typically taken into account. It is commonly acknowledged that stature and sex are two crucial characteristics that a forensic anthropologist may utilise to create a biological profile of unidentified human remains that can aid in personal identification out of the four main parameters of identification—race, sex, stature, and age (Aeri, 2015).It plays a key role in legal and humanitarian proceedings in the court of law.

1.2 CHEILOSCOPY

Cheiloscopy is the tried-and-true techniques for identifying an individual. According to several forensic investigations, lip impressions left on surfaces at crime scenes serve as a source of human identification. The word „cheiloscopy“ is derived from two Greek words, “cheilos”, which means “lips”, and “skopein”, which means “to see”. It can be used alone, as a personal identification means, or in combination with other techniques, such as fingerprint and DNA analysis. The term "cheiloscopy" refers to the study of lip prints. The term "" comes from the Greek word Cheiloscopy is the scientific study of the "wrinkles and grooves," which refers to the cells that lie between the outer ectodermal tissue of the lip and the inner labial mucosa Lip prints may serve as evidence at a geographic crime scene. The suspect can be directly identified by their lip prints, which are typically left at the crime site. They can be found at a crime scene either directly from a body or indirectly from a variety of

items such clothes, cups, cigarette butts, letters, windows, and doors. These prints are far more likely to be discovered in rape situations and criminal scenes when glass has been used, such as in burglaries. Lip prints on the surface of a spoon, a wind instrument, glasses, and fruits are frequently captured at crime scenes. Saliva frequently moisturises lips, which raises the possibility that lip prints will appear on objects including glass, plates, paper, cigarette butts, clothing, and the skin. In certain situations, researchers may employ cheiloscopy as supporting evidence and comparing the groove patterns of males and females may also aid in determining gender. Because each person's lip print is different, it may be used to identify them personally. They offer a clear connection to the suspect and are typically left at the scene of the crime. The problem has been that a lip smear is frequently disregarded as an unidentifiable fingerprint when it is found at the crime scene. Given their potential as information sources, it is best to recognise that lip prints have been retrieved from crime scenes (Saleem, H.M., Sodhi, S., Kale, L. and Hashmi, 2018).

Edmond Locard, however, was the one who suggested using lip prints for criminal identification and identification in 1932 LeMoyne Snyder first proposed the use of lipstick as a form of identification in order to assist forensic experts. The mouth may be open, relaxing, smiling, or kissing, among other positions. Depending on how the muscles flex, lip prints may appear differently. This leads to the observation of grooves that are only vertical (perpendicular) and not horizontal (transverse). It looks at the valleys, wrinkles, furrows, and grooves in the lip's vermilion zone (Venkatesh R, 2011).

1.3 DEVELOPMENT OF PATTERNS

As early as the sixth week of intrauterine life, lip print patterns can be recognised. They are specific to each person and remain constant throughout their existence. The upper lip is formed by the fusion of two maxillary prominences with the paired medial nasal prominences. The medial nasal and maxillary prominences merge caudally from the paired labial furrows, which are located lateral to the frontonasal groove along the upper lip. The cheeks and epithelial tissue leading to the nose are formed by the maxillary prominence. The lower lip is developed from mandibular prominence. Mandibular prominence is a derivative from the branch of the first pharyngeal arch. The anterior body of the 4 mandible is covered by the lower lip. It is lowered by the depressor labii inferioris muscle. Orbicularis oris muscle forms

the musculature periphery of the oral cavity (Priya, S.P., Salem, A.A., Almadhani, A., Thomas, S., Bhaskar, S., Alkhaldi, C.K.H., Al Samahi, H.A. and Ahmed, 2019).

1.4 LIP PRINT CLASSIFICATION SYSTEM

Lip prints are distinct, just like fingerprints. Lip prints are typical creases and cracks found in the human lip's transitional region that take the shape of wrinkles and grooves. These grooves are called "sulci labiorum," and the lip prints that contain them are called "linearum labiorum rubrorum" by (Gaur, 2013).

To examine lip prints, the most popular classification in literature to date was proposed by Tsuchihashi and Suzuki for lip prints. Tsuchihashi proposed the four-quadrant approach. An upper right (quadrant I), upper left (quadrant II), lower left (quadrant III), and lower right (quadrant IV) quadrant were created by dividing a lip print using this procedure in a clockwise manner Suzuki and Tsuchihashi classified the pattern of lip prints into six types :

Type I: A clear-cut groove or line running vertically across the breadth of the lip (full vertical).

1. **Type I'**: The vertical grooves which disappear half-way instead of covering the entire breadth of the lip (half vertical).
2. **Type II**: Lip grooves which fork in their course(branching.).
3. **Type III**: Lip grooves which intersect with each other(intersection).
4. **Type IV**: Lip grooves which are reticulate in nature (reticular).
5. **Type V**: Lip grooves which do not fall into any of the above categories and cannot be differentiated morphologically(irregular).

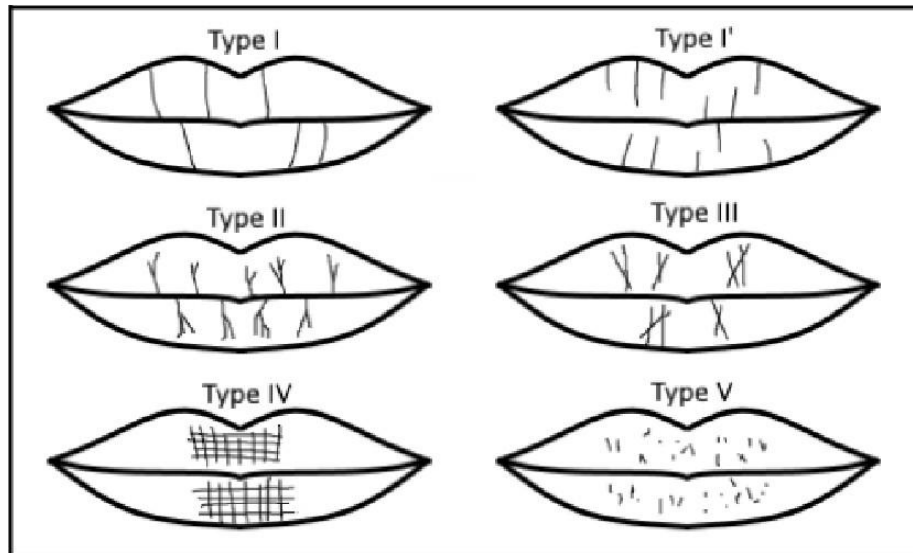


Figure 1.1 : Suzuki and Tsuchihashi classification of lip grooves, adapted from (Suzuki, K., & Tsuchihashi, 1971)

1.5 DERMATOGLYPHICS

Dermatoglyphic features have long been employed widely in comparative studies of human population variation and have been important in assessing ethnic affiliations because of their genetic control and immunity to environmental and climatic stressors. Dermatoglyphic characteristics have been widely used in comparative studies of human population variation and have historically been important in determining ethnic affinities. Latent prints, such as palm and finger prints, are extremely important in the field of forensic identification and investigation and are used to bring suspects to the level of prosecution in court . Because dermatoglyphic patterns are genetically determined, universal, permanent, and non-invasive to measure, they are useful in population investigations (Gaur, R., Kaur, K., Aeri, R., Jarodia, K., Sood, R., Kumar, 2013).

1.6 PALM PRINTS

The study of the arrangement of hairless epidermal ridges on the autopods' functional contact areas—the palms, fingers, soles, and toes—is known as dermatoglyphics. In addition to preventing slippage, these friction skin ridges improve grip and contact with surfaces and contain the sweat gland apertures on their peak .

In recent years, the investigators/ Police are increasingly using the palm prints as powerful means for criminal identification. It has become an active research topic for practical application with the physiological & behavioral characteristics of humans. An impression of the friction ridges may be left behind when someone touches a surface or grasps an object. Therefore, a thorough examination of the palmprints and fingerprints found at the crime scene helps identify the culprit in a particular case. Palm and finger prints are frequently found on crime scene items, including steering wheels, window glass, gun handles, and knife hilts. It is important to keep in mind that one cannot avoid contacting or gripping the surface while writing, creating art, etc (Yingbo Z, 2011). A portion of the palm should rest on the writing surface to provide support and ease hand movement. It is anticipated that the lower portion of the palm (the hypothalar area) will leave latent impressions on the writing surface or sheets as it meets it since the palm and fingers contain raised lines and furrows with sweat pores that keep the ridges moist. Sweat is a colourless fluid, therefore the prints that are left behind are not apparent to the unaided eye and are made more obvious. A positive and great progress have been made for effective identification from palm prints of an individual because of its stability and availability of large area for feature extraction (Chauhan, A., & Singh, 2014). On the other hand, Palm prints are more distinctive and have much larger area containing much more minutiae for personal identification than the fingerprints. Palm is the inner surface of hand between wrist and fingers which is covered with two unique patterns named as palmar friction ridges and palmar flexion creases. It includes a discriminating number of features such as principal lines, wrinkles ridges, minutiae, singular points etc (Yang X, Feng J, 2011). These characteristics are claimed to be perpetual and unique of an individual throughout the life similar like the fingerprints.

1.7 PALM PRINT DEVELOPMENT

The human skin weighs approximately eight pounds and covers an area of about 2500 to 3000 square inches of the body consisting two primarily layers as the inner “dermis layer” and outer layer or the protective layer “Epidermis layer”. The palm prints, fingerprints and the sole prints are the representation of the outer layer “epidermis layer” of the skin. The Palmar and Planter surface of primate are featured by the presence of dermal ridges. Palmar surface or the planter surface contain a pattern of interleaved ridges and furrows that allows human to grasp and grip the objects, these ridges are called friction ridges. These intricate patterns of epidermis which forms at a very early stage in the fetal life during the gestational

period of 12-19 weeks. This formation of epidermis is fixed for lifetime permanently. These prints are expected to grow in size and remain unaltered throughout the life of an individual.

1.8 PALM PRINT CLASSIFICATION

Wu et al.(Wu, X., Zhang, D., Wang, K., & Huang, 2004) classified palm prints on the basis of primary lines on the palms of an individual, as research work by using this classification was very limited. He categorized in six different categories:

- **Category 1:** Palmprints with one principal line.
- **Category 2:** Palmprints with two principal lines and no intersection.
- **Category 3:** Palmprints with two principal lines and one intersection.
- **Category 4:** Palmprints with three principal lines and no intersection.
- **Category 5:** Palmprints with three principal lines and one intersection.
- **Category 6:** Palmprints with three principal lines and more than one intersection.

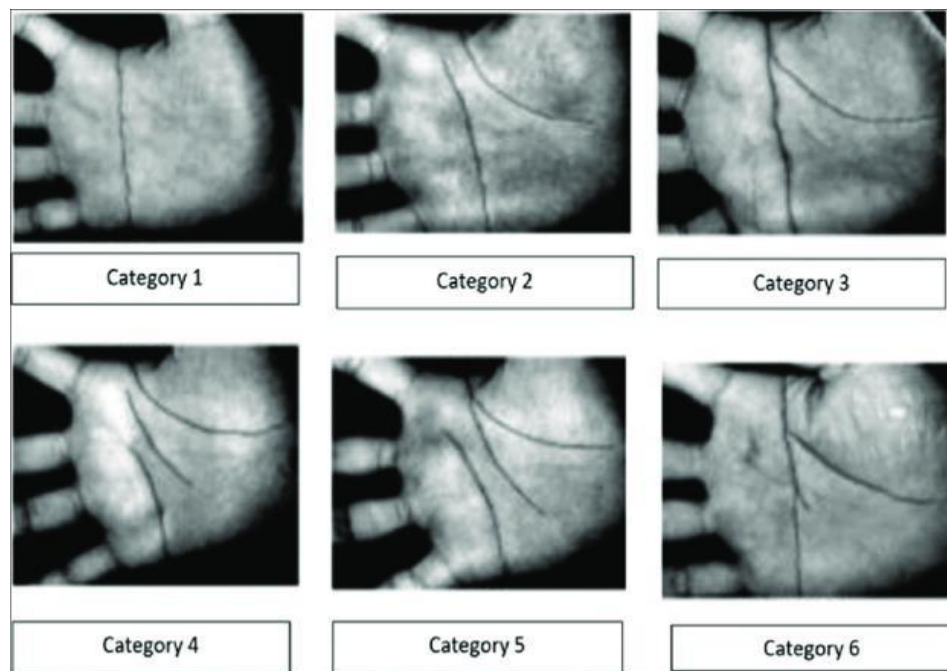


Figure 1.2: Classification of Palm Prints According to Wu et al.

1.9 SIGNIFIANCE OF THE STUDY

Dermatoglyphic and Cheiloscopy patterns, which include palm prints and lip prints respectively, are a unique and long-lasting method of biometric and personal identification.

Both palm and lip prints have similar embryological beginnings. But they still haven't reached their full potential, particularly when it comes to the connections between various pattern kinds and the gender differences among a larger population demographic. By methodically analysing lip print and palm print patterns, their relationships, and their variations between males and females. This study attempts to give a thorough understanding of lip and palm prints by examining, comparing and analysing prevalent patterns whether there is any association between the two. These prints help to compare between both male and female individuals based on a sample population group taken from all over India with uniformity with shedding light to the importance of primary lines of palms and how it helps to distinguish between the two above mentioned genders as research was very limited in the field.

1.10 AIMS & OBJECTIVES

1. To analyze the predominant pattern of lip prints.
2. To analyze the predominant pattern of palmprints.
3. To identify the correlation between the palm and lip print patterns.
4. To compare the lip print and palmprint patterns among genders.

CHAPTER 2

LITERATURE REVIEW

(Sangam, M.R., Praveen, K., Bokan, R.R., Vinay, G., Kaur, A. and Deka, 2024) conducted a cross-sectional study aimed to investigate the distribution of lip print patterns, to assess gender differences, and to calculate the lip score using a weighted value scoring system. The sample size comprised of a total of 200 individuals (100 males and 100 females) were included in the study from AIIMS, Guwahati, India, from May to October 2023. The result of the crosssectional study was that the most common pattern observed is type II, with 3,816/12,000 (31.8%), followed by type I' with 3,146/12,000 (26.21%), type I with 1,865/12000 (15.54%), type III with 1,491/12,000 (12.42%), type IV with 1,133/12,000 (9.44%), and type V with 549/12,000 (4.5%).

(Kurniawan, 2023) conducted a study that examined the detectability, possibility for sex distinction and forensic consequences of lip print patterns. The sample size was one hundred sixty-one subjects (101 females and 60 males, ages 18 – 20 years) with normal lip surfaces. The result of the study showed that type II lip print type was the prevailing type in Indonesian males and females and there were noticeable variances based on sex were seen in the upper left (UL) and lower middle (LM) quadrants.

(Anai, T.A., Rajab, M.S., Mohammed, S.M. and Jasem, 2022) conducted a study to determine lip print patterns among samples of the Salah El-Din population in Iraq and distribution their pattern type of lip print . The total sample size was 100 (50 females & 50 males) and their ages were more than 10 years old. The result of the study discovered that no two samples from the same family have identical lip-print patterns. Females had the greatest recorded pattern of groove type I (long vertical grooves), and males had the highest recorded pattern of groove type II (branched grooves). This pattern was most observed in the lower middle region.

(CHHIKARA, P. and SINGH, 2022) conducted a experiment to evaluate lip-prints as a tool of forensic identification. The study was done in North Haryana on 1000 subjects aged

between 15 and 25 years over a period of 2 years. The result of the experiment showed that no two individuals had similar lip prints. Type I pattern was most common followed by Type II whereas Type V was least common.

(Thomas et al., 2019) conducted a study focused on the reliability of the lip prints for the personal identification by comparing the registered lip prints with the developed latent lip prints made on the porcelain cups. The sample consisted of 102 subjects (52 males and 50 females) within the age group of 18–30 years were included of Ajman University—Fujairah branch students. The Ajman University. The result of the study showed that Type III was the most frequent pattern observed in the study group.

(Yendriwati, J.J. and Fitri, 2029) conducted a study to investigate the difference of dominant lip print pattern in general and also according to the different gender (male and female) among Malaysians with Chinese ethnicity at University of Northern Sumatran. The study sample consisted of 30 students, 15 each of males and females. The result of the study demonstrated that Malaysian Chinese students generally have type II as a dominant lip print pattern and there was a significant difference between male and female lip print patterns. Type II lip print patterns was the highest number found in males, whereas type IV was in females.

(Amit, C., Jyoti, S. and Singh, 2015) conducted the present study is to ascertain whether lip prints have the potential for assessment of sex of an individual from the configuration and to identify the most common pattern. The study comprised of 200 patients reporting to the outpatient department of CSMSS Dental College, Aurangabad (100 males and 100 females in the age group of 18–30 years). The result of the study showed that the most common pattern found in female was Types I and I', while Type IV and Type V were predominant among males.

(Alzapur, A., Nagothu, R.S. and Nalluri, 2017) studied the uniqueness, prevalence, and gender significance of lip print patterns in human subjects on 100 randomly selected male and female undergraduate medical students from Medi Citi Institute of Medical Sciences Hyderabad, India. The result of the study showed that Type I lip pattern was the commonest.

(Kaul, R., Shilpa, P.S., Padmashree, S., Bhat, S. and Sultana, 2017) conducted a study to find the most and the least prevalent lip print patterns in these groups and also to observe any similarities or differences that may exist in these groups in terms of lip print patterns. The study consisted of 755 subjects of Indian origin (375 males and 380 females) aged between 1 year and 80 years and they were divided into four ethno-racial groups: Caucasoids, Australoids, Mongoloids, and Negritos. The result of the study showed that among all the three ethno-racial groups, Type I was the most prevalent lip print pattern observed. The least prevalent lip print pattern in all the three groups was Type IV.

(Jeergal, P.A., Pandit, S., Desai, D., Surekha, R. and Jeergal, 2016) conducted a study to classify the characteristics of lip prints and to know the most common morphological pattern specific to Mangalorean people of Southern India. The study also assessed the association between gender and different lip segments within a population. The study comprised a total of 200 Participants of both sex with an age ranging from 18 years to 60 year. The result of the study showed that in males, the groove Type I' was the highest recorded followed by Type III, Type II, Type I, Type IV and Type V in descending order. In females, Type I' was the highest recorded followed by Type II, Type III, Type IV, Type I and Type V in descending order.

(Makesh Raj, L.S., Sai Krishna, P., Shankar, K.A., Jude, J., Jai Santhosh Manikandan, V. and Priyadarshini, 2016) conducted a study to find out most common lip print pattern and to assess their efficacy in sex determination. The total sample size comprised of 100 individuals including 46 males and 54 females in the age group of 18 to 25 years. The result of the study showed that Type I (vertical) was the predominant pattern in both males and females. The study also showed statistically significant difference between gender and type of upper lip print pattern is present but there is no correlation regarding lower lip pattern contradictory to many earlier studies.

(Ranjan, V., Sunil, M.K. and Kumar, 2014) conducted a study on the lip groove patterns in all the quadrants of both male and female subjects to identify the sex, based on the patterns of the grooves of the lip prints. The study consisted of volunteers from D. J. College of Dental Sciences and Research, Modinagar (UP) and the sample size was 300. The result of the study showed that none of the lip prints were identical, thus confirming the role of lip prints in individual identification.

(Sandhu, S.V., Bansal, H., Monga, P. and Bhandari, 2012) conducted a study to determine the predominant lip print type in a Punjabi population on 106 students comprised 56 males and 50 females in the age group of 18-25 years. The result of the study stated that no two lip prints matched with each other. Type 1 pattern (vertical grooves that run across the entire lip) was found to be predominant in both males (51.02%) and females (43.47%) and there was no statistically observed difference between males and females in individual lip print types.

(Venkatesh, R. and David, 2011) conducted a study to establish the uniqueness of lip prints which aids in personal identification. The sample comprised of 200 subjects who were divided into four groups: group 1 consisted of 85 males and 85 females of the age group between 5 and 30 years; group 2 comprised of five pairs of twins; group 3 comprised of five families (father, mother, child A and child B in each family); and group 4 comprised of 10 males and 10 females, whose lip prints were recorded twice at the interval of 3 months. The result of the study showed that lip prints are unique and permanent for each individual, and the lip prints among family members and between twins revealed different patterns on the whole with few similar grooves suggesting the existence of heredity in the lip prints.

(Ali, F.I. and Ahmed, 2020) conducted a study that aimed to assess the topological variability in palmar ridge densities and its applicability to estimate sex among Sudanese Arabs. The sample size of the study were obtained from bilateral palmprints of 168 (94 males and 74 females) Sudanese subjects aged between 18 and 30 years. The result of the study showed that the females had a significantly greater mean ridge density than the males in all areas bilaterally. Side asymmetry between areas in ridge density was more evident in males.

(Adetona, 2018) conducted a research to examine the variability of palm ridge density (PRD) from palm prints among Hausa, Igbo and Yoruba ethnic groups and its ability to infer sex in forensic examinations. The sample size consisted of bilateral palm prints of 560 healthy adults (251 females and 309 males) from three ethnic groups in southwestern states. The result of the study showed significant differences in palm ridge densities among Nigerian major ethnic groups and there are also gender, right and left hand differences in this dermatoglyphic parameter.

(Ranade, 2017) conducted a research to determine the sex of individual from the palm print ridge density. The sample size consisted of 50 males and 50 females. The result of this experiment showed that males have less ridge count as compared to females.

(Amit, C., Jyoti, S. and Singh, 2015) conducted a study on latent palm prints and their possibility to identify the suspects from such latent prints from scene of occurrence, even on documents. The sample size was 60 including (30 male & 30 female) aging from 18-55 years taken from the population of Uttar Pradesh, North part of India. The result of the study showed that higher ridges densities are found in females in comparison of males which indicated that the differentiation of sex from the latent palm prints can be done successfully on the basis of ridge density of latent palm prints.

(Krishan, K., Kanchan, T., Sharma, R. and Pathania, 2014) conducted a study that aims at the variability of palmprint ridge density in a North Indian population, and its significance in inference of sex in forensic examinations. The sample consisted of 157 healthy young adults (110 females and 47 males) from Shimla city in North India. The result of the study showed variability of palmprint ridge density among sexes and in different regions of the palm on both sides.

(Sen, J., Kanchan, T. and Mondal, 2011) conducted a study to establish personal identification in forensic cases. Two such populations are the Rajbanshi and the Mech. The sample size consisted of 192 adult Rajbanshi (105 men and 87 women) and 100 adult Mech (50 men and 50 women) from the northern part of West Bengal. The result of the study showed differences between the Rajbanshi and Mech individuals with respect to these dermatoglyphic variables. The uses of these variables were limited only to ethnic identification, not personal identification. The present investigation further highlights the racial affinity, sex, and bilateral differences among Rajbanshi individuals using dermatoglyphic palmar variables.

(Reddy, B.K.C. and Reddy, 2006) conducted a research on bilateral palm prints. The sample size consisted of 75 males and 75 females of Sugali, a tribal population of Andhra Pradesh were analysed for principal main line formulae, C- line polymorphism, main line index, a-b ridge count and 'atd' angle. The result of the study showed that main line index value found to be more among males (8.33 ± 0.31) than that of females (7.30 ± 0.24) and a-b ridge counts

are found to be higher on left palms than the right ones and both the sexes show significant bilateral difference.

(Kamali, M.S., Malhotra, K.C. and Chakraborty, 1986) conducted a study on bilateral palmar prints. The sample size consisted of 604 male individuals from 12 Iranian groups, six Mongoloid and six Caucasoid. The result of the study demonstrated the existence of variation in the size of the palmar patterns across different populations within an ethnic group, as well as that among different ethnic groups, and seems to be a better indicator of inter population diversity than the palmar pattern frequencies.

CHAPTER 3

MATERIALS AND METHODS

3.1 Sample Size

The study was conducted in the Department of Forensic Science, Jaipur - 303905, after obtaining the permission letter from the concerned authority.

The total sample size was 100 with equal gender distribution.

3.2 Sample Details

The present study comprised of 100 individuals (50 males and 50 females) aged 18-25 years. The palm prints and lip print of samples were collected after obtaining their informed consent at the Department of Forensic Science and also from the Department of Physics, JECRC University, Jaipur, Rajasthan, India.

3.3 Inclusion Criteria

- Individuals aged 18-25 years.
- Individuals from various regions of India but studying in JECRC University.
- Lips and palms free from any pathology (congenital and acquired), and having normal transition zone between the mucosa and skin were included in the study.

3.4 Exclusion Criteria

- Individuals with known allergy to lipstick and colouring medium.
- Individuals with inflammation of lips and fingers following trauma, malformation, deformity, surgical scars, facial palsy, and active lesions of the lips and fingers. - Non ambulatory patients.

3.5 Research Design

The present study on dermatoglyphic patterns and cheiloscopy patterns is a cross-sectional descriptive study.

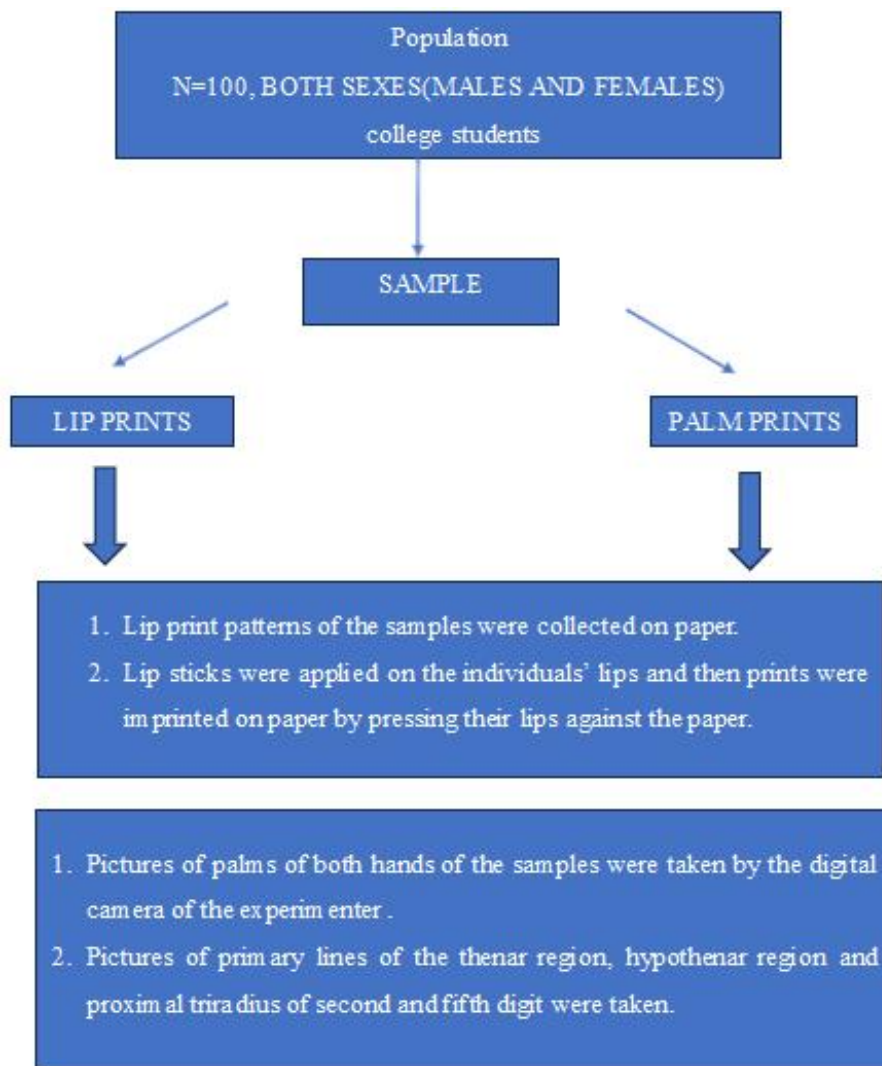


FIGURE 3.1 Schematic representation of the research design

- 50 males and 50 females were included in the study after taking their informed consent.
- Lip print patterns of the samples were collected on paper.
- Collected patterns were analyzed and tabulated in microsoft excel sheet.
- Palm pattern pictures of the samples were taken.
- Collected patterns were analyzed and tabulated in microsoft excel sheet.
- Statistical analysis was done as per the objectives of the research.

Objectives:

1. To analyze the predominant pattern of lip prints.
2. To analyze the predominant pattern of palmprints.
3. To identify the correlation between the palm and lip print patterns.

4. To compare the lip print and palmprint patterns among genders

3.6 Sample Collection

All the study participants were from India. Prior to the sampling, the purpose and technical details of the study were explained to the study participants. The participants were given participant information sheet, describing the purpose of the present study. A written consent was obtained from the participants (cases/controls) who were willing to participate in the study. The lip print and palm print patterns were collected from Department of Forensic Science and also from the Department of Physics, JECRC University, Jaipur, Rajasthan, India.

3.7 Materials for Cheiloscopy and Dermatoglyphics

The armamentarium used for the current research can be broadly divided based on the usage as in 1) Cheiloscopy and 2) Dermatoglyphics.

3.8 Cheiloscopy

Armamentarium required for collection of lip groove patterns (Figure 3.2).

1. Dark and non-glossy lipstick with disposable applicator brushes
2. Pencil, ruler and eraser.
3. Magnifying lens
4. A4 sized paper



Figure 3.2: Materials required for collecting Lip Print Patterns

3.8.1 Methods of Collecting Cheiloscopy and Dermatoglyphic Patterns

The sample collection was done at the Department of Forensic Science, JECRC University, Jaipur, Rajasthan, and supervised by a co-observer. The methodology is broadly divided into:

1. Lip print pattern collection and analysis and, 2) Palm print pattern collection and analysis.

3.9 Lip Print Pattern Collection and Analysis

After taking informed consent, lip print patterns were collected from the male (n=50) and female (n=50) female participants in the study, at the Department of Forensic Science, JECRC University, Jaipur, Rajasthan. The sample collection was aided by a co-observer.

3.9.1 Collection of Lip Prints

The participants were instructed as follows: i) to clean up their lips following which lip stick was applied on the lips preferably with a single stroke. ii) To rub the lips in order to spread the lip sticks uniformly from centre to corner of lips. iii) To stop moving the lips during the procedure, and iv) To keep the lips in relaxed state. Lip prints were obtained in the normal resting position of the lips. Then A4 size sheet was placed on the table top and the subject pressed gently his or her lips on the piece of paper to get the print of both upper and lower lips.

Care was taken to avoid sliding of lips, and to prevent smudging of lip prints collected.



Figure 3.3: Type I of a Male Subject



Figure 3.4: Type I of a Female Subject

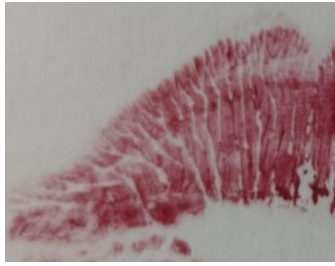


Figure 3.5: Type II of a Female Subject

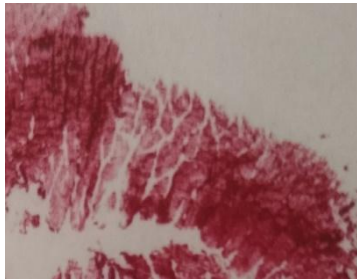


Figure 3.6: Type III of a Female Subject

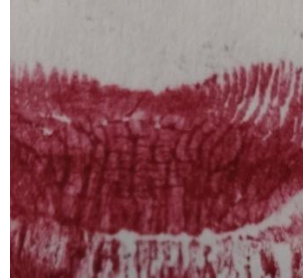


Figure 3.7: Type IV of a Female Subject

The analysis was done as per the Suzuki and Tsuchihashi classification. The classification is as follows:

- Type I (a clear cut groove running vertically across the lip),
- Type I' (a partial-length groove of type I),
- Type II (a branched groove), Type III (an intersected groove),
- Type IV (a reticular pattern), and
- Type V (other patterns)

3.9.1.1 Analysis of Lip Print Patterns (Qualitative and Quantitative)

Lip groove patterns collected were qualitatively and quantitatively analysed in each of the four quadrants. The type of lip groove patterns were evaluated and counted in each quadrants separately. The obtained data is entered in an excel sheet along with the name and gender of the individual. The tabulated lip groove patterns were assessed for the predominant pattern in each quadrant of the lip. All the lip groove patterns with the highest number of lines in the specified quadrant was considered predominant in the specified region.

The patterns (qualitative and quantitative) identified were entered in an excel sheet against the gender of the individual for the entire samples.

3.9.2 Palm Print Pattern Collection and Analysis

After taking informed consent, palm print patterns were collected from the male (n=50) and female (n=50) female participants in the study, at the Department of Forensic Science, JECRC University, Jaipur, Rajasthan. The sample collection was aided by a co-observer.

3.9.2.1 Collection of Palm Print Patterns

The palms of both left and right hands of the individual subject was cleaned properly with soap and made dry with a clean handkerchief and then the pictures of both hands' palms were taken by using a camera of the android phone of the experimenter for primary lines analysis.

3.9.2.2 Analysis of Palm Print Patterns (Qualitative and Quantitative)

The palm patterns collected were classified and qualitatively and quantitatively assessed for primary lines identification on the basis of Wu et al. classification- Category 1: Palmprints with one principal line.

- **Category 2:** Palmprints with two principal lines and no intersection.
- **Category 3:** Palmprints with two principal lines and one intersection.
- **Category 4:** Palmprints with three principal lines and no intersection.
- **Category 5:** Palmprints with three principal lines and one intersection.
- **Category 6:** Palmprints with three principal lines and more than one intersection.



Figure 3.8: Category 1 in Right Palm of a Female Subject

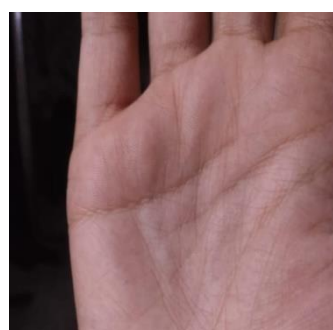


Figure 3.9: Category 2 in Right Palm of a Female Subject



**Figure 3.10: Category 3 in Left Palm
of a Female Subject**



**Figure 3.11: Category 4 in Left Palm
of a Male Subject**



Figure 3.12: Category 5 in Right Palm of a Male Subject

The patterns (qualitative and quantitative) identified were entered in an excel sheet against the gender of the individual for the entire samples.

3.10 Statistical Analysis

Measures of central tendency and descriptive statistics were used to summarize the collected data on lip and finger prints. Mean and standard deviation was calculated and assessed for each groups separately. SPSS version 22 software was used to evaluate the data collected. The correlation of lip print and palm print with gender of an individual was assessed by Karl person correlation coefficient and chi square test.

CHAPTER 4

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents an in-depth evaluation of the data analysis that was carried out. The initial component of the analysis involves presenting descriptive statistical results and findings, accompanied by the inclusion of mean score, standard deviation, and figures. The subsequent section presents the outcomes and observations of inferential statistics, specifically the Pearson product moment correlation coefficient. These results are accompanied by graphical representations for better understanding.

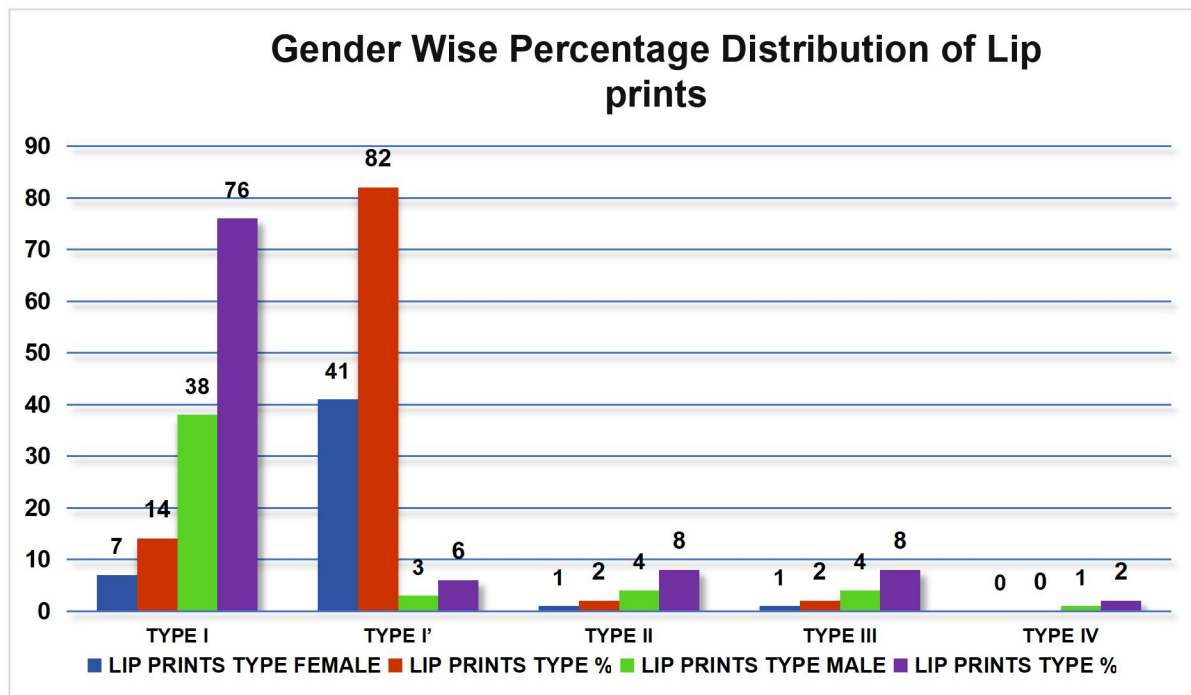
4.1 Descriptive Statistical Analysis

A self-report schedule was developed to collect data pertaining to both Male and Female on palm prints and lip prints for the present study. The tables and graphical representations presented below depict the data collected through an interview schedule administered to both Juvenile Delinquents and Juvenile Non-Delinquents. The results are presented below.

Table No 4.1 Descriptive Statistics for Gender Wise Percentage Distribution of Lip prints

LIP PRINTS TYPE	Gender Wise Percentage Distribution of Lip prints			
	FEMALE	%	MALE	%
TYPE I	7	14	38	76
TYPE I'	41	82	3	6
TYPE II	1	2	4	8
TYPE III	1	2	4	8
TYPE IV	0	0	1	2
	50	100	50	100

Figure 4.1 Gender Wise Percentage Distribution of Lip prints



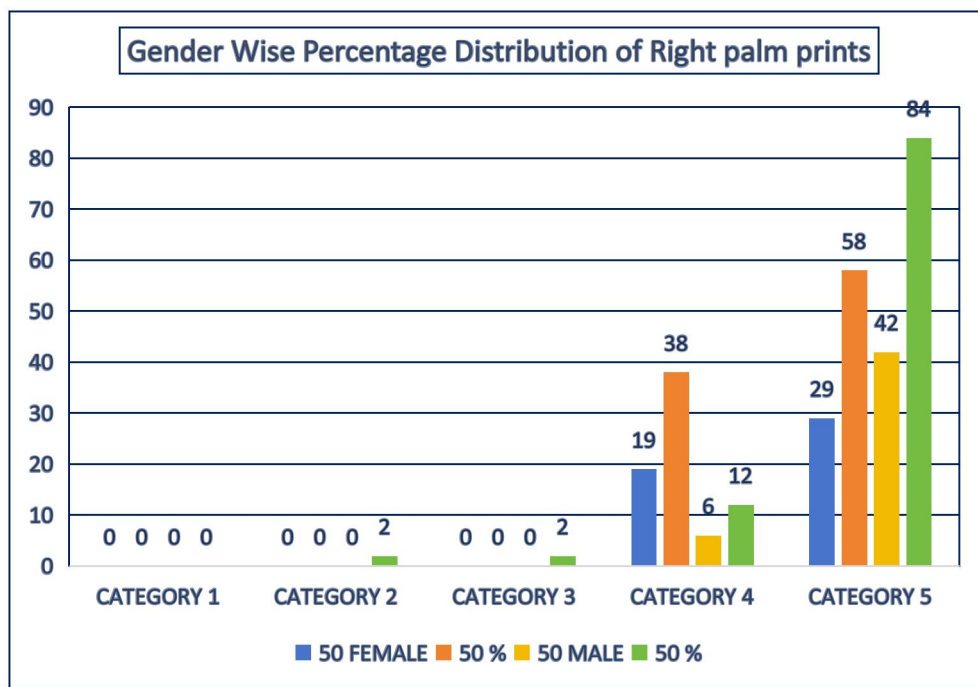
The data presented in Table 4.1 and Figure 4.1 indicate that a significant proportion of the Lip print Patterns among females in the present study was found to be (14%) in Type I (82%) in Type I', (2%) in Type II, (2%) in Type III, (0%) in Type IV; whereas in males (76%) in Type I, (6%) in Type I' and (8%) in Type II, (8%) in Type III, (2%) in Type IV . The most common pattern was being Type I' in females and Type I in males.

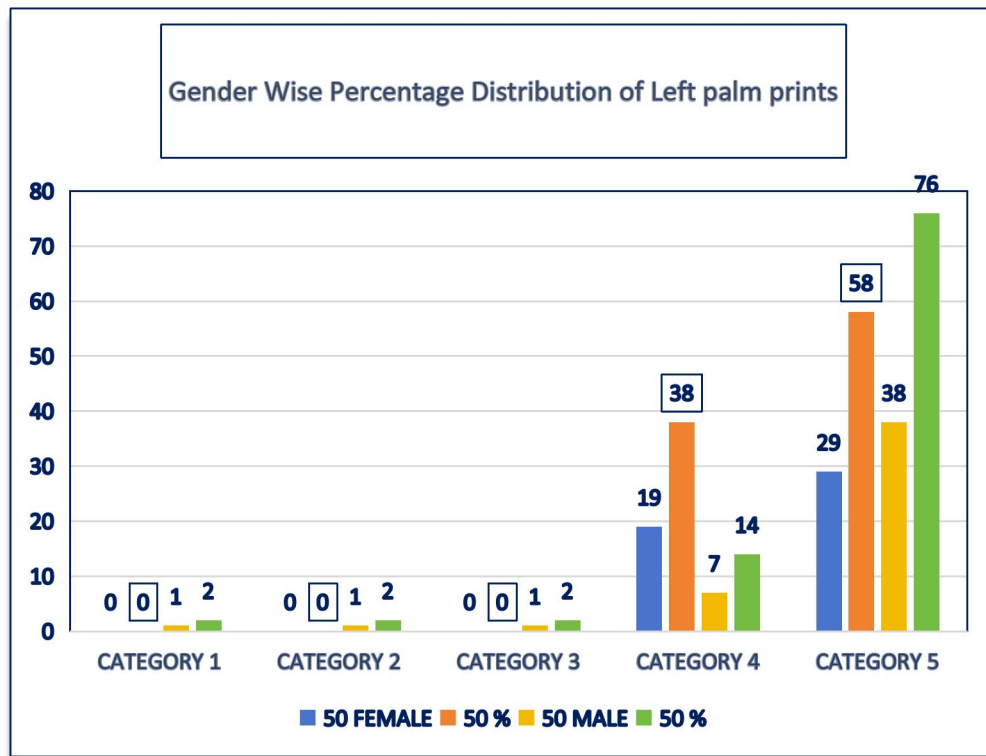
Table 4.2 Descriptive Statistics for Gender Wise Percentage Distribution of Left and Right Palm prints

PALM PRINTS TYPE	TOTAL NUMBER OF LEFT PALM PRINT DISTRIBUTION (N=50)				TOTAL NUMBER OF RIGHT PALM PRINT DISTRIBUTION (N=50)			
	FEMAL E	%	MAL E	%	FEMAL E	%	MAL E	%

CATEGORY 1	0	0	1	2	0	0	0	0
CATEGORY 2	0	0	1	2	0	0	1	2
CATEGORY 3	0	0	1	2	0	0	1	2
CATEGORY 4	19	38	7	14	19	38	6	12
CATEGORY 5	29	58	38	76	29	58	42	84

Figure 4.2 Gender Wise Percentage Distribution of Left and Right Palm prints





Chi-Square Test Results

Table 4.3 Chi-Square Test Results for Correlation between Right Palm Prints and Lip Print Patterns in Females

Chi-Square Tests				
Gender		Value	Df	Asymp. Sig. (2-sided)
Female	Pearson Chi-Square	2.527	3	.470
Male	Pearson Chi-Square	3.372 ^c	4	.498
Total	Pearson Chi-Square	5.868	4	.209

Pearson Chi-Square Test

- The p-values for both males (0.498) and females (0.470) are greater than 0.05, indicating no statistically significant relationship between lip print patterns and right palm print patterns in either gender.

No significant correlation exists between lip print patterns and right palm print patterns in either gender. This result suggests that lip and palm print patterns are likely independent of each other.

Chi-Square Test Results

Table 4.4 Chi-Square Test Results for Correlation between Light Palm Prints and Lip Print Patterns in Males

Chi-Square Tests				
Gender		Value	Df	Asymp. Sig. (2-sided)
Female	Pearson Chi-Square	3.791	3	.285
Male	Pearson Chi-Square	14.077	16	.593
Total	Pearson Chi-Square	27.958	16	.032

Interpretation of Results

- For females, the p-value = 0.285 (> 0.05), meaning no significant correlation between lip print patterns and left palm print patterns.
- For males, the p-value = 0.593 (> 0.05), indicating no significant correlation.
- For the total sample, the p-value = 0.032, which is statistically significant at $\alpha = 0.05$.

No significant correlation exists between lip print patterns and left palm print patterns for males or females individually.

CHAPTER 5

CONCLUSION

5.1 Conclusion:

Lip impressions and palm prints are valuable and unique identifiers in crime scenes, particularly in homicide, robbery, and sexual assault cases. Palm prints offer more detailed ridge patterns and are valuable in forensic investigations when fingerprints are unavailable. When properly collected and examined, lip and palm prints can significantly improve criminal investigations. Lip prints are unique to an individual, just like fingerprints. They can be employed for personal identification: unique patterns of lip grooves or wrinkles, known as sulci labiorum that persist throughout a person's lifetime. Lip prints can be found on glasses, cigarettes, garment, or body skin can indicate a suspect. These prints also display differences between male and female lip print patterns which can make this process of identifying the perpetrator and lipstick residues may provide clues about the brand used, which can help in profiling a suspect. Palm prints, including ridge patterns and creases as well as primary lines can be used for personal identification as palm prints have unique ridge patterns that remain unchanged throughout life just like fingerprints. They are usually found at crime scenes on surfaces on which a criminal has touched his or her hands, such as doors, windows, or weapons. Palm prints can provide significant behavioural insights – A person's grasp or pressure in pressing his palm against a surface can be helpful in understanding movements and activities within a crime scene.

5.2 Limitations:

Further multicentric research with a large sample size, involving larger number of participants, would help in establishing the significance of lip and palm prints and gender dimorphism for personal identifications in criminal investigation

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