International Journal of Anatomy and Research,
Int J Anat Res 2021, Vol 9(3.1):8027-33. ISSN 2321-4287
DOI: https://dx.doi.org/10.16965/ijar.2021.137

Original Research Article

Dermatoglyphics and Essential Hypertension

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ABSTRACT

Essential hypertension falls in the category of hypertension that has no identifiable cause and affects 90-95% of hypertensive patients. Several studies have utilize dermatoglyphics as models for preliminary diagnosing diseases with genetic and non-genetic origins. However, little studies have been conducted to determine the relationship between dermatoglyphics and essential hypertension. The aim of the study was to generate detailed baseline data on the relationship between dermatoglyphic patterns and essential hypertensive to serve as a preliminary non-invasive diagnostic tool. A total of 400 participants out of which 200 were clinically diagnosed essential hypertensive patients from the Hypertensive Unit of Mampong Government Hospital (Ghana) and 200 clinically confirmed normotensive individuals were recruited for the present study. The fingerprints and palm prints of the participants were taken using a CanonScan Lide 120 colour image scanner which was connected to a Hp laptop. For the distribution of the sub-types of fingerprint patterns, ulnar loop dominated in both groups with the control group recording the highest. Statistically, there was no significant difference between the two groups. Significant difference was recorded between the two groups for the palmar ATD angle for both palms with the control group recording the highest. For the PIC patterns, PIC 300 and 310 dominated in both groups. Statistically, there was no significant difference between the two groups. The results of the present study have shown that, there is some relationship between dermatoglyphics and essential hypertension. This will serve as a preliminary diagnostic tool for the earlier diagnosis of the disease.

KEY WORDS: Dermatoglyphics, Essential Hypertension, ATD angle, PIC pattern.

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Access this Article online	Journal Information
Quick Response code	**International Journal of Anatomy and Research** ISSN (E) 2321-4287 | ISSN (P) 2321-8967 **https://www.ijmhr.org/ijar.htm** **DOI-Prefix:** https://dx.doi.org/10.16965/ijar
DOI: 10.16965/ijar.2021.137	**Article Information** Received: 14 May 2021 Accepted: 14 Jun 2021 Peer Review: 15 May 2021 Published (O): 05 Jul 2021 Revised: None Published (P): 05 Sep 2021

INTRODUCTION

Palmar and digital dermatoglyphics are genetically determined, infallible, durable and stable throughout an individual's lifetime [1]. Scientists all over the world have taken advantage of these properties of

dermatoglyphics to correlate it with some genetic and non-genetic diseases. Different patterns of fingerprints represent various pathologies [2]. Hypertension is a major contributor to the global burden of disease and mortality [3]. Therefore, a major medical advancement would be a better means to ascertain which persons are at higher risk for becoming hypertensive beforehand. Dermatoglyphics serves as a useful clinical and research tool which can reliably be used with some degree of certainty to diagnose vast array of genetic and non-genetic diseases [4]. It has clearly been established that, medical conditions such as hypertension have a genetic background and hence dermatoglyphics which is under a strong genetic influence can be a useful tool in its diagnosis [5]. Therefore, the aim of this study was to use dermatoglyphics, which is inexpensive and non-invasive as a preliminary diagnostic tool in determining the relationship between fingerprints, palm prints and essential hypertension.

MATERIALS AND METHODS

Four (400) participants out of which 200 were clinically diagnosed essential hypertensive patients from the Hypertensive Unit of Mampong Government Hospital, Ghana (100 males and 100 females) and two hundred (200) clinically confirmed normotensive individuals (100 males and 100 females) were recruited for the present study. Ethics Committee approval was obtained from the KSMD/KATH Committee of Human Research, Publications and Ethics. The research and its protocol were fully explained to the understanding of the participants for their consent. Participants who were clinically confirmed of having essential hypertension and were 18 years and above with all ten fingers and palms intact were recruited. Patients suffering from any other in-patient and out-patient cases other than hypertension were excluded. Participants with any apparent palm and finger-related disease, pregnancy or under the age of 18 years were excluded from the study. The control group consisted of clinically confirmed normotensive individuals above the age of 17 without any permanent scared or burnt fingers and palms. Those with deformity in the fingers, being acquired or congenital such as leprosy were also excluded. Participants with extra, webbed or worn-out fingers were excluded from the present study.

The hands of the participants were washed thoroughly with soap and water and dried completely with a tissue paper to remove dirt from the hands. In order to capture the best images, the digital surface of the CanonScan Lide 120 colour image scanner (Canon Canada) was dusted gently after the palm and fingerprint of each participant were taken. For capturing the palmar and fingerprints, the right and left hands were initially placed gently on the glass surface of CanonScan Lide 120 colour image scanner which was connected to an HP 15 laptop computer with Corel Draw X7 Software. The fingers were in extension. The CanonScan Lide 120 scanner was properly tuned to gain clear and decipherable images. The lid of the CanonScan Lide 120 scanner was closed when scanning and printing were done to minimize undesirable stray light. The index, middle and ring fingers were adducted while the thumb and little finger were slightly abducted. The middle finger was in alignment with the long axis of the forearm with no ulnar and radial deviations. The left and right thumb prints were scanned again separately for better image. Any areas not scanned satisfactorily due to the concave nature of certain regions of the palm, were rescanned. Care was taken during the scanning to ensure that, the hands were stationary to avoid smudging and blurring of the prints and to include all of the fingers as well as the triradii which were present. The glass surface of the CanonScan Lide 120 scanner was gently cleaned with soft white wipes impregnated with alcohol after printing the images of each participant. The scanned images were immediately coded with age and sex for case and control groups and then subjected to elaborate dermatoglyphic analysis.

Assessment of the fingerprint and palm print variables: The scanned palm and fingerprints of each individual were given a code. The coded palm and fingerprints were magnified to reveal the necessary details using Picasa photo viewer software. Qualitative

parameters studied for the fingerprints included frequency of the fingerprint patterns. Arches, loops, whorls and their subtypes were classified according to the standard classification criteria used by US Federal Bureau of Investigation (Figure 1). The fingers were labeled as: Thumb – 1; Index finger – 2 ; Middle finger – 3; Ring finger – 4; Little finger – 5. The right and left fingers were represented by 'R' and 'L' respectively. Qualitative parameters studied for the palm included 'ATD' angle and the number of Primary palmar flexion creases, number of Intersection and Complete transverse crease present (PIC pattern). For the 'ATD' angle, A straight line was drawn from the axial triradius ('t') (located proximal to the wrist crease) to the palmar triradii 'a' (located at the base of the index finger) and 'd' (located at the base of the little finger). A protractor was then used to measure the ATD angle (Figure 2). The nature and pattern of the palmar flexion creases were also noted and recorded. The number of primary palmar flexion creases, their intersections if present and a complete transverse crease extending from the radial end to the ulnar end of the palm if present were observed and recorded as the PIC pattern.

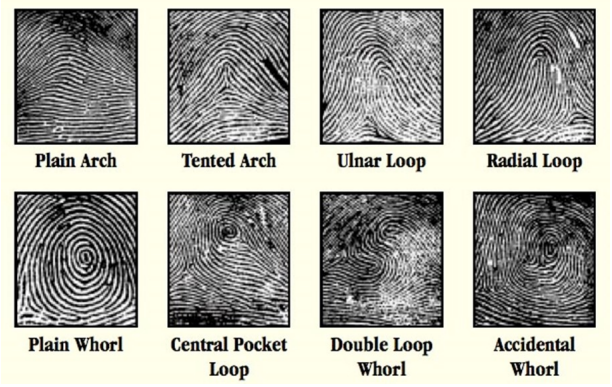

Fig. 1: A schematic diagram showing the eight sub-classification of the fingerprint patterns (Source: Verma *et al*., 2015)[6].

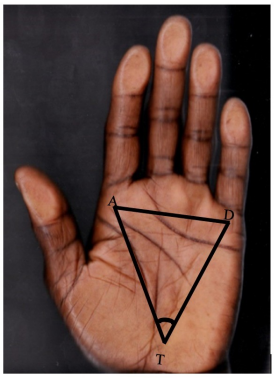

Fig. 2: A photograph of the palm illustrating ADT and DAT angles (× 0.2).

Statistical analysis: All the finger and palm print parameters were analyzed three times. The average was used for further calculations. The data obtained after for both control and study groups were tabulated in Microsoft excel sheet (2018) for statistical analysis. Data analysis was done using IBM Statistical Package for Social Sciences (SPSS) for Windows (Version 22.0., Armonk, NY: IBM Corporation). A p-value < 0.05 was considered statistically significant.

RESULTS

General Distribution Of Fingerprint Patterns Among The Hypertensive And Control Groups: A total of 4000 fingerprints were obtained. Out of the these, 2000 belonged to the essential hypertensive group whilst the remaining 2000 were of the control group. Using the Galton-system of classification, all the fingers of both groups recorded the general trend of fingerprint pattern distribution. This trend was dominated by loop, followed by whorl and then arch. Out of 2000 fingerprints for the essential hypertensive group, loop recorded 1303(65.15%), this was followed by whorl recording 456(28.80%) and then arch recording 241(12.05%) (Table 1). For the control group, loop recorded 1348(67.40%), this was followed by whorl recording 414(20.70%) and then arch recording 236 (11.9%) (Table 1).

Distribution of the Sub-Types of Fingerprint Patterns among the Hypertensive and Control Groups: Table 2 shows the distribution of the eight sub-types of fingerprints patterns among the essential hypertensive and control groups. The eight sub-types of fingerprints were categorised using the Henry's system of classification. The predominant fingerprint pattern observed in the essential hypertensive group was ulnar loop with a frequency of 1251(62.55%). This was followed by plain concentric whorl (321), plain arch (169), double loop whorl (84), tented arch (72), radial loop (52), accidental whorl (28) and central pocket whorl (23) representing 16.05%, 8.45%, 4.20%, 3.60%, 2.60%, 1.40% and 1.16% respectively (Table 2). For the control group, a similar trend with slight variation was observed with ulnar loop dominating (1293) and representing 64.65%. This was followed by plain concentric

whorl (323), plain arch (207), radial loop (55), central pocket whorl (47), double loop whorl (44), tented arch (31), and accidental whorl representing 16.15%, 10.35%, 2.75%, 2.35%, 2.20%, 1.55% and 0.00% respectively (Table 2).

Comparison of 'ATD' Angle between the Hypertensive and Control groups: An independent samples t-test was conducted to compare the ATD angle between the hypertensive and the control groups. The control group recorded a slightly higher ATD angle (41.00 ± 4.40°) than the hypertensive group (39.84 ± 4.05°) for the right palm (Table 3). This difference was statistically significant (p = 0.006). A similar trend was observed for the left palm with the control group recording a slightly higher ATD angle (41.19 ± 4.91°) than the hypertensive group (40.03 ± 3.60°). A statistical analysis yielded a significant difference between the left palm of the hypertensive and control groups (p = 0.008) (Table 3).

Distribution of Palm Print Patterns (PIC) among the Study Population: Table 11 stratifies the distribution of the palm print patterns among the hypertensive and control groups. The palm print patterns were classified as PIC 200, PIC 201, PIC 300, PIC 301, PIC 310, PIC 311, PIC 320, PIC 321, PIC 400, PIC 410, PIC 420 and PIC 430. Out of the 800 palm prints analyzed(400 each for the hypertensive group and control group), the highest PIC pattern in the hypertensive group was PIC 300 with a frequency of 198, this was followed by PIC 310 with a frequency of 186. PIC 301 and 410 then followed recording frequencies of three each. PIC 420 and 430 then followed recording a frequency of two each. For the control group, PIC 300 dominated with a frequency of 216. This was followed by PIC 310, PIC 200, PIC 311, PIC 410, PIC 321, PIC 420, PIC 430, PIC 201, PIC 400 and PIC 320 with frequencies of 162, 4, 4, 4, 2, 2, 2, 1, 1, 1 and 1 respectively. PIC 300 recorded the highest, both in the male and female hypertensive and control groups followed by PIC 310 (Table 4). Collectively, PIC 300 and PIC 310 accounted for 96.0% and 94.5% of the distribution of the PIC patterns observed in the hypertensive and control groups respectively. Statistically, there was no significant difference between the hypertensive group and control group after Chi-square analysis ($\chi^2 = 8.996$; degrees of freedom = 11; p = 0.622).

Table 1: General distribution of fingerprint pattern among the hypertensive group and control group.

Fingerprint pattern	HG-RH	HG-LH	Total R+L	HG (%)	CG-RH	CG-LH	CG R+L	%
Whorl	213	243	456	22.8	238	176	414	20.7
Loop	682	621	1303	65.15	639	709	1348	67.4
Arch	105	136	241	12.05	123	115	236	11.9
Total	1000	1000	2000	100	1000	1000	2000	100

HG-RH-hypertensive group, right hand; **HG-LH**-hypertensive group, left hand; **RH**-right hand; **LH**-left hand; **CG**- control group; %- percentages

Table 2: Distribution of the eight sub-types of fingerprints among the study population.

	Hypertensive group			HG	Control group			
FPP	**RH**	**LH**	**R+L**	**%**	**RH**	**LH**	**R+L**	**%**
PCW	152	169	321	16.05	176	147	323	16.15
DLW	37	47	84	4.2	35	9	44	2.2
CPLW	12	11	23	1.15	27	20	47	2.35
AW	12	16	28	1.4	0	0	0	0
UL	655	596	1251	62.55	618	675	1293	64.65
RL	27	25	52	2.6	21	24	55	2.75
PA	62	107	169	8.45	110	97	207	10.35
TA	43	29	72	3.6	13	18	31	1.55
Total	**1000**	**1000**	**2000**	**100**	**1000**	**1000**	**2000**	**100**

FPP-fingerprint pattern; **RH**- right hand; **LH**- left hand**; R+L**- right + left hands; **CPLW**- Central pocket loop whorl; **DLW** –Double loop whorl; **PCW** – Plain concentric whorl; **RL**- Radial loop; **UL**- Ulnar loop; **PA**- Plain arch; **TA**- Tented arch; **%**- percentages

Table 3: Comparison of 'ATD' Angle between the hypertensive group (N=200) and Control Groups (N=200).

	Hypertensive group		Control Group		95% C.I.			
Side	Mean	± SD(°)	Mean	± SD(°)	Lower	Upper	t	p
Right	39.84	4.05	41	4.4	-1.989	-0.329	-2.745	0.006***
Left	40.03	3.6	41.19	4.91	-2.001	-0.31	-2.686	0.008***

Data are expressed in Mean ± standard deviation (SD), Range with lower and upper limits, t = t-statistic and p-value- significant level at 0.05.

Table 4: Distribution of Palm Print Patterns (PIC) among the Study Population.

	Hypertensive group			Control group		
PIC pattern	Males	Females	Total	Males	Females	Total
200	1	0	1	2	2	4
201	1	0	1	1	0	1
300	96	102	198	107	109	216
301	2	1	3	1	0	1
310	95	91	186	84	78	162
311	1	0	1	1	3	4
320	0	1	1	0	1	1
321	1	0	1	0	2	2
410	2	1	3	2	2	4
400	0	1	1	1	0	1
420	1	1	2	1	1	2
430	0	2	2	0	2	2
TOTAL	**200**	**200**	**400**	**200**	**200**	**400**

DISCUSSION

The highest fingerprint pattern recorded in the present study was loops, followed by whorls and then arches in both hypertensive and control groups. For the hypertensive group, loop recorded 1303 out of a total of 2000 representing 65.15%, whorls recorded 456 representing 22.80% and arch recorded 241 representing 12.05%. For the control group, out of a total of 2000, loops recorded 1348 representing 67.40%, whorls recorded 414 representing 20.70% and arch recording 236 representing 11.90%. This general trend of primary fingerprint pattern distribution is consistent with several literatures in different populations across the world [1,2,4,7-13]

The inheritance modes of various genetic traits are not well and fully understood because of the complexity of dermatoglyphic genetics. Medland *et al*. (2007) observed a polygenic mode of inheritance for fingerprint pattern and therefore reported a significant genomic linkage on chromosomes 5 and 1 (5q14.1) [14]. The genetic alterations responsible for inherited essential hypertension remain largely unknown and as such, results from pedigree analysis shows several possible intermediary phenotypes (genetic traits) that may be related to inherited high blood pressure [15].

The present study tried to zoom in to find out which of the eight sub-types of fingerprint pattern was specific to the essential hypertensive group as well as the control group. Ulnar loop dominated in the distribution of the sub-types of fingerprint patterns in both the essential hypertensive and control groups. This was followed by plain concentric whorl, plain arch, double loop whorl, tented arch, radial loop, accidental whorl and then central pocket whorl. For the control group, this was followed by plain concentric whorl, plain arch, radial loop, central pocket whorl, double loop whorl and then tented arch. A study by Iqbal *et al.* (2012) reported a significantly higher frequency of whorl (67%), followed by loop (28%) and then arch (5%). This discrepancy might be attributed to ethnic and racial variations characteristic of the distribution of fingerprint patterns [16].

For the ATD angle, the control group recorded a slightly higher ATD angle (41.00 ± 4.40^0) than the hypertensive group (39.84 ± 4.05^0) for the right palm. This was statistically significant

($p = 0.006$). A similar trend was also observed for the left palm with the control group recording a slightly higher ATD angle (41.19 ± 4.91^0) than the hypertensive group (40.03 ± 3.60^0). A statistical analysis yielded a significant difference between the left palm of the hypertensive and control groups ($p = 0.008$). This is inconsistent with a study by Palyzova *et al*. (1991) in a Czech Republican population who recorded higher 'ATD' angle in both hands of the hypertensive group as compare to the control group [17]. Although the study by Palyzova *et al*. (1991) did not record a significant difference between the essential hypertensive and control groups, they reported a higher mean ATD angle in the essential hypertensive group than the control group both in the right and left palms [17]. The differences observed between the present study and that of Palyzova *et al*. (1991) might be due to some underlying genetic factor(s) [17]. The slight difference might be due to ethnic and racial variations.

The palmar flexion creases are the parts of the palm which are firmly attached to the underlying dermis of the skin. It consist of major flexion creases (principal lines) and minor flexion creases (secondary creases or wrinkles). The major palmar flexion creases consist of proximal transverse crease, distal transverse crease and radial longitudinal crease [18].

Based on the number of principal lines present, the intercessions between these principal lines and whether any of the principal line begins from the radial end of the palm to the ulnar end of the palm (complete crease), Mensvoort (2015) classified the PIC model into eight sub-categories on the basis of the palmar flexion crease pattern and the relationships between the three major palmar flexion creases[19]. These PICs were PIC 101, PIC 200, PIC 201, PIC 210, PIC 211, PIC 300, PIC 311 and PIC 310. The present study recorded these PICs: PIC 200, PIC 201, PIC 300, PIC 301, PIC 310, PIC 311, PIC 320, PIC 321, PIC 400, PIC 410, PIC 420 and PIC 430. PIC 400, PIC 410, PIC 420 and PIC 430 appear unreported in literature with the exception of Nketsiah et al (2020) who reported these PICs in the Ghanaian population in correlating dermatoglyphics and sickle cell anaemia [1]. Collectively PIC 300 and PIC 310 accounted for 96.0% and 94.5% of the distribution of the PIC patterns observed in the hypertensive and control groups respectively. Statistically, there was no significant difference ($x^2 = 8.996$; degrees of freedom = 11; $p = 0.622$) between the hypertensive group and control group when subjected to Chi square analysis. Offei *et al.* (2014) reported that, PIC 300 and PIC 310 dominated (76.2%) among 320 Senior High School students in Ghana. The findings of the present study are also in agreement with the study by Darko (2017) who reported that, the predominant PIC pattern among blood groups A, AB and O were PIC 310 followed by PIC 300 among 249 medical students of the Kwame Nkrumah University of Science and Technology-Ghana. These similarities might be due to the fact that, all these studies were conducted in the same geographical location [20].

CONCLUSION

For the general distribution of the three main fingerprint patterns, the highest fingerprint pattern recorded in the present study was loops, followed by whorls and then arches in both hypertensive and control groups. For the distribution of the sub-types of fingerprint patterns, ulnar loop dominated, followed by plain concentric whorl, plain arch, double loop whorl, tented arch, radial loop, accidental whorl and central pocket whorl in the hypertensive group. A similar trend was observed in the control group. Statistically, there was no significant difference between the two groups. Significant difference was recorded between the essential hypertensive group and control group for the palmar ATD angle for both palms with the control group recording the highest. For the PIC patterns, PIC 300 and 310 dominated in both groups. Statistically, there was no significant difference between the two groups. This study has provided some baseline data correlating dermatoglyphics and essential hypertension.

ACKNOWLEDGEMENTS

We are grateful to the staff at the Hypertensive Unit of Mampong Government Hospital (Ghana).

Conflicts of Interests: None

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How to cite this article:

Kwame Adu Ofori, Nketsiah James, Adjei-Antwi Collins, Tetteh Joshua, Nancy Darkoa Darko, Chrissie Stansie Abaidoo, Micheal Amoah. Dermatoglyphics and Essential Hypertension. Int J Anat Res 2021;9(3.1):8027-8033. **DOI:** 10.16965/ijar.2021.137