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Original Research Article

Dermatoglyphic Study of Fingertip Patterns in Type 2 Diabetes Mellitus

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ABSTRACT

Background: There is a paucity of dermatoglyphic studies on diabetic patients in and around Salem district of Tamil Nadu. This study attempts to delineate the fingertips pattern and ridge counts of diabetic patients of this area.
Materials and Methods: Dermatoglyphic finger prints of one hundred normal subjects (equal number of males and females) were compared with equal number of Type 2 Diabetic males and females. The fingertips patterns were noted, ridge counts of fingertips were carried out and recorded. Results were tabulated and statistically analyzed.
Results: Significantly decreased levels of left thumb mean ridge count was observed in male Type 2 Diabetes mellitus patients (14.90) when compared to the normal male subjects (18.76). It was increased in female Type 2 Diabetes mellitus (15.24) compared to normal females (14.62).It was statistically insignificant. Increased percentage level of ulnar loop pattern was observed in right thumb, right index, right middle, right ring, right little, left thumb, left middle, left ring and left little fingers in Type 2 Diabetic males compared to normal males. Increased percentage level of ulnar loop pattern was observed in right thumb, left thumb and left index fingers of Type 2 Diabetic females compared to normal females.
Conclusion: The knowledge of the fingertip patterns and ridge counts is essential for Diabetologist and other clinicians.
Key words: Dermatoglyphics, Diabetes mellitus, ridge count, tri-radius, loop, whorl, arch.

INTRODUCTION

The analysis of dermal ridges and their configurations by studying prints of them is called Dermatoglyphics. [1] The term "Dermatoglyphics" was introduced by Cummins. [2]

The epidermal ridge patterns on the hands and soles are fully developed at birth and thereafter remain unchanged for life. Dermal ridge differentiation takes place early in fetal development. The epidermal ridge patterns are formed at the site of fetal volar pads. The formation of these pads is first visible on the fingertips in the sixth to seventh week of embryonic development. The pads become very prominent during the subsequent several weeks, diminish again in the fifth month and disappear completely in the sixth month. Within this period the dermal ridges coalesce into specific

patterns, replacing the volar pads. The presence of volar pads as well as their size and positions are responsible for the configuration of papillary ridge patterns. The small fetal volar pads would result in a simple pattern called as an arch, whereas more prominent pads would tend to lead to the development of large and more complex system of ridge configurations known as loops and whorls. Similarly, the fetal pads positioned symmetrically on the volar aspect of the fingertip would give rise to a pattern centered in the middle of the pattern area like whorl and asymmetrical pads to a pattern asymmetrically oriented within the pattern area like loop, either ulnar or radial according to the position of the pad. The critical period of ridge formation begins in the at approximately 70mm crown rump length, i.e., about 3 months of intrauterine life. The epidermal ridge patterns are completed only after the sixth prenatal months. The ridge configurations are genetically determined. [3]

The knowledge of the dermatoglyphic study on type 2 Diabetes mellitus is essential for the Diabetologist, diabetic patients as well as parents of potential diabetics which we can be used as an early diagnostic tool with lesser cost. There is a paucity of information regarding the dermatoglyphic studies on type 2 Diabetes mellitus in this part of the country in the literature. The present study aims to fill up this gap.

MATERIALS AND METHODS

Data for this study was collected from Dermatoglyphic finger prints of one hundred normal subjects (equal number of males and females) were compared with equal number of Type 2 Diabetic males and females belonging to, in and around Salem population of Tamil Nadu. The age groups of Type 2 Diabetics were 35 - 78 years and normal subjects were 40 - 82 years. The collection of the finger prints was carried out on the diabetic patients and normal subjects attending VMKV Medical College Hospital and M. G. Diabetes Specialty and Research Centre, Salem.

The patients belonging to other states, other countries, patients with other metabolic disorders, polydactyly and loss of fingers were excluded from the study. The presences of fingertip patterns were noted and ridge count was carried out using hand lens. Results were tabulated and statistically analyzed.

RESULTS

Significantly decreased levels of left thumb mean ridge count was observed in male Type 2 Diabetes mellitus patients (14.90) when compared to the normal male subjects (18.76). It was increased in female Type 2 Diabetes mellitus (15.24) compared to normal females (14.62). It was statistically insignificant (Table - 1).

Table 1: Finger tip ridge count of normal males and normal females and Type 2 Diabetic males and females.

Parameters	Male subjects					Female Subjects				
	Normal		Type 2 DM		P value	Normal		Type 2 DM		P value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Right thumb	18.96	6.45	17.38	4.85	> 0.05	16.34	6.22	16.42	6.71	> 0.05
Right index	13.86	6.23	11.68	6.64	> 0.05	11.18	6.38	11.96	6.75	> 0.05
Right middle	13.30	6.81	12.36	4.81	> 0.05	12.50	5.47	12.82	6.22	> 0.05
Right ring	17.06	6.31	15.14	5.72	> 0.05	14.78	5.14	15.10	6.37	> 0.05
Right little	13.22	5.45	12.80	4.09	> 0.05	11.22	4.67	11.92	4.85	> 0.05
Left thumb	18.76	6.74	14.90	5.03	<0.05*	14.62	6.34	15.24	5.68	> 0.05
Left index	11.40	7.69	10.54	6.58	> 0.05	10.94	6.37	10.78	6.39	> 0.05
Left middle	13.46	6.93	12.58	6.49	> 0.05	12.82	5.64	12.44	5.97	> 0.05
Left ring	18.12	7.69	14.86	6.61	> 0.05	14.54	5.41	14.98	7.01	> 0.05
Left little	14.22	5.46	13.36	4.82	> 0.05	11.72	4.51	12.92	5.64	> 0.05

Statistical analysis was done by t-test: Data expressed as mean and SD,
* P-value < 0.05 was considered as statistically significant.

Increased percentage level of ulnar loop pattern was observed in right thumb, index, middle, ring and little fingers in Type 2 male Diabetes mellitus patients compared to

normal males. Decreased percentage level of Whorl patterns was observed in right thumb, index, ring and little fingers of Type 2 Diabetes mellitus males compared to normal males. Decreased percentage level of CPUW pattern was observed in right ring finger of Type 2 DM males compared to normal males (Table - 2).

Table 2: Finger tip patterns of right hands of normal and Type 2 diabetic males.

Patterns		Normal male					Type 2 DM male				
		Right thumb	Right index	Right middle	Right ring	Right little	Right thumb	Right index	Right middle	Right ring	Right little
Ulnar loops	UL	32	34	64	34	74	58	54	70	40	82
	TUL	0	0	4	4	4	0	0	2	4	4
	Total	**32**	**34**	**68**	**38**	**78**	**58**	**54**	**72**	**44**	**86**
Radial loops	RL	0	10	0	0	0	0	0	0	0	0
	TRL	0	2	0	0	0	0	0	0	2	0
	Total	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**
Whorls	DLW	14	4	2	0	0	12	2	4	0	0
	SWCW	10	8	0	14	2	2	2	0	12	4
	SWACW	22	12	18	14	4	20	16	12	14	2
	CPUW	4	2	2	32	14	0	0	6	20	8
	CPRW	8	14	2	0	0	2	12	2	0	0
	LPULW	6	4	0	0	2	4	2	2	4	0
	LPRLW	0	2	0	0	0	0	2	0	0	0
	CW	2	0	0	0	0	0	0	0	0	0
	ACC.W	0	2	0	0	0	0	0	0	2	0
	Total	**66**	**48**	**24**	**60**	**22**	**40**	**36**	**26**	**52**	**14**
Arches	A	2	6	8	2	0	2	8	2	2	0
	TA	0	0	0	0	0	0	2	0	0	0
	Total	**2**	**6**	**8**	**2**	**0**	**2**	**10**	**2**	**2**	**0**

Data expressed in percentage.

Abbreviations: Ulnar Loop(UL), Symmetrical Whorl Clock Wise (SWCW), Symmetrical Whorl Anti Clock Wise (SWACW), Double Loop Whorl (DLW), Transitional Ulnar Loop (TUL), Transitional Radial Loop (TRL), Radial Loop (RL), Central Pocketed Ulnar Whorl (CPUW), Central Pocketed Radial Whorl (CPRW), Lateral Pocketed Ulnar Loop Whorl (LPULW), Lateral Pocketed Radial Loop Whorl (LPRLW), Arch (A), Tented Arch (TA), Accidental Whorl (ACC.W).

Increased percentage level of ulnar loop pattern was observed in left thumb, middle, ring and little fingers in Type 2 Diabetic males compared to normal males. Decreased percentage level of Whorl patterns was observed in left thumb, index, middle, ring and little fingers of Type 2 Diabetic males compared to normal males. Decreased percentage level of SWCW pattern was observed in left thumb finger of Type 2 Diabetic males compared to normal males (Table - 3).

Table 3: Finger tip patterns of left hands of normal and Type 2 diabetic males.

Patterns		Normal male					Type 2 DM male				
		Left thumb	Left index	Left middle	Left ring	Left little	Left thumb	Left index	Left middle	Left ring	Left little
Ulnar loops	UL	40	42	56	28	76	64	42	68	42	80
	TUL	2	0	2	2	2	2	0	0	4	6
	Total	**42**	**42**	**58**	**30**	**78**	**66**	**42**	**68**	**46**	**86**
Radial loops	RL	0	2	0	0	0	0	10	0	2	0
	TRL	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**2**	**0**	**0**	**0**	**0**	**10**	**0**	**2**	**0**
Whorls	DLW	28	12	14	2	0	26	10	6	0	0
	SWCW	22	14	10	38	12	4	10	10	30	10
	SWACW	0	0	2	2	0	0	2	0	2	0
	CPUW	2	0	0	8	4	0	0	0	12	4
	CPRW	0	12	0	0	0	0	6	6	0	0
	LPULW	0	2	2	14	6	0	0	0	0	0
	LPRLW	4	0	2	0	0	2	4	0	0	0
	CW	0	0	0	0	0	0	0	0	2	0
	ACC.W	0	0	0	0	0	0	0	0	0	0
	Total	**56**	**40**	**30**	**64**	**22**	**32**	**32**	**22**	**46**	**14**
Arches	A	2	12	12	4	0	2	12	8	6	0
	TA	0	4	0	0	0	0	4	2	0	0
	Total	**2**	**16**	**12**	**4**	**0**	**2**	**16**	**10**	**6**	**0**

Data expressed in percentage.

Abbreviations: Ulnar Loop(UL), Symmetrical Whorl Clock Wise (SWCW), Symmetrical Whorl Anti Clock Wise (SWACW), Double Loop Whorl (DLW), Transitional Ulnar Loop (TUL), Transitional Radial Loop (TRL), Radial Loop (RL), Central Pocketed Ulnar Whorl (CPUW), Central Pocketed Radial Whorl (CPRW), Lateral Pocketed Ulnar Loop Whorl (LPULW), Lateral Pocketed Radial Loop Whorl (LPRLW), Arch (A), Tented Arch (TA), Accidental Whorl (ACC.W).

Increased percentage level of ulnar loop pattern was observed in right thumb of Type 2 Diabetic females compared to normal females. Decreased percentage level of Whorl patterns was observed in right ring finger of Type 2 Diabetic females compared to normal females. Decreased percentage level of SWCW pattern was observed in right ring finger of Type 2 Diabetic females compared to normal females (Table - 4).

Table 4: Finger tip patters of right hands of normal and Type 2 diabetic females.

Patterns		Normal female					Type 2 DM female				
		Right thumb	Right index	Right middle	Right ring	Right little	Right thumb	Right index	Right middle	Right ring	Right little
Ulnar loops	UL	50	52	78	50	80	68	48	70	48	84
	TUL	2	0	0	6	0	0	0	2	0	2
	Total	**52**	**52**	**78**	**56**	**80**	**68**	**48**	**72**	**48**	**86**
Radial loops	RL	0	6	0	0	0	0	2	0	0	0
	TRL	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**6**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**
Whorls	DLW	14	4	0	0	0	6	4	6	2	0
	SWCW	2	14	2	12	2	0	8	0	20	2
	SWACW	18	4	4	4	0	12	14	4	4	2
	CPUW	2	2	4	22	16	2	2	10	20	8
	CPRW	0	2	2	2	0	0	6	0	0	0
	LPULW	6	4	2	0	2	6	2	0	2	0
	LPRLW	0	0	0	0	0	0	0	0	0	0
	CW	0	0	0	0	0	0	0	0	0	0
	ACC.W	0	0	2	2	0	0	0	0	0	0
	Total	**44**	**30**	**16**	**42**	**20**	**26**	**36**	**20**	**48**	**12**
Arches	A	6	8	4	2	0	6	12	8	4	2
	TA	0	4	2	0	0	0	2	0	0	0
	Total	**6**	**12**	**6**	**2**	**0**	**6**	**14**	**8**	**4**	**2**

Data expressed in percentage.

Abbreviations: Ulnar Loop(UL), Symmetrical Whorl Clock Wise (SWCW), Symmetrical Whorl Anti Clock Wise (SWACW), Double Loop Whorl (DLW), Transitional Ulnar Loop (TUL), Transitional Radial Loop (TRL), Radial Loop (RL), Central Pocketed Ulnar Whorl (CPUW), Central Pocketed Radial Whorl (CPRW), Lateral Pocketed Ulnar Loop Whorl (LPULW), Lateral Pocketed Radial Loop Whorl (LPRLW), Arch (A), Tented Arch (TA), Accidental Whorl (ACC.W).

Table 5: Finger tip patters of left hands of normal and Type 2 diabetic females.

Patterns		Normal female					Type 2 DM female				
		Left thumb	Left index	Left middle	Left ring	Left little	Left thumb	Left index	Left middle	Left ring	Left little
Ulnar loops	UL	44	46	72	48	74	66	50	72	46	74
	TUL	0	0	4	8	0	0	2	0	6	2
	Total	**44**	**46**	**76**	**56**	**74**	**66**	**52**	**72**	**52**	**76**
Radial loops	RL	2	8	0	0	0	2	2	0	0	0
	TRL	2	2	0	0	0	0	0	0	0	0
	Total	**4**	**10**	**0**	**0**	**0**	**2**	**2**	**0**	**0**	**0**
Whorls	DLW	24	8	6	4	0	16	4	6	4	2
	SWCW	12	14	4	28	14	8	12	8	22	14
	SWACW	0	0	0	4	2	2	2	0	2	0
	CPUW	4	0	2	2	0	0	0	2	12	2
	CPRW	4	8	4	2	2	2	10	4	0	0
	LPULW	0	0	2	0	4	0	0	0	0	4
	LPRLW	2	0	0	0	0	0	0	0	0	0
	CW	0	0	0	0	2	0	0	0	2	0
	ACC.W	0	0	0	2	0	0	0	0	0	0
	Total	**46**	**30**	**18**	**42**	**24**	**28**	**28**	**20**	**42**	**22**
Arches	A	6	12	6	2	2	4	18	8	6	2
	TA	0	2	0	0	0	0	0	0	0	0
	Total	**6**	**14**	**6**	**2**	**2**	**4**	**18**	**8**	**6**	**2**

Data expressed in percentage.

Abbreviations: Ulnar Loop(UL), Symmetrical Whorl Clock Wise (SWCW), Symmetrical Whorl Anti Clock Wise (SWACW), Double Loop Whorl (DLW), Transitional Ulnar Loop (TUL), Transitional Radial Loop (TRL), Radial Loop (RL), Central Pocketed Ulnar Whorl (CPUW), Central Pocketed Radial Whorl (CPRW), Lateral Pocketed Ulnar Loop Whorl (LPULW), Lateral Pocketed Radial Loop Whorl (LPRLW), Arch (A), Tented Arch (TA), Accidental Whorl (ACC.W).

Increased percentage level of ulnar loop pattern was observed in left thumb and index fingers of Type 2 Diabetic females compared to normal females. Decreased

percentage level of Whorl patterns was observed in left thumb and index fingers of Type 2 Diabetic females compared to normal females. Decreased percentage level of DLW pattern was observed in left thumb finger of Type 2 Diabetic females compared to normal females (Table - 5).

DISCUSSION

Rakate et al observed in a sample of 75 type 2 Diabetes Mellitus patients. An increase in the number of whorls of both right and left hands in males and females, compared with control group. The frequency of ulnar loop was more in control group than diabetic patients. It has been found that total finger ridge count increased in diabetic patients compared to normal population. Average of total finger ridge count measured in males was 74.62 in right hand, 73.60 in left hand and in females was 72.70 in right hand, 74.54 in left hand which was more compared to 75 non-diabetic population, which shows average total finger ridge count of 67.02 on right hand and 69.17 on left hand in males while in females right hand 65.71and left hand 61.89. [4]

Desai et al reported that in Diabetes Mellitus type 2 with hypertension had increase in number of arches and loops while decrease in number of ulnar loops and whorls in male study group compared to controls with both hands combined. In females increase in number of arches, ulnar loops and whorls while decrease in number of radial loops in study group compared to controls with both hands combined. [5]

Shivaleela et al., in their study of the digital finger print pattern of 25 cases of Type 2 Diabetes mellitus patients, found a higher frequency of whorls (36.7%) than other patterns and in T2 Diabetes mellitus patients with ischemic heart disease exhibited less frequency of arches, high frequency of whorls and ulnar loops when compared with Type 2 Diabetes mellitus patients without ischemic heart disease. [6]

Umana et al. have concluded that male with arch pattern of finger print in their right hand are at risk of developing diabetes. The percentage of loop and whorl patterns was higher in the normal subjects while the percentage of arch was higher in diabetics in their study. [7]

Sharma et al., have reported a highest pattern of distribution of the whorl, loop and arch in the 4th, 5th and 2nd fingers respectively, whereas they were present in the 4th, 5th and 3rd fingers in the controls respectively. The whorl spiral (D-41%, C-52%) and the whorl symmetrical (D-41% ,C- 57%) were found to be highest in the 4th finger, but a double loop whorl was seen in the 1st finger (D-23%, C- 16%). The loop ulnar was the highest in the 5th finger (D-80%, C-76%), but the loop radial was highest in the 2nd finger (D-8%, C-7%). These differences between the two groups were statistically insignificant. In diabetic males, the whorl, loop and arch frequency were 47.2%, 48% and 5.2% in comparison to the controls in which they were 37.6%, 57.7% and 4.35% respectively. These differences were significant ($p < .05$) but these were insignificant when the fingers were compared individually. [8]

Burute et al., reported higher frequency of arches and ulnar loops in male diabetic patients than the corresponding control group. For whorls, the frequency was lower among male diabetics than male controls. The results were statistically not significant in male group. A higher frequency of arches was observed in female diabetic patients than the control group. The differences were, more marks in left hand compared to right hand. The results for arches were statistically significant in left hand (($X^2 = 7.472$, $P=0.006$)) and combined right and left hands of female group ($X^2 = 10.139$, $P=0.001$). For whorls, the frequency was lower among female diabetics than female controls. The difference was more marked on right side. Analysis of Absolute Finger Ridge Count (AFRC) shows that, the highest percentage of AFRC (14.85%) belongs to the class interval (101-125) in Diabetic group. In Control group the highest percentage

(18.00%) belongs to the class interval (126-150). Mean AFRC in diabetic group was less than control group in males and females. With regard to Total Finger Ridge Count (TFRC), in Diabetic group the highest percentage of TFRC (23%) was observed in the class interval (101-125) whereas in the control group the highest percentage (29%) was observed in the class interval (126-150). Mean TFRC in diabetic group was less than control group in males and females. Statistically significant differences in AFRC and TFRC are evident in females only. [9]

Padmini et al., found that higher incidence of variation in means of ulnar loops (83.2), composite whorl (1.8), total finger ridge count (TFRC -108.6), absolute finger ridge count (AFRC -138.55) in diabetics than in controls, compared with that of controls with a mean of (81.6) for ulnar loops, (0.4) for composite whorl, (95.5) for TFRC, (122.1) for AFRC. There is an increase in means of ulnar loops (41.6), radial loops (1.7), TFRC (106.25), AFRC (137.58) in male diabetics than in controls with ulnar loops (40.4), radial loops 0.8), TFRC (97.25), AFRC (121.65). There is significant increase in simple arches (5.7), TFRC (110.94), AFRC (139.52), in female diabetics than in controls with means of simple arch (2.3), TFRC (110.94), AFRC (139.52). [10]

Sengupta et al found in cases of male diabetes patients, whorls were comparatively more than loops, but it was just reverse in case of female. Arch pattern in male shows relatively higher frequency than female. In both male and female control series, loops were found to be more than that of whorls. The frequency of the loop was more in female than in male. Occurence of arch was almost similar in both sexes. The salient features that emerge out are relatively less frequency of loop as compared with control group in both the sexes but other finger patterns are found to be more in patients than in control. [11]

The study of Ravindranath et al., showed a significant increase in frequency of ulnar loops, radial loops and arches and a decreased frequency of whorls in both male and female diabetics. A preliminary analysis by means of Chi squared test showed that with the hands combined, the difference was significant at the 0.5 percent level both in male and female diabetics. In male diabetics the proportions were in more ulnar loops (64.49%, in patients and 52.67% in controls) and arches (6.94% in patients and 4.33% in controls) and less in whorls (25.63% in patients and 40.83% in controls). In female diabetics, the proportions of difference were in more ulnar loops (64.4% in patients and 56.67% in controls) and less in whorls (26.93%, in females and 36.83% in controls). Analysis of individual hands showed that in males the difference was significant in both hands as 0.5 percent level and in females for the left hand at 2.5 percent level. [12]

In the present study significantly decreased levels of left thumb mean ridge count was observed in male Type 2 Diabetes mellitus patients (14.90) compared to the normal male subjects (18.76) and it was increased in female Type 2 Diabetes mellitus (15.24) compared to normal females (14.62) but it was statistically insignificant (Table - 1).

Increased percentage level of ulnar loop pattern was observed in right thumb, index, middle, ring and little fingers in Type 2 male Diabetes mellitus compared to normal males. Decreased percentage level of Whorl patterns was observed in right thumb, index, ring and little fingers of Type 2 DM males compared to normal males. Decreased percentage level of CPUW pattern was observed in right ring finger of Type 2 DM males compared to normal males (Table - 2). Increased percentage level of ulnar loop pattern was observed in left thumb, middle, ring and little fingers in Type 2 Diabetic males compared to normal males. Decreased percentage level of Whorl patterns was observed in left thumb, index, middle, ring and little fingers of Type 2 Diabetic males compared to normal males. Decreased percentage level of SWCW

pattern was observed in left thumb of Type 2 Diabetic males compared to normal males (Table - 3).

Increased percentage level of ulnar loop pattern was observed in right thumb of Type 2 Diabetic females compared to normal females. Decreased percentage level of Whorl patterns was observed in right ring finger of Type 2 Diabetic females compared to normal females. Decreased percentage level of SWCW pattern was observed in right ring finger of Type 2 Diabetic females compared to normal females (Table - 4). Increased percentage level of ulnar loop pattern was observed in left thumb and index fingers of Type 2 Diabetic females compared to normal females. Decreased percentage level of Whorl patterns was observed in left thumb and index fingers of Type 2 Diabetic females compared to normal females. Decreased percentage level of DLW pattern was observed in left thumb finger of Type 2 Diabetic females compared to normal females (Table - 5).

CONCLUSION

The present study adds knowledge of patterns and ridge counts of fingertips of Type 2 diabetic patients of all age groups, which can be used to identify the potential diabetics in and around Salem population of Tamil Nadu.

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