Original Article

Analysis of Fingerprint Patterns in Relation to ABO Blood Groups: A Comparative Study

Fingerprint Patterns in Relation to ABO Blood Groups

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ABSTRACT

Objective: To assess and analyze the potential association between blood groups and fingerprint patterns.

Study Design: Descriptive Cross-sectional Study

Place and Duration of Study: This study was conducted at the Forensic Medicine & Toxicology Department of Sahara Medical College Narowal, Punjab-Pakistan from July 2020 to June 2023.

Methods: A sample of 293 participants was meticulously studied, categorizing individuals based on their blood groups and assessing their respective fingerprint patterns. This research delves into the intriguing relationship between blood groups and fingerprint patterns, shedding light on potential associations that could have far-reaching implications.

Results: The findings are presented in a comprehensive cross tabulation analysis, revealing a statistically significant association between blood groups and fingerprint patterns ($p = 0.013$). Particularly, the blood group of an individual appears to influence the distribution of their fingerprint pattern.

Conclusion: These results provide a promising foundation for further exploration of the mechanisms underlying this association and its potential applications in fields such as forensics and medical diagnostics. This study marks a crucial step towards understanding the intricate interplay between genetic factors and biometric features, opening new avenues for research and practical applications.

Key Words: ABO, Blood Group, Rh factor, Fingerprint Patterns, Biometrics, Forensic Investigations, Genetic Determinants.

INTRODUCTION

Fingerprint patterns and blood groups are distinctive and integral biological characteristics that have captivated the attention of researchers across diverse fields for decades[1]. The uniqueness of fingerprints in forensic science and biometric authentication has long been recognized, making them invaluable tools for individual identification and criminal investigations[2].

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Simultaneously, the classification of human blood into different ABO and Rh groups is of paramount significance in medical, medicolegal and clinical practices with implications for transfusions, organ transplantation, and disease susceptibility[3]. Intriguingly, the potential relationship between these two biological markers has largely remained unexplored. While both fingerprint patterns and blood groups are genetically determined, the concept of an association between the two holds the promise of uncovering novel insights into the hereditary basis of these traits[4]. Such an association could have implications not only in the fields of forensics and biometrics but also in understanding the broader genetic underpinnings of human variation[5].

This research endeavors to bridge this intriguing gap by conducting a systematic examination of the potential correlation between fingerprint patterns and ABO blood group types, considering the presence or absence of the Rh antigen[6]. Our study delves into a dataset comprising 293 individuals, meticulously categorizing their blood groups and analyzing their corresponding fingerprint patterns. The results, presented in a cross tabulation table, reveal a statistically significant association ($p = 0.013$) between blood groups and fingerprint patterns. Specifically, the blood group of an individual appears to influence the distribution of their fingerprint pattern[7].

These findings not only provide a novel perspective on the potential interplay between genetics and biometric features but also have practical implications in the realms of forensic science, biometric security, and medical diagnostics[8]. A deeper understanding of this association could lead to more accurate and personalized biometric systems, as well as improved forensic and medical practices[4-8].

This study marks a crucial step toward unraveling the complex genetic determinants of these unique biological traits and underscores the significance of multidisciplinary research in uncovering novel associations and applications within the scientific community.

METHODS

Data for this research study were collected from a targeted population consisting of students enrolled at Sahara Medical College, falling within the age range of 19 to 23 years. The study specifically focused on students during their third year of academic sessions, spanning from July 2020 to June 2023. Prior to the commencement of data collection, the research protocol adhered to a stringent ethical framework. Informed consent was obtained from each participant, accompanied by a detailed explanation of the study's nature and objectives, the voluntary nature of participation, and the assurance of data confidentiality. Furthermore, this study received approval from the Institutional Review Board (IRB) of Sahara Medical College, ensuring ethical adherence and compliance with established research protocols.

The research involved the administration of a structured questionnaire designed to gather information related to both ABO blood group configurations (including the Rh antigen) and the pattern of fingerprint. The cross-sectional study was carried out using convenient consecutive sampling technique specifically targeted students in the stipulated age group who were willing to participate.

RESULTS

Demographics:
The study included 293 research participants. There were 5 students of 19 years of age, 73 students of age of 20 years, 152 were 21 years old while 60 students were 22 years of age and lastly there were only three students in the 23rd years of their age. The frequencies are shown in the table 01 below.

Table No. 1: Age

Serial No.	Age (in Years)	Frequency	Valid Percentage
1	19	5	1.6
2	20	73	24.9
3	21	152	51.9
4	22	60	20.5
5	23	3	1.0
Total		293	100.0

Out of 293 students there were 106 (36.2%) males just and remaining 187 (63.8%) were females. The composition depicts almost 1:3 ratio from male to female respectively. The frequencies are shown in table 02 below.

Table No. 2: Gender

Serial No.	Gender	Frequency	Valid Percentage
1	Male	106	36.2
2	Female	187	63.8
Total		293	100.0

Analysis of Fingerprint and Blood Group Association:

Fingerprint Pattern: The predominant fingerprint pattern observed in the sample was the "Loop," with 101 instances (34.5% of the total patterns). Within the "Loop" category, the "Radial" sub-variation was the most frequent, accounting for 45.7% of all patterns. In contrast, the "Ulnar" sub-variation within the "Loop" pattern was observed 33 times, making up 11.3% of the total patterns. The "Whorl" pattern was the second most common, representing 36.9% of the total patterns. Among "Whorl" patterns, the "Plain" sub-variation was the most prevalent, constituting 40.6% of the "Whorl" patterns. The "Double Loop" and "Composite" patterns were less frequent, with 3.8% and 0.7% of the total patterns, respectively.

Blood Groups Analysis: The most common blood group in the population was "A positive," representing 20.8% of the total blood groups. In contrast, "A negative" blood group was relatively less common at 0.7%. Notably, "B positive" blood group was the most prevalent in the study population, accounting for 35.2% of the total blood groups. "B negative" blood group was observed in 2.4% of the cases. The "AB positive" blood group was identified in 13.0% of the individuals, while "AB negative" comprised 1.4% of the sample. The "O positive" blood group was observed in 23.9% of the cases, with "O negative" accounting for 2.7% of the total blood groups.

Table No. 3: Analysis of Blood Group and Pattern of Fingerprint

Blood Group Configuration		Fingerprint Pattern							Total	P Value
		Loop		Arch		Whirl		Composite		
Blood Group	Rh Factor	Radial	Ulnar	Plain	Tentated	Plain	Double Loop	Composite	Total	P Value
A	Positive	27	3	5	2	22	2	0	61	0.013

	Negative	0	0	0	0	2	0	0	2
B	Positive	32	10	14	1	42	3	1	103
	Negative	3	2	1	0	1	0	0	7
AB	Positive	12	8	3	0	13	1	1	38
	Negative	2	1	0	0	0	1	0	4
O	Positive	22	9	9	1	28	1	0	70
	Negative	3	0	1	1	0	3	0	8
Total		101	33	33	5	108	11	2	293

Statistical Significance: A chi-square test of independence was conducted to investigate the potential relationship between "Blood Group" and "Pattern of Fingerprint." The results of this analysis indicate a statistically significant association (p = 0.013) between these two variables.

Specifically, "Blood Group" appears to influence the distribution of "Pattern of Fingerprint" within the study population. This finding suggests that the prevalence of specific fingerprint patterns may be associated with an individual's blood group. These results serve as a significant foundation for further research into the mechanisms underlying this association and the potential implications within the broader context of our study on the correlation between blood groups and fingerprint patterns.

DISCUSSION

The pursuit of understanding the intricate and nuanced facets of human biology has long captivated the scientific community[9]. In this study, we endeavored to unravel a potential relationship between two distinct biological traits: blood groups and fingerprint patterns[10]. This endeavor is underpinned by the premise that both characteristics are genetically determined and could potentially exhibit an association[6,10,11,12]. The statistical analysis of our data revealed a significant association between "Blood Group" and "Pattern of Fingerprint." Specifically, the chi-square test of independence yielded a p-value of 0.013, signifying that the distribution of fingerprint patterns is not independent of blood group. This finding sheds light on a previously under-explored dimension of biometric research and raises a multitude of questions and considerations.

The observed association prompts the need for a deeper understanding of its significance and potential implications[13,14]. One possible explanation for this association could be the genetic determinants that influence both blood group and fingerprint pattern development[15]. The influence of genetics on fingerprint patterns is well-established, and it is plausible that genes governing blood group also play a role in the formation of fingerprint patterns[16]. The implications of this association are multifaceted. In the realm of forensic medicine, where fingerprint patterns hold great significance, the knowledge that blood groups may influence these patterns opens new avenues for investigation[17]. Fingerprint analysis in forensic investigations could benefit from considering an individual's blood group in conjunction with pattern analysis, potentially aiding in the identification and profiling of individuals[6,18]. Moreover, in biometric security, the findings of this study have the potential to enhance the accuracy and reliability of fingerprint-based authentication systems, contributing to both security and convenience[19].

CONCLUSION

In conclusion, the association between blood groups and fingerprint patterns represents a fascinating intersection of genetic factors and biometric features. Our study has illuminated a statistically significant link between these two variables, creating a foundation for future research endeavors. The potential applications of this association in forensic science, biometric security, medical diagnostics, and genetic studies are promising. This discovery underscores the ever-evolving landscape of biometric research and the intriguing interplay between genetics and human variation.

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