

# Dankmeijer's Index (D.I.) In Mental Retardation

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## Abstract

Dermatoglyphics is the study of epidermal ridges on fingers, toes and feet of a particular individual. These are permanent ridges, once formed in the fetal stage, remain same throughout life. The freedom from environmental influences makes the study of dermatoglyphics more significant. Present study was done on five hundred mentally retarded patients from different districts of Haryana. Digital dermatoglyphics of mentally retarded patients was studied and Dankmeijer's index was calculated. Maximum difference was observed in the DI (Dankmeijer's index) of 1<sup>st</sup>, 4<sup>th</sup> and 5<sup>th</sup> digits of mentally retarded patient and normal individuals. In toe pattern, highest value of DI was seen in the 5<sup>th</sup> digit. This study of dermatoglyphics of mental retardation carried out in order to establish an index for mentally retarded patients that would assist with clinical diagnosis of the diseases among other modalities.

## INTRODUCTION

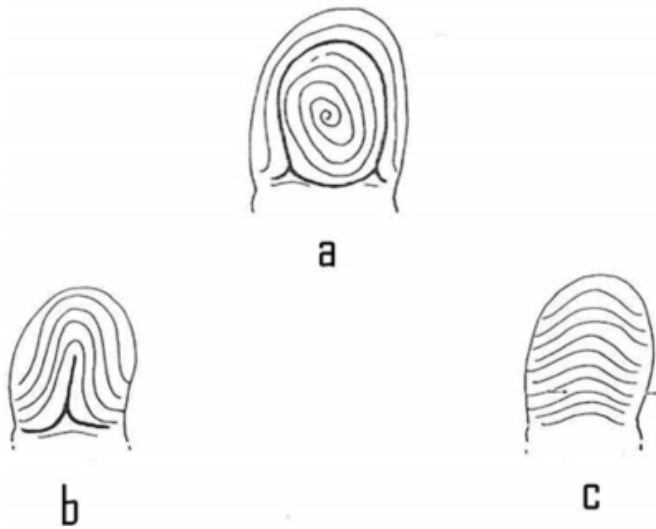
Dermatoglyphics is the study of epidermal ridges on fingers, toes and feet of a particular individual<sup>1</sup>. These are permanent ridges, once formed in the fetal stage, remain same throughout life<sup>2</sup>. It has been postulated that ridges are influenced by blood vessels-nerve pairs at border between the dermis and epidermis during prenatal development features such as inadequate oxygen supply, abnormal nerve growth, unusual patterns or distribution of sweat gland and alteration of epithelial growth<sup>3</sup>. The freedom from environmental influences makes the study of dermatoglyphics more significant. The emerging association combination of dermatoglyphics traits and specific chromosome aberration established a useful diagnostic and an integral part of the medical diagnostics<sup>3</sup>. A number of genetic diseases like leukemia, congenital, heart disease and chromosomal disorders like Down syndrome have been shown to be associated with certain dermatoglyphics patterns<sup>4</sup>. Down syndrome (DS) is the most common cause of mental retardation. The frequency of DS patients is about 1:800 and is mainly because of the presence of extra copy of chromosome number 21<sup>5</sup>. Advantages of dermatoglyphics studies in population are derived from their genetic determination, lifelong stability and absence of environmental influences<sup>6,7,8</sup>. Present study was done on digits of hand and toes of five hundred mentally retarded patients and control group (normal individuals).

## MATERIALS AND METHODS

Five hundred mentally retarded patients from 30 centers of 12 districts of Haryana and five hundred healthy normal individuals (as control) were studied for patterns of digital variability of hands and toes. Fingerprinting of digits was done by using inkpad method<sup>9</sup> after the consent of patient /guardian. One finger was inked at one time. Finger was rolled across the inkpad in one continuous motion. Entire area was carefully covered with ink and pattern was transferred to strip of paper. These fingerprints were carefully studied for the presence of different configurations i.e. arch (no triradius and simplest pattern), whorl (two or rarely three triradii, ridges forming concentric circle or loop like arrangement) (Figure-I).

**Figure 1**

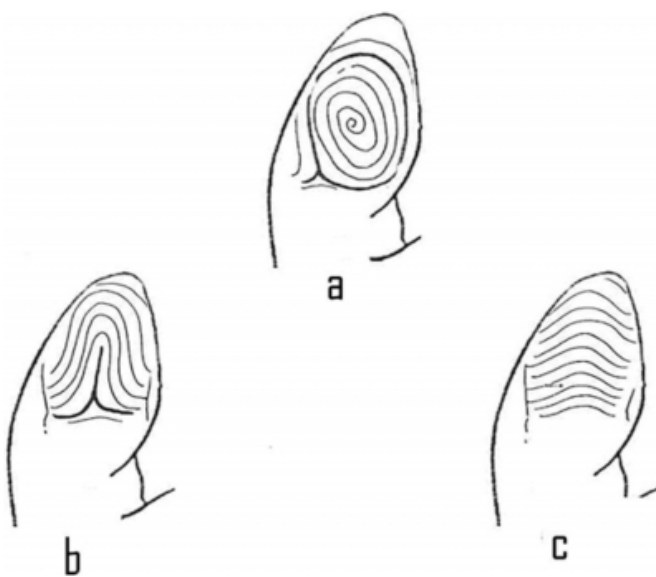
Figure-I: Different finger tip patterns: (a) Whorl, (b) Tented arch, (c) Simple arch.



Percentage frequency of arch and whorl pattern was calculated in both mentally retarded and control groups as analyzed by Cummins and Midlo's method<sup>10</sup>. To obtain toe print, ink was applied to toes area after the consent of patient /guardian. Big toe was printed again separately to know configuration. Toe printing was difficult to obtain. In some cases toes were read directly with the help of magnifying lens without taking the print due to denial of inking by the patients. The toes were studied for configuration of whorls and arches (Figure-II).

**Figure 2**

Figure-II: Different toe patterns in sole: (a) Whorl, (b) Tented arch, (c) Simple arch.



Digital pattern variability of finger and toes was compared

by DI (Dankmeijer's index). It is calculated as the total frequency of arches divided by total frequency of whorls x100.

## OBSERVATIONS AND RESULTS

In fingertip patterns, Dankmeijer's index for all the five digits of fingertips was calculated. Three types of fingertip patterns were found in present study. Whorls, loop, arch were of common occurrence in control group as well as in cases of mental retardation. Whorl patterns showed same frequency both in cases of mental retardation as well as in control group (37.62%). Arch patterns showed comparable higher values in mentally retarded (MR) patients. There were no arch patterns in 4<sup>th</sup> and 5<sup>th</sup> digits of control group. Arch frequency was found maximum (11%) in the 1<sup>st</sup> digits of mentally retarded cases, whereas in control group it was 4.7% (Table-1).

**Figure 3**

Table-1. Percentage frequency of different fingertip patterns of mentally retarded patients and control group.

	Whorl pattern		Arch pattern	
	Mental Retarded	Control	Mental Retarded	Control
I	35.0	44.1	11.0	4.7
II	31.8	41.6	7.4	11.5
III	35.8	29.0	7.8	4.5
IV	51.8	53.6	4.4	-
V	34.3	18.2	8.6	-
Total	37.62	37.3	7.84	4.14

Dankmeijer's index value for total frequency of all digits was 22.02% for mentally retarded patients and 10.76% for control groups (Table-2).

**Figure 4**

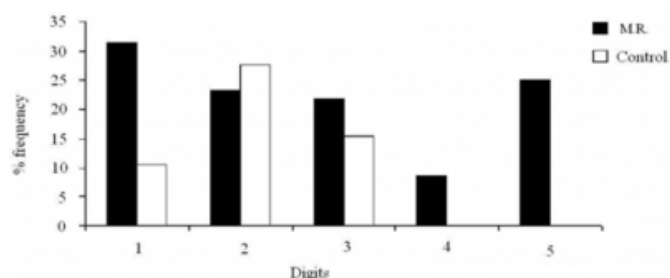
Table-2: Dankmeijer's index (D.I= Arch/whorl index) for Fingertip patterns in mentally retarded patients (M.R.) and control group(C)

Digits of patients & control group	Arches/Whorls index of M.R.	Arches/Whorls index of control group
1	31.42	10.65
2	23.27	27.64
3	21.78	15.51
4	8.59	-
5	25.07	-
Average	22.02	10.76

Maximum differences were observed in Dankmeijer's index of 1<sup>st</sup>, 4<sup>th</sup>, 5<sup>th</sup> digit (Figure-III).

**Figure 5**

Figure-III: Dankmeijer's index (D.I= Arch/whorl index) of Fingers of mentally retarded patients (M.R.) and control group(C).



Toe configuration of MR showed 18.92% whorl, 27.08% arch patterns frequency. Whorl was more in control group (28.5%) as compared to mental retarded patients (18.92%). Similar observation was made in frequency of arch pattern. Percentage frequency of arch patterns was 27.08 in MR patients and 33.38 in control group (Table-3).

**Figure 6**

Table-3. Percentage frequency of different toes patterns of mentally retarded patients and control group.

Whorl pattern			Arch pattern	
	Mental Retarded	Control	Mental Retarded	Control
I	16.9	27.2	20.6	17.1
II	18.9	46.0	18.4	8.5
III	27.4	47.5	17.1	8.0
IV	20.1	17.0	27.3	56.2
V	11.3	4.8	52	77.1
Total	18.92	28.5	27.08	33.38

In toe patterns, Dankmeijer's index of toe patterns of mentally retarded patients revealed very high values as compare to fingertips patterns. DI Value for total frequency of toes was 176.3 in MR patients and 406.97 in control groups respectively (Table-4).

**Figure 8**

Figure-IV: Dankmeijer's index (D.I= Arch/whorl index) of Toes of mentally retarded patients (M.R.) and control group(C).

Toes of patients and control group	Arches/Whorls index of patients	Arches/Whorls index of control group
1	121.89	62.86
2	101.65	18.47
3	62.40	16.84
4	135.82	330.5
5	460.17	1606.2
Average	176.38	406.97

Highest values of Dankmeijer's index were seen in fifth digit (Figure-IV).

{image:8}

## DISCUSSION

Variability in the digital patterns of mentally retarded patients and control group was compared with the help of Dankmeijer's index (DI). DI Value of fingerprints was 22.02% and 10.76% in the mentally retarded patients and control group respectively. Toe pattern of control group revealed much higher percentage frequency (406.97), whereas cases of mental retardation had frequency of 17.63%. Currently no such data is available for Dankmeijer's index. However its importance was evident in a Malawian study, in which reports higher DI values for females was reported<sup>11</sup>. Similarly reports on ethnic and population races variability of DI index are available in the literature<sup>12, 13</sup>. However in the reported literature<sup>14</sup>, values of Dankmeijer's index were in the range of control group of present study. Significantly lower DI value for toe pattern had proved to be a definitive diagnostic tool for mental retardation in the present study.

In a study done by Saadat the fingerprint patterns, simian crease, and total ridge count of 41 mild and 61 severe mentally handicapped patients with Down syndrome (DS) were compared with a control group of 200 mentally normal individuals. Significant differences were observed within DS patients with different levels of mental retardation<sup>15</sup>.

The greater diversity in the types and combinations of patterns on fingertips, toes suggest that the formation of the dermal ridges would be determined by many genes spread over many chromosomes. Although no dermatoglyphic trait or crease configuration can be considered alone in making a diagnosis, several dermatoglyphic features when combined can be used to confirm a suspected diagnosis or to detect a disorder that might otherwise be overlooked or discovered only later.

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