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DESCRIPTIVE STUDY ON EARLY DETECTION OF AUTISM FROM FINGERPRINT

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Abstract
Introduction; The prevalence of autism is increasing in India and there is no diagnostic tool available for predicting the possibility of autism as on now.
Objective; The current study aims at finding evidence that will help in early diagnosis or predict the possibility of ASD at the time of birth using fingerprints.
Methods; Fingerprints being a very strong and permanent phenotypical input, should bestudied in detail. The data available also is very limited. So, the present study tries to correlate the data obtained from ASD children with that of typical, school going children. The data was taken with informed consent from the parents. Statistical analysis was done to determine the frequency and intensity of data
Result; Indicated that there is significant difference in fingerprint pattern between Autistic and non-autistic children. The intensity of Whorl among autistic group is significantly high as well as the intensity of loops in non-autistic is also significantly high.
Conclusion; The increased prevalence of whorls in autistic group supports the hypothesis of altered embryological development during critical gestational period. These findings suggest that dermatoglyphics could serve as a non-invasive supplementary tool for early detection and risk assessment of neuro developmental conditions

Key words: Dermatoglyphic patterns, Autism spectrum disorder, early screening, neuro developmental conditions

Introduction

Dermatoglyphics, the study of permanent epidermal ridge patterns, offers a unique window into prenatal development given that dermal ridges and the central nervous system develop simultaneously in utero, researchers have explored fingerprint patterns as non- invasive biomarkers for neurological conditions. This paper examines the history of dermatoglyphics in clinical presentation of autism spectrum disorder(ASD) and the potential correlation between specific ridge patterns such as increased whorls, and asymmetry and the presence of ASD.

Dermatoglyphics

The scientific study of ridge patterns in the fingers palms and soles known as dermatoglyphics. The term was coined by Harold Cummins and Charles Midlow in 1943. Cummins is widely regarded as the father of modern dermatoglyphics having established that every fingerprint is distinct. Prior to Cummins, Sir Francis Galton attempted the first scientific analysis in 1892 book Fingerprints, Galton identified three fundamental patterns Loops, Whorls and Arches. He also introduced the concept of minutiae -the inconsistencies discontinuities and branching in ridges that make each fingerprint unique. Crucially Dalton demonstrated that the fingerprints are permanent appearing at birth and remaining unchanged throughout a lifetime

Biological development of fingerprints.

The biological development of dermal ridges start from very early stage of foetal development .While the genetic code provides a master design for ridge formation external factors and the physical /emotional state of the mother can influence the final's design the formation of this pattern is closely linked to foetal volar pads. The exact Process underlie the formation of epidermal ridges is yet not completely understood.

Fingerprints are classified into three primary categories, Loops, Whorls and Arches. One or more of the following pattern traits will be present in them.

A core: It is the centre of attention that the ridges flow around.

Delta: the point from which three directions of flow combine to form a triangle pattern Minutia: Each print's minute details, which distinguish each one

Loops

- Present in 60 to 70 % of population

- Features one delta and core

Ridges enter an exit from same s Whorls

- Present in 30 to 35% of population
- Circular patterns requiring at least two deltas and a core Arches
- Present in 5% of population so least common
- Ridges enter from one side and exit from the other side
- There is no delta

Autism spectrum disorder

The Autism Society of America defines autism as a complex developmental disability resulting from a neurological disorder that affects brain function specifically impacting social interaction and communication. Historically autism was not recognized as a distinct diagnosis in early versions of Diagnosis and Statistical Manual (DSM) It was often misdiagnosed as schizophrenia. In DSM III (1980), added pervasive developmental disorder (PDD) In 1987 the term was modified to autism disorder the DSM-5 proposed a significant but controversial modification to the diagnosis, excluding Asperger's syndrome, which was previously seen as a mild type of autistic disorder.

Clinically the children with ASD typically develop normally until about 12 to 18 months of age. As the condition progresses, they show decreased verbal nonverbal expression and restricted repetitive behaviors Common symptoms include poor eye contact echolalia, and sensory difficulties

In India the prevalence of ASD is approximately 0.11% in urban population and 0.09 % in rural population. Given India's massive population this represents a significant public health and financial challenge.

Current diagnostic methods for ASD rely on clinician observations and parental data which can be subjective Imaging methods are often inconsistent. Consequently, there is a need for non- invasive permanent phenotypic marker that can be used from birth. The investigator feels that a diagnostic measure which can predict the possibility of occurrence of autism can be done more effectively by studying fingerprints which are permanent phenotypic codes

The goal of the current study was to find out if there were any digital dermatoglyphic characteristics that people with clinically confirmed autism share. This was accomplished by comparing the data with those of individuals who were not autistic but of a comparable age, sex, and ethnicity in order to identify characteristics exclusive to the former group that can help in the early identification of autism spectrum disorder.

Methodology

Aim

To analyse the fingerprint of person with the diagnosed cases of autism Objective

To establish any feature exclusive to fingerprint patterns of diagnosed cases of autism which would help in early identification of ASD

Participants

Study sample was obtained from 275 students attending special Schools in the state of Kerala who scored between 70-200 on the ISAA (Indian Scale for Autism Assessment) The average age of the participants was 10.12years.163 males and 112 females participated in the study. For comparison 275 Samples were taken from general school going Students from the state of Kerala. Informed consent from parents and assent from students were taken from both groups.

Procedure

Indian Scale for Autism Assessment (ISAA) was used to assess the participants. The scale is proven to be valid, reliable, consistent and sensitive. Basic demographic details of each participant were considered and stored using the advanced dermatoglyphics analysis software. 3views—central right and left—of each finger were taken using a fingerprint scanner device and compatible software (a total of 30 images were taken from each participant) and analyzed each fingerprint in detail and tabulated the results.

Result

Descriptive Statistics

Category	Age		Sex			ISAA	
	Mean	SD	Male	Female	Total	Mean	SD
Autistic -group	10.13	4.47	156	119	275	107.72	28.92
Non-autistic group	9.6	4.9	146	139	285	51.9	6.0

Patterns over individual fingers

		Group			
		Autistic		Non-Autistic	
		f	%	f	%
Pattern LT	Loop	86	31.3%	179	62.8%
	Whorl	137	49.8%	81	28.4%
	Arch	52	18.9%	25	8.8%
Pattern LI	Loop	73	26.5%	165	57.9%
	Whorl	145	52.7%	77	27.0%
	Arch	57	20.7%	43	15.1%
Pattern LM	Loop	96	34.9%	188	66.0%
	Whorl	103	37.5%	56	19.6%
	Arch	76	27.6%	41	14.4%
Pattern LR	Loop	68	24.7%	134	47.0%
	Whorl	171	62.2%	142	49.8%
	Arch	36	13.1%	9	3.2%
Pattern LL	Loop	104	37.8%	259	90.9%
	Whorl	95	34.5%	18	6.3%
	Arch	76	27.6%	8	2.8%
Pattern RT	Loop	44	16.0%	141	49.5%
	Whorl	158	57.5%	135	47.4%
	Arch	73	26.5%	9	3.2%
Pattern RI	Loop	111	40.4%	211	74.0%
	Whorl	92	33.5%	60	21.1%
	Arch	72	26.2%	14	4.9%
Pattern RM	Loop	104	37.8%	160	56.1%
	Whorl	98	35.6%	105	36.8%
	Arch	73	26.5%	20	7.0%
Pattern RR	Loop	37	13.5%	58	20.4%
	Whorl	168	61.1%	205	71.9%
	Arch	70	25.5%	22	7.7%
Pattern RL	Loop	103	37.5%	187	65.6%
	Whorl	102	37.1%	83	29.1%
	Arch	70	25.5%	15	5.3%

The data was analyzed in two ways,-consolidated and individual fingers Consolidated data was analyzed using Chi square test and the result is as follows:

	Autistic		**Non-Autistic**			
Pattern	f	%	f	%	**2**	***p-value***
Loop	826	30.04 %	1682	59.02 %	566.95	*< 0.001*
Whorl	1269	46.15 %	962	33.75 %		
Arch	655	23.81 %	206	7.23 %		

The above table interprets overall pattern in Autistic and Non-Autistic Group. Since the p-value < 0.001, we can conclude that there is significant difference in pattern between Autistic and non-autistic.

Discussion

Based on this table there is a strong statistical basis to conclude that fingerprint patterns are distributed differently between autistic and non-autistic individuals .The whorl and arch patterns appear much more frequently in autistic group while the loop pattern is significantly more common in non-autistic group .The intensity of Whorl among autistic group is significantly high (46.15%) as well as the intensity of loops in non-autistic is also significantly high (59.02%).

Almost all fingers the same trend of higher whorls and arches in the autistic group. Certain fingers show much more dramatic shifts. Left index finger shows a very strong contrast. The autistic group has 52.7% whorls while the non- autistic group has only 27 %. In right thumb there is a massive difference in Archs.26.5 % in the autistic group versus only 3.2 % in the non- autistic group .The left little finger is one of the most stark difference in this data. In the non-autistic group

90.9% have loops, where as in the autistic group the number crashes to 37.8 %with a huge surge in the Whorls and Arches. For the autistic the whorl frequency is very high in both the left ring and the right ring fingers 62.2% and 61.1% respectively. This symmetry suggests that the biological factors influencing these patterns are systemic rather than localized to one hand These results suggest dermatoglyphics could potentially serve as a non- invasive biomarker, since fingerprint pattern formed in during the same time as the development of the central nervous system especially between the 10^{th} and 24^{th} weeks of gestation. The significant rise in arches also to be noticed arcs are usually the rarest pattern in the general population as observed in non- autistic group 7.23 %only Whereas they occur more than three times often in the autistic group (23.81%)

The aggregate data and the finger by finger analysis revealed that the increased prevalence war and arc patterns in the autistic was consistent across all ten finger

Conclusion and clinical implication

The data shows a clear phenotypic deviation. While clinical diagnosis must remain rooted in behavioural and neurodevelopmental assessment, the high statistical significance and the consistent digit specific deviations found in the study support the use of digital dermatologist as a viable cost-effective accessory screening tool. Since fingerprints are permanent and present from birth, we may use it as a screening or an early warning protocol. Though this cannot replace the clinical behavioural diagnosis, it can serve as a low cost, non-invasive, first tier screen at birth.

Limitations and future research

ASD it self is diverse in nature, so considering ASD as a single group is a limitation. Though there is a high intensity of whorls and archs in autistic group, some of the non autistic group also process these patterns. This overlap prevents from considering this as a conclusive tool. This study is done only in the state of Kerala, these percentage thresholds cannot be applied universally. Extraneous factors like maternal conditions thought process were not considered. It can only be used for proactive monitoring.

More universal studies using more samples from different ethnicity should be studied and other variables such as pattern symmetry, pattern indices ,longitudinal birth cohorts also should be studied

Author contributions

Conceptualization :Radhakrishnan D; Investigation :Radhakrishnan D

Methodology: Radhakrishnan D, Preet K; Statisical analysis:Radhakrishnan D,Preet K ; Project administration: Radhakrishnan D, Visualization: Radhakrishnan D,

Writing original draft:Radhakrishanan D, Writing-review and editing: Radhakrishanan D,Preet K

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Data Availability

Data can be made available on request. Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper.

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