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Original Research Article

Revealing the Fingertip Patterns of Asthma: A Case-Control Study

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Abstract:

Introduction: Asthma is a chronic respiratory disorder influenced by both genetic and environmental factors. During the same time span, intrauterine environmental factors will shape the fingerprint's orientation and design. This study aims to determine if there are any differences in fingerprint patterns between individuals with bronchial asthma and healthy controls.

Method: A case-control study of 460 participants aged 5 to 50 years, comprising 230 bronchial asthma patients and 230 healthy individuals were conducted. The fingerprints of all participants were obtained using the Indian Ink method. Statistical analysis was conducted using SPSS Version 20 and significance was tested using the Chi-square test ($p < 0.05$).

Result: The analysis of statistical data has revealed significant differences in the distribution of fingertip patterns between bronchial asthma patients and controls across all fingers: first finger ($\chi2 = 110.87$, $p < 0.00001$), second finger ($\chi2 = 56.73$, $p < 0.00001$), third finger ($\chi2 = 25.45$, $p < 0.00001$), fourth finger ($\chi2 = 18.97$, $p < 0.000076$), and fifth finger ($\chi2 = 11.3$, $p = 0.0035$). These findings indicate a clear relationship between dermatoglyphic patterns and bronchial asthma, suggesting potential diagnostic and prognostic implications.

Conclusion: Bronchial Asthma patients consistently displayed fewer arch patterns but more loop and whorl patterns across all fingers compared to controls. These findings suggest a link between bronchial asthma and fingerprint patterns, indicating the potential of dermatoglyphic analysis as a non-invasive means of asthma risk assessment.

Keywords: Bronchial Asthma, Dermatoglyphics, Case-Control Study.

Introduction

Bronchial asthma stands as one of the most prevalent chronic respiratory disorders worldwide, affecting millions of individuals across all age groups.

Characterized by recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, asthma poses significant challenges to healthcare systems and adversely impacts the quality of life for those affected. While advancements in treatment modalities have improved symptom management, the etiology and pathogenesis of asthma remain complex and multifaceted [1].

Genetic predisposition plays a significant role in the development of asthma, with numerous studies highlighting the hereditary nature of the condition. However, the precise genetic mechanisms underlying asthma susceptibility and manifestation remain elusive, prompting researchers to explore alternative avenues for insight and understanding [2].

Dermatoglyphics, the study of intricate fingerprint patterns etched on the volar aspect of fingers and palms, has garnered attention for its potential role in elucidating genetic predispositions to various conditions, including asthma. The unique and heritable nature of dermatoglyphic patterns offers a noninvasive avenue for exploring the genetic underpinnings of complex disorders such as asthma.

Early embryonic development lays the foundation for dermatoglyphic patterns, with genetic and environmental factors influencing their formation. As such, dermatoglyphics may serve as a window into an individual's genetic composition, potentially reflecting susceptibility to certain diseases, including asthma [3].

While previous research has explored dermatoglyphic patterns in various congenital and chronic conditions, including Down's syndrome, hypertension, and diabetes mellitus, limited studies have investigated the correlation between dermatoglyphics and bronchial asthma. Understanding the relationship between fingerprint patterns and asthma susceptibility could offer valuable insights into the early identification and management of the condition [4,5].

Therefore, this study aims to investigate the correlation between dermatoglyphic fingertip patterns and bronchial asthma. By analyzing dermatoglyphic patterns in both control subjects and asthma patients, we seek to uncover potential associations that may contribute to our understanding of asthma etiology and pathogenesis. Through rigorous analysis and statistical evaluation, we endeavour to shed light on the intricate interplay between genetics, dermatoglyphics, and bronchial asthma, with implications for personalized medicine and targeted interventions.

Methodology

A case control study was conducted at the Pacific Institute of Medical Sciences (PIMS) from Nov. 2021 to March 2023 following approval from the Institutional Human Ethics Committee (IHEC).

The study enrolled a total of 230 patients clinically diagnosed with bronchial asthma and an equivalent number of controls. Controls were selected from diverse groups, including medical students, hospital employees, paramedical staff, and Udaipur residents, devoid of respiratory issues or asthma symptoms.

Participants, ranging in age from 5 to 50 years and of both sexes, were included based on specific criteria. Inclusion criteria encompassed cases diagnosed with bronchial asthma who visited the outpatient department (OPD) at the Pacific Institute of Medical Sciences, Umarda, and Udaipur's TB Chest department during the study period. Exclusion criteria excluded individuals under five years old or those with long term respiratory condition other than asthma. Additionally, participants unwilling to participate were not considered.

Inclusion and Exclusion Criteria

Cases who were diagnosed as Bronchial asthma were consulted in the OPD and diagnosed by the physician at the Pacific Institute of Medical Sciences in Umarda, Udaipur, throughout the study period from Nov. 2021 to March 2023 were included. The control group consisted of Udaipur residents, medical students, paramedical workers, hospital employees, and their children; these individuals did not exhibit any asthmatic symptoms or respiratory issues.

Individuals under five years old, those with additional co-morbidities, those with immunological disorders and co-occurring, uncontrolled severe asthma, and those with long-term respiratory conditions other than asthma are excluded from the study. Individuals with malformed fingers and palms, wounds, illnesses, or burn scars on either hand were not considered as cases. Those Patients who were not willing to participate are also excluded.

Material

For the fingerprinting process, the following materials were employed:

Camel duplicating ink, durable plain white paper sized 8½"×11", handy roller, inking glass slab, round bottle, magnifying lens, scale, pointed HB pencil, biological pointed indispensable needle protractor.

The fingertip patterns obtained were analyzed under the following categories:

- Cases & controls

Data Collection Procedure

The Indian Ink method, established by Cumins and Midlow in 1961, was employed for fingerprint collection [6]. Prior to and after each fingerprinting session, all equipment underwent thorough cleaning. Informed consent was obtained from participants after explaining the procedures.

General data, including name, age, sex, residential address, and family history, was collected and recorded in an organized proforma. Before fingerprinting, participants' hands were washed using soap and water.

A minute amount of duplicating ink was dispensed from the roller onto a thin film, facilitating direct ink application onto the fingers. During the fingerprinting process, anatomical adjustments were made to minimize discomfort.

The thumb was positioned with the ulnar edge facing downward and rolled towards the body, while the other digits were placed with the radial edge facing downward and rolled away from the body. Subsequently, the obtained prints were scrutinized under different criteria using a magnifying lens and recorded in the proforma for further analysis.

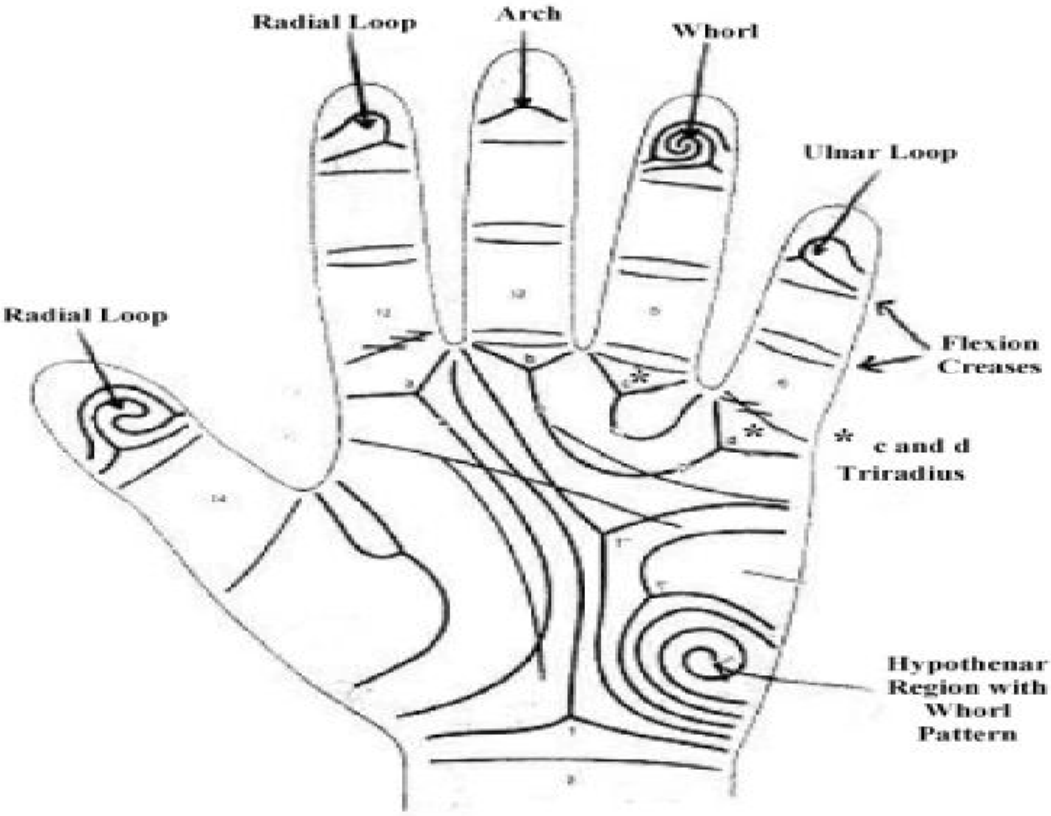

Figure 1: Dermatoglyphic patterns on the volar aspect of hand [7]

Operational definitions:

Fingerprint Pattern Configurations:

Arches (A): Arches consist of parallel ridges that traverse the pattern area, forming a concave curve proximally.

Two subcategories exist within arch patterns:

Simple arch: Characterized by ridges that cross the fingertip in a straight line without curvature.

Tented arch (TA): Comprising ridges converging at a single point, disrupting the smooth sweep of ridges. The triradius of the TA is positioned near the midline axis of the distal phalanx.

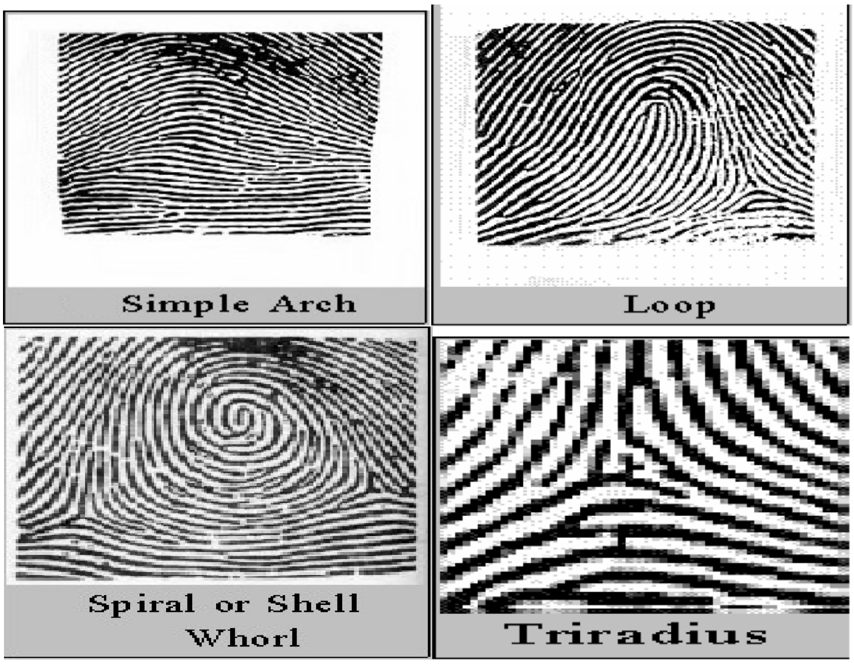

Figure 2: Fingerprints classification according to United states Department of Justice (FBI)

Loops (L): Loops feature a sequence of ridges entering the pattern area from one side of the digit, making a sudden recurve, and exiting on the same side.

Subtypes include:

Ulnar loop (U, LU): Where the ridge opens on the ulnar side.

Radial loop (R, LU): Where the ridge opens towards the radial margin.

Whorls (W): Whorls exhibit ridges encircling a core. They can manifest as:

Concentric whorls: Comprising concentric rings or ellipses.

Double or spiral whorls: Where ridges spiral clockwise or counter clockwise around the core.

Tiny whorls: Enclosed within a loop of a central pocket loop or whorl.

Accidentals: Complex patterns not fitting into the aforementioned categories.

- **Triradius:** Resulting from three ridge systems converging at an angle of approximately 120°.
- **Core:** Central feature of the pattern, which may vary in form, appearing as straight, rod like ridges or circular/elliptical shapes.
- **Radiants:** Ridges surrounding the pattern region, extending from the triradius and forming the framework of the pattern [8].

Figure 3: Original hand print

Statistical Analysis: Collected data was entered into a Microsoft Excel spreadsheet in the form of a master chart and analyzed using standard statistical software (SPSS Version 20). Significance testing was conducted using the Chi-square test, with a p-value of < 0.05 considered statistically significant.

Results

The fingertip prints of 230 individuals diagnosed with bronchial asthma and 230 control subjects underwent thorough analysis, comparison, and statistical tabulation. Within both cases and controls, there were equal proportions of male and female participants, with 100 individuals of each gender. Additionally, the study incorporated 15 male and female children in both the cases and controls. Fingertip pattern data obtained from all fingers of the participants were meticulously analyzed for the study.

The distribution of fingertip patterns of the first finger in asthma patients and controls shows that arch (A) patterns were observed only in 3.69% of asthma patients compared to 11.52% of controls. Loop (L) patterns were present in 40% of asthma patients and 65.43% of controls.

Whorl (W) patterns were identified in 56.30% of asthma patients and 23.04% of controls.

The differences in distribution between asthma patients and controls were statistically significant for all patterns (p < 0.00001). [Table 1]

Table 1: Distribution of fingertip patterns of first finger in asthma patients and control

I Finger of both hands						
Patterns	**Cases (n=460)**	**%**	**Controls (n=460)**	**%**	**χ^2**	**p- value**
A	17	3.69	53	11.52	110.87	0.00001
L	184	40	301	65.43		
W	259	56.30	106	23.04		

The distribution of fingertip patterns of the second finger in asthma patients and controls illustrates that arch (A) patterns were found in 3.26% of asthma patients and 18.69% of controls. Whereas Loop (L) patterns were observed in 62.17% of asthma patients and 50% of controls. Whorl (W) patterns were present in 34.56% of asthma patients and 31.30% of controls. The differences in distribution between asthma patients and controls were statistically significant for all patterns (p < 0.00001). [Table 2]

Table 2: Fingertip Pattern Distribution in the Second Finger among Asthma Patients and Controls

II finger of both hands						
Patterns	**Cases (n=460)**	**%**	**Controls (n=460)**	**%**	**χ^2**	**p- value**
A	15	3.26	86	18.69	56.731	0.00001
L	286	62.17	230	50		
W	159	34.56	144	31.30		

Fingertip patterns distribution of the third finger in asthma patients and controls depicts that Arch (A) patterns were identified in 15% of asthma patients and 8.91% of controls. Whereas Loop (L) patterns were found in 75% of asthma patients and 70.21% of controls. On the other hand, Whorl (W) patterns were present in 10% of asthma patients and 20.86% of controls. The differences in distribution between asthma patients and controls were statistically significant for all patterns (p < 0.00001). [Table 3]

Table 3: Comparing fingertip patterns of the third finger between asthma patients and controls

III finger of both hands						
Patterns	**Cases (n=460)**	**%**	**Controls (n=460)**	**%**	**χ^2**	**p- value**
A	69	15	41	8.91	25.457	0.00001
L	345	75	323	70.21		
W	46	10	96	20.86		

The fingertip pattern distribution of the fourth finger in asthma patients and controls describes Arch (A) patterns that were observed in 9.78% of asthma patients and 7.60% of controls. Loop (L) patterns were present in 43.04% of asthma patients and 57.39% of controls. Whorl (W) patterns were found in 47.17% of asthma patients and 35% of controls. The differences in distribution between asthma patients and controls were statistically significant for all patterns (p < 0.000076). [Table 4]

Table 4: Distribution of fingertip patterns in the fourth finger among asthma patients and controls

IV Finger of both hands						
Patterns	**Cases (n=460)**	**%**	**Controls (n=460)**	**%**	**χ^2**	**p- value**
A	45	9.78	35	7.60	18.97	0.00007
L	198	43.04	264	57.39		
W	217	47.17	161	35		

Fingertip pattern distribution of the fifth finger in asthma patients and controls represents that Arch (A) patterns were identified in 10% of asthma patients and 17.39% of controls. Loop (L) patterns were observed in 66.52% of asthma patients and 58.91% of controls. Whorl (W) patterns were present in 23.47% of asthma patients and 23.69% of controls. The differences in distribution between asthma patients and controls were statistically significant for all patterns (p < 0.0035). [Table 5]

Table 5: Fingertip pattern distribution of the fifth finger among asthma patients and controls

V finger of both hands						
Patterns	**Cases (n=460)**	**%**	**Controls (n=460)**	**%**	**χ^2**	**p- value**
A	46	10	80	17.39	11.3	0.0035
L	306	66.52	271	58.91		
W	108	23.47	109	23.69		

The analysis of fingertip patterns in individuals with bronchial asthma compared to control subjects revealed significant differences across all fingers. Arch patterns were consistently less prevalent in asthma patients compared to controls, while loop patterns were more common among asthma patients. Whorl patterns showed varying distributions across fingers but were generally more frequent in asthma patients. These differences were statistically significant for all patterns across all fingers (p < 0.05).

Overall, the findings suggest a potential association between dermatoglyphic patterns and bronchial asthma. The lower prevalence of arch patterns and higher prevalence of loop and whorl patterns in asthma patients across multiple fingers indicate a possible dermatoglyphic marker for asthma susceptibility. Further research is warranted to elucidate the underlying mechanisms and clinical implications of these findings, which could potentially lead to the development of non-invasive diagnostic tools for assessing asthma risk based on dermatoglyphic patterns.

Discussion

Different diagnostic criteria are accessible for mentioning bronchial asthma, like clinical history, family background, examination, and research facility concentrates on things like skiagrams, spirometry, and sensitivity tests. Aside from propels in clinical symptomatic methodology, the conclusion of bronchial asthma is troublesome, as patients with asthma are heterogeneous and they present a wide range of signs and symptoms which fluctuate in seriousness, from one patient to another and from one season to another.

So, to assist the finding of bronchial asthma, the dermatoglyphics with canning assume a significant part, despite the fact that it has its own limits. As bronchial asthma and dermatoglyphic examples of the individual, both still up in the air, the examples might help the determination of asthma in patients and their family members.

The dermatoglyphics were referred to since old times as private distinguishing proof checks and were utilized for recognizing criminals [4] and furthermore involved them as a demonstrative guide in clinical sicknesses. From that point forward it has turned into an important device in medico-legitimate, anthropological, and hereditary examinations.

The dermatoglyphic study is profitable on account of its simple openness, harmless nature, less extensiveness, and pertinence to all ages. However, the benefits are many, the constraints of this strategy ought not be ignored. Dermatoglyphic qualities of a given sickness may likewise be found in a completely typical individual due to an extraordinary fluctuation of example in ordinary populace. The analysis of dermatoglyphic patterns in bronchial asthma patients compared to control subjects in this study yielded significant differences across all fingers, indicating a potential association between dermatoglyphic patterns and asthma susceptibility (p-value<0.05).

The consistent observation of lower prevalence of arch patterns and higher prevalence of loop and whorl patterns among asthma patients suggests a distinct dermatoglyphic profile associated with asthma. These findings align with previous research indicating a link between dermatoglyphic patterns and various genetic and developmental disorders. A study done by Amanuel Tadesse et al. (2022) investigated the association between dermatoglyphic patterns and diabetes mellitus found similar trends of altered fingertip patterns among diabetic patients of Ethiopia, characterized by reduced arch patterns and increased loop and whorl patterns, compared to healthy controls [5].

The study conducted by UK Gupta et al. (2003) also found a similar association between fingertip patterns and bronchial asthma cases, which supports the findings of our study [9]. This parallel observation strengthens the hypothesis of dermatoglyphic patterns as potential markers for disease susceptibility and underscores the significance of dermatoglyphic analysis in understanding the pathophysiology of different conditions.

However, it is crucial to acknowledge contradictory findings from other studies to provide a comprehensive perspective on the relationship between dermatoglyphic patterns and disease susceptibility. A research by Fereshteh Shakibaei et al. (2011) at Iran examined the association between dermatoglyphic patterns and schizophrenia failed to identify significant differences in fingertip patterns between schizophrenia patients and controls [10].

Unlike the consistent patterns observed in the asthma study, the schizophrenia study did not reveal any distinct dermatoglyphic markers for the disease, suggesting that the relationship between dermatoglyphic patterns and disease susceptibility may be context-dependent and disease-specific.

Conclusion & future scope

The research revealed notable variations in dermatoglyphic fingertip patterns between bronchial asthma patients and the control group. A decreased occurrence of arch patterns and an increased prevalence of loop and whorl patterns among those with asthma indicate a possible link between dermatoglyphic features and susceptibility to asthma. These results underscore the promise of dermatoglyphic analysis as a non-invasive method for identifying individuals prone to developing asthma. Moving forward, further research is needed to elucidate the underlying mechanisms linking dermatoglyphic patterns and asthma susceptibility. Longitudinal studies could explore the predictive value of dermatoglyphic patterns in identifying individuals predisposed to asthma development. Additionally, investigating the genetic basis of dermatoglyphic patterns associated with asthma could provide valuable insights into the molecular pathways involved in the disease. Ultimately, the integration of dermatoglyphic analysis into clinical practice could facilitate early identification and personalized management strategies for individuals at risk of asthma.

Limitations

Subjective interpretation of dermatoglyphic patterns could introduce bias. Mechanisms underlying the observed associations remain unclear, and publication bias may affect the results' interpretation. Further research addressing these limitations is needed for a comprehensive understanding of dermatoglyphic patterns' association with asthma susceptibility.

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