

Finger Print Pattern among Mentally Challenged Adolescent Population in Kerala

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ABSTRACT

Dermatoglyphics is widely used in very many applications like medical sciences, forensic science, criminology etc and is a good tool for prognosis of several diseases, malnutrition, genetic syndromes, in-born errors in metabolism and mental retardation. Genetic diseases, mental retardation and other neurological disorders can be characterized dermatoglyphically at the earliest age as possible. Mentally retarded or challenged adolescent patients with different syndromes like Down syndrome, cerebral palsy, microcephaly and general mental retardation were selected randomly and different dermatoglyphic parameters were measured and compared to normal people in the present study. Finger print patterns from five fingers of both hands were assessed and compared with normal population and left-right asymmetry was also assessed for mentally retarded adolescents. A total of seven type finger print patterns were observed in all ten fingers together and left small, ring, index and thumb showed significant ($P < 0.05$) difference in finger print pattern. Similarly right thumb, middle and ring finger print pattern also showed significant ($P < 0.05$) difference between mentally retarded adolescents and normal population. The asymmetry between left and right finger pattern within mentally retarded adolescents showed that ring and middle finger pattern registered significant ($P < 0.05$) difference.

1. Introduction

Dermal palmer and plantar ridges are highly useful in biological and anthropological studies. Their notably variable characteristics are not duplicated in other people, even in monozygotic twins or even in the same person, from location to location. The details of these ridges are permanent, yet while the individual characteristics are variable, that diversity falls within pattern limits that permit systematic classification.

Those using dermatoglyphics in biology and medicine have long been interested in abnormal psychology and congenital defects. Bagga surveyed and studied the subject of the dermatoglyphic patterns of schizophrenics (Bagga, 1989). Hrish could report that studies had been performed in relationship to mental retardation, congenital heart defects, diabetes mellitus, several child psychiatric groups, retarded growth, and a number of syndromes (Hrish, 1978). Autosomal trisomies, Trisomy 21 (Downs Syndrome), Trisomy 13, 18 and trisomy 8 (Mosaicism) have long been the subjected to studies in relationship to dermatoglyphic patterns. In addition to the trisomy, diabetes mellitus, congenital heart defect and schizophrenia subjects, Loesch also reported relationship studies with sexual chromosomal anomalies, cleft lip and palate, leukaemia and other conditions (Loesch, 1983).

Finger print pattern can be used for identification of various phenotypic characteristics even in normal population. Jameela used the same methodology to identify different types of mentally retarded groups like Autism, Down's syndrome, learning disability etc (Jameela, 2006). Early parental environmental effect on finger print pattern was described by Kahn et al. (2008). Binorkar studied the finger print pattern and gender distribution in and around Nanded district of Maharashtra state (Binorkar and Kulkarni, 2017). Kumari et al.

(2018), used the finger print pattern to identify sex of normal population. The present study was undertaken to understand the finger print pattern of mentally retarded adolescent and their difference from normal population.

2. Materials and Methods

2.1. Sample size and Collection

A total of 165 adolescent subjects, below 45 years of age, including male and female belonging to different mental conditions were randomly selected from different institutions within the Kerala State. Similarly 155 normal adolescents with age and sex matched people, without any mental retardation were randomly selected from different localities near to the sampled institutions and Mar Thoma College, Tiruvalla (Pathanamthitta District) who were willing and given consent to take part in the study.

2.2 Finger Print Collection Procedure

All measurements and identification were taken according to the techniques described by Law Enforcement Agencies (USA). The specific method followed was of that of Cummins and Midlo (1961). Finger and palm prints of both hands were taken for analysis. The palms were thoroughly cleaned with cotton soaked in alcohol/spirit to remove any dirt, perspiration, oil content etc. The finger prints were taken in art paper of high quality, preferably behind the serially numbered/coded questionnaire/data sheet form. Printer's ink, rubber roller, glass/metal inking slab, sponge rubber pad and magnifying glass were used take print and measure various counts.

Little printer's ink was pasted on inking slab, spread evenly with rubber roller to form a thin ink film. Each fingertip was also inked and got the print of all five fingers in order from left to right

for left hand and vice versa for the right hand so that the thumb impression will come in the middle. Special care was taken to get a clear and rolled finger print without over- or under- inking. Print of both the hands and fingers were taken on same paper and labeled properly. The quality of the prints were checked with the magnifying glass and in case of poor printing of either of the hands or both the hands, the palms were cleaned and the entire process was repeated. Since the cases were mentally retarded subjects, good prints were obtained only after repeated turns. After obtaining good quality prints, the hands were washed immediately by soap and again cleaned with spirit/alcohol for ink stain remains after soap washing.

2.3. Finger Print Pattern (FPP)

Finger print patterns were classified as simple arch (SA), tented arch (TA), ulnar loop (Lu), radial loop (Lr), simple whorl (SW), central pocket whorl (CPW) and double loop whorl (DLW) (Schaumann and Alter, 1976). Pattern asymmetry was assessed by counting pattern matches on the five pairs of homologous fingers. The fingers were identified as left small finger (L5), left ring finger (L4), left middle finger (L3), left index finger (L2) and left thumb (L1). Similarly right hand fingers were identified as right thumb (R1), right index finger (R2), right middle finger (R3), right ring finger (R4) and right small finger (R5).

2.4. Statistical Analyses

The data was entered into a personal computer for analysis and the data was analysed using 'R' software for statistical and mathematical computations. The finger print pattern of the population is given as frequency and percentage. Chi square test was employed to compare finger print pattern between mentally retarded adolescents and normal population and paired Student's 't' test was performed to compare between control and mental retardation group as non-parametric test and parametric test (Snedecor and Cochran, 1968) respectively. A probability level of < 0.05 was considered significant for all statistical evaluations.

3. Results

The finger print pattern of both the hands were observed in mentally retarded and normal population and compared using Chi square tests. Most of the patterns were found in both the groups but their number differed for most of the fingers.

3.1. Small Finger Print Pattern (L5 & R5)

Left hand small finger (L5) print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. Of which, double loop whorl was registered only in mentally retarded group. Patterns showed significant difference between mentally retarded and normal group (P < 0.05) as depicted in table 1. The major pattern manifested was ulnar loop in both the group but ulnar loop was more in normal group than mentally retarded group. Right hand small finger (R5) print pattern also registered simple arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In right small finger, all patterns registered in both normal and mentally retarded groups except simple arch, which was not seen in mentally retarded group and that too in one or two cases. Print pattern showed no

*Table 1.
Finger print pattern in small finger (L5 & R5)*

Pattern	L5		R5	
	Normal	Mentally Retarded	Normal	Mentally Retarded
SA	2	1	2	
	1.30%	0.60%	1.30%	
TA	1	1		
	0.60%	0.60%		
Lu	129	126	114	130
	83.20%	76.40%	73.50%	78.80%
Lr	4	2	8	4
	2.60%	1.20%	5.20%	2.40%
SW	6	14	16	16
	3.90%	8.50%	10.30%	9.70%
CPW	13	18	14	14
	8.40%	10.90%	9.00%	8.50%
DLW		3	1	1
		1.80%	0.60%	0.60%
Total	155	165	155	165
	$\chi^2 = 7.737; P < 0.05$		$\chi^2 = 4.074; P > 0.05$	

significant difference between mentally retarded and normal group (P > 0.05). Ulnar loop was more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but ulnar loop pattern was more in study group and simple whorl was more in normal group.

3.2. Ring Finger Print Pattern (L4 & R4)

Left hand ring finger (L4) print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. Of which, tented arch and double loop whorl was registered only in mentally retarded group. Pattern showed significant difference between mentally retarded and normal group in both the hands (P < 0.05) as depicted in table 2. Simple whorl and simple arch pattern was more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by central pocket whorl in both the groups but both the pattern were more in normal group than mentally retarded group. Right hand ring finger (R4) print pattern also registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In right ring finger, all patterns registered in both normal and mentally retarded groups except tented arch and double loop whorl, which was seen only in mentally retarded group and that too in one or two cases. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but ulnar loop pattern was more in study group and simple whorl was more in control group.

Table 2.
Finger print pattern in ring fingers (L4 & R4)

Pattern	L4		R4	
	Normal	Mentally Retarded	Normal	Mentally Retarded
SA	2	3	3	3
	1.30%	1.80%	1.90%	1.80%
TA		2		1
		1.20%		0.60%
Lu	78	76	74	91
	50.30%	46.10%	47.70%	55.20%
Lr	5	4	3	1
	3.20%	2.40%	1.90%	0.60%
SW	45	51	48	51
	29.00%	30.90%	31.00%	30.90%
CPW	25	25	27	16
	16.10%	15.20%	17.40%	9.70%
DLW		4		2
		2.40%		1.20%
Total	155	165	155	165
	$\chi^2 = 6.4060; P < 0.05$		$\chi^2 = 8.352; P < 0.05$	

3.3. Middle Finger Print Pattern (L3 & R3)

Middle finger (L3) print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket

Table 3.
Finger print pattern in middle fingers (L3 & R3)

Pattern	L3		R3	
	Normal	Mentally Retarded	Normal	Mentally Retarded
SA	5	8	5	6
	3.20%	4.80%	3.20%	3.60%
TA	3	4		
	1.90%	2.40%		
Lu	106	109	113	135
	68.40%	66.10%	72.90%	81.80%
Lr	5	4	3	
	3.20%	2.40%	1.90%	
SW	25	22	19	16
	16.10%	13.30%	12.30%	9.70%
CPW	9	10	10	6
	5.80%	6.10%	6.50%	3.60%
DLW	2	8	5	2
	1.30%	4.80%	3.20%	1.20%
Total	155	165	155	165
	$\chi^2 = 4.524; P > 0.05$		$\chi^2 = 7.280; P < 0.05$	

whorl and double loop whorl patterns. In left middle finger, all patterns registered in both normal and mentally retarded groups and no patterns was found specific to study group. Pattern showed no significant difference between mentally retarded and normal group ($P > 0.05$) as depicted in table 3. Central pocket whorl and double loop whorl pattern were more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but both the pattern were more in normal group than mentally retarded group. Right hand middle finger (R3) print pattern also registered simple arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In right middle finger, all patterns registered in both normal and mentally retarded groups except radial loop, which was not seen in mentally retarded group. Print pattern showed significant difference between mentally retarded and normal group ($P < 0.05$). Ulnar loop was more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but ulnar loop pattern was more in study group and simple whorl was more in control group.

3.4. Index Finger Print Pattern (L2 & R2)

Table 4
Finger print pattern in index fingers (L2 & R2)

Pattern	L2		R2	
	Normal	Mentally Retarded	Normal	Mentally Retarded
SA	10	11	12	8
	6.50%	6.70%	7.70%	4.80%
TA	3	5	1	4
	1.90%	3.00%	0.60%	2.40%
Lu	59	87	78	100
	38.10%	52.70%	50.30%	60.60%
Lr	19	23	11	12
	12.30%	13.90%	7.10%	7.30%
SW	40	24	37	23
	25.80%	14.50%	23.90%	13.90%
CPW	20	12	9	11
	12.90%	7.30%	5.80%	6.70%
DLW	4	3	7	7
	2.60%	1.80%	4.50%	4.20%
Total	155	165	155	165
	$\chi^2 = 12.141; P < 0.05$		$\chi^2 = 8.525 > 0.05$	

Index finger (L2) of left hand print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In left index finger, all patterns registered in both normal and mentally retarded groups and no patterns was found specific to study group. Print pattern showed significant difference between mentally retarded and normal group ($P < 0.05$) as depicted in table 4. Radial loop and ulnar loop patterns were more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by

simple whorl in both the groups but both the patterns were more in study group than control group. Right hand index finger (R2) print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In right index finger, all patterns registered in both normal and mentally retarded groups. print pattern showed no significant difference between mentally retarded and normal group ($P > 0.05$). Ulnar loop, tented arch and central pocket whorl patterns were more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but ulnar loop pattern was more in study group and simple whorl was more in control group.

3.5. Thumb Finger Print Pattern (L1 & R1)

Table 5.
Finger print pattern in thumb finger (L1/R1)

Pattern	L1		R1	
	Normal	Mentally Retarded	Normal	Mentally Retarded
SA	7	9	5	5
	4.50%	5.50%	3.20%	3.00%
TA		1		
		0.60%		
Lu	83	99	86	114
	53.50%	60.00%	55.50%	69.10%
Lr	6	1	3	
	3.90%	0.60%	1.90%	
SW	33	21	34	23
	21.30%	12.70%	21.90%	13.90%
CPW	8	10	8	11
	5.20%	6.10%	5.20%	6.70%
DLW	18	24	19	12
	11.60%	14.50%	12.30%	7.30%
Total	155	165	155	165
	$\chi^2 = 9.671; P < 0.05$		$\chi^2 = 10.795; P < 0.05$	

Left hand thumb finger (L1) print pattern registered simple arch, tented arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In left thumb finger, all patterns registered in both normal and mentally retarded groups and tented arch was seen only in study group. Print pattern showed significant difference between mentally retarded and normal group ($P < 0.05$) as given in table 5. Ulnar loop and central pocket whorl patterns were more shown by mentally retarded group. The major pattern manifested was ulnar loop followed by simple whorl in both the groups but both the patterns were more in study group than control group. Right hand thumb finger (R1) print pattern also registered simple arch, ulnar loop, radial loop, simple whorl, central pocket whorl and double loop whorl patterns. In right thumb finger, all patterns registered in both normal and mentally retarded groups except radial loop, which was seen only in normal group. Print pattern showed significant difference between mentally retarded and normal group ($P < 0.05$). Ulnar loop and central pocket whorl patterns were more shown by mentally retarded group.

The major pattern manifested was ulnar loop followed by simple whorl in both the groups but both the patterns were more in study group and control group.

3.6. Asymmetry

Table 6.
Comparison of left and right hand finger print pattern in mentally retarded group

Finger Pair	Mean	\pm SD	t value
L5-R5	3.56	1.16	0.791
	3.50	1.02	
L4-R4	4.15	1.34	2.418*
	3.92	1.24	
L3-R3	3.55	1.35	2.795**
	3.28	0.99	
L2-R2	3.56	1.29	-0.505
	3.60	1.33	
L1-R1	3.91	1.67	1.855
	3.71	1.40	

* $P < 0.05$; ** $P < 0.01$

Asymmetry between left and right half of normal people was also common in many parameters but the dermatoglyphic characteristics of mentally retarded people may be peculiar from that of normal people. Hence left and right finger print pattern (FPP) was compared between respective fingers of left and right side of mentally retarded study group. Finger print pattern score was significantly differed in ring finger and middle finger between left and right side. Other fingers did not showed statistical difference between two sides, which shows symmetry between fingers of left and right hands. The finger print pattern is given in table 6.

4. Discussion

Even though the entire human population show some 5 to 9 finger print pattern in common and about 20 to 23 rare patterns, manifestation of these pattern and its detailed characters differ individually which is the reason for taking fingerprint to individual identification, more over left-right asymmetry. However each population or sub-population shows some common characteristics in finger print pattern. The distribution of finger patterns in the Indian population generally shows a preponderance of loops over whorls, the present study also corroborates the fact.

Different genetic abnormalities were dermatoglyphically detailed by different authors. A comprehensive literature survey and analysis of various syndromes like microcephaly, cerebral palsy, Down syndrome and autism were discussed by Jameela (2006). The present study results were similar to that of Jameela. In a comparative study by Arreita et al., the frequency of digital pattern types of autistic and controls were discussed (Arreita et al., 1990). The comparative study of each type of pattern showed significantly more transitional radial loops in autistic boys in finger 2 of the right hand, in the right hand as a whole and in both hands. In the present study, no transitional

radial loops were observed and radial loops appeared more on the left side in males. The change in position of the radial loop was significant and radial loop was seen only in second finger of control group. Whorls are identified as such and no distinction between mono-centric and di-centric whorls is done in the present study as done by Arrieta et al (1990).

Finger pattern concordance was less in mentally retarded group compared to control group. Asymmetrical finger patterns were reported in certain other diseases like schizophrenia and learning disability. The presence of dissimilar pattern across homologous finger was observed in studies reported earlier. More dissimilar pattern has been reported several authors in different disorders including schizophrenic patients and psychotic twins (Markow and Wandler, 1986; Markow and Gottesman, 1989). Naugler and Ludman supported the use of this trait as a risk marker for developmental disorders (Naugler and Ludman, 1996).

The present study identifies few characters as dermatoglyphic salient features for mentally retarded adolescents of Central Kerala. Jameela reported few characteristics features of such mentally challenged Kerala population (Jameela, 2006). The present study results were in tune with earlier reports and delineate the few dermatoglyphic characteristics for the mentally challenged adolescents of Central Travancore, Kerala. They have more percentage of ulnar loops in all finger prints, double loop whorl (left small and ring finger), tented arch (left thumb, right ring finger) patterns were present, where are radial loop (right thumb, right middle) and simple arch (right small finger) absent.

Dermatoglyphic parameters can be used to characterize the mentally retarded adolescents. The characters can be used as prognostic parameters to identify the mental retardation at an earlier age itself. But more studies are warranted to establish the fact with children below 4 years of age since mental retardation shall be confirmed by that age. Moreover, more dermatoglyphic parameters have to be assessed to elucidate more characteristic features of the study group. Similarly, different mentally retarded groups such as Down's syndrome, Klienfilter's syndrome, Cerebral palsy, microcephaly, autism, schizophrenia etc are to be studied separately. So that each syndrome can be diagnosed correctly at an early age enabling

early management and special education of such subjects. Hence more studies are warranted in this area to develop the subject and to contribute more knowledge in the field.

The asymmetry in dermatoglyphic pattern in normal population is evident from earlier studies and the genetic difference between right and left hand was also examined (Holt, 1964). She found all familial correlations close to zero and concluded that nearly all variations in asymmetry were environmentally determined. The genetics of asymmetry and diversity of finger ridge counts in man has been examined by different authors (Martin et al., 1982, 1999). Both the studies reported that variation of finger print patterns are under genetic control, but there are all possibility that certain aspects of this variation are genetically controlled while other (asymmetry) are mainly environmentally determined.

5. Conclusion

Finger Print Pattern (FPP) for mentally retarded group has the following significant characteristics when compared to normal population. High ulnar loop percentage found in Left hand ring finger. Left middle, index and thumb finger also showed high ulnar loop percentage. Left index and thumb finger showed high tented arch. All right hand fingers showed high ulnar loop percentage. Radial loop was absent in right thumb and middle finger. Tented arch was present in right ring finger and simple arch was absent in small finger. By observing the print pattern, mentally retarded Kerala population can be very well distinguished and more studies are warranted to identify other dermatoglyphic characters.

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