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FINGERPRINT DISTRIBUTION PATTERNS IN DIABETICS AND NON-DIABETICS AT CENTRAL HOSPITAL, BENIN CITY NIGERIA

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ABSTRACT: *Fingerprints are skin markings delineated by epidermal ridge patterns present on the skin of the fingers and palms of the hand. It has been referenced as a supportive and predictive tool for personal identification and gene-linked disorder. The aim of this study was to determine dermatoglyphic features among diabetic and non-diabetic control at Central Hospital, Benin- City. Nigeria. The diabetic patients (100) comprised of fifty (50) males and fifty (50) females who had their fingerprint distribution pattern compared with equal number of healthy control subjects with the aid of semi-structured questionnaire and a computer based Hp Scanjet scanner. Data collected were subjected to analysis using Chi-square and p-value < 0.05 was considered significant. The results generally showed insignificant (p>0.05) differences in the fingerprint distribution pattern between the diabetics and the control. The ulnar loop and whorl patterns were insignificantly (p>0.05) more while the arch and radial loop patterns were insignificantly (p>0.05) lesser in diabetics compared to control. The inference from this study is that fingerprint distribution pattern is not a definitive predictive tool for type 2 diabetes mellitus.*

KEYWORDS: Fingerprint, Pattern, Diabetics, Controls, Central Hospital, Benin-City.

INTRODUCTION

Diabetes mellitus is an endocrine disorder involving the pancreatic islet cells resulting in elevated blood glucose level (WHO, 2016.) The aetiology is multi-factorial, inclusive of genetic and environmental contributions. Diabetes mellitus is essentially classified into two discrete types, the type -1 and type – 2 which are due to complete insulin lack or its relative insufficiency, respectively. Type -1 develops from the auto-destruction of the body's immune system leading to complete elimination of insulin secretion while type -2 results from the body's inability to make effective use of the insulin secreted (IDF, 2000). The resultant effect of either condition is elevated and uncontrolled blood sugar levels with the attendant deleterious consequences. It was estimated that more than 15 million people in Africa have diabetes mellitus and Nigeria is among the top five countries with the burden of the disease in Africa ((IDF, 2017). The highly exorbitant nature of the treatment demand considering the prognostic indications, finance and required expertise to manage the disease makes early detection a necessity. Hence, application of the knowledge of biomarkers like fingerprint had been widely canvassed as helpful for early, prompt and effective screening of susceptible individuals from larger population settings (Mahdavii and Rezaeinezhad, 2010). Dermatoglyphics are skin markings engraved on the fingers and palms of the hand as well as toes and soles of the feet (Marera *et al.*, 2015). Fingerprint assessment in dermatoglyphics involves skin markings called epidermal ridge patterns being studied and used in prior detection of genetic disorder (Nayak *et al.*, 2015).

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It has been posited that dermatoglyphics as a field serves as a supportive and economically viable tool in the prediction and diagnosis of diabetes mellitus amongst individuals predisposed to developing this disorder (Burute *et al.,* 2013; Parveen Ojha, 2014).

Type-1 diabetes which is known to be genetically influenced is not routinely discernible among patients attending clinic because of the lack of diagnostic or predictive apparatus involving biomarkers. The essential reliance is on the age of the patients and clinical presentations which may be very devastating especially in type 1 diabetes due to the absolute insulin lack or in uncontrolled type 2 diabetes with complications. However, most of the diabetic patients seen in the clinic are essentially of the type 2 because the age of onset is often at later stages in life.. Be that as it may, this study focuses on the possibility of applying dermatoglyphics in predicting diabetes mellitus and to verify if the preponderant portion of the population under review is actually of the type 2 which ought to be less genetically influenced and reliably predicted with fingerprint distribution pattern.

Furthermore, there is paucity of similar studies on the relationship between finger print and ridge patterns as veritable tool of predicting diabetes and most disease conditions in the environment, hence this study was carried out to determine the fingerprint distribution patterns among diabetes mellitus patients and non-diabetic controls attending Central Hospital, Benin city, Edo State Nigeria.

MATERIALS AND METHOD

Research design: The study adopted the descriptive cross-sectional survey of the quantitative design.

Study population: A total of two hundred (200) respondents aged 34 years and above were used for the study. It captured the major ethnic groups around the geopolitical zone that attended Central hospital, Benin City, Nigeria most of whom reside in Benin City and some are referred cases from outside Benin City. The study population was essentially thus, of the following ethnic groups: Ibo, Yoruba, Bini, Esan, Afemai, Urhobo and Ika.

Sampling Technique: In the study center, whole subjects attending the clinic were used. Out of the two hundred (200) subjects, one hundred (100) diabetic patients of both sexes were diagnosed at the diabetic clinic, Central Hospital, Benin-City between January and March, 2017. Also, another one hundred (100) non-diabetic respondents of both sexes with no family history of diabetes were used as the control group. The study groups, thus comprised of 100 diabetic patients made up of 50 males and 50 females and 100 non-diabetic subjects as control group made up of 50 males and 50 females.

Selection Criteria: The inclusion criteria adopted was absence of physical deformities on the fingertips, subjects as Nigerians by origin and evidence of diagnosed diabetes mellitus for at least one year. The exclusion criteria were subjects with deformities and inflammation on their fingers, non-Nigerians and individuals who declined assent for inclusion in the study.

Study Area: The study was carried out at Central Hospital, Benin City Edo state, Nigeria. The study essentially involved Nigerians. Nigeria is an African country on gulf of Guinea with many natural landmarks and wildlife reserves. She has a population density of about 205perkm^2 and a total land area of 910,802km$^{2.}$ According to the National Population Commission (2006), the current population of Nigeria is 140,431,790. Edo State with Benin City as the capital is the State where the study was carried out. It has an estimated population of 3 million (NPC, 2006). The State is located in South-South geo-political zone of Nigeria, bordered by Kogi state to the North and Delta state to the East and South, Ekiti and Ondo to the West.

Methodology: Prior to data collection, ethical approval was obtained from the Research and Ethics Committee of Central Hospital, Benin-City and from the Postgraduate Committee of the Department of Anatomy, School of Basic Medical Sciences, University of Benin, Benin-City. The study and its aim were explained to the subjects whose consents were thereby sought. Demographic details was obtained using a semi-structured questionnaire which comprised of subjects bio-data such as gender, age, marital status, tribe, occupation, diagnosis and number of children. Glucometer was used to screen and re-affirm the control subjects before taking their prints. Finger print was collected using a computer assisted data capture. Firstly, the palm was exposed and all forms of liquid was wiped with a tissue paper. Forthwith, the hand was placed with the palm flat on the HP scanner (Hp G4010 Scanjet Scanner (4800x9600 dpi resolution) with the thumb approximately 30-40 degrees and other fingers 10-15 degree in abduction. The palm and finger images were recorded in jpeg format on the computer (Oghenemavwe and Osaat, 2015).

Data Analysis: The data collected from the subjects were recorded and analyzed with the aid of the IBM Statistical Package of Social Sciences (SPSS) version 23. A p-value of <0.05 was considered significant. Obtained data were presented using descriptive statistics (standard deviation and mean). Chi- square test was used to assess the association between the variables.

RESULTS

The results of study revealed (Table 4.1) a total of 200 questionnaires administered, out of which 100 (50 males and 50 females) were diabetic and 100 (50 males and 50 females) were non-diabetic control subjects. The age of respondents was 34 years and above, from which 45% were within the age range of 34-60 years while 60 years and above recorded 55%. More than half (67.5%) of the respondents were Binis while 32.5% was shared among the following tribes: Esan (13.5%), Afenmai (5.5%), Urhobo (4.5%), Ika (3%), Ibo (4.5%) and Yoruba (1.5%). Majority of the respondents (74%) were traders, 25.5% were civil servants and 0.5% were in school. One hundred and ninety three (96.5%) of the respondents were married while 3.5% were single. All the subjects were Christians. More than half (56.5%) had five children and above while those with children below five were 43.5%. Majority of them had their educational level up to primary (25%) while 38% were without educational background. Those with secondary and post-secondary educational status were 13.5% and 23.5% respectively. One hundred and eighty (90%) of the respondents were of the AA genotype and 10% were AS. Those belonging to blood group ‘A’ were (68.5%) while those of blood group ‘O’ were (27.5%). Others include those of ‘B’ and ‘AB’ blood groups with proportions of 4% and 0% respectively. More than half (64%) of the respondents had no family history of diabetes while 36% had family history of diabetes.

Table 4.2 showed the total distribution of two thousand (2000) fingerprint patterns of diabetic and the non diabetic controls (1000 fingerprints each respectively). These were obtained by assessing each individual’s ten fingerprints distribution pattern from the respective groups for the followings: Arch, Ulnar loop, Radial loop and Whorl. For the control group, of the one thousand (1000) fingerprint patterns assessed from the 100 respondents, Arch was 123 (12.3%), Ulnar loop, 623 (62.3%), Radial loop, 22 (2.2%) and Whorl, 232 (23.2%). The result obtained from the 100 diabetic is as follows: Arch, 88 (8.8%), Ulnar loop, 652 (65.2%), Radial loop, 17 (1.7%) and Whorl, 243 (24.3%). The findings here showed that the distribution of arch pattern was insignificantly lesser (p>0.05) in diabetics compared to control. The ulnar loop was though predominant in diabetics compared to control, but was also insignificant (p>0.05). There was also an insignificantly (p>0.05) lesser distribution of radial loop pattern and insignificantly (p>0.05) more distribution of whorl pattern in diabetics compared to control.

Table 4.3 on gender distribution of fingerprint pattern in diabetics and control showed a total of 500 fingerprint patterns of the ten fingers of the 50 males and 50 females of both study groups. For the males, the followings were found: Arch, 54 (10.80%) in control and 37 (7.40%) in diabetic group, Ulnar loop, 313 (62.60%) in control and 336 (67.20%) in diabetic group. The result for the Radial loop was 12 (2.40%) and 7 (1.40%) and the Whorl was 121(24.20%) and 120 (24.00%) for the control and diabetic groups, respectively. In females, the result was as follows: Arch, 69 (13.80%) and 51 (10.20%) for the control and diabetic groups respectively, Ulnar loop for the control was 310 (62.00%) and for the diabetics was 316 (63.20%) while the Radial loop was 10 (2.00%) in control and 10 (2.00%) in the diabetic group, Whorl was 111 (22.20%) and 123 (24.60%) for the control and the diabetics, respectively. The findings here showed that the distribution of arch pattern was insignificantly (p>0.05) lesser in diabetic group of both sex compared to control. The ulnar loop was though predominant in diabetic patients of both sex but significant (p>0.05) compared to control. The distribution of radial loop pattern was insignificantly (p>0.05). lesser in the male diabetic group compared to control whereas in females, there was no disparity. The whorl pattern was insignificantly (p>0.05) lesser in the male diabetic group but more in the females compared to control.

The fingerprint pattern of distribution between the right and left hands of male diabetics and control (Table 4.4) showed a total of 250 fingerprint patterns on the left and right hands respectively of the study groups. For the left hand, the followings were found: Arch, 29 (11.60%) in control and 21 (8.40%) in diabetics while the Ulnar loop was 161 (64.40%) and 172 (68.80%) for control and diabetic groups, respectively. The result for the Radial loop was 7 (2.80%) and 4 (1.60%), Whorl, 53 (21.20%) and 53 (21.20%) for the control and diabetic groups respectively. On the right hand side, the result was as follows: Arch, 25 (10.00%) and 16 (6.40%), Ulnar loop, 152 (60.80%) and 164 (65.60%), Radial loop, 5 (2.00%) and 3 (1.20%), Whorl, 68 (27.20%) and 67 (26.80%) for the control and diabetic groups, respectively. The results revealed that while the arch pattern was lesser in diabetic subjects than in the control in both hands, there was however no significant difference (p>0.05). The ulnar loop pattern was more in diabetic group compared to control in both hands, but with no significant difference (p>0.05). There was also insignificantly (p>0.05) lesser distribution of radial loop pattern in diabetics compared to control. The whorl pattern was lesser on the right hand of the diabetic patients compared to control whereas on the left hand, there was no significant (p>0.05) disparity.

Table 4.5 showed the comparative distribution of fingerprint patterns of the right and left hands of female diabetics and the control. A total of 250 fingerprint patterns on the left and right hands respectively of the study groups were also assessed. From the left hand, the followings were found: Arch, 37 (14.80%) in control and 29 (11.60%) in diabetics while the Ulnar loop was 153 (61.20%) and 155 (62.00%) for the control and diabetic groups, respectively. The results for the Radial loop was 6 (2.40%) and 4(1.60%) and Whorl was 54 (21.60%) and 62

(24.80%) for control and diabetic groups, respectively. On the right hand, the result was as follows: Arch, 32 (12.80%) and 22 (8.80%), Ulnar loop, 157 (62.80%) and 161 (64.40%), Radial loop, 4 (1.60%) and 6 (2.40%) and the Whorl was 57 (22.80%) and 61 (24.40%) for the control and the diabetic groups, respectively. The findings revealed that the distribution of arch pattern was insignificantly lesser (p>0.05) in both hands of the diabetics compared to control. The ulnar loop pattern was though predominant in both hands of the diabetics compared to control, but was also insignificant (p>0.05). The radial loop pattern was insignificantly (p>0.05) lesser on the left hand of diabetics but more on the right hand compared to control. There was also more but insignificant (p>0.05) distribution of whorl pattern in both hands of the diabetic group compared to control.

Table 4.1a: Socio demographic characteristics of respondents

N=200

VARIABLE	NUMBER	PERCENTAGE (%)
Status		
Diabetic	100	50
Non-diabetic	100	50
Gender		
Male	100	50
Female	100	50
Age		
34-60	90	45
60+	110	55
Ethnicity		
Bini	135	67.5
Esan	27	13.5
Afenmai	11	5.5
Urhobo	9	4.5
Ika	6	3
Ibo	9	4.5
Yoruba	3	1.5
Religion		
Christianity	200	100
Muslims	0	0

Table 4.1b: Socio demographic characteristics of respondents

N=200

VARIABLE	FREQUENCY	PERCENTAGE (%)
Marital status		
Married	193	96.5
Single	7	3.5
Number of children		
Below 5	87	43.5
5 and above	113	56.5
Educational status		
Nil	76	38
Primary	50	25
Secondary	27	13.5
Post-secondary	47	23.5
Occupation		
Civil servants	51	25.5
Trading	148	74
In school	1	0.5
Genotype		
AA	180	90
AS	20	10
Blood group		
A	137	68.5
B	8	4
AB	0	0
O	55	27.5
Family history		
Yes	72	36
No	128	64

Table 4.2: Total distribution of fingerprint patterns of diabetics and control.

PATTERN	CONTROL	%	DIABETIC	%	p-value
Arch	123	12.3%	88	8.8%	0.160
Ulnar loop	623	62.3%	652	65.2%	0.417
Radial loop	22	2.2%	17	1.7%	0.614
Whorl	232	23.2%	243	24.3%	0.423
Total	1000	100%	1000	100%	

Table 4.3: Gender Distribution of fingerprint pattern of diabetics and the Control

PATTERN	CONTROL Male	DIABETIC Male	p-value	CONTROL Female	DIABETIC Female	p-value
Arch	54(10.80%)	37(7.40%)	0.075	69(13.80%)	51(10.20%)	0.100
Ulnar loop	313(62.60%)	336(67.20%)	0.367	310(62.00%)	316(63.20%)	0.810
Radial loop	12(2.40%)	7(1.40%)	0.251	10(2.00%)	10(2.00%)	1.000
Whorl	121(24.20%)	120(24.00%)	0.949	111(22.20%)	123(24.60%)	0.433
Total	500(100%)	500(100%)		500(100%)	500(100%	

Table 4.4: Comparative Distribution of Fingerprint Patterns Between the Right and Left Hands of Male Diabetics and Control.

PATTERN	LEFT			RIGHT		
	CONTROL	DIABETIC	p-value	CONTROL	DIABETIC	p-value
Arch	29(11.60%)	21(8.40%)	0.258	25(10.00%)	16(6.40%)	0.160
Ulnar loop	161(64.40%)	172(68.80%)	0.547	152(60.80%)	164(65.60%)	0.500
Radial loop	7(2.80%)	4(1.60%)	0.366	5(2.00%)	3(1.20%)	0.480
Whorl	53(21.20%)	53(21.20%)	1.000	68(27.20%)	67(26.80%)	0.931
Total	250(100%)	250(100%)		250(100%)	250(100%)	

Table 4.5: Comparative Distribution of Fingerprint Patterns Between the Right and Left Hands of Female Diabetics and Control.

PATTERN	LEFT HAND			RIGHT HAND		
	CONTROL	DIABETIC	p-value	CONTROL	DIABETIC	p-value
Arch	37(14.80%)	29(11.60%)	0.325	32(12.80%)	22(8.80%)	0.174
Ulnar loop	153(61.20%)	155(62.00%)	0.909	157(62.80%)	161(64.40%)	0.823
Radial loop	6(2.40%)	4(1.60%)	0.527	4(1.60%)	6(2.40%)	0.523
Whorl	54(21.60%)	62(24.80%)	0.458	57(22.80%)	61(24.40%)	0.713
Total	250(100%)	250(100%)		250(100%)	250(100%)	

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DISCUSSION

From Table 1 in the study, most of the respondents were 34 years and above. This invariably implies that the diabetics examined at the hospital were mostly of maturity-onset diabetes. Majority of the respondents were Christians in the population, had no family history of diabetes and were of the AA genotype.

The findings from this study (Table 4.2) showed that the distribution of arch and radial loop patterns was insignificantly (p>0.05) lesser in diabetics compared to control while the ulnar loop and whorl patterns were though more in diabetics but insignificant (p>0.05) compared to control. This finding on arch pattern is consistent with the report of Sharma and Sharma, (2013) and Sachdev, (2012) who reported that diabetics have significantly lower arches. Panda *et al*., (2004); Burute *et al.,* (2013) and Marera *et al.,* (2015) showed significant increase of arch patterns in diabetics. The finding of this study on lesser number of radial loops is supported by Bets *et al*., (1994) but contradicted by Ravindranath *et al.,* (1995) and Panda *et al.,* (2004) who found increase in radial loop pattern in both sexes, while other reports (Sant *et al.,* 1983; Mandascue., *et al.*, 2000; Rajnigandah *et al.*, 2006 and Nayak *et al.*, 2015) found no significant difference in radial loop pattern between the diabetics and the control. In this study, the findings of more but insignificant ulnar loop pattern in the diabetics compared to control correlates with Nayak *et al.*, 2015 who found no significant difference. Ravindranath *et al.*,(1995) and Panda *et al.,* (2004) found significant increase in ulnar loop pattern in both sexes among diabetics compared to control but Sant *et al.,* (1983) observed the reverse. The finding in this study on the whorl pattern of the diabetic group corresponds with Mandascue *et al.,* (2000) and Rajnigandha *et al.,* (2006) who also remarked no significant difference between the diabetics and control in their studies, but this is contrary to Sant *et al.,* (1983) who found significant increase in the frequency of whorls in both sexes of the diabetics while Panda *et al.,* (2004) reported significant decrease in the number of whorls in diabetics, compared to controls. Burute *et al.,* (2013) and Umana *et al.,* (2013) found whorl pattern as insignificantly (p>0.05) lesser in diabetics compared to control.

The gender distribution of fingerprint patterns of diabetic and non-diabetic subjects (Table 4.3) showed an insignificantly (p>0.05) lesser distribution of arch pattern among diabetic males and females compared to control. This is consistent with the Shrivastava *et al.,* (2016). While Sant *et al.*, (1983), Rezal *et al.*, (1999) reported more arches only in diabetic females. Roshani *et al.,* (2016) and Padmini *et al.,* (2011) remarked more arches in females than males while Sengupta and Borush (1996) showed more arches in diabetic males. However, no significant increase in either sex was also reported in other studies (Rajaniganda *et al.*, 2006; Mandascue *et al.,* 2000; Umana *et al.*, 2013 and Nayak et al., 2015). The radial loop pattern in this study was insignificantly (p>0.05) lesser in male diabetics but with no disparity in the females. These finding conforms to the report of Rakate and Zambare (2014) as well. The whorl pattern from the study was insignificantly (p>0.05) lesser in the male diabetics but more in female diabetics compared to control. Sant *et al.,* (1983) observed increase in the number of whorls in both hands of the male and female diabetics compared with control. The ulnar loop pattern was also more but insignificant (p>0.05) in both male and female diabetics compared to control, a report consistent with Ravindranath *et al.,* (1995) and Burute *et al.,* (2013) while Sant *et al.,* (1983), Shrivastava and Rajasekar (2014) and Rakate and Zambare, (2014) found it more in the controls. The distribution of fingerprint patterns in males only, with both hands assessed (Table 4.4) revealed lesser but insignificant (p>0.05) distribution of arch pattern in diabetics compared to control. This finding is consistent with previous report (Pathan and Hashmi, 2013) but is at variance with other submissions (Sharma and Sharma, 2012; Umana *et al.*, 2013 and Shrivastava and Rajasekar, 2014) who observed more prevalent arch patterns in diabetics compared to control. The radial loop was insignificantly (p>0.05) lesser in diabetics compared to control from this study but although the whorl pattern was also insignificantly (p>0.05) lesser on the right hand of diabetics, there was no disparity seen on the left hand, compared to control. Ulnar loop pattern was more but insignificant (p>0.05) in diabetics compared to control in this study which conforms with the observations of Burute *et al.*, (2013) but varies from other similar studies (Rakate and Zambare, 2013; Srivastava and Rajasekar, 2014).

The distribution of fingerprint patterns between diabetic and non-diabetic females, with both hands assessed (Table 4.5) showed an insignificantly (p>0.05) lesser distribution of arch pattern in diabetic patients compared to control. This finding conforms with previous reports (Rakate and Zambare, 2013; Pathan and Hashmi, 2013; Rakate and Zambare, 2014; Ojha and Gupta, 2014) but is at variance with the submissions of Sharma and Sharma (2012), Umana *et al.*, (2013) and Srivastava and Rajasekhar (2014) where they found more arch patterns in diabetics compared to control. The radial loop pattern here was insignificantly (p>0.05) lesser on the left hand but more on the right hand of diabetics compared to control as opposed to the reports of Burute *et al.*, (2013). Whorl pattern in this study was more but insignificant (p>0.05) in the right and left hands of diabetics compared to control. The finding correlates with the reports of Umana *et al.*, 2013 and Srivastava and Rajasekhar, (2014). The ulnar loop pattern was more but insignificant (p>0.05) in diabetic females compared to control from this study. This is consistent with the reports of Burute *et al.*, 2013; Umana *et al.*, 2013 but however differs from the findings of Ojha and Gupta (2014).

In this study, the summary of findings showed more but insignificant (p>0.05) distribution of ulnar loop as well as whorl pattern in diabetics generally, while the arch and radial loop patterns were insignificantly (p>0.05) lesser in diabetics compared to control.

Several studies conducted in diverse regions revealed varied findings on fingerprint distribution patterns in diabetics compared to controls. The pattern type and preponderance rate identified, differ from one region to another. It is opined that the marked disparity maybe due to racial influence, small sample size, inadequate control group and the combination of both diabetes types in the study due to inability to separate patients with their distinct type of diabetes for verification as in this study.

CONCLUSION

The study showed that there was no significant difference in the distribution of fingerprint pattern between the diabetics and the control. Also, there was no significant sex association in the pattern of fingerprint distribution between the diabetics and the control. It is an understandable finding given the fact that most of the diabetic respondents are invariably of the type 2 type that is less genetically influenced and more of maturity onset in classification. Thus the inference from the study is that fingerprint may not be a definitive predictive tool for diabetes mellitus unless we can clearly delineate the types and separate the type 1 variant exclusively for investigation, a notable fact for further study.

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