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Fingerprint pattern association in relation with blood groups and gender in specific populations: A Review

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Abstract

This review examines the potential association between fingerprint patterns, blood groups, and gender in specific populations. It discusses the biological basis of fingerprint formation and blood group inheritance, summarizing the key studies that investigated the relationship between these variables. The review explores the distribution of fingerprint patterns across different blood groups and genders within the target population. Potential applications in forensics and personal identification are highlighted. Limitations of existing research and future directions for investigating this association in diverse populations are also discussed. Finally, recommendations for future research directions are provided to deepen the understanding of this intriguing relationship.

Keywords: fingerprint patterns, gender, blood group, ABO/Rh blood grouping, forensic identification.

Introduction: Fingerprints have long been acknowledged as an invaluable means for personal identification because of their distinctive and enduring characteristics. These intricate arrangements of ridges and valleys on the fingertips are formed during foetal development and remain consistent and essentially unaltered throughout an individual's lifetime. The detailed study and comprehension of fingerprint patterns, including their differences and anomalies, has drawn a great deal of interest and attention from an extensive spectrum of subject areas, including anthropology, genetics, forensic science, and other domains as well.

One area of research that has attracted significant attention is the potential correlation between fingerprint patterns, blood group types, and gender variations. This line of inquiry is rooted in the understanding that both fingerprints and blood groups possess a genetic basis, and their manifestations could be influenced by common underlying genetic factors. Exploring these potential associations holds the promise of unveiling valuable insights into the realms of

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population genetics, forensic investigations, and the intricate interplay between genetic expressions and observable phenotypic traits.

This review will cover the research on the existing literature investigating the relationship between fingerprint impressions, blood groups, and gender. Fingerprint patterns can be broadly classified into three main categories: loops, whorls, arches, and composites, each with distinct characteristics, variations, and subtypes. Similarly, the ABO and Rh blood group systems are determined by specific genetic markers and exhibit significant variations across different populations. This review aims to critically analyse the existing literature, synthesize the findings, and fill the gaps that warrant further investigation.

Fingerprint patterns: Fingerprints are the unique patterns formed with ridges and furrows on the fingertips. It provides significant importance in medico-legal and forensic contexts due to their individuality and permanence. These distinctive patterns serve as valuable tools for personal identification, criminal investigations, and establishing biological relationships, underscoring their pivotal role in various legal and forensic applications.

Identification and analysis part of fingerprint patterns is based on classification as loops, whorls, and arches and their further sub-divisions which also play a crucial role in criminal investigations, victim identification, and resolving paternity disputes., hence making them an indispensable tool in the field of forensics.

Blood groups and gender: Blood groups are classified primarily based on the ABO-Rh systems, which are genetically determined and play a crucial role in various biological processes. These are traits with significant biological and clinical implications. The ABO blood group system encompasses four primary categories of blood types (A, B, AB, and O), which are characterized by the existence or absence of distinctive antigen molecules situated on the exterior membrane of erythrocytes, commonly referred to as red blood cells. While the Rh system differentiates Rh-positive and Rh-negative individuals based on the Rh antigen. These blood groups exhibit varying distributions across populations and can influence inheritance. apartment, blood group analysis plays a crucial role in a criminal investigation, aiding in personal identification, crime scene reconstruction, and paternity testing. Additionally, the inheritance patterns of blood groups are closely linked to an individual's gender, as they are governed by genes on autosomal chromosomes and the X chromosomes. Exploring the

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potential association between blood groups and other genetic markers, such as fingerprint patterns and gender, could provide valuable insights into the underlying biological mechanisms and their forensic applications.

Association between fingerprint patterns, gender, and ABO/Rh blood groups:

Numerous studies have explored the distribution of fingerprint patterns among individuals with different blood type and gender. Some researchers have reported correlations between certain patterns and specific blood groups, while others have found no significant associations.

In 2015, research presented by Usha Verma, Ritu Singroha, and Preeti Malik showed that fingerprint patterns and genders are correlated, suggesting that dermatoglyphic patterns and blood group types have correlations as well. A was the most common blood type found in individuals. The people with O blood type have more whorls on the left and right hands of subjects. Results showed that fingerprint distribution differs between blood types and fingers, suggesting genetic linkages. Certain finger patterns were more common in both hands for each blood type. Generally, there were fewer arches observed.

In a work experimented by Mohammed Abdul Khalid, Yerukala Komera Chinna Rangaiah, and Bandameedi Lakshmi Narayana in 2016, at Andhra Pradesh, they examined the fingerprint patterns of 100 distinct individuals from the Tirupati region (equal number of male and female) and concluded that blood group and gender had varied distributions, which demonstrated the potential of fingerprint analysis for individual identification. The study showed frequent appearance of loops, then whorls, arches, and composites come following. Loops are more dominant in men, while in females more whorls and arches were found. Composite refers to both genders being in equal proportion. The most frequent blood group to have loops was O positive and then B positive. Ulnar loops were the primary loops identified.

The study's findings presented by Amit Patil, Amrit Malik, Treza Shirole in 2017 revealed that in 170 participants, blood group B was the most common, after the O, A and AB blood groups with Rh-positive being predominant. There has been no obvious association between gender and either the Rhesus factor or ABO blood group. The most common patterns encountered were loops accounted for 62.35%, followed by whorl 32.92% and arch 4.7%. Statistical

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techniques were employed using SPSS with cutoff for significance $p < 0.05$. The study concluded with no evidence of any significant association between the individuals' gender and either blood group or Rhesus factor. Nonetheless, research showed close connection between observed fingerprints and blood types under observation.

Sudikshya KC, Niroj Maharjan, Nischita Adhikari and Pragya Shrestha; (2018) proposed the following literature review in which the following conclusions could be drawn: Slide agglutination method was utilized in this study to determine the blood groups of 300 participants in the experiment. The most frequently detected blood type according to the results was O came first, the B, A and lastly AB. There didn't seem to be any apparent difference in fingerprint patterns depending on gender and most of the participants were Rh-positive. The most predominant pattern was loop accompanied by whorl and arch patterns. The study discovered a noteworthy correlation between certain fingerprints and certain blood groups. However, it failed to find any signification variations in fingerprint patterns depending on gender among Nepalese individuals investigated.

Kawakeb.A. Saad, Heba S. Abd Alalim, Kawakeb A Saad in 2020 proposed research on the study of fingerprint patterns present on the thumb of the right hand and the association between fingerprint, blood group and gender among Libyan population. After reviewing this available research even though gender and blood groupings were strongly correlated, it was not possible to find apparent relationship between blood groups or gender and fingerprint patterns. This study examined 480 subjects, finding a predominance of O blood group (38.33%) and a higher percentage of females (52.08%). This research observed no significant associations within fingerprint patterns, gender, or blood groups except for a comparable pattern of distribution of whorl and loop patterns. The study demonstrated a significant association between blood group types and gender but failed to find significant association neither in between fingerprint patterns and gender nor between fingerprint patterns and blood group types.

In research proposed by Dr. Chandra Shekhar Vadde, et, al in 2020 determined a positive correlation between distribution of fingerprint patterns, blood groups and gender in a population of 186 subjects from Visakhapatnam region. The most predominant pattern found in research was loops and composites were found least, also loop being the dominant pattern in all blood groups. Majority of the blood types were positives and AB- negative was found to

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be rarest. Rh-positive was compared with Rh-negative and it was determined to be significant according to the collected data.

In 2021, Dr. Ramrekh Dhaker, Dr. Ramakant Varma, Dr. Vabhav Bhatnagar, Dr. Mukesh Kumar Meena presented a study analyzing the association between gender, blood groups, and fingerprint patterns among 100 participants (50 male, 50 female) from Jhalawar region, Rajasthan. The fingerprint impressions were classified into composites, whorls, loops, and arches. The study aimed to identify predominant patterns and blood grouping with Rhesus factors. The collected blood data revealed that blood group O (46%) was prevalent accounting nearly half of the samples. Blood group B, followed in frequency at 35% while group A and AB were less common at 14% and 5% respectively. Additionally, the study discovered that in ABO-Rh combinations, O-positive was most common while Rh-positive was dominant at 94%. The study also shows that, O blood group is shared by the majority of the participants. The most prevalent fingerprint pattern is that of loops, then composites and after continued to whorls and arches. Males have more loops, while females have more whorls and arches. The proportion of composites is the same for both genders. Among blood types, O-positive exhibits the greatest prevalence of loops, followed closely by B-positive group.

In 2023, Tariq Al Habsi, Hussein Al Khabori, Sara Al Qasmi, Tasnim Al Habsi, Mohamed Al Mushaiqri, Srijit Das and Srinivasa Rao Sirasanagandla presented an examination which demonstrated a relationship between Omani population and ABO-Rh blood types and patterns. The research involving 200 participants found a significant link, with loops being the most typical pattern (49.4- 69%). The distribution of fingerprint patterns showed no variations by gender. Since, earlier studies on Omani population were restricted to other places, this study filled the research void on the population. It mentions the benefits of forensic applications and the possibility for developing local biometric databases of specific population.

In research proposed by Lalit Panwar, Dr. Priyanka Verma in 2023 reveals the dermatoglyphic fingerprint patterns of individuals from Indian and African origin representing regions like Haryana, Himachal Pradesh, and Kerala. The researchers classified fingerprints into arches, loops, and whorls using the Henry system. This study concludes that the interracial comparison among the people of Indian and African regions on the basis of fingerprints indicates that Indian fingerprints and African fingerprints are quite similar to each other in every proportion and in

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every characteristic. The study contributes to forensic science and encourages us by providing insights into personal identification and potential age, gender, and regional associations in criminal investigations.

The cross-sectional observational study involving 800 individuals with different blood groups examined by Ashok Rastogi, MD. Abu Bashar, and Nishat Ahmed Sheikh; (2023) in order to find any kind of correction in specific fingerprint impressions and many blood types, in Eastern Indian population under research. The study's findings demonstrated an extensive link between an individual blood type and their unique patterns, indicating a relationship in certain patterns with various blood groups. Statistical tests like Fischer's exact test and Chi-square tests were utilized for comparing the variables and determining the association. Analysis revealed no significant difference ($p= 0.11$) in pattern distribution in genders. Unlike, Rh types where the difference was ($p=0.08$). In contrast, the distributions of fingerprint patterns exhibited a significant difference.

An article written on study by Pratinidhi et al, (2023) demonstrates a cross-sectional design with the participation of 271 volunteers, who are students, and the primary objective is to access any link might exist between the variables: fingerprint patten-blood types-gender. In all blood groups loop is shown to be the most common pattern type across all blood type. The affiliation between blood types and major fingerprint patterns showed evidence of statically significant. In conclusion, the link between the aforementioned components could facilitate improved identity prediction and authentication in field of forensics.

A contradictory finding was proposed by Avinash Thakur, Jayanti Yadav, Gaurav Tiwari in 2019 which was cross-sectional in format and involved 300 individuals overall—150 male and 150 female—who ranged in age from 18 to 40, took place in Bhopal. Most of the study's subjects 118 (39.3%), are classified as belonging to the B blood type continuing with O 87 (29%) and A 72 (24%) then AB 23 (7.7%) next in sequence. Expect for the O blood group, where loops had a higher dispersed rate between subjects of distinct blood groups, it was determined that whorl was frequent among the various ABO blood groups, followed by loops and arches. In addition, it was observed that there was no apparent association between fingerprints and gender. Furthermore, it is highlighted that there isn't any statistically significant correlation between patterns and blood types. The findings indicate that the security

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and identification of any person can be achieved with the independent use of fingerprints, gender and blood types.

Limitations and Future Directions:

Existing research has provided valuable insights into the potential relationship between fingerprint patterns, blood types, and gender within a population. Further studies should address several limitations, similar to the following:

- While many studies used general populations, further upcoming research should target specific groups to gain deeper knowledge into human diversity, emphasizing the importance of considering cultural and environmental contexts when interpreting genetic and phenotypic data.
- Many research studies have relatively small sample sizes, limiting the statistical power and generalizing their data. It also affects the accuracy of representing the diversity within the population and could lead to biased or inconsistent findings.
- Additionally, there is a lack of standardized methodologies for classifying and analysing fingerprint patterns, leading to potential inconsistencies across studies.
- Most studies have focused on the primary classification of fingerprint patterns (loops, whorls, and arches), overlooking the potential significance of fingerprint pattern subdivisions and classifications.
- Environmental factors such as diet, lifestyle, and occupational exposures, which can influence fingerprint patterns or blood group expression, are often not adequately controlled. For future research one should aim to address these limitations by conducting the investigation on a large scale.
- Well-designed methodology studies with robust statistical analysis and standardized fingerprint classification technique is essential. Moreover, investigating the genetic and epigenetic factors underlying the observed associations could provide deeper insights into the biological mechanisms involved, such as the formation and expression of fingerprint patterns and blood groups.
- Incorporating advanced technologies such as high-resolution imaging and computational analysis could potentially improve the accuracy of fingerprint pattern analysis.

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Conclusion:

This review examined the literature on fingerprint patterns, blood groups, and gender associations in a specific population. While some studies reported significant associations, others yielded contradictory or inconclusive findings. The underlying biological and genetic mechanisms remain largely unexplored. Future research should employ larger, diverse samples to overcome previous limitations like small sizes and methodological inconsistencies. This review fills research gaps, providing a comprehensive understanding of these relationships with implications for forensics, identification, and population genetic studies within the target population, contributing to our broader knowledge of human variation.

References

1. Usha Verma, Ritu Singroha, Preeti Malik. (2015). A study to find correlation between dermatoglyphics patterns and ABO blood groups. International Journal of Anatomy and Research. 3(3).
2. Bandameedi Lakshmi, Yerukala Komera, Mohammed. (2016). STUDY OF FINGERPRINT PATTERNS IN RELATION TO GENDER AND BLOOD GROUP. Journal of Evolution of Medical and Dental Sciences. 5(14)
3. Amit Patil, Amrit Malik, Treza Shirole. (2017). Fingerprint patterns in relation to gender and blood groups - A study in Navi Mumbai. 4(3):204-208
4. Sudikshya KC, Niroj Maharjan, Nischita Adhikari, Pragya Shrestha. (2018). Qualitative Analysis of Primary Fingerprint Pattern in Different Blood Group and Gender in Nepalese. Hindawi Anatomy Research International.
5. Kawakeb A. Saad, Heba S. Abd Alalim, Kawakeb A. Saad. (2020). Association between fingerprint and blood group among Libyan students. Journal of Medical and Dental Science Research. 6(3): 07-10
6. Dr. Chandra Shekar Vadde, Prathipati Ashok Kumar. (2020). A Study of Pattern of Fingerprints in Relation to Blood Groups. East African Medical Journal. 3(2): 37-40
7. Dr.Ramrekh Dhaker, Dr.Ramakant Varma, Dr.Vabhav Bhatnagar, Dr.Mukesh Kumar Meena. (2021). STUDY OF FINGERPRINT PATTERN IN RELATION TO GENDER AND BLOOD GROUP IN JHALAWAR REGION. International Journal of Medical and Biomedical Studies. 5(9):68-71.
8. Tariq Al Habsi, Hussein Al Khabori, Sara Al Qasmi andTasnim Al Habsi, Mohamed Al Mushaiqri, Srijit Das and Srinivasa Rao Sirasanagandla. (2022). The association

between fingerprint patterns and blood groups in the Omani population. Arab Gulf Journal of Scientific Research.

9. Lalit Panwar, Dr. Priyanka Verma. (2023). Interracial Comparison of Ten-Digit Fingerprints of Different Regions of India and Africa. Pakistan Heart Journal. 56(03):376-386
10. Ashok Rastogi, MD. Abu Bashar, Nishat Ahmed Sheikh. (2013). Relation of Primary Fingerprint Patterns with Gender and Blood Group: A Dermatoglyphic Study from a Tertiary Care Institute in Eastern India. Cureus 15(5).
11. S. A. Pratinidhi, Vaishali Lunawat, Mohak Tilokchandani, Chaitanya Bhujbal, Rutuja Shejul, Madhumita Sahoo. (2023). Study of fingerprint patterns in relation to gender and blood groups. International Journal of Clinical Biochemistry and Research. 10(2):149-153.
12. Avinash Thakur, Jayanti Yadav, Gaurav Tiwari. (2019). Fingerprint Patterns in Relation to Gender and Blood Group among Residents of Central Indian District. Indian Journal of Forensic Medicine & Toxicology. 13(3).