FINGERPRINT PATTERN DISTRIBUTION BETWEEN TYPE II DIABETES MELLITUS AND NORMAL INDIVIDUALS AMONG EGYPTIAN POPULATION: A PILOT STUDY FROM CAIRO, EGYPT

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ABSTRACT

Fingerprints are skin markings delineated by epidermal ridge patterns present on the skin of the hands' fingers and palms. There is a positive association between fingerprint distribution and different diseases like diabetes mellitus, making it a useful tool for its prediction. The study aimed to determine if fingerprint pattern distribution could be used as an early screening tool for predicting type II diabetes among at risk Egyptian populations. This study was carried out on 138 patients with type II diabetes mellitus diagnosed at the diabetic clinic, Al kasr Alainy hospital, Cairo city, between September and December 2019. Another 138 participants were included as a control group for this study. The fingerprint distribution pattern between the diabetics and the control showed insignificant (p>0.05) differences except for whorls which showed significantly lesser distribution among diabetics. The ulnar, radial, and double loops were insignificantly (p>0.05) more, while the arch & composite patterns were insignificantly (p>0.05) lesser in diabetics compared to control. The study concluded that the distribution pattern of a fingerprint is not a definitive predictive tool for type II diabetes mellitus.

KEYWORDS: Fingerprint, Pattern, Diabetics, Controls, Forensic, kasr Alainy

INTRODUCTION

Dermatoglyphics is the study of the epidermal ridge patterns of the skin of the fingers, palms, toes, and soles (Singh et al., 2016). They are grouped into three distinct types, loop, whorl and arches that constitute 60-65%, 30-35%, and 5%, respectively, in normal individuals (Sehmi,2018).

This pattern exhibits several properties, and differs between sexes, ethnic groups and age categories (Crawford and Duggirala,1992). Dactyloscopy or Dactylography - currently known as the Henry-Galton system is used to identify such pattern (Gutiérrez-Redomero et al., 2014). Dermatoglyphic variation is utilized as an investigation for early diagnosis, prediction of diabetes mellitus, and many other medical disorders (Sehmi,2018; Ali,2018).

Type II diabetes is a global endocrine disorder with a considerable financial burden especially in the middle- and low-income countries. Finding new strategies for early predication of its occurrence with subsequent implementation of preventive measures is necessary (Mohan and Jaybhaye ,2015). Egypt was ranked among the world's top 10 countries on diabetes prevalence based on The International Diabetes Federation (IDF) (Hegazi et al.,2015). In these limited-resource settings, the availability of convenient and affordable tests for early diagnosis of diabetes is considered a real challenge (Elgharably et al.,2017). Previous multiple studies across different world regions revealed a significant correlation between different fingerprint patterns and diabetes (Marera et al.,2015).

Therefore, the current study aimed to compare the different fingerprint patterns in patients suffering from type II diabetes mellitus with normal individuals among Egyptian populations. Also, evaluation of the use of these fingerprint patterns as a predictive tool for early identification of type II diabetes in high-risk individuals.

PARTICIPANTS AND METHODS

Study design and setting:

We conducted a descriptive pilot study employing a purposeful convenience sample from September 1st to December 31st, 2019. The research was carried out at Kasr Al Ainy hospital, located in Cairo's metropolitan area (El Dib, 2015). The approval of the ethical committee was taken before study from Faculty of Medicine, Cairo University, Egypt and informed consent was collected from all subjects before enrollment in the study. Moreover, the purpose, voluntary nature of participation and potential benefits of the study were explained to all participants.

Study population:

Out of 325 patients who regularly attended the diabetic outpatient clinic at Kasr Alainy hospital during the study period, one-hundred thirty-eight were included (Group I) Fig.1. Patients were eligible to participate if they were Egyptian, diagnosed with type II diabetes at least one year earlier (Khalil et al.,2018), with absence of physical deformities on the fingertips. Those who had inflammation or finger deformities, nationality other than Egyptian and those who declined to participate were excluded from the study. A 138 age-and sex-matched non-diabetic healthy individuals from the family medicine clinic at the same hospital during the same period were recruited as the control group (Group II).

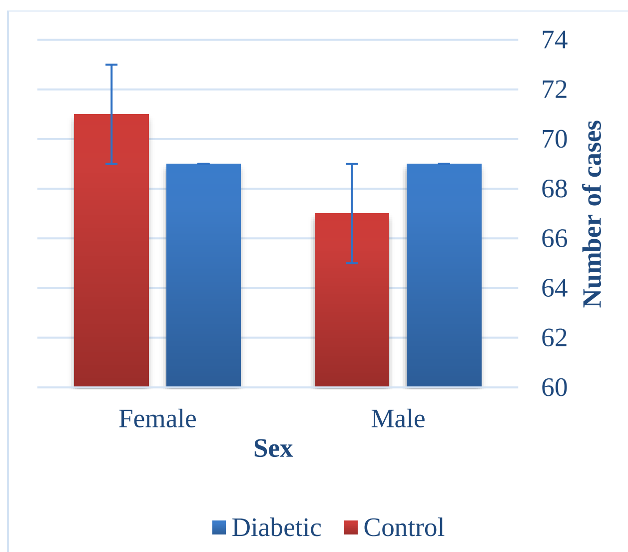

Figure 1: Gender distribution among studied groups

Study measurements and data collection

The study population’s socio-demographic details, including biodata such as gender and age were obtained using a semi-structured questionnaire. A well-qualified team in collecting and identifying fingerprints patterns was assigned to attend both diabetic and family medicine clinics during the study period. The respondents' fingers were first cleaned with either alcohol or soapy water then dried with tissues for collecting fingerprint patterns. A fingerprint pattern was taken by pressing each finger using inked stamp pad and printed onto white coded paper that contains serial numbers of fingers (Nikmah & Fatchiyah ,2017; Profilleme ,2014). The fingerprint pattern was done by finger rotation from the right to the left side or vice versa (FBI,2015). Then identification and analysis of the characteristic of fingerprint patterns from the respondents were made.

Data Analysis:

The collected data were recorded and analyzed with the IBM Statistical Package of Social Sciences (SPSS) version 23. Simple statistical methods were used. Comparison between groups was made using Chi square test. Probability (P) values equal or less than 0.05 were considered as statistically significant.

RESULTS

Table (1) showed the total distribution of (2760) fingerprint patterns of diabetic and the nondiabetic controls (1380 fingerprints each, respectively). Everyone's ten fingerprints distribution pattern from the respective groups were assessed for the followings: arch, ulnar loop, radial loop, composite, double loop and whorl.

The findings from table 1 showed that the ulnar loop’s distribution was predominant in diabetics 583 (42.2%) compared to control 561 (40.7%) but without statistical significance. However only whorl pattern showed higher statistical distribution (p value <0.006) among control group 533 (38.6%) than diabetics 487 (35.3%).

Table (1): Total distribution of fingerprint patterns of control and diabetic groups.

Pattern	Control group	%	Diabetic group	%	P value
Whorl	533	38.6	487	35.3%	0.006*
Arch	168	12.2	139	10.1	0.65
Radial loop	97	7	142	10.3	0.42
Ulnar loop	561	40.7	583	42.2	0.86
Composite	7	0.5	19	1.4	0.51
Double loop	14	1	10	0.7	0.81
Total	**1380**	**100**	**1380**	**100**	

*p<0.05 is significant

Table (2) showed gender distribution of fingerprint pattern in diabetics and control (69 males and 69 females of diabetics and 67 males and 71 females of control). For the males, higher frequencies of ulnar loop and whorls were observed among both groups. The ulnar loop was 278 (41.5%) in the control and 306 (44.3%) in the diabetic group, followed by whorl, which was 248(37%) and 229 (33.2%) for the control and diabetic groups, respectively. No statistical significance was found regarding different fingerprint distribution between males of both groups.

In females, the result was as follows: whorl was 285 (40.1%) followed by ulnar loop for the control 283 (39.9%) and the diabetics' ulnar loop was 277 (40.2%) followed by whorls 258 (37.4%). Also, no statistically significant difference was found between females of both groups and fingerprint distribution.

Table (2): Gender distribution of fingerprint pattern of control and diabetic groups.

Pattern	Male				P value	Female				P value
	Control group (67)	%	Diabetic group (69)	%		Control group (71)	%	Diabetic group (69)	%	
Whorl	248	37	229	33.2	0.56	285	40.1	258	37.4	0.85
Arch	83	12.4	66	9.6	0.50	85	12	73	10.6	0.82
Radial loop	50	7.5	75	10.9	0.46	47	6.6	67	9.7	0.40
Ulnar loop	278	41.5	306	44.3	0.86	283	39.9	277	40.2	0.87
Composite	4	0.6	7	1	0.76	3	0.4	12	1.7	0.35
Double loop	7	1	7	1	0.99	7	1	3	0.4	0.62
Total	**670**	**100**	**690**	**100**		**710**	**100**	**690**	**100**	

The fingerprint pattern distribution between the right and left hands of control and diabetics (Table 3,4) showed a total of 690 fingerprint patterns on each of left and right hands of the study groups without any statistically significant difference in their distribution. For the left hand, the following were found: Arch, 95 (13.7%) in control and 73 (10.6%) in people with diabetes, while the ulnar loop was 271 (39.3%), and 290 (42%) for control and diabetic groups, respectively. The result for the radial loop was 43 (6.3%) and 68 (9.9%), whorl, 271 (39.3%) and 244 (35.4%) for the control and diabetic groups respectively. On the right-hand side, the result was as follows: Arch, 73 (10.6%) and 66 (9.6%), ulnar loop, 290 (42%) and 293 (42.5%), radial loop, 54 (7.8%) and 74 (10.7%), whorl, 262 (38%) and 243 (35.2%) for the control and diabetic groups, respectively.

(Table 3): Distribution of fingerprint patterns in the right hands of control and diabetic groups.

Pattern	Right hand				P value
	Control group	%	Diabetic group	%	
Whorl	262	38	243	35.2	0.74
Arch	73	10.6	66	9.6	0.82
Radial loop	54	7.8	74	10.7	0.50
Ulnar loop	290	42	293	42.5	0.95
Composite	4	0.6	9	1.3	0.61
Double loop	7	1	5	0.7	0.81
Total	**690**	**100**	**690**	**100**	

(Table 4): Distribution of fingerprint patterns in the left hands of control and diabetic groups.

Pattern	Left hand				P value
	Control group	%	Diabetic group	%	
Whorl	271	39.3	244	35.4	0.65
Arch	95	13.7	73	10.6	0.52
Radial loop	43	6.3	68	9.9	0.37
Ulnar loop	271	39.3	290	42	0.76
Compo site	3	0.4	10	1.4	0.45
Double loop	7	1	5	0.7	0.81
Total	**690**	**100**	**690**	**100**	

DISCUSSION

This current study showed that the distribution of whorls, arch and composite patterns was lesser in diabetics compared to control while the ulnar, radial and double loops were though more in diabetics. This finding conforms to the general international distribution of fingerprint patterns recorded in the literature (Van Mensvoort,2019).

This study's distribution of the arch patterns is consistent with Sharma and Sharma,2012 who found that diabetics have lower arches distribution. However, Marera et al.,2015 and Panda et al,2004 showed significant increase of arch patterns in people with diabetes.

A higher frequency of radial loops was observed among people with diabetes than control group. Panda et al.,2004 similarly Ravindranath and Thomas,1995 found an increase in radial loop pattern among diabetic patients. The present result disagreed with Bets et al,1994.

Increased ulnar loop pattern in the diabetics compared to control correlates with Nayak et al.,2015, Ghosh et al.,2016, Dike Eberechi et al.,2012 and Marera et al.,2015 where the ulnar loop was commonly observed in diabetic patients as compared to nondiabetic. However, Ataman and Okoro,2018 observed the reverse. Both Rajanigandha et al.,2007 & Nayak et al.,2015 found that ulnar loop distribution was not significantly different between diabetics and non-diabetic subjects.

There was a statistically significant decrease in whorl pattern among diabetics compared to control in this study which, agreed with Panda et al.,2004, Burute et al.,2013, Ghosh et al.,2016 & Ravindranath and Thomas,1995. However, the present result disagreed with Srivastava and Rajasekar ,2014 & Mehta and Mehta,2015, who found an increased frequency of whorl pattern in both sexes. Rajnigandha et al.,2007 and Nayak et al.,2015 found that whorls were distributed equally in diabetics and non-diabetic subjects.

The gender distribution of fingerprint patterns of diabetic and nondiabetic subjects showed a lesser distribution of whorls and arch patterns among diabetic males and females than the control group. While increased loop and composite patterns were consistent with the results of Shrivastava et al.,2016 & Ravindranath and Thomas,1995 who had reported an increase in a loop pattern and decrease in whorl pattern in diabetic male and female patients.

Increased loop and composite patterns in this study were consistent with Pathan and Hashmi,2013& Ravindranath and Thomas,1995 who recorded that there was an increase in the frequency of ulnar loops in both males and females, while this observation was contradicted with findings of

Ojha and Gupta,2014 ,Sant et al,1983 , Barta et al,1978 and Banerjee et al.,1985 , where total distribution patterns on the right and left hands of each group of patients showed an increase in whorl pattern and decrease in loop pattern with a statistical significance only in male diabetics. Also, Ataman and Okoro,2018 & Mehta and Mehta,2015, Pathan and Gosavi,2011 observed an increase in the number of whorls in both the male and female diabetics compared with control.

Higher frequency of both ulnar loop and arch while the lower frequency of whorl among diabetic females than nondiabetics were also observed by Burute et al.,2013, Ghosh et al., 2016 & Roshani et al.,2016 reported an increase in the arch pattern only in diabetic females.

The distribution of fingerprint patterns between diabetic and nondiabetic males, with both hands assessed, showed a lesser distribution of whorls and arch patterns in diabetic patients than the control. Srivastava and Rajasekar,2014, Ataman and Okoro,2018 also found that whorl pattern was lesser on the right hand of diabetics. There was no disparity seen on the left hand. Rakate and Zambare, 2013, Sengupta and Borush,1996 & Sant et al.,1983, who have observed an increase in whorl pattern in the hands of male diabetics. Sengupta and Borush,1996 showed more arches in diabetic males.

The current study was a pilot study; thus, a more extensive study that covers different parts of the country is needed to verify our results.

CONCLUSION

The study showed an insignificant difference in fingerprint pattern distribution between the diabetics and the control groups except for the whorl pattern. Also, there was no significant sex association in the fingerprint distribution pattern between the diabetics and the control.

The distribution of whorls, arch and composite patterns was lesser in diabetics than control while the ulnar, radial and double loops were higher in diabetics.

So, this study concluded that fingerprint distribution pattern is not a definitive predictive tool for type II diabetes mellitus.

Conflict of interest statement: The authors declared that they have no conflict of interest.

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REFERENCES

Ali, A. K. (2018): Hereditary human disorders identification through fingerprint analysis. *Journal of Education for Pure Science*, *8*(2), 76-89.

Ataman, J. E., & Okoro, E. C. (2018): Fingerprint distribution patterns in diabetics and non-diabetics at central hospital, Benin city Nigeria. *Int J Dent Diabetes Endocrinol Oral Hyg*, *1*, 1-11.

Banerjee, A. R., Banerjee, N., Sarkar, N., Pal, S., & Gupta, M. (1985): Dermatoglyphics in disease diabetes mellitus. *Ind J Physical Antropology and Hum Genetics*, *11*, 165-70.

Barta, L., Regöly-Mérei, A., & Kammerer, L. (1978): Dermatoglyphic features in diabetes mellitus. *Acta paediatrica Academiae Scientiarum Hungaricae*, *19*(1), 31.

Bets, L. V., Dzhanibekova, I. V., Lebedev, N. B., & Kuraeva, T. L. (1994): Constitutional and dermatoglyphic characteristics of children with diabetes mellitus. *Problemy endokrinologii*, *40*(1), 6-9.

Burute, P., Kazi, S. N., Swamy, V., & Arole, V. (2013): Role of dermatoglyphic fingertip patterns in the prediction of maturity onset diabetes mellitus (Type II). *IOSR-JDMS*, *8*(1), 1-5.

Crawford, M. H., & Duggirala, R. (1992): Digital dermatoglyphic patterns of Eskimo and Amerindian populations: Relationships between geographic, dermatoglyphic, genetic, and linguistic distances. *Human biology*, 64:683-704.

Dike Eberechi, U., Oladipo Gabriel, S., & Okoh Peter, D. (2012): A comparative study of the digital pattern, position of triradii, b-c and a-d palmar distances of diabetic subjects and essential hypertensive individuals in River State. *Int J Adv Biotechnol Res.* 2012;3(2):615–620.

El Dib, N. A. (2015): Kasr Al Ainy, the story of a palace that became a medical school. *Kasr Al Ainy Medical Journal*, *21*(1), 1.

Elgharably, A., Gomaa, A. I., Crossey, M. M., Norsworthy, P. J., Waked, I., & Taylor-Robinson, S. D. (2017): Hepatitis C in Egypt–past, present, and future. *International journal of general medicine*, *10*, 1.

FBI (2015): Recording legible fingerprints. https://www.fbi.gov/. Accessed: January 2020.

Ghosh, J. R., GhoshDastidar, P., Dey, B., & Bandyopadhyay, A. R. (2016): Finger and palmar ridge pattern in NIDDM patients and controls. *Hum Biology Rev*, *5*, 86-91.

Gutiérrez-Redomero, E., Rivaldería, N., Alonso-Rodríguez, C., & Sánchez-Andrés, Á. (2014): Assessment of the methodology for estimating ridge density in fingerprints and its forensic application. *Science & justice*, *54*(3), 199-207.

Hegazi, R., El-Gamal, M., Abdel-Hady, N., & Hamdy, O. (2015): Epidemiology of and risk factors for type 2 diabetes in Egypt. *Annals of global health*, *81*(6), 814-820.

Profilleme, A. A. (2014): Forensic profiling of Javanese and Madurese families in Malang and Madura, East Java Indonesia. *Cukurova Medical Journal*, *39*(1), 26-38.

Khalil, S. H. A., Megallaa, M. H., Rohoma, K. H., Ismael, H., AbouSeif, M., Kharboush, I., ... & Sallam, H. (2018): Prevalence of type 2 diabetes mellitus in a sample of the adult population of Alexandria, Egypt. *Diabetes research and clinical practice*, *144*, 63-73.

Marera, D. O., Oyieko, W., & Agumba, G. (2015): Variation in Dermatoglyphic patterns among diabetics in Western Uganda population. *African Journal of Science & Research*, *7*(3), 20-5.

Mehta, A. A., & Mehta, A. A. (2015): Study of fingerprint patterns in type II diabetes mellitus. *Int J Anat Res*, *3*(2), 1046-1048.

Mohan, S., & Jaybhaye, P. L. (2015): Study of fingerprint pattern in patients with diabetes mellitus in a tertiary care centre. *IOSR Journal of Dental and Medical Sciences*, *14*, 39-41.

Nayak, V., Shrivastava, U., Kumar, S., & Balkund, K. (2015): Dermatoglyphic study of diabetes mellitus Type 2 in Maharashtrian population. *International Journal of Medical Science Research and Practice*, *2*(2), 66-69.

Nikmah, I., & Fatchiyah, F. (2017): Identification of Fingerprints Pattern in Mixed Family of Chinese-Javanese Ethnic. Journal of Tropical Life Science, 7(3), 263-267.

Ojha, P., & Gupta, G. (2014): Dermatoglyphic study: A comparison in hands of type II diabetes mellitus patients and normal persons of Udaipur Region. *Journal of Evolution of Medical and Dental Sciences*, *3*(47), 11358-11369.

Panda, M., Chinara, P. K., & Nayak, A. K. (2004): Dermatoglyphics in diabetes mellitus. *J Anat Soc India*, *53*(1), 33-66.

Pathan, F. K. J., & Gosavi, A. G. (2011): Dermatoglyphics in type II diabetes mellitus. *MIMSR Medical College, Latur's Journal of Medical Education & Research*, *1*(1), 6-8.

Pathan, F. K. J., & Hashmi, R. N. (2013): Variations of dermatoglyphic features in non-insulin dependent diabetes mellitus. *Int J Rec Tren Sci Tech*, *8*, 16-9.

Rajanigandha, V., Mangala, P., Latha, P., & Vasudha, S. (2007): Digito-palmar complex in non-insulin dependent diabetes mellitus. *Turkish Journal of Medical Sciences*, *36*(6), 353-355.

Rakate, N. S., & Zambare, B. R. (2013): Comparative study of the Dermatoglyphic patterns in type II diabetes mellitus patients with non-diabetics. *International Journal of Medical Research & Health Sciences*, *2*(4), 955-959.

Ravindranath, R., & Thomas, I. M. (1995): Finger ridge count and fingerprint pattern in maturity onset diabetes mellitus. *Indian journal of medical sciences*, *49*(7), 153.

Roshani, S., Amita, S., Prabhakar, S., Bezbaruah, N. K., & Anshu, M. (2016): Dermatoglyphic patterns among type 2 diabetic adults in north Indian population. *Int J Curr Med Pharma*, *2*(8), 609-61.

Sant, S. M., Vare, A. M., & Fakhruddin, S. (1983): Dermatoglyphics in diabetes mellitus. *J Anat Soc India*, *32*(3), 127-30.

Sehmi, S. (2018): Dermatoglyphic patterns in type 2 diabetes mellitus. *Anatomy Journal of Africa*, *7*(1), 1162-1168.

Sengupta, S., & Boruah, J. (1996): Finger dermatoglyphic patterns in diabetes mellitus. *Journal of Human Ecology*, *7*(3), 203-206.

Sharma, M. K., & Sharma, H. (2012): Dermatoglyphics: A diagnostic tool to predict diabetes. *J Clin Diagn Res*, *6*(3), 327-332.

Singh, P., Srivastava, R., Indurkar, P., & Singh, A. (2016): Comparative study on the dermatoglyphic pattern among diabetic (type 2) and non-diabetic adults in North Indian population. *The Indian Practitioner*, *69*(10), 11-14.

Srivastava, S., & Rajasekar, S. S. (2014): Comparison of digital and palmar dermatoglyphic patterns in diabetic and non-diabetic individuals. *IOSR Journal of Dental and Medical Sciences*, *13*(7-2I), 93-95.

Van Mensvoort M. (2015): Hand Research: Global News & Science about Hands. Available at http://www.handresearch.com.

الملخص العربى

الانماط المختلفة لبصمات الاصابع بين مرضى داء السكرى النوع التانى والافراد الاصحاء بين سكان مصر : دراسة تجريبية من القاهرة , مصر

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الملخص:بصمات الاصابع هى علامات جلدية تحددها انماط حواف البشرة الموجودة على جلد أصابع اليدين وراحة القدمين.هناك علاقة ايجابية بين توزيع بصمات الاصابع و الأمراض المختلفة مثل داء السكرى,مما يجعلها أداة مفيدة للتنبؤ بها.هدفت الدراسة الى تحديد اذا ما كان توزيع نمط بصمات الأصابع يمكن استخدامه كأداة فحص مبكر للتنبؤ بمرض السكرى من النوع الثانى بين السكان المصريين المعرضين لخطر الاصابة بهذا المرض.أجريت هذه الدراسة على 138 مريضا يعانون من داء السكرى النوع الثانى تم تشخيصهم فى عيادة السكرى, مستشفى القصر العينى ,القاهرة بين سبتمبر وديسمبر 2019.وضمت الدراسة 138 مشاركا اخر كمجموعة ضابطة لهذه الدراسة.أظهر نمط توزيع بصمات الاصابع بين مرضى السكرى والاصحاء اختلافات طفيفة باستثناء النمط الدائرى الذى اظهر توزيعا اقل بكثير بين مرضى السكر.كانت البصمات الزندية والقطرية والمزودجة غير ذات دلالة اكثر بينما كانت البصمات القوسية والمركبة اقل فى مرضى السكر مقارنة مع مجموعة التحكم . وخلصت الدراسة الى ان نمط توزيع البصمة ليس اداة تنبؤية نهائية لمرض السكر من النوع الثانى.

كلمات مفتاحية: البصمة,النمط,مرضى السكر,الضوابط,الطب الشرعى,القصر العينى