



## Significance of fingerprint pattern in Bipolar disorder among south Indian population: a case-control study

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### Abstract:

**Background:** Bipolar disorder (BD) is a multifaceted disease where frequent moderate to severe mood disturbance and physiological malfunctioning is its clinical manifestation. The severe and persistent mental illness in Bipolar Disorder makes it one of the major reasons for disability. **Aim:** This study aims to study the dermatoglyphic pattern in bipolar disorder patients by correlating it with healthy individuals. **Methodology:** The dermatoglyphic prints of both hands were taken from 100 bipolar disorder patients of both gender, aged 18 to 60 years old. Individual digits' fingertip patterns were studied using the "Ink and paper" method. The patterns such as Whorl, Loop, and Arch were analyzed using ANOVA and chi-square Test in SPSS 20.0 software. **Results:** In the right hand, the presence of more whorls pattern in 1<sup>st</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> digits and less number of loops pattern were found in 2<sup>nd</sup>, 4<sup>th</sup>, and 5<sup>th</sup> digit were found in bipolar disorder patients when compared with healthy individuals. Similarly, in the left hand, the whorl pattern in the 1<sup>st</sup> and 3<sup>rd</sup> digits and the loop pattern in the 5<sup>th</sup> digit were found. There is a significant decrease in the Total Finger Ridge Count (TFRC) and absolute finger ridge count (AFRC) ( $p < 0.0001$ ) in the bipolar-diseased group when compared to the control group. **Conclusion:** Dermatoglyphics is a simple, inexpensive, and non-invasive diagnostic tool for bipolar disorder. The presence of an increase in the number of whorls and fewer loops and arches can be utilized as an investigative sign for bipolar disorder patients.

**Keywords:** Arches, Bipolar Disorder, Fingerprints, Loops, Ridge count, Whorls.

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### Introduction:

Bipolar disorder is a complex, disabling, and long-term health issue with a prevalence of 1 -5 percent, depending on whether it solely types 1, type 2, or both and the average age of onset is around 20 years. Due to high rates of suicide and greater comorbidity, patients with bipolar disorders

have a shorter life expectancy. Suicide attempts among bipolar disorder patients are estimated to be between 32.4 and 36.3 percent, and suicide mortality is nine times greater than in the general population.<sup>1, 2</sup> Anxiety disorders, substance and alcohol addiction, metabolic diseases, and cardiovascular diseases are common co-



morbidities of bipolar disorder<sup>3</sup>. Bipolar disorder is a multisystem disorder involving mood, cognitive, endocrine, autonomic, and sleep/wake dysfunctions, rather than just an affective or mood disorder. Bipolar disorder is primarily diagnosed with the patient's testimony and clinical observation. There are currently no laboratory or neuro-imaging tests available to support the diagnosis of bipolar disorder, other than complementary testing to rule out secondary causes of mood disorders. So Putative diagnostic biomarkers have failed to give consistent reliability due to the complexity of the diagnosis and clinical presentation of bipolar disorder, which is associated with a polygenic biological base and psychosocial variables. Furthermore, the identification of biomarkers in bipolar disorder may aid in the understanding of the pathophysiological mechanisms behind the disease's onset and course<sup>4</sup>. Recently, dermatoglyphics, as part of physical examination in the diagnosis of bipolar disorder is gaining interest.

Dermatoglyphics is the study of surface markings of the skin, especially of the palmar and plantar regions. The study of pattern tracteries of fine ridges on the fingers, the palm, and the sole have been a useful tool for personal identification and determination of paternity<sup>5</sup>. Palmar creases develop during the 2<sup>nd</sup> and 3<sup>rd</sup> months of intrauterine life and are not influenced by the movement of the hand in utero<sup>6</sup>. Dermatoglyphic pattern formation and differentiation are complex processes occurring at the boundary between the epidermis and dermis with a possible correlation with palmar and plantar development. The precise mechanisms of ridge configuration and the factors influencing this process have been exciting researchers' interests since dermatoglyphics became a science. The patterns of early differentiation and genetic uniqueness as well as the relatively simple methods to obtain and store fingerprints make it possible to study the

relationship between certain dermatoglyphic characteristics and the underlying pathological processes in many diseases, including psychological disorders<sup>7, 8</sup>. Both finger and palm prints give clues to various pathological conditions in human beings. Bipolar disorder consists of one exciting episode and one or more depressive episodes<sup>9</sup>.

Although much scientific evidence is there to prove dermatoglyphics is the diagnostic tool to identify several disorders such as genetic diseases. Due to the high variability in the clinical manifestation of neurological disorders specifically bipolar disorder, it is worth continuing research into dermatoglyphics, as a tool of diagnosis for bipolar disorder patients. The current study aimed to evaluate the dermatoglyphic pattern in bipolar disorder patients by correlating it with healthy individuals. Furthermore, to investigate the different fingerprint patterns in bipolar patients was conducted.

#### **Material and Methods:**

In this case-control study on 100 bipolar disorder patients who visited the psychiatric outdoor or were admitted to the mental wards of several recognised hospitals in Karnataka and Andhra Pradesh. The control group were 100 healthy individuals taken from the locality around Sharavathi Dental College, Shivamogga, Karnataka. Institutional Human Ethical Committee approval was obtained with the following reference No: (Ref # IRB/IEC, SDC/ET HI/20-21/001). The participants of both gender, aged between 18 to 60 years old were included through community mental health screening. The bipolar disorder patients were selected according to DSM IV criteria<sup>10</sup>. Participants with malformed fingers and palms, infections and burns on their fingers and palms, and scars from burns on both hands' fingers and palms were excluded from the study. The participants were informed about the



procedure and they were asked to sign a consent form.

The participants were identified by a code, fingerprint patterns were classified using a single-blind approach. The hands were scrubbed with water and soap, and the palm's dampness was removed with Ether, which also cleaned the palm's greasy surface. The "ink and paper" method was employed for making fingerprints where a stamp pad splattered with black ink is utilized instead of the traditional 'Cummins ink method'<sup>11</sup>. It has been proven to be a more effective and convenient way. Fingerprints from both hands (all the digits) were taken by using the standard method, the ulnar edge of the thumb is placed downward and turned toward the body, while the radial edge of the remaining digits is placed downward and turned away from the body. With the use of a hand lens and dissecting microscope, these palmar prints will be examined for pattern kinds, whorls, loops, and arches.

**Whorl:** In this pattern, the ridge courses follow circuits around the core which might be either circular or elliptical. Whorls have two triradii and come in a variety of shapes, including spiral whorls, double loop whorls, and symmetrical whorls. Whorls are sometimes single-cored, but most of the time they are double-cored. Symmetrical whorls are made up of concentric ridges that circle a central point (Whorls concentric). The whorl has a single center and spirally organized ridges that twine clockwise or anticlockwise (Whorl spiral).

**Loop:** In contrast to the whorl, the loop is straightforward. There are only one triradii on it. The head of the loop is the twisting point of the ridges. The ridges flow from the pattern's opposite extremity to the digits' margins. It's an ulnar loop if it opens to the ulnar side, and a radial loop if it opens to the radial edge.

**Arch:** The simple arch is made up of ridges that run across the finger and have a little distal bow without any triradii. The ridge

pattern in a tented arch is nearly identical, but there is a sudden rise of the transversely coursing ridges, generating the "tent" that gives the pattern its name<sup>12</sup>.

The following parameters were measured

1) Ridge Count (RC) is the number of ridges that intersect or touch the line drawn from the easily recognized triradius (where three ridges meet) to the center of the pattern. 2) Total Finger Ridge Count (TFRC) is the sum of the ridge count of all ten fingers. In this count, only one count is taken to each finger, in the Whorls pattern the higher ridge count is taken, and TFRC represents the pattern size. 3) Absolute Finger Ridge Count (AFRC) is the total ridge count of all fingers. AFRC reflects the intensity and size of the pattern. 4) a-b ridge Count is the number of ridges between triradii a and b, located beneath the bases of the index and middle fingers.<sup>13</sup> The meeting point of three ridge systems is called triradii.

**Statistical analysis:** Data were analyzed using SPSS 20.0 version. Data obtained from participants were analyzed using the Chi-square test and ANOVA. The results were expressed as mean + SE and values with  $P < 0.05$  were considered statistically significant.

#### **Results:**

The socio-demographic details of the participants are 100 bipolar disorder patients and 100 healthy individuals (50 male and 50 female in each group). The respondent rate of participants in this study is 100%. In the present study, the results of different fingerprint patterns in the bipolar disorder patients group showed a significant increase at the level of  $p < 0.05$ , in the number of whorls in the right hand in 1, 3, and 5 digits when compared with the control group.

A decrease in the loop pattern of the fingerprints was found in all five digits, but a significant decrease ( $p < 0.05$ ) in loops was found only in the 2, 4, and 5th digits when compared with the control group. However, there was a decrease in arches in all the



studied fingerprint patterns but it was non-significant when compared with the control group (Table 1). Whereas, in the left hand a significant increase ( $p < 0.01$ ) in whorls was noticed in 1 and 3 digits when compared with the control subjects. The loop pattern found a significant increase ( $p < 0.01$ ) only in the 5th digit when compared to the control group. The increase in the arch pattern of the fingerprints was found in the 2nd and the 4th digits but this increase was significant ( $p < 0.5$ ), only in the 2nd digit when compared with the control group (Table 2). The a-b ridge count of bipolar-diseased patients is significantly decreased when compared to the control group (Table 3). There is a significant decrease in the TFRC ( $p < 0.0001$ ) in the bipolar-diseased group when compared to the control group (Table 4). There is a significant decrease in the AFRC ( $p < 0.0001$ ) in the bipolar-diseased group when compared to the control group (Table 5).

#### **Discussion:**

Bipolar disorder is a long-term medical illness that is common, severe, and debilitating. The lifetime prevalence of bipolar disorder ranges from 1 to 5%, depending on whether it is type 1 or type 2, and the mean age of onset is around 20 years. Because of high suicide rates and increased comorbidities of medical conditions, people with bipolar disorders have a shorter life span. The incidence of suicide attempts in bipolar illness patients was estimated to be between 32.4 and 36.3 percent in a recent meta-analysis<sup>14</sup> and suicide mortality is nine times greater in this population than in the overall population<sup>15</sup>. Panic attacks, substance and alcoholism, endocrine and metabolic diseases, and cardiovascular diseases are all common comorbidities of bipolar disorder<sup>16</sup>. As a result, rather than being only an affective or mood disease, bipolar disorder is a multisystem disorder involving mood, cognitive, endocrine, autonomic, and sleep/wake dysfunctions<sup>17</sup>.

Bipolar disorder may be influenced by genetic factors. The dermatoglyphic patterns are also genetically determined, which may have a correlation that could be of help in predicting the occurrence of bipolar disorder. Dermatoglyphics can play an important role in the diagnosis of bipolar disorder. Bipolar disorder is still identified based on the patient's report and clinical observation. There are currently no laboratory or neuroimaging tests available to support the diagnosis of bipolar illness, other than complimentary screenings to rule out secondary causes of mood disorders<sup>18</sup>. Dermatoglyphics may be used as a reliable indicator for screening bipolar disorder because it is a simple, inexpensive, and non-invasive method. According to some recent studies, dermatoglyphic patterns have proved to be of diagnostic value in certain clinical disorders associated with chromosomal and developmental defects like mongolism, Turner's syndrome, cardiovascular disease, diabetes, and schizophrenia<sup>19-22</sup>. However, the studies on the correlation between dermatoglyphic patterns in bipolar disorder patients are very few. Examination of these patterns may help to diagnose many disorders in early phases and thus benefits many patients. Hence, the present study was undertaken to observe the dermatoglyphic patterns of bipolar disorder patients.

In the present study, when the fingerprint patterns of bipolar disorder patients were compared to a control group, we found that both hand fingers had more whorls, fewer loops, and arches. Manic depression patients (MDP) dermatoglyphics were found to have more loops, whorls, and fewer arches than the control group, according to Balgiret al<sup>23</sup>. The remaining findings of the prior study are consistent with those of the current investigation, except for loops, which were shown to be reduced in the current study. When fingerprint frequencies in both hands of MDP patients were



compared to controls, Chakraborty D et al. discovered that MDP patients had more whorls and fewer loops, as well as arches. The findings of the previous study are consistent with the report of the current analysis<sup>24</sup>. The mean distribution of the a-b ridge count is decreased compared to the control group which is not significant (Table 3). Bipolar diseased patients had decreased mean value of TFRC<sup>25</sup> and AFRC compared with normal individuals (Control) respectively. The limitations of this study were the small sample size, which could have resulted in an underreporting of any meaningful relationship. Lack of discussion of more specific BD problems regarding specific fingerprint patterns for it, so it is necessary to study more deeply what pattern must be considered for different types of BD that can help to differentiate other similar disorders from BD and diagnosis can be done quickly.

#### **Conclusion:**

Dermatoglyphics, a non-invasive, simple, inexpensive tool could serve as a screening indicator for the follow-up of individuals in threatened families for bipolar disorder. The differences in dermatoglyphic patterns observed in bipolar disorder patients in our study institute the fact that there is an association between palmar patterns and the incidence of bipolar disorder. It is possible to assured extent to predict the occurrence of bipolar disorder from certain dermatoglyphic parameters. Putting into practice our findings in the screening test for bipolar disorder patients has to be evaluated by further elaborate studies.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Conflicts of interest:** The authors declare no conflict of interest.

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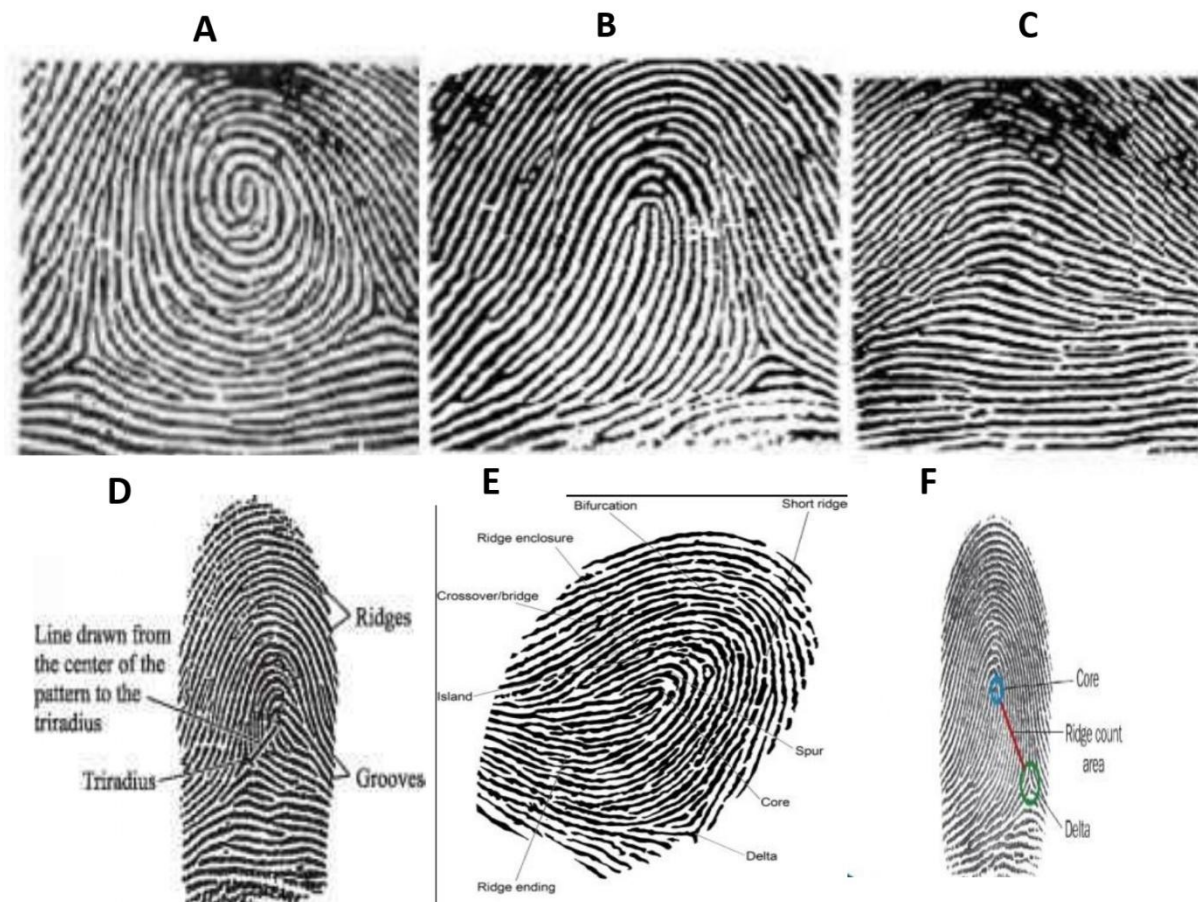


Fig 1: Types of Fingerprint patterns (A – Whorl, B – Loop, C – Arch), D - Total finger ridge count, E - Absolute finger ridge count, F- a-b ridge count

**Table1: Comparison of fingerprint patterns of the right hand in bipolar disorder patients and controls (n1=100 & n2=100, P< 0.05\*P<0.001\*\*).**

Right Digit 1(Thumb)				
	Whorl	Loop	Arch	Total
Control	30	38	32	100
Bipolar disorder	48	28	24	100
Chi-square test = 6.812 P = 0.033				
Right Digit 2 (Index)				



	Whorl	Loop	Arch	Total
Control	48	42	10	100
Bipolar disorder	59	30	11	100
Chi-square test = 3.178 P = 0.204				
Right Digit 3(Middle)				
	Whorl	Loop	Arch	Total
Control	40	38	22	100
Bipolar disorder	58	30	12	100
Chi-square test = 7.188 P = 0.027				
Right Digit 4(Ring)				
	Whorl	Loop	Arch	Total
Control	32	43	25	100
Bipolar disorder	48	32	20	100
Chi-square test = 5.369 P = 0.068				
Right Digit 5(Little)				
	Whorl	Loop	Arch	Total
Control	42	36	22	100
Bipolar disorder	58	22	20	100
Chi-square test = 6.035 P = 0.049				

**Table2: Comparison of fingerprint patterns of the left hand in bipolar disorder patients and controls (n1=100 & n2=100, P< 0.05\*P<0.001\*\*)**

Left Digit 1(Thumb)				
	Whorl	Loop	Arch	Total
Control	42	36	22	100
Bipolar disorder	58	28	14	100
Chi-square test = 5.338 P = 0.069				
Left Digit 2 (Index)				
	Whorl	Loop	Arch	Total
Control	52	32	16	100
Bipolar disorder	45	28	27	100
Chi-square test = 4.170 P = 0.124				
Left Digit 3(Middle)				
	Whorl	Loop	Arch	Total
Control	40	32	28	100
Bipolar disorder	58	26	16	100
Chi-square test = 7.2 P = 0.027				
Left Digit 4(Ring)				
	Whorl	Loop	Arch	Total
Control	36	46	18	100
Bipolar disorder	44	32	24	100
Chi-square test = 4.170 P = 0.0124				
Left Digit 5(Little)				
	Whorl	Loop	Arch	Total



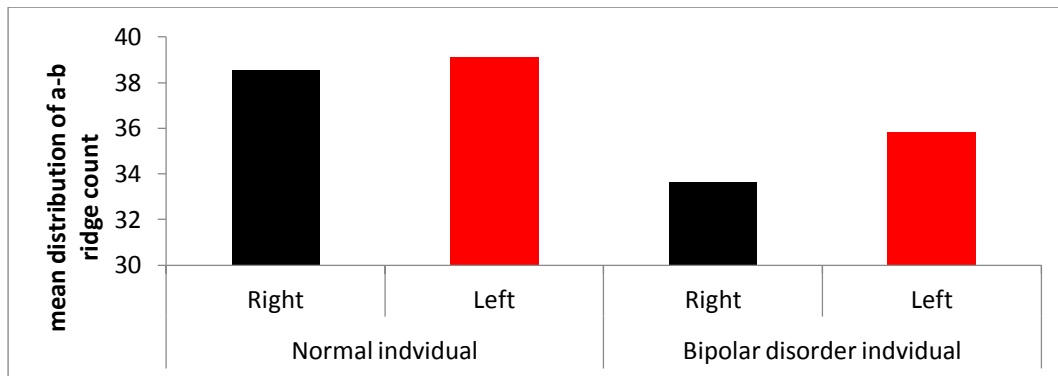


Control	43	35	22	100
Bipolar disorder	34	54	12	100
Chi-square test =8.049 P = 0.018				

**Table 3 Mean distribution a-b ridge count in normal individual and bipolar disorder individual**

		Number of palms	Mean	SD	p-Value
<b>Control</b>	Right	100	38.53	5.57	0.28 (NS)
	Left	100	39.12	6.12	
<b>Bipolar disorder</b>	Right	100	33.62	4.78	
	Left	100	35.82	5.58	

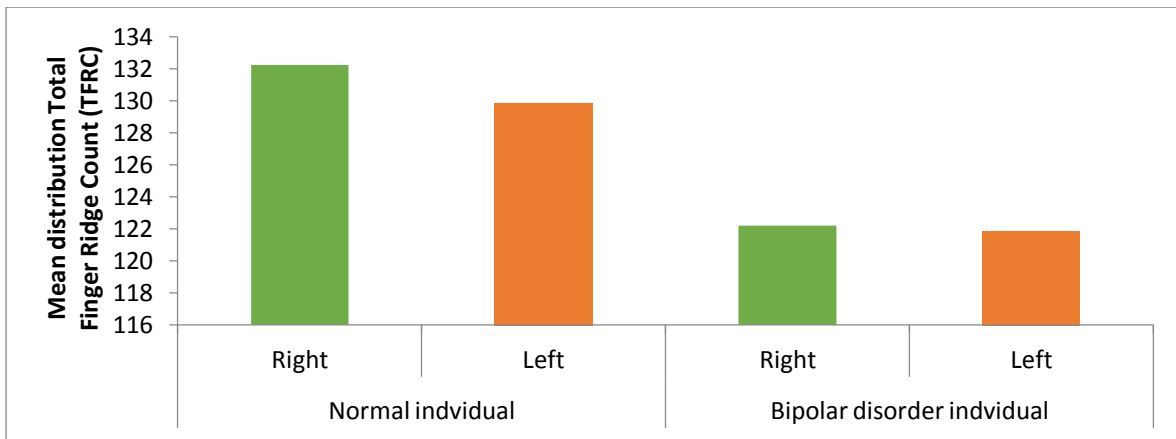
N S- Not significant



**Table 4 Mean distribution Total Finger Ridge Count (TFRC) in normal individuals and bipolar disorder individual**

		Number of palms	Mean	SD	p-Value
<b>Control</b>	Right	100	132.26	10.56	0.0001
	Left	100	129.89	12.75	
<b>Bipolar disorder</b>	Right	100	122.22	13.54	
	Left	100	121.89	11.25	





**Table 5 Mean distribution Absolute Finger Ridge Count (AFRC) in normal individuals and bipolar disorder individual**

		Number of palms	Mean	SD	p-Value
<b>Control</b>	Right	100	82.24	5.89	0.0001
	Left	100	81.65	6.21	
<b>Bipolar disorder</b>	Right	100	76.44	8.44	
	Left	100	77.88	9.39	

