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Original Research Article

Comparative analysis of quantitative dermatoglyphic markers in schizophrenia patients and controls attending a superspeciality hospital in West Bengal

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ABSTRACT

Background: Schizophrenia is a psychiatric disorder encompassing multiple etiological variables. Association of dermatoglyphic traits with schizophrenia has been observed and reported. This study was undertaken to evaluate epidermal ridge patterns in patients of schizophrenia as compared to healthy controls attending a superspeciality hospital in West Bengal. Establishing dermatoglyphic parameters as biomarkers for early diagnosis will ensure prompt intervention and a greater scope of recovery in schizophrenia and thus promote a better quality of life for the individual as well as lower the burden of disease for the society.
Methods: Quantitative dermatoglyphic parameters namely, total finger ridge count (TFRC), total A-B ridge count (TABRC) and ATD angle of 50 schizophrenia patients were compared to 50 age and gender matched healthy controls.
Results: TFRC and TABRC were found to be decreased in schizophrenia, while ATD angle was increased in schizophrenia as compared to the control group.
Conclusions: This study found a significant association between dermatoglyphic pattern anomalies and the development of schizophrenia. This may offer a scope of primordial prevention of schizophrenia in future, utilising dermatoglyphics as an investigative tool.

Keywords: Schizophrenia, Dermatoglyphics, Epidermal ridge, Total finger ridge count, Total A-B ridge count, ATD angle

INTRODUCTION

The scientific study of epidermal ridge configuration of palm, finger and sole is known as dermatoglyphics.[1] The term dermatoglyphics owes its roots to the Greek word derma that refers to skin and glyphics which translates into carvings.[2] Cummins et al are credited with the invention of the term dermatoglyphics.[3] Primary volar skin ridges start appearing during the eleventh gestational week and subsequently they differentiate during the fifteenth to seventeenth gestational week of the foetus. Secondary ridges develop during the fourth to sixth month of intra uterine life. After maturation of primary and secondary ridges at about the 24th gestational week, the ridge pattern only increases in size with age but ridge sequence remains unchanged throughout rest of the life.[4]

Schizophrenia is considered as one of the most puzzling as also disabling brain disorder, with its severe and persistent psychotic symptoms, along with cognitive

dysfunction of varying degrees and marked psychosocial impairment. The disease is hallmarked by fundamental and characteristic distortions in the domains of thought, perception and affect.[5] Looking back at history, Kraeplin pioneered the psychiatric nosology and classified primary psychotic disorders into two broad groups, namely, manic depressive psychosis and dementia praecox (meaning dementia of the young).[6] The long term prognosis and course of illness were the basic principles of this classification. The term schizophrenia was coined by Eugen Bleuler in 1911, to signify the splitting of psychic functions, which is instrumental in the development of schizophrenia.[6] Schneider introduced the concept of first rank symptoms as the core features of schizophrenia, which include thought echo, third person hallucinations (voices discussing among themselves or running commentary hallucinations), thought alienation (thought insertion, withdrawal and broadcasting), made phenomenon, delusional perception and somatic passivity.[6]

Whether schizophrenia is a developmental disorder, is a question that has attracted researchers since a long time. Brain development is a complex process involving an intricate sequence of events, with sensitive or critical time periods when neural circuits are in their most plastic stage, allowing essential developmental changes to occur. These critical time periods also make neurodevelopment a highly vulnerable stage. Disruptions during these time periods lead to permanent adaptations in brain circuitry and consequently, behaviour.[7] The exact ethology of schizophrenia is unknown and considered to be multifactorial.[8] However, genetic predisposition has been clearly established. So also environmental role has been proven by the fact that monozygotic twins have about 50% concordance rates in schizophrenia.[7] Currently it has been accepted that an interplay of genetic risk factors and exposure to environmental variables lead to the development of schizophrenia.

According to the neuro-developmental hypothesis of schizophrenia, prenatal stress to the developing foetus whether genetic or environmental or both is a key risk factor for the genesis of schizophrenia.[9] Because the brain and skin are both ectodermal descendants, damage to the developing brain is linked with alterations of a number of dermatoglyphic parameters.[10,11] The epidermal ridges of finger, palm and sole appear and differentiate during the late 1st and 2nd trimester of intra uterine life. Once formed, they remain constant throughout life except for general growth along with the whole of the body. Dermatoglyphic deformities can originate from a variety of physiological insults that can occur at the time of foetal development including exposure to environmental toxins, viral infections or genetic abnormalities.[12]

The second trimester is also a crucial period for significant foetal brain development. During this trimester, neutrons migrate upward from the ventricular wall to their respective critical layer. Postmortem studies in cortical tissues from schizophrenics revealed ectopic neutrons and abnormal cytoarchitecture in prefrontal cortex and entorhinal cortex. This was consistent with an impairment of neuronal migration during the critical developmental period (namely the second trimester) in schizophrenic patients.[7]

Thus the critical period of development of both the foetal brain and epidermis present a similar developmental timeframe.[13] Hence any insult or disruption, be it genetic and environmental, during this particular timeframe will potentially involve both.

Studies have revealed that dermatoglyphic traits are genetically influenced.[14] Genetic or other factors alone or in combination may result in dermatoglyphics malformation before the end of 5th month of Intra uterine life.[12] Evidence gathered from adoption, family and twin studies established the genetic basis of schizophrenia. Thus, dermatoglyphics alterations may serve as a potential investigative marker in schizophrenia.[15]

This study was undertaken to ascertain whether dermatoglyphics can provide a valuable clue regarding future risk of developing schizophrenia.

METHODS

The study type was a cross-sectional study was undertaken using non probability, purposive sampling. The study took place at Suri superspeciality hospital, Suri, Birbhum, West Bengal. The duration of study was from September 2019 to February 2020.

Cases

Cases were chosen from clients attending psychiatry outpatient department of Suri superspeciality hospital, Suri, Birbhum, West Bengal. 50 individuals were chosen for the study, comprising 25 males and 25 females.

Selection criteria

Individuals were diagnosed as suffering from schizophrenia (F20) as per the ICD 10 criteria, patients aged group between 18 to 60 years, freely consenting individuals and only cooperative patients with whom rapport could be established were chosen for the study.[5]

Exclusion criteria

Patients with other psychiatric disorders like schizoaffective disorder, schizotypal disorder, schizophreniform disorder, bipolar affective disorder, acute transient psychotic disorders, obsessive compulsive disorder, cognitive disorders or substance use disorders or with associated genetic abnormalities or with other comorbid illnesses were not included in the study. Violent or uncooperative patients were also excluded from the study.

Control group

50 individuals, comprising 25 males and 25 females were selected from the community to serve as the control group. They were screened using the general health questionnaire (12 item version) to rule out the presence of any psychiatric disorders. Their age group ranged between 18 to 60 years. It was ensured that these individuals did not have any co-morbid medical illnesses or family history of psychiatric disorders.

Study procedure

The procedure and purpose of the study was thoroughly explained to the research participants in their local language and informed consent was taken from each individual before including them in the study.

A standardized procedure was employed to collect finger and palm prints from both the hands of cases and controls. Before taking the print, the study subject was instructed to properly wash his or her hands with soap and water to ensure that the dirt and oil were removed, which might otherwise impair the quality of the print to be taken. The hand was then dried using a cloth. Using an ink roller, a small coating of ink was applied to clean, dry hands and smeared uniformly across the palm and all fingers, in order to evenly distribute the ink. An A4 size paper was put over a cylinder with a flat surface. The wrist was put at the bottom of the paper and gently rolled over the paper, which was placed over the cylinder. To ensure that the complete palm print was correctly captured, the dorsum of the hand was softly pushed over the paper. The recording continued in this manner until the finger tips were reached. The same procedure was applied to both the hands of an individual. Fingertip prints were obtained independently at the bottom of the same paper. The fingerprints were numbered from I to V, beginning with the thumb. The ink was washed off the hands at the end of the procedure.

The finger and palm prints so obtained, were examined manually using a magnifying glass to determine the values of the dermatoglyphic parameters to be studied.

Dermatoglyphic parameters studies were TFRC; finger ridge count (FRC) of right and left hands separately; TABRC; A-B ridge count (ABRC) of right and left hands separately and ATD angle of right and left hands.

TFRC

TFRC refers to the sum of the greater ridge count obtained from all the ten fingers of both hands. A straight line was drawn between the core of the pattern and the digital triradius. The total number of ridges encountered along this line represented the TFRC. If two counts were made on a single finger then the larger value was considered. There were three major fingerprint patterns, arch, loop and whorl. Ridge count in arch was zero. In case of a loop, ridges were counted along the straight line from the core to the triradial point. In case of a whorl, the greater ridge count among the two values was accepted (Figure 1).

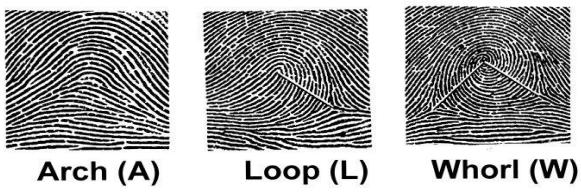

Figure 1: Three major types of fingerprint pattern with associated triradius; arch has no triradius; loop has one triradius; whorl has two triradii.

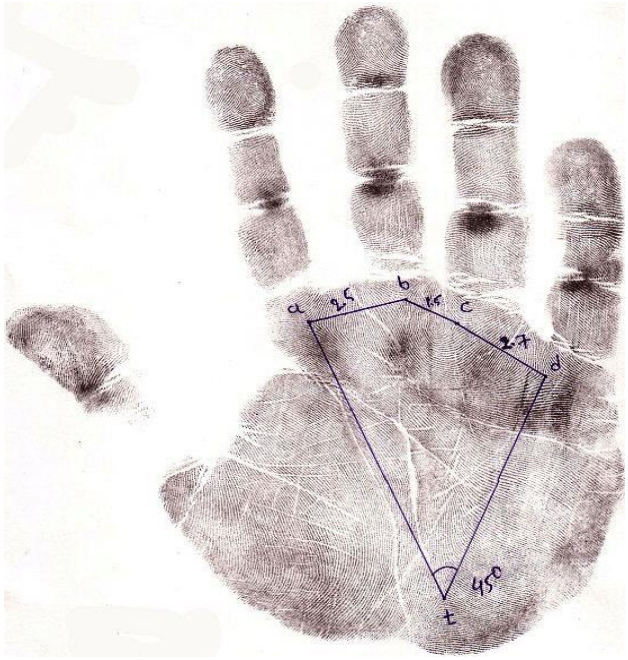

Figure 2: Palmar print showing ABRC and ATD angle.

TABRC

TABRC refers to the summation of ABRC of right and left hands together. The ABRC represented the number of ridges present between the adjacent triradius a at the proximal end of index finger and the triradius b at the proximal end of middle finger (Figure 2).

ATD angle

The ATD angle was measured in degrees between straight lines obtained by joining the digital triradius a at the base of index finger to axial triradius t at the proximal palmar margin (near the wrist) in between the thenar and hypothenar eminence and then from this point to the digital triradius d at the base of little finger (Figure 2).

Ethical approval

Ethical approval was obtained from the local ethics committee.

Statistical analysis

The data chart was prepared using Microsoft excel spreadsheet. statistical softwares namely StatCalc, Graphpad and statistical functions of MS excel were used to analyze the results. Two tailed unpaired t test was employed to compare the means of case and control groups. Statistical significance was set at p value less than 0.05, using 95% confidence intervals (CI).

RESULTS

Socio-demographic profile

Cases and controls were matched for their age and gender. Maximum number of study subjects belonged to the age group of 31 to 40 years, in both case and control groups (47% and 54% respectively). Both case and control groups comprised of 25 males and 25 females. 67% of the cases belonged to the rural background while 33% of them belonged to the urban background. Taking into account the educational level in cases, 13% received no formal education, 33% were educated upto the primary level, 34% upto the secondary level, 12% upto graduation level and 8% upto post-graduation level.

Analysis of dermatoglyphic parameters

Table 1 reveals that the mean TFRC in cases was 103.18 (±17.94) while that in controls was 137.36 (±8.45). TFRC was thus found to be significantly lower in schizophrenic patients than in healthy controls.

Table 2 further demonstrates the FRC separately in right and left hands. The mean FRC in right hand was 51.66 (±8.78) and 68.34 (±4.52) in cases and controls respectively. The mean FRC in left hand was found to be 51.50 (±9.58) and 69.02 (±4.33) in cases and controls respectively. FRC in each hand was also found to be significantly diminished in schizophrenic patients as compared to controls.

Table 3 summarizes the TABRC, which shows the mean TABRC to be 76.88 (±3.60) and 80.72 (±3.09) in cases and controls respectively. TABRC was found to be significantly lowered in cases than in controls.

Table 1: Comparison of TFRC between cases and controls.

Subjects	Mean	Maximum	Minimum	Standard deviation	P value
Case (N=50)	103.18	142	75	17.94	<0.0001
Control (N=50)	137.36	150	121	8.45	

Table 2: Comparison of FRC in right and left hands in cases and controls.

Subjects		Mean	Maximum	Minimum	Standard deviation	P value
Right FRC	Case (N=50)	51.66	72	37	8.78	<0.0001
	Control (N=50)	68.34	77	60	4.52	
Left FRC	Case (N=50)	51.5	74	34	9.58	<0.0001
	Control (N=50)	69.02	76	61	4.33	

Table 3: Comparison of TABRC between cases and controls.

Subjects	Mean	Maximum	Minimum	Standard deviation	P value
Case (N=50)	76.88	81	69	3.60	<0.0001
Control (N=50)	80.72	85	72	3.09	

Table 4: Comparison of ABRC in right and left hands in cases and controls.

Subjects		Mean	Maximum	Minimum	Standard deviation	P value
Right ABRC	Case (N=50)	38.4	42	34	2.41	0.0005
	Control (N=50)	40.02	44	35	2.07	
Left ABRC	Case (N=50)	38.48	42	35	1.81	<0.0001
	Control (N=50)	40.7	45	36	2.18	

Table 5: Comparison of ATD angle in right and left hands in cases and controls.

Subjects		Mean (in º)	Maximum (in º)	Minimum (in º)	Standard deviation	P value
Right ATD angle	Case (N=50)	42.5°	52°	31°	5.75	0.0029
	Control (N=50)	38.98°	50°	31°	5.77	
Left ATD angle	Case (N=50)	43.3°	51°	32°	5.70	0.0002
	Control (N=50)	39.18°	49°	30°	4.81	

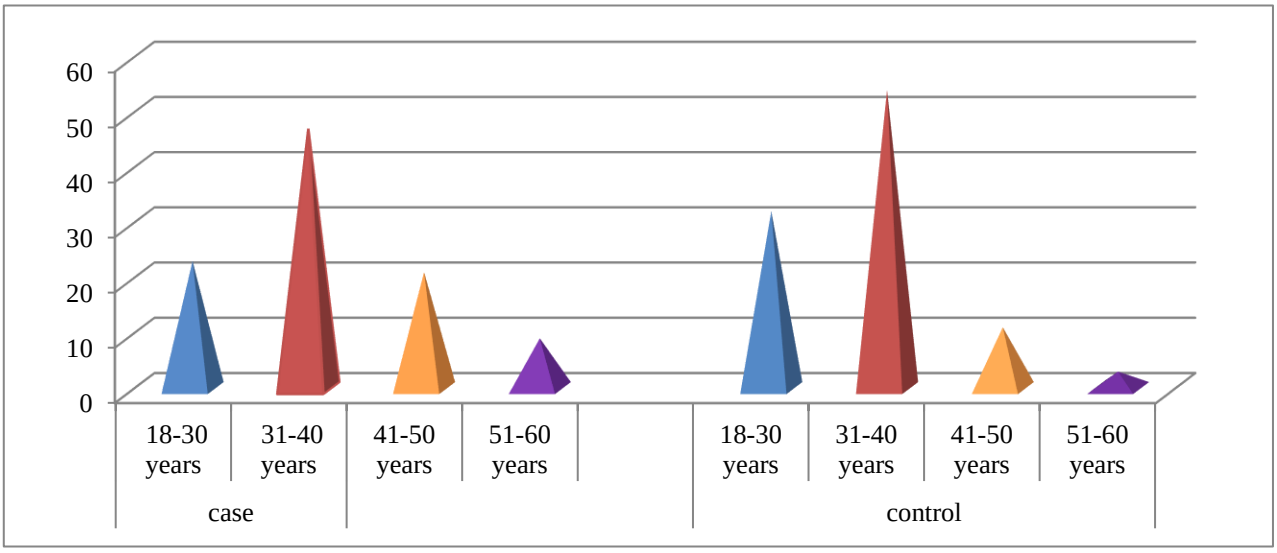

Figure 3: Distribution of age group (in percentages) among cases and controls.

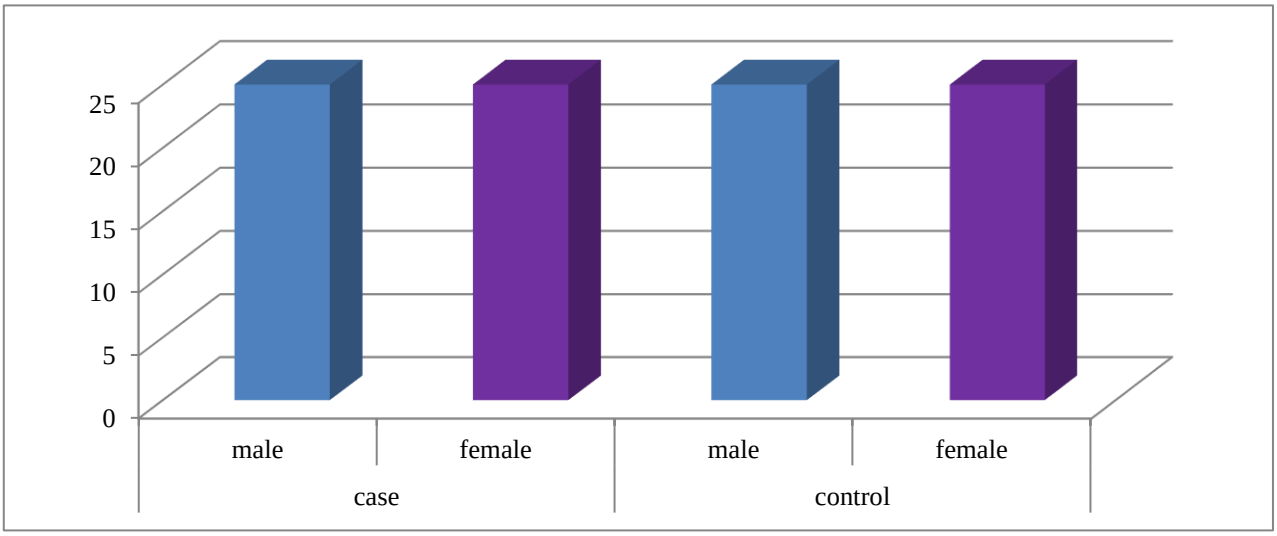

Figure 4: Distribution of gender among case and control groups.

Table 4 further elaborates the ABRC individually in right and left hands. Mean ABRC in right hand in cases and controls was found to be 38.4 (±2.41) and 40.02 (±2.07) respectively. Mean ABRC in left hand was found to be 38.48 (±1.81) and 40.7 (±2.18) respectively in cases and controls. ABRC was also found to be significantly decreased in each hand separately in schizophrenics as compared to the healthy controls.

Table 5 demonstrates that the mean ATD angle in right hand was found to be 42.5° (±5.75) and 38.98° (±5.77) in cases and controls respectively. Mean ATD angle in left hand was found to be 43.3° (±5.70) and 39.18° (±4.81) in cases and controls respectively. ATD angle was found to be significantly increased in schizophrenic patients in each hand as compared to controls.

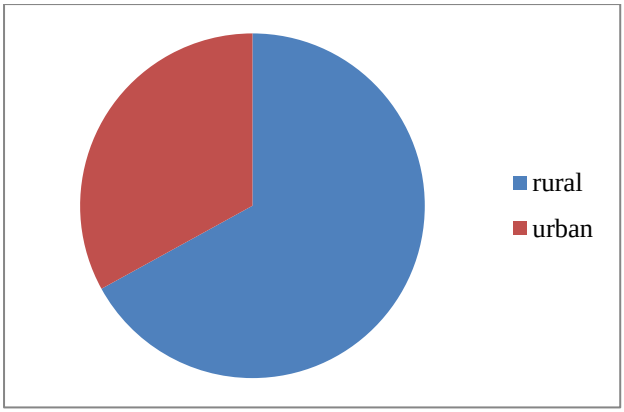

Figure 5: Distribution of rural versus urban background (in percentages) among cases.

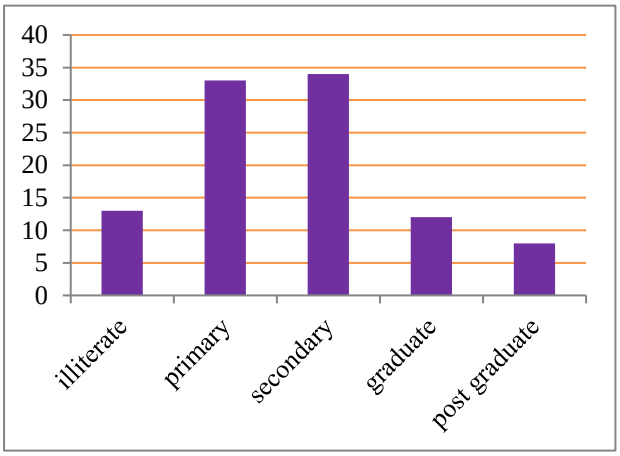

Figure 6: Distribution of educational level among cases (in percentages).

DISCUSSION

Schizophrenia has been observed to have a polygenic inheritance pattern. Copy number variations associated with schizophrenia included 1q21.1, NRXN1, 3q29, 15q11.2, 15q13.3, 16p13.11, 16p12.1, 16p11.2, 22q11.2.[16-18] Genome wide association studies and copy number variation studies have suggested a role of putative risk genes of schizophrenia, neuregulin (NRG), dystrobrevin binding protein 1 (DTNBP-1), disrupted in schizophrenia 1 and 2 (DISC 1 and 2), regulator of G protein signalling 4 (RGS 4), dopamine receptor D2 (DRD2), glutamatergic neurotransmission and synaptic plasticity (GRM3, GRIN2A, SRR, GRIA1), calcium signalling (CACNA1C, CACNB2 and CACNA1I), NRXN1 and genes encoding the N-methyl D-aspartate (NMDA) receptor.[16,19-22] Genes associated with voltage gated calcium channels and the signalling complex formed by the activity regulated cytoskeleton associated scaffold protein (ARC) of post synaptic density has been found to have importance in schizophrenia.[23] Several studies pointed out the genetic basis of schizophrenia.[24-28] Single nucleotide polymorphism SNP rs1344706 in ZNF804A gene was one of the most supported risk variants for schizophrenia.[16]

Several studies had been conducted to correlate the epidermal configuration with occurrence of schizophrenia. Holt, a modern day physician, recognized the relevance of epidermal ridges in the relationship with schizophrenia.[29] Mellor discovered a qualitative and quantitative link between dermatoglyphic pattern and schizophrenia.[30] Ponnudurai recently documented the sequential development of a characteristic pattern in schizophrenia patients.[31] A number of studies were undertaken to find a connection between ABRC and the development of schizophrenia. Bramon et al demonstrated a substantial drop in ABRC especially in schizophrenics with obstetric complications as compared to controls.[32]

In our current study, TFRC was seen to be significantly diminished in schizophrenia patients compared to controls which was consistent with the findings of Avila et al.[33] Fananas et al found no significant difference in TFRC between patients and controls.[34] Murthy et al discovered a reduction in TFRC in both males and females but it was not statistically significant.[35] Jhingan et al research showed a decrease in mean TFRC of male catatonic schizophrenic patients when compared to controls.[36] The present study revealed significantly lowered ABRC in schizophrenic patients as compared to controls, which was in accordance with results of previous studies.[37-39] The ATD angle was found to be significantly greater in schizophrenia patients than in controls in our study. Previous investigations demonstrated comparable outcomes.[40]

Limitations

The study was conducted on a small sample size, 50 cases and 50 controls. Further, non-probability, purposive sampling method was chosen. Only cooperative patients were included in our study, while violent and hostile patients were excluded. The cases chosen were predominantly of the paranoid or undifferentiated subtype, while hebephrenic and catatonic subtypes of schizophrenia were mostly eliminated either because they were uncooperative or due to unavailability of such cases in adequate numbers. Moreover, patients with spectrum disorders like schizoaffective disorder, schizophreniform disorder were excluded from the study. Thus the cases chosen may not be truly representative of the entire population of patients with schizophrenia. Further we adopted the manual method of interpreting the dermatoglyphic parameters, which could serve as a source of observer errors. These factors may have impacted the results of this study.

CONCLUSION

According to the current study, the TFRC, TABRC and ATD angle may be utilized as accurate predictors of the

future development of schizophrenia in an individual. Further research in a broader population COHORT will lend greater credibility to the study's conclusions. Early identification of prospective schizophrenic patients by dermatoglyphic markers may provide a scope for the primordial prevention of schizophrenia in future or at least, enable the early institution of intervention in such patients and thus improve the treatment outcome.

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