A Comparative Study of Palm Print Features Among Male Hard Workers and Non-Hard Workers in Mangalore City

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I. INTRODUCTION

Palm print is the unique feature present on palm of every individual. It varies on each individual. The friction ridge skin present in the palm develop in the uterus during First and second trimester. A palm print is a highly unique biometric identifier consisting of creases, ridges, and valleys on the inner hand, offering higher accuracy than fingerprints due to having ~1,500 distinct characteristics. Used in forensics and security, it captures both structural lines and skin texture, making it ideal for authentication via scanners or, historically, ink. The palm itself consists of principal lines, wrinkles (secondary lines), and epidermal ridges. It differs to a fingerprint in that it also contains other information such as texture, indents and marks which can be used when comparing one palm to another. Palm prints can be used for criminal, forensic, or commercial applications. Palm prints are often found at crime scenes as the result of the offender's gloves slipping during the commission of the crime, and thus exposing part of the unprotected hand. Palm prints can have around 1,500 different characteristics whereas
fingerprints can only have around 150.

1.1 : Ridges of palmprint

The palm print mainly consists of three lines or ridges: the main line, the secondary line (wrinkles), and the epidermal line. Palm prints are unique to each individual.

The Principal Lines (Major Creases/Flexion Creases) are the deep, visible lines formed in the foetus. It consists of Heart Line (Distal Transverse Crease): Starts below the little finger and runs toward the index finger, Head Line (Proximal Transverse Crease): Runs horizontally across the middle of the palm, Life Line (Radial Transverse Crease/Thenar Crease): Curves around the base of the thumb.

The Secondary Lines (Wrinkles/Minor Creases): Thinner, more numerous irregular lines scattered across the palm that differ from the stable principal lines. The Epidermal Ridges (Friction Ridges): Tiny corrugated skin patterns containing sweat glands that form the actual "print" used for identification, similar to fingerprints.

1.2 : Regions of palmprint

The Areas in the Palm are Thenar Area: Located at the base of the thumb, this area is associated with the life line and often contains dense, thin creases (wrinkles).

The Hypothenar Area: Situated on the ulnar side (opposite the thumb) of the palm, this area is often large and frequently contains distinct ridge patterns, making it highly valuable for identification. The Inter digital Area: Located at the top of the palm, directly below the four fingers (digits II-V), this region includes four digital tri radii.

A palm print differs from a fingerprint in that it contains information such as texture, indentations, and markings that can be used when comparing one palm with the other.

The occupational marks present in palm of occupants can be based on repetitively friction applied by them in mostly the thenar and hypothenar region of Palm. By the usage of sharp instrument there might be marks or scars in their palm.

Palm print is considered validated in courts as a evidence. As it is considered as evidence, it is applied to other laws linking with biological Evidences. In BNSS, the Evidences related to the palm print can be

considered as a evidence for further examination of it.

1.3: Comparative study on palmprint features among male hard and non-hard workers

In this study, A comparative study on palm print features among hard and non-hard workers, the palm print of hard worker (construction workers) and non-construction workers(staff) will be taken. Both palm will be taken for analysis. Here, The Palm print is looked for the principal lines, short creases, cuts/scars, and ridges characters.

II. REVIEW OF LITERATURE

A literature review is a detailed summary and analysis of existing research on a particular topic. It involves examining scholarly books, articles, and other academic sources to understand what has already been studied, what gaps exist, and how your research fits into the broader academic conversation. The Review of literature are displayed based on the year of publications.

The study conducted by Xiangqian Wua, David Zhang b, Kuanquan Wanga, Bo Huanga titled Palmprint classification using principal lines examined the principal lines.This study used a biometric image processing method for classification of extraction of principle Lines. This study focuses on identifying number of principle lines and number of it intersecting the line. The palmprint images are collected using CCD camera-based device.The samples used for the study is 13,800palmprint images (10 images per palm). The result for the study is that the classification is accurate to 96.03%. The Suggestion given is use of enhanced biometric system.

The study conducted by Hlaing Htake Khaung T (2012) titled "Personal Identification and Verification using Palm Print Biometric" examined the developing a biometric authentication system using palm print images. The sample in this study consisted of multiple palm print images captured using a digital camera/webcam (resolution 640×480), rather than a fixed human sample size, as it is a system-based experimental study. The samples included grayscale palm images used for testing the system. It specifically analyzing unique features such as principal lines, wrinkles, and ridges of the palm, along with image processing techniques like image acquisition, pre - processing, segmentation, and feature extraction. The findings showed that the proposed palm print biometric system was efficient for personal identification and verification, demonstrating that palm prints provide stable and unique characteristics that remain unchanged over time and can be effectively used for authentication purposes.

The study conducted by Yong, xu, Linke,fei,& Devid, Zhang, (2015) titled Combining left and right palmprint images for more accurate personal identification focused on matching score level fusion method. The sample size includes Poly U Palmprint Database- 3750 images from 187 individuals, IITD Palmprint Database - 3290 images from 235 individual. The result showed that right and left Palmprint of the same person are correlated. The suggestions for the study extend this approach to other biometric combination (face palmprint)

A study conducted by Mahalakshmi, B. S., & Sheela, S. V (2018) titled "A review on palmprint authentication system using various feature extraction and classification techniques" examined the comparison different feature extraction techniques. The data consists of variously published data.The result include texture based and transform based method provides higher accuracy. As it is secondary data, age group and jurisdiction are not considered. The suggestions for the study are palmprint recognition is reliable, cost efficient, and accurate compared to some other biometric system,future system should use hybrid techniques, improves real time processing speed.

The study conducted by Mahendra Rajput and Sakshi Manhas (2023) titled "Comparison of Occupational Marks in Finger and Palmprint Impressions of Potters, Brick Kiln Labourers & Masons with Reference Samples "examined the analysis of occupational effects on fingerprints and palm prints for forensic identification. The sample size included individuals working as potters, brick kiln labourer, and masons, along with reference (control) samples, although the exact number is not specified l. The samples consisted of fingerprint and palm print impressions collected from these occupational groups. The principle applied in this research is dermatoglyphics and forensic identification, focusing on friction ridge patterns and occupationally induced features such as calluses, scars, abrasions, burns, stains, and blisters. The methodology involved comparative visual and morphological analysis of prints between occupational

groups and reference samples. The results revealed that each occupation produces distinct and consistent occupational marks on fingerprints and palm prints due to repetitive manual activities, making them useful indicators in forensic investigations. Therefore, further large-scale and technologically advanced studies are required to strengthen the reliability and applicability of occupational fingerprint analysis in forensic science.

The study conducted by Rajan Sharma, Rupak mukhopadhyay,afreen tarunam, Preet kumar, Jaswinder Singh Chauhan, Deepika bhandari (2024) titled "Personal identification from occupational marks present on the palm prints: A study of the urban region of new Delhi"examined the role of occupational marks in Palm prints for personal identification. The method of sample collection is ink method. The sample size is 150 individuals (50 each of construction workers, mechanical pullers, rickshaw pullers). The age group included here is 15-60 years (mechanical Workers :20-45years, construction workers: 15-60years: rickshaw pullers: 20-50 years. The result of this Study has Different characteristic ridge pattern for different workers. The suggestions include development of standardized database of occupational palmprint features,using advanced techniques.

The study conducted by Dhakal, S., & Kaul, P. (2025) titled "The Hidden Potential of Lateral Palm Prints in Occupational and Forensic Identification Systems" states that in lateral Palmprint hypothenar region plays an important role in identification of individual. The method of collection is using stamp pad and magnifying lens. Sample size is 50 individuals (10 each of field workers, construction workers, drivers, bankers, police personnel. The age group included is 25-55. The result of this study is that Palmprint has different characters for different occupation, hypothenar region provides major role in identification. The suggestions for this study are using advanced learning and machine learning.

The study conducted by Gautam Kumar, Khalida Nazeer, Namrata Singh, Asim Ameen, Roomi Parveen, and Ekta Singh Yadav (2025) titled "A Multivariate Study on the Role of Palm Print Features for Estimating Age, Gender, Lineage and Profession". The study is a narrative literature review covering research published between 1987 and 2025. As it is a review-based study, no fixed sample size was used. The study examined palm print samples in terms of ridge patterns,crease morphology, and ridge density influenced by biological, hereditary, and occupational factors. The tool applied is Dermatoglyphics and biometric identification, along with modern computational approaches such as CNN, ResNet-50, and Automated Palmprint Identification Systems (APIS) for feature extraction and demographic estimation. The results showed that palm prints are unique andpermanent; aging affects ridge clarity, gender differences exist in ridge density, hereditary traits influence crease patterns, and occupations involving manual labour cause permanent alterations in palm feature useful for forensic identification. The findings for the study are age; gender affects palmprint characters. The suggestions here are to apply it in large scale,and to develop standardized databases.

After going through all the above studies, it was found that construction workers study is not much focused for identifying Palm Print. As the construction workers give more pressure to their palm region during workers,it might have been focused. The comparative analysis in occupant with hard and non-hard workers are not much focused. In some of the studies construction workers are included along with some other hard workers. In these studies, some uses inked techniques and some used devices to identify the features.In.this study comparative study is conducted along with the usage of mobile application for image extraction.

III METHODOLOGY

Research methodology is the structured plan a researcher follows to conduct a study. It includes the strategies, techniques, and tools used to gather and analyze data. The purpose of a research methodology is to ensure that the study is systematic, valid, and reliable. A well-defined methodology helps others understand how the research was done and allows them to replicate or evaluate the work effectively.

3.1 : Need for the study

This study can be useful in Identification of occupants based on their Palm prints during investigation and it can be useful to understand the palm print features

clearly. If the palmprint is found in the crime scene it can be useful for the identification of individual.

3.2 : Objective

- To analyse the palm print features of male hard and non-hard workers
- To compare ridge characters and pattern variations between the group of two occupantion.
- To determine the occupation influences on palm print characteristics.

3.3 : Aim

To compare the palm print features of male hard and non-hard workers in Mangalore city

3.4 : Research questions

- What are the differences in palm print features in male hard and non-hard workers?
- How do ridge characteristics and pattern variations differ between hard workers and non-hard workers?
- How palm print features influences in occupational identification?

3.5 : Research design

A research design is defined as the overall plan or structure that guides the process of conducting research. The present study will adopt Experimental-field based with both quantitative and qualitative research, as it will focus on ridge characters along with features in palm print.

3.6 : Universe, sample, sampling technique

The present study is conducted in the Mangalore city among males between age group 25- 40years. The samples are collected using a Mobile application 'Ifing scanner'. The respondent's taken for the study are 5 hard Workers and 5 non-hard workers using probability random sampling techniques with purposive sampling

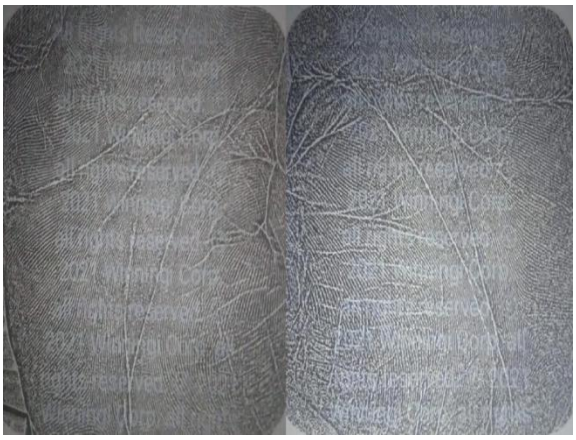
3.7 : Tools and procedure for data Collection

The tool used in this study for the data collection is mobile application 'ifng scanner'. The respondents are instructed to wash their hands and dry beforecapturing their palm print. The 'ifing scanner' application will be opened and scan option will be clicked. The camera is opened and respondent is requested to place their palm in the plain surface and the camera is focused on the Palmer regions.

The respondent is requested to stand still until the scan captures the palm print. This application creates separate folder to scan each person's left and right palms. The folder is named based on the occupation and numbering is given based on the collection of samples. The Application scans the features in palm and created extracted image. Separate folder was be created for each respondent.



Photographs of right and left palm of construction worker



Right palm print of construction worker and Left palm print of construction worker Captured in Ifing scanner



Photograpghs of left and right palm of one of the non-construction workers

Right palm print of non-construction worker and Left palm print off non construction worker Captured in Ifing scanner

3.8 : Inclusion Criteria

- The Palm prints of occupants with more than 3years of experience are selected.
- The occupants are selected between the age group 25-40years.

3.9 : Exclusion criteria

- The occupants working in other areas are excluded
- The occupants with less than 3 years of experience are excluded. The following criteria are used for the study

Data coding, presentation and analysis

The gathered data will be categorized and assigned a code as in codebook. By referring to the codebook the data will be in Microsoft excel. The SPSS (Statistical Package for the Social Sciences) is applied to present the data in double variate table and histogram.

Report design

The present study is categorized into five chapters.

Chapter 1- Introduction: It contains brief about the topic, causes, laws related to it

Chapter 2: Review of literature: It contains reviews of related papers and research gap

Chapter 3: Methodology: It contains need for the Study, objectives, aim, research question, research design, Universe of the study, sample, sample size, tools for data collection, inclusion criteria, exclusion criteria limitations

Chapter 4: Data analysis: It contains Cross related data analysis

Chapter 5: Findings, suggestions, conclusion:This includes highlight of the study, major findings, limitations, suggestion.

Limitations

- The characters are observed only when the clear image is captures.
- The study only focused on male hard workers.
- The study is focused on Mangalore city.

IV. DATA ANALYSIS AND INTERPRETATION

Data analysis

Data analysis is the systematic process of cleaning, transforming, modeling, and examining data to discover useful information, suggest conclusions, and support decision-making.

A hard palm (or firm palm) generally refers to the physical consistency or texture of the hand's skin and underlying tissue.

The principal lines of the palm are the longest, deepest, and most visible creases on the palmar surface of the hand. They form before birth to help the skin fold, stretch, and grip objects, and they serve as primary features in biometric recognition.

4.1 : Qualitative features of palm of male hard and non-hard workers



The data presented in Table 4.1 shows the qualitative differences in palmprint features between male hard workers and non-hard workers, particularly with respect to hardness of the palm and the appearance of principal lines.

With regard to hardness, it is observed that the palms of hard workers are predominantly rough in texture, whereas the palms of non-hard workers are comparatively smooth. This variation can be attributed to the nature of occupational activities, where hard workers are frequently engaged in manual labour involving continuous friction, pressure, and use of tools, leading to the development of rough skin texture. In contrast, non-hard workers are less exposed to such physical stress, resulting in smoother palm surfaces.

With respect to principal lines, hard workers exhibit darker and more prominent lines, while non-hard workers tend to have lighter and less distinct lines. The increased prominence of principal lines among hard workers may be due to repeated mechanical stress and strain on the palm, which enhances the visibility and depth of these lines over time.

The overall comparison of qualitative features clearly indicates a noticeable distinction between the two groups. Hard workers show more pronounced physical characteristics in their palmprints, whereas non-hard workers display comparatively softer and less defined features.

The significant finding of this table is that occupational activity plays a major role in influencing qualitative palmprint characteristics, particularly in terms of palm hardness and prominence of principal lines.

4.2 : Quantitative Features of Male Hard Workers

The distribution of quantitative palmprint features, particularly short creases and triradii, in the left and right palms of male hard workers.

With regard to the short creases in the left palm, it is observed that the thenar region consistently exhibits a higher number of short creases compared to the hypothenar region. In most of the samples, the hypothenar region shows either absence or very minimal presence of short creases, whereas the thenar region shows relatively higher values. The interdigital region also shows moderate presence of short creases but is comparatively lower than the thenar region.

In the right palm, a similar trend is observed. The thenar region again records a higher frequency of short creases among hard workers, followed by the interdigital region. The hypothenar region shows minimal occurrence when compared to other regions.

With respect to triradii, both left and right palms demonstrate a relatively consistent distribution across individuals. The triradii counts do not vary as significantly as short creases, indicating that triradii are more stable anatomical features compared to creases which are influenced by external factors.

The overall analysis indicates that among male hard workers, short creases are predominantly concentrated in the thenar region of both palms, followed by the interdigital region, while the hypothenar region shows the least presence.

The significant finding of this table is that the thenar region of hard workers shows a higher number of short creases, which may be attributed to continuous pressure and friction experienced during manual labour activities.

4.3 : Quantitative Features of Male Non-Hard Workers

The quantitative distribution of short creases and triradii in the left and right palms of male non-hard workers.

With regard to the short creases in the left palm, it is evident that the thenar region shows a higher number of short creases compared to the hypothenar region. However, when compared to hard workers, the overall number of creases is relatively lower. The interdigital region shows moderate presence of short creases, sometimes comparable to or slightly higher than the thenar region in certain samples. The hypothenar

region shows comparatively higher values than that observed in hard workers, indicating variation in distribution.

In the right palm, the thenar region continues to show the highest concentration of short creases, followed by the interdigital region. The hypothenar region displays noticeable presence, which is comparatively higher than that of hard workers.

Considering the triradii, both left and right palms exhibit a fairly uniform distribution across all samples. The number of triradii remains stable and does not show major variation between individuals, suggesting that triradii are less influenced by occupational factors.

The comparative observation within non-hard workers indicates that although the thenar region has the highest number of short creases, the difference between regions is less pronounced compared to hard workers. Additionally, the hypothenar region shows relatively more contribution in non-hard workers.

The significant finding of this table is that non-hard workers exhibit fewer short creases in the thenar region compared to hard workers, and a relatively more even distribution across different regions of the palm.

4.4 : Short creases and triradii present in left and right palm of hard and non-hard worker

Respondents	Short creases in percentage						Triradii	
	Left palm			Right palm			Left	Right
	Hypo thenar	thenar	Inter digital	Hypo thenar	thenar	Inter digital		
Hard workers	0	70.73	29.27	2.02	66.67	27.27	5.5	4.5
Non hard workers	9.84	57.38	32.79	11.48	55.74	32.79	5.8	4.2

The data in the table shows the percentage of short creases and triradii present in left and right palm of the hard and non-hard workers.The short creases of the left palm of hard and non-hard workers across the thenar, hypothenar, and interdigital regions are analyzed. In the hypothenar region of the left palm, non-hard workers exhibit a short crease at 9.84%, whereas hard workers show a complete absence. In the left thenar region, the hard workers show short creases at 70.73%, whereas 57.38% in non-hard workers. In the left inter-digital region, the non-hard. workers show short creases at 32.79%, whereas in 29.27% for hard workers.

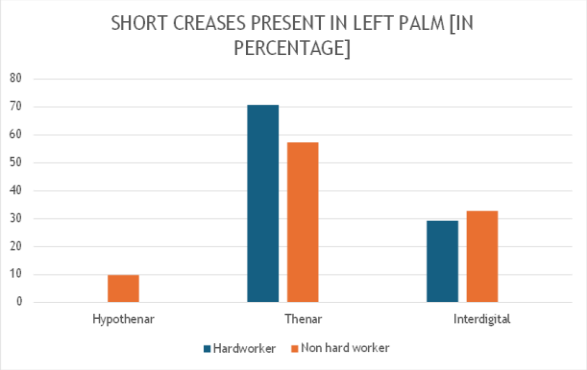
The short creases present in the right palm of hard and non-hard workers across the thenar, hypothenar, and interdigital regions are analysed. The right hypothenar region shows that non-hard workers have short creases at 11.48%, while hard workers have 2.02%. In the right thenar region, hard workers have 66.67% of short creases, whereas 55.74% were found in non-hard workers. The right inter-digital region of non-hard workers have short creases at 32.79% compared to 27.27% for hard workers.

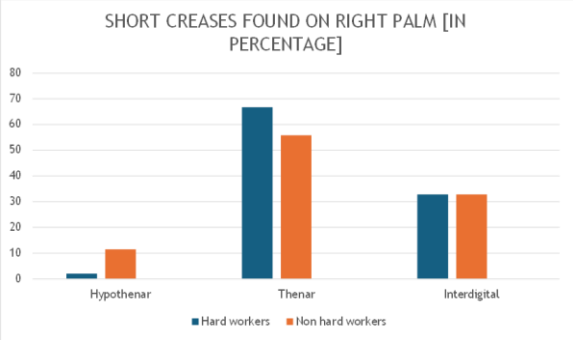
The triradii count introduces an assessment of structural palm markers across both hands. For the left palm, non-hard workers show triradii count at 5.8%, while hard workers show an average of 5.5%. The right palm, the hard workers possess a higher average triradius count at4.5% compared to 4.2% for non-hard workers.

The left thenar region of hard workers showed a higher percentage of short creases at 70.73% in comparision with right and left palm.

Looking at the overall distribution, short creases are overwhelmingly more prevalent in the thenar region across both groups and both hands than in any other part of the palm. In conclusion, the comparative layout shows that hard workers consistently maintain higher percentages of short creases exclusively in the thenar regions, whereas non-hard workers consistently hold higher percentages in the peripheral hypothenar and inter-digital regions of both palms.

The following are the bar graphs of features found in palmprint





V. MAJOR FINDINGS, SUGGESTION AND CONCLUSION

Major findings

The palmprint shows occupational variation between the two groups.

- The thenar region consists of more short creases compared to other regions of palm.
- The characteristics such as hardness are mostly found in palms of hard workers.
- Hypothenar region of left palmprint of construction workers had no short creases.
- The thenar region of left palmprint of construction workers showed more short creases.
- Non-construction workers exhibited a significantly higher number of short creases in the interdigital region compared to construction workers, with an equal distribution observed between their left and right palmprints

Suggestions

- The researcher can use more features for the comparative analysis of further study.
- The researcher can use different occupation for comparison to understand the more variation.
- The researcher can take principal lines for comparison, as they also show variations.

Conclusion

The present study concludes that occupational activity significantly influences palmprint characteristics. Hard workers exhibit increased short creases and rough palm texture due to repeated work stress, whereas non hard workers show smoother palmer surface with few short creases.

In spite of this difference, palm prints maintain identifiable patterns making them reliable for personal identification. Therefore, palmprint analysis can provide supportive evidence in determining occupational influence in forensic investigations.

REFERENCES

[1] Wu, X., Zhang, D., Wang, K., and Huang, B., "Palmprint classification using principal lines," Pattern Recognition, 2004.

[2] Hlaing, H., and Khaung, T., "Personal identification and verification using palm print biometric," International Journal of Latest Technology in Engineering, Management & Applied Science, 2012.

[3] Xu, Y., Fei, L., and Zhang, D., "Combining left and right palmprint images for more accurate personal identification," IEEE Transactions on Image Processing, 2015.

[4] Mahalakshmi, B. S., and Sheela, S. V., "A review on palmprint authentication system using various feature extraction and classification techniques," International Journal of Engineering Research & Technology, 2018.

[5] Rajput, M., and Manhas, S., "Comparison of occupational marks in finger and palmprint impressions of potters, brick kiln labourers & masons with reference samples," Pakistan Heart Journal, 2023.

[6] Sharma, R., Mukhopadhyay, R., Tarunam, A., Kumar, P., Chouhan, J. S., and Bhandari, D., "Personal identification from occupational marks present on the palm prints: A study of the urban region of New Delhi," Indian Journal of Physical Anthropology & Human Genetics, 2024.

[7] Dhakal, S., and Kaul, P., "The hidden potential of lateral palm prints in occupational and forensic identification systems," International Journal for Multidisciplinary Research, 2025.

[8] Kumar, G., Nazeer, K., Singh, N., Ameen, A., Parveen, R., and Yadav, E. S., "A multivariate study on the role of palm print features for estimating age, gender, lineage and profession," Biokultur, 2025.