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Original Research

Occupational Marks Present on the Palm Prints: A Study of the Urban Region of Bhopal

[1]Shaifali Rathore, [2]Subhra Suhaney*

[1,2]Department of Forensic Science, Institute for Excellence in Higher Education, Bhopal (M.P.), India

ABSTRACT

Background: Occupational activities involving repetitive friction, mechanical pressure, and handling of tools or materials may produce visible morphological changes in the palms and fingers. These characteristics may provide supplementary information in forensic investigations. The aim of this study is to examine and describe occupationally associated palm and finger morphological characteristics among individuals from selected occupational groups.

Methods: A descriptive observational study was conducted among 200 individuals from Bhopal district, Madhya Pradesh, equally distributed across four groups: brick kiln labourers (n=50), carpenters (n=50), cobblers (n=50), and corporate workers (n=50). Participants' age ranged from 21 to 55 years. Palm prints were collected using fingerprint ink and printing materials and examined visually with a magnifying glass.

Results: Each occupational group represented 25% (50/200) of the study population. Brick kiln labourers exhibited calluses, skin hardening, cuts, scars, blisters, and apparent friction ridge alterations, with grouped average work experience ranging from 7 to 28 years. Carpenters demonstrated roughness, blister formation, calluses, cuts, and scars, with work experience ranging from 12 to 25 years. Cobblers showed needle marks, finger bending, scars, skin thickening, and calluses, with work experience ranging from 12 to 30 years. No visible occupationally associated marks were reported in the 50 corporate worker samples (0/50).

Conclusion: Distinct descriptive patterns of palm and finger alterations were observed across occupational groups. These characteristics may provide supplementary information in occupational and forensic assessments; however, further quantitative studies with standardised scoring and statistical testing are required to establish their reliability and occupational specificity.

Keywords: Occupational Morphology, Palm Prints, Fingerprints, Calluses

***Corresponding Author:** Subhra Suhaney, Assistant Professor, Department of Forensic Science, Institute for Excellence in Higher Education, Bhopal (M.P.), India

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INTRODUCTION

Alike to fingerprints, palm prints are unique and serve as a means for personal identification, because it shows characteristics features like wrinkles, principal lines, and singular points that don't change over time aiding in personal identification [1]. Although the primary purpose of these prints is identification, they may also provide important forensic information, especially in occupational investigations. Individuals' palm prints may show occupational marks, which are small physical modifications or characteristic patterns resulting from prolonged exposure to particular occupations. The repetitive nature of some everyday jobs, like manual work or difficult crafting, might eventually affect these scars, leaving unique imprints that might connect a person to a specific occupation. Examining and analysing physical marks or injuries on a person's body that are connected to their line of work is known as the forensic study of occupational marks. When it comes to identifying the nature of occupation a suspect might have had or figuring out what caused an injury, these marks can offer important

information in criminal investigations. With a specific cobblers, and corporate employees, this study aims to investigate how forensic analysis of palm prints can provide insights into occupational characters. This study intends to examine the effects of age, job experience and the specific conditions of each occupation on the development of occupational marks within palm prints by examining a dataset of 200 palm print examples. The research study shows that occupations involving a lot of manual labour or direct tool contact may leave markings that are different from those of more inactive or office-based occupations. Occupational marks present themselves in varied forms, including various skin rashes, blisters, dryness, and irritation affecting different body parts, resulting in visible modifications to the skin. [2] In the present work, an effort was made to study palm prints from Brick kiln labourers, carpenters, cobblers (mochi), and corporate workers of the urban area of Bhopal District of Madhya Pradesh. The aim of this research paper is to identify any morphological variations in the palm prints that might be related to the demands and characteristics of each occupation. By doing this, the study will offer insight into the probable application of palm prints as a criminal investigation tool, not only for identifying individuals but also for occupational profiling.

Problem analysis: Forensic research has traditionally relied heavily on the palm prints analysis, especially when it comes in the context of biometric authentication and criminal identification. Similar to fingerprints, palm prints are unique to each individual and have been used for decades as a form of personal identification. However, nothing is known about how palm prints might convey information beyond identification. Specifically, the influence of work-related activities on the morphological features of palm prints has received less attention. Only a few research papers have focused on the investigation of occupation marks from a forensic viewpoint [3-11]. Sankaranarayanan & Mahesh (2020) investigated variation in ridge density and crease Development in palm prints among agricultural and industrial labourers. [12] Found statistically significant thickening of main creases in workers exposed to repetitive stress. Patil et al. (2021) focused on palm print identification and its role in crime scene investigation. [13] Noted how ridge deformities due to work strain could provide occupational clues in partial prints. Garg et al. (2021) conducted a forensic study on palm print variations in skilled workers such as masons and blacksmiths, highlighting occupation-specific ridge distortions and pressure zones. [14] Kumar & Sharma (2022) analysed over 300 palm effort on the palm prints of labourers, carpenters, prints to evaluate pressure patterns and crease depths in different occupational groups. [15] Emphasized the role of mechanical tool use in shaping the thenar region. Nair et al. (2020) studied the correlation between hand dominance, palm line deviation, and occupational stress in palm prints among manual workers [16], found deviation patterns unique to cobblers and carpenters. Alenezi et al. (2023) used AI-assisted palm print recognition models to classify prints based on occupational signatures. [17] Demonstrated promising results in distinguishing worker types through biometric learning. Rahman & Zafar (2022) explored how long-term exposure to vibration tools in carpenters alters ridge symmetry and depth in palm prints. [18] Linked specific tool usage to fingerprint degradation. Singh & Patel (2023) reviewed biometric distortion due to repetitive mechanical stress, specifically in cobblers and artisans. Found visible distortion in distal transverse creases over time. [19] This research gap serves as the foundation for the problem that this study attempts to address. The physical demands of different activities vary widely; hence, it seems logical that long-term participation in some occupations could modify the morphology of the hands and, subsequently, palm prints. For instance, due to constant physical stress, a person who performs severe manual tasks on a daily basis may have thicker skin, more obvious flexion creases, or distinct wear patterns in their palms. Similar to this, utilising woodworking equipment can cause a carpenter's hands to develop different ridge patterns or stress marks. Even while these occupational signs could be tiny, if they could be regularly associated with particular jobs, they might be valuable from a forensic standpoint for police and forensic profiling in the urban area of Bhopal District of Madhya Pradesh.

MATERIALS AND METHODS

Study Design and Study Population: The present study employed a comparative observational design to examine morphological changes in palm prints associated with different occupational activities. A total of 200 individuals from four occupational groups in Bhopal district, Madhya Pradesh, India, were included in the study. The participants were divided equally into four groups: brick kiln labourers (n = 50), carpenters (n = 50), cobblers (n = 50), and corporate workers (n = 50). Corporate workers were considered the reference group for comparison with individuals engaged in occupations involving regular manual work. The reported age ranges were 25–50 years for

brick kiln labourers, 30–41 years for carpenters, 30–51 years for cobblers, and 21–55 years for corporate workers. The source document states that participants were selected randomly; however, the specific sampling procedure was not described.

Materials and Equipment: Palm prints were collected and examined using fingerprint collection and visual inspection equipment. The materials included an inkless fingerprint pad measuring 5 × 10 inches, fingerprint ink, wooden fingerprint slabs measuring 4 × 7 inches, a small fingerprint roller, and a magnifying glass or hand lens. Additional materials included A4 sheets, a pen, a pencil, highlighting markers, and waterless hand-cleaning tissues. The equipment was used to facilitate palm print collection, documentation, and visual examination of surface characteristics.

Palm Print Collection and Documentation: Palm print samples were collected from participants representing the four occupational groups. Fingerprint collection materials, including the fingerprint pad, ink, roller, and slabs, were used as described in the study protocol. The collected impressions were examined visually with a magnifying glass or hand lens to identify observable morphological characteristics of the palms and fingers. Relevant features were documented for subsequent comparison across occupational groups. The original study description does not specify whether both hands were recorded, the precise printing procedure, the number of impressions obtained per participant, or the measures used to standardise print quality.

Assessment of Occupationally Associated Morphological Characteristics: The collected palm prints were examined for visible morphological features that could be associated with repeated occupational contact, friction, pressure, or minor injuries. The assessment included the following characteristics:

a. **Calluses and skin thickening:** Raised, hardened, or roughened areas of skin on the palms and fingers were documented as potential indicators of repeated friction or pressure during manual activities. Skin thickening, including features described as hyperkeratosis, was recorded when visibly apparent.
b. **Scars and cuts:** Visible scars and cut marks were documented, with attention to their location and appearance on the palms and fingers. These findings were considered possible consequences of previous injuries, including those sustained during occupational activities.
c. **Abrasions and wounds:** Superficial skin damage and other visible injury-related marks were recorded where identifiable in the collected samples.
d. **Blisters**: Visible features consistent with blister formation were documented when present in the examined palm prints.
e. **Friction-related changes and roughness:** Areas showing rough, hardened, or visibly altered skin texture were noted as potential manifestations of repeated contact with tools, materials, or work surfaces.
f. **Ridge alteration or depletion:** Areas in which the normal appearance or continuity of the friction ridge pattern appeared reduced or disrupted were documented descriptively.
g. **Indentations and depressions:** Visible depressions or pressure-related alterations in the palmar surface were considered during the examination.
h. **Pigmentation changes, wrinkles, and creases:** Observable variations in skin pigmentation and prominent skin folds were included among the morphological features of interest.
i. **Needle marks and finger deformities:** Particular attention was given to needle-associated marks and visible finger bending or deformity in cobblers, as these characteristics were reported in the study observations. These features were recorded descriptively. Their presence alone was not considered definitive evidence of a particular occupation because similar changes may arise from non-occupational injuries, individual skin characteristics, age, and other environmental exposures.

Comparative Analysis Across Occupational Groups: The morphological findings were compared across the four occupational groups to identify similarities and differences in the distribution of visible palm and finger characteristics. Brick kiln labourers, carpenters, and cobblers represented the manual occupational groups, while corporate workers served as the reference group. The comparison focused on the occurrence and anatomical distribution of calluses, scars, cuts, roughness, skin thickening, ridge alterations, needle marks, and other documented features. The source observations also included grouped summaries of age and work experience, with findings presented for successive sets of participants within each occupational group. These summaries were considered descriptively to explore possible patterns between occupational exposure, work experience, and visible morphological changes. Because the available description does not establish a standardised scoring system or formal statistical

procedure, no inferential statistical method is specified here.

Data Recording and Presentation: The observations were organised into tables according to occupational group, reported age, work experience, and the morphological characteristics identified in the collected samples. Representative palm print images were used to illustrate selected features, including calluses, cuts, roughness, scars, ridge alterations, needle marks, and finger bending. The corporate worker samples were presented as the reference for comparison with the manual occupational groups. The findings were intended to provide a descriptive comparison of occupationally associated palm print characteristics. Any interpretation of these characteristics as occupation-specific indicators requires further validation using standardised definitions, reproducible assessment procedures, and appropriate statistical analysis.

RESULT

Study Population and Occupational Distribution

A total of 200 participants were included in the study, with 50 individuals representing each of the four occupational groups: brick kiln labourers, carpenters, cobblers, and corporate workers shown in Figure-1. The reported age ranges were 25–50 years for brick kiln labourers, 30–41 years for carpenters, 30–51 years for cobblers, and 21–55 years for corporate workers. Visual examination of the palm print samples revealed differences in the types of morphological characteristics documented across the occupational groups. The principal observations included callus formation, skin thickening, roughness, scars, cuts, blister formation, ridge alterations, needle marks, and finger bending.

Table 1. Occupation, Sample Size and Age Group

S. No.	Occupation	Sample size	Age group
1	Corporate work Standard	50	21 to 55 yrs.
2	Brick kiln labourers	50	25 to 50 yrs.
3	Carpenter	50	30 to 41 yrs.
4	Cobbler	50	30 to 51 yrs.
	Total	200	21 to 55 yrs.

Occupational Characteristics of Palm Prints

Brick Kiln Labourers: Palm print examination of brick kiln labourers revealed calluses, hardened skin, cuts, scars, blister formation, and apparent depletion of friction ridges in selected palmar regions. Calluses were particularly noted in the interdigital areas, while skin hardening and ridge alterations were observed in the middle region of the palm in the representative samples. The grouped observations indicated that participants with reported average work experience of 24–28 years exhibited hardness, cuts, calluses, skin thickening, or scars. Participants in the group with an average work experience of seven years were reported to have calluses and ridge alterations. Overall, calluses and skin thickening were recurring findings in this occupational group, although the document does not provide individual-level frequencies for these characteristics.

Carpenters: The palm prints of carpenters exhibited roughness, calluses, scars, cuts, blister formation, and apparent alterations in the friction ridge patterns of the fingers Figure 1.



Figure 1. Palm print sample 1 and 2 of carpenter

Representative samples demonstrated rough skin, blister formation, and cuts, while the grouped observations included scars and skin changes among participants with longer work experience. Participants with reported average work experience of 24–25 years showed scars or roughness, whereas those with approximately 12 years of experience exhibited roughness, blister formation, calluses, or related skin changes. These observations indicate that several types of morphological changes were documented among carpenters; however, the available data do not establish a statistically significant relationship between work experience and the occurrence of individual features.

Cobblers: Cobblers displayed a combination of needle marks, calluses, cuts, scars, roughness, skin thickening, and finger bending. Needle marks were documented in the representative palm print samples, alongside callus formation and hardening of the hypothenar region. Finger bending or deformity was also reported in selected samples in Figure-2. The grouped observations indicated that participants with average work experience of 29–30 years exhibited needle marks, finger bending, or scars, while those with approximately 12–25 years of experience showed calluses, roughness, cuts, or skin hardening. Needle-associated marks and finger bending were notable features in the available cobbler observations,

although their specificity to this occupation cannot be established without systematic comparison with the other groups.



Figure 2. Palm print sample 1 and 2 of cobbler

Corporate Workers: The corporate worker group served as the reference group for the comparative assessment. According to the study observations, the examined samples did not show visible impressions or occupationally associated changes such as cuts, scars, roughness, skin thickening, or calluses. This finding contrasts with the range of morphological characteristics documented in the manual occupational groups. However, the absence of these features should be interpreted as an observation from the examined samples rather than evidence that such characteristics are universally absent among corporate workers.

Comparative Summary of Morphological Findings

Table 2. Descriptive Comparison of Palm Print Characteristics Across Occupational Groups

Occupational group	Principal characteristics reported	Notable observations
Brick kiln labourers (n = 50)	Calluses, hardened skin, cuts, scars, blisters, and apparent ridge alterations	Calluses in interdigital areas and hardening of the middle palmar region
Carpenters (n = 50)	Roughness, calluses, scars, cuts, blisters, and apparent ridge alterations	Rough skin and scars were reported in the grouped observations
Cobblers (n = 50)	Needle marks, finger bending, calluses, cuts, scars, roughness, and skin thickening	Needle marks and finger bending were documented in representative samples
Corporate workers (n = 50)	No visible occupationally associated marks reported in the examined samples	Served as the reference group for comparison

Relationship Between Work Experience and Morphological Characteristics: The grouped observations documented several morphological features among participants with different levels of occupational experience. In brick kiln labourers, the groups with reported average work experience of 24–28 years showed hardness, calluses, cuts, skin thickening, or scars. Among carpenters, scars and roughness were recorded in groups with average work experience of 24–25 years. Among cobblers, needle marks, scars, and finger bending were reported in groups with average work experience of 29–30 years. These descriptive patterns suggest that occupational exposure and repeated manual activities may be associated with visible changes in the hands. Nevertheless, because individual-level measurements and statistical comparisons were not provided, the findings cannot establish a dose–response relationship or demonstrate that longer work experience independently predicts the presence or severity of these features.

DISCUSSION

The present study examined occupationally associated palm morphological characteristics among 200 individuals belonging to four occupational groups: brick kiln labourers, carpenters, cobblers, and corporate workers. The findings revealed qualitative differences in the observed palm and finger characteristics across occupational groups. Brick kiln labourers predominantly exhibited calluses, skin hardening, cuts, scars, blister formation, and apparent friction ridge alterations. These findings may reflect repeated friction, mechanical pressure, and contact with rough materials during manual activities. Among carpenters, roughness, calluses, scars, cuts, and blisters were documented, potentially associated with repetitive tool handling and contact with wood. Cobblers demonstrated needle marks, calluses, cuts, skin thickening, and finger bending, with needle-associated marks being a notable observation. In contrast, the examined corporate worker samples reportedly showed no visible occupationally associated marks, providing a descriptive reference for comparison.

Variations in morphological characteristics were observed among groups with different levels of work experience. However, the available data do not establish a direct relationship between employment

duration and the frequency or severity of these features. Age, previous injuries, protective equipment, individual skin characteristics, and non-occupational activities may also influence palm morphology. From a forensic perspective, occupationally associated palm characteristics may provide supplementary contextual information regarding patterns of manual activity. Nevertheless, features such as calluses, scars, and needle marks cannot independently establish an individual's occupation because they may occur across different occupational and non-occupational settings.

The study has limitations, including the absence of quantitative feature frequencies, a standardised morphological scoring system, and reported statistical comparisons. Future research should incorporate individual-level data, standardised assessment criteria, inter-observer reliability, and appropriate statistical analyses to evaluate associations between occupational exposure and palm characteristics. Overall, the findings suggest that palm morphology varies descriptively across occupational groups. Further systematic investigation is required to establish the reliability, specificity, and potential forensic applicability of these observations.

CONCLUSION

The present study identified descriptive differences in palm and finger morphological characteristics among brick kiln labourers, carpenters, cobblers, and corporate workers. Manual occupational groups exhibited features such as calluses, skin thickening, scars, cuts, blisters, needle marks, and apparent friction-related changes, whereas the examined corporate worker samples reportedly showed no visible occupationally associated marks. These observations suggest that palm morphology may reflect patterns of manual activity and occupational exposure. However, the findings do not establish a direct causal relationship between occupation and specific palm characteristics. The absence of quantitative measurements and statistical comparisons also limits the interpretation and generalisability of the results. Therefore, further studies using larger samples, standardised assessment methods, quantitative analysis, and reliability testing are required to evaluate the potential forensic relevance of occupationally associated palm morphology.

DECLARATIONS

Ethics approval and consent to participate: Informed verbal consent was obtained from the participants of the study.

Consent for Publication: Not applicable.

Availability of Data and Materials: All data analysed during this review are included within this manuscript. Additional information is available from the corresponding author upon reasonable request.

Conflict of Interest: The authors declare that they have no competing interests.

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