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Finger and Palmar Prints as a Biomarker of Bronchial Asthma: A Study of Abuja Residents.

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ABSTRACT
Palmer dermatoglyphics is a simple, inexpensive and non-invasive anatomical procedure which may be used as a reliable indicator for screening of high risk population in a developing country like India. Bronchial asthma is influenced by genetic factors and the present study was carried out to show the relationship between the dermatoglyphic quantitative & qualitative parameters with patients of bronchial asthma. Dermatoglyphic prints were obtained from both hands of clinically diagnosed cases of 50 bronchial asthma patients and 50 normal healthy individuals, without family history of bronchial asthma (control group). The study included both qualitative and quantitative tests. Qualitative study includes finger print patterns (whorls, radial loop, arches, and ulnar loop). Quantitative study includes Total Finger Ridge count (TFRC), Left and Right Finger ridge count (LFRC and RFRC) and ATD angle. In this study a significantly higher number of ulnar loops and whorls were seen in the bronchial asthma group and it was seen that the presence of arches and radial loop were lower (although not significantly) than that compared to the control group. TFRC was seen to be significantly higher among the bronchial asthma patients. No significant results were obtained for LFRC and RFRC. ATD angle was significantly higher in patients with Asthma compared to control. Evaluation of dermatoglyphic patterns may be useful in identifying patients prone to developing Bronchial Asthma.

Keywords: bronchial asthma, dermatoglyphics, fingerprints.

INTRODUCTION
Dermatoglyphics and Bronchial asthma are both influenced by genetic factors. Hence, the proposed work is intended to access the diagnostic potential of correlation between finger and palmar prints patterns and bronchial asthma.

The study of the epidermal ridge patterns of the skin of the fingers, palms, toes, and soles is known as 'Dermatoglyphics' (1). Harold Cummins coined the term 'Dermatoglyphics' in 1926 (Greek derma-skin, Greek Glyphein- to carve).The dermatoglyphic science is based upon two major facts; Firstly, the ridges are slightly different for the fingers and no two persons, not even uni-ovular twins, show exactly similar finger print patterns and Secondly, the ridges are permanent throughout life and they survive superficial injuries and also environmental changes after the 21st week of the intra-uterine life. The dermal ridge differentiation takes place early in the foetal development. The resulting ridge patterns are genetically determined and are influenced by environmental factors. The patterns which are once established never change throughout life. The specific dermatoglyphic traits were claimed to be inherited as dominant, incompletely dominant recessive, single gene or polygenic with complete or incomplete penetrance and as a variable expression of genes (1, 2).

Dermatoglyphics has been studied in certain clinical disorders which are associated with chromosomal and developmental defects like mongolism, Turner's syndrome, cardiovascular disease, Diabetes mellitus, schizophrenia and ischemic heart disease. The dermatoglyphic analysis has many advantages as a diagnostic tool (3).

Bronchial asthma is one of the most extensively studied respiratory diseases and its genetic basis has been well established. The dermatoglyphic traits are formed under genetic control, early in the development, but they may be affected by environmental factors during the first trimester of pregnancy. They however do not change significantly thereafter, thus maintaining a stability which is not greatly affected by age. These patterns may represent the genetic make-up of an individual and therefore his/her predisposition to certain diseases. The patterns of dermatoglyphics have been studied in various congenital disorders like Down's syndrome and Kleinfelter's syndrome and also in chronic diseases like hypertension, Diabetes mellitus, etc. The prints can thus represent a non-invasive anatomical marker of the bronchial asthma risk and they can thus facilitate an early detection and

treatment of the diseases (4).
Much little is known as far as the dermatoglyphics in 'bronchial asthma' is concerned. These days, dermatoglyphics as a genetic marker, is attracting the attention of many workers (4).

The genetic factors are clearly operational in case of atopy and asthma. Linkages have been found between the similar chromosomal sites for both atopy and asthma. The asthma phenotypes are polygenetic and they require the expression of multiple genes (5).

MATERIALS AND METHODS

Study Design: Diagnostic Study- The material for this study was clinically diagnosed cases of Bronchial asthma in adults.
Ethical approval for this study was obtained from various private and public hospitals Ethical review boards. In addition, patient consent as well as those of the control was obtained. The work protocol was submitted to the ethical. The purpose and procedure of the study was explained to all the patients and their consent taken.
Study Setting: Out Patient Department of Private and Public Hospitals in FCT, Abuja.
Sample Size/ Nature: With the average prevalence rate of bronchial asthma being 9.7% (6). At 95% (0.05) confidence interval and ±5 margin of error, the calculated sample size is 35 using statistical formula (Fischer formula); Hence 50 cases of bronchial asthma and 50 controls were included in the study. Regardless of sex.

$$\text{Sample size} = \frac{z^2 \times p \times q}{d^2}$$

z= 1.96
p = prevalence rate, 0.097
d= confidence interval, 0.05
q= 1-p = 1-0.097= 0.903
n= Sample size [where population > 10,000]

$$= \frac{1.92^2 \times 0.097 \times 0.903}{0.05^2}$$

$$= \frac{3.8416 \times 0.097 \times 0.903}{0.0025}$$

$$= \frac{0.087591}{0.0025}$$

= 35.0364
N = 35 (Sample Size).

Research Instrument: The research instrument that was used is a HP Scanjet 300 Flatbed Photo Scanner.
Procedure for Collecting Data: Data collection was mainly carried out by the researcher with the help of skilled personnel in the out-patient department of private and public hospitals ensuring quality and integrity of my data.
Scanning of finger and palmar prints patterns using digital scanner. The following parameters were studied and analyzed from the print's patterns

ATD Angle
Whorls
Arches
Radial Loops
Ulnar Loops
Absolute finger ridge count
Total finger ridge count

Data Collection Methods: During the data collection for this study, the method used was non-invasive, convenient and not potentially harmful to the participants. Also, to ensure that there was minimal disturbance to all subjects, great care was taken.
All volunteers were asked to assume a sitting position convenient for them and stretch out their hands, spreading out their palms and fingers as well. Scans were taken using the scanner.
The study was conducted on all the Clinically Diagnosed bronchial asthma patients who attended the Out Patient Department during the study period, at GarkiHospital, FCT, Abuja; National Hospital, FCT, Abuja; and Maitama General Hospital, FCT, Abuja. Matched controls were selected from among the medical doctors, staff members and the paramedical staff of the hospital (those who did not have any respiratory problem or any symptoms which were related to asthma), after taking their informed consent and after getting permission from the institutional review board and the ethical committee of the aforementioned hospitals respectively. The data collection and the fingertip prints of 50 patients and 50 controls were taken.

The proformas were filled after the clinically diagnosed patients and the controls were selected. The procedure which was used for taking the prints was the digitalized scanner method. The instruments were cleaned before and after taking the prints. The subjects were convinced about the procedures and the idea behind taking the prints and his or her informed consent was taken. The subject was asked to relax and to co-operate to achieve the required movement of the finger. The fingers were cleaned with soap, water and spirit to remove oily dirt, sweat and other dirt. The hands were placed on the scanners and the scans were taken.
The work protocol was submitted to the ethical committee for approval and the necessary permission was taken. An Informed consent was signed and taken from all the individuals. The dermatoglyphic patterns were read on the digits. The following patterns were studied and analyzed in the present study: fingertip patterns: whorls, arches, total loops, radial loops, ulnar loops, the Absolute Finger Ridge Count (AFRC) , the Total Finger Ridge Count (TFRC), and the ATD angle.

Study Participants, Inclusion and Exclusion Criterion: The study was conducted on the clinically diagnosed Bronchial Asthma patients attending the Out Patient Department .All suspected patients of Bronchial Asthma were subjected to pulmonary

function test, and Bronchial Asthma was confirmed. Adults were selected. Non-asthmatic participants were considered as controls and selected from among the Out Patient Department visitors and residents around health facility.

Inclusion Criteria

1) This research work includes persons who reside in FCT, Abuja.
2) Adult.
3) Clear prints.

Exclusion Criteria

1) This includes persons who do not reside in FCT, Abuja.
2) Children and Infants.
3) Blurred prints.

Statistical Analysis: Descriptive statistics was established using median for the discrete variables, while the categorical variables were described in frequencies (%) using cross-tabulations. Inferential statistics was achieved using Pearson's Chi-square to test distributional differences in the case (asthma) and control groups, while Mann-Whitney U was used to test the difference in the distribution of the quantitative dermatoglyphic attributes. Confidence level was set at 95%, with P-value less than 0.05.

RESULTS

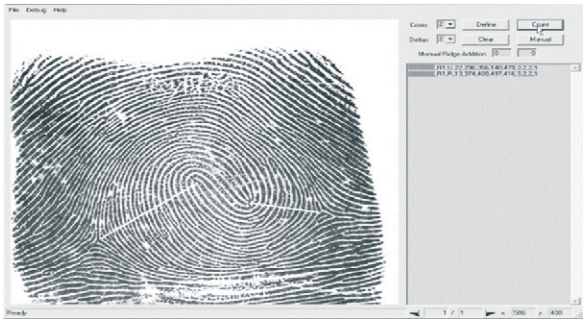
Qualitative differences: The graphs of **Figure 4-8** show the frequency of the various fingerprint patterns on each digit (ulnar, whorl, loop, radial) between the asthma and the control patients.

1.Test of distributional difference in the patterns (Figure 4-8)

Digit	Chi-square test association with pattern distribution			
	Right		Left	
	χ^2	P-value	χ^2	P-value
1D	4.597	0.204	3.413	0.332
2D	**9.092**	**0.028**	7.805	0.050
3D	5.909	0.116	6.406	0.093
4D	5.398	0.145	6.171	0.104
5D	**9.842**	**0.020**	4.940	0.176

Fig 1: HP Scanjet 300 Flatbed Photo Scanner.

•**Fig 2:** Scanned imaged of patient's palm.



•**Fig 3:** Zoomed in image of patient's thumb under analysis.

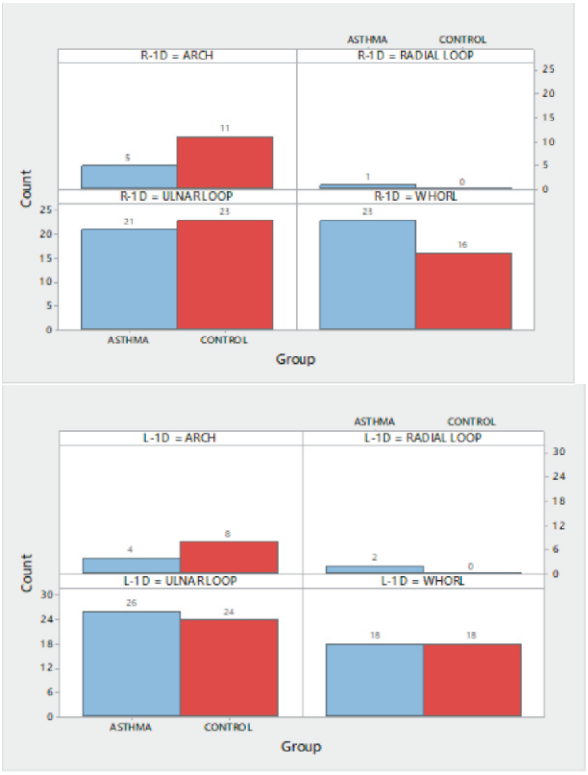


Fig 4: Pattern distribution on the right (R) and left (L) thumb (1D).

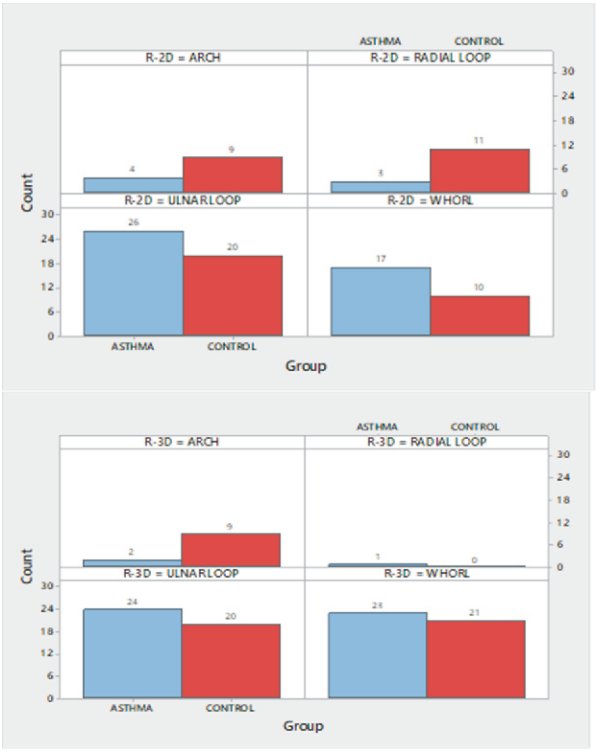


Fig 5: Pattern distribution on the right (R) and left (L) index finger (2D).

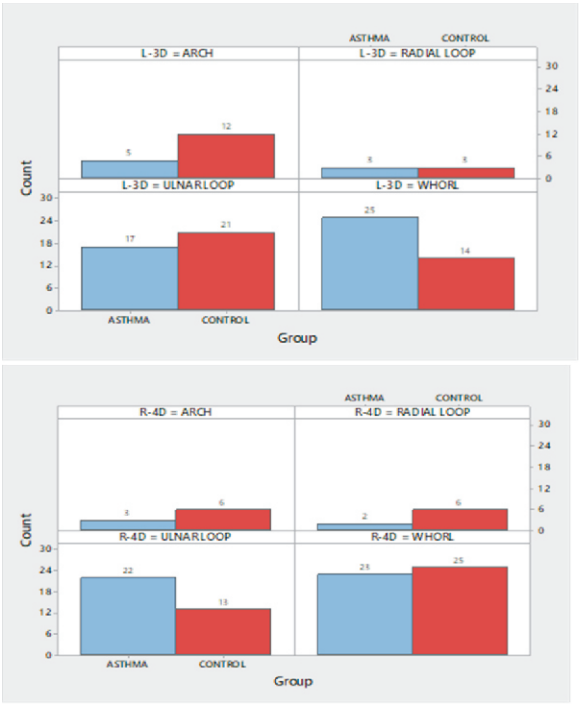


Fig 6: Pattern distribution on the right (R) and left (L) middle finger (3D).

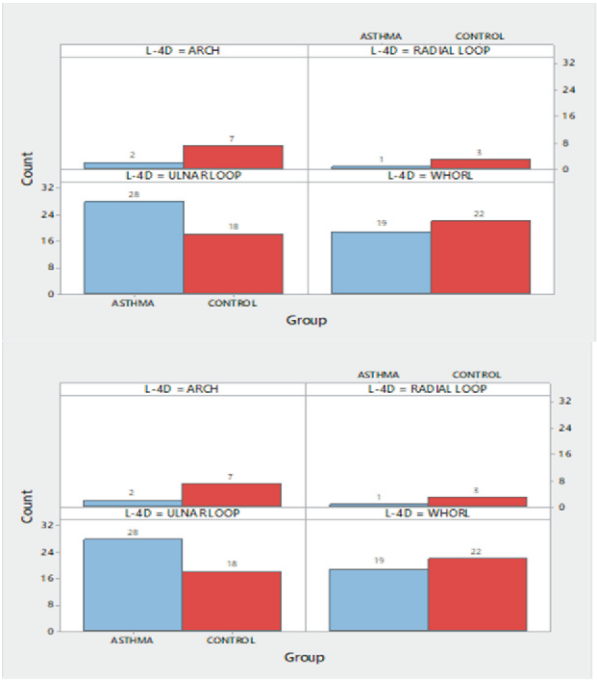


Fig 7: Pattern distribution on the right (R) and left (L) ring finger (4D.

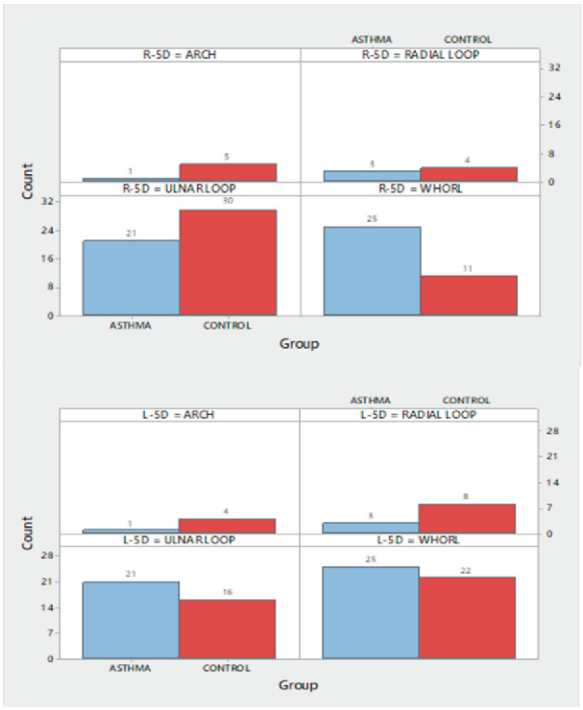


Fig 8: Pattern distribution on the right (R) and left (L) little finger (5D).

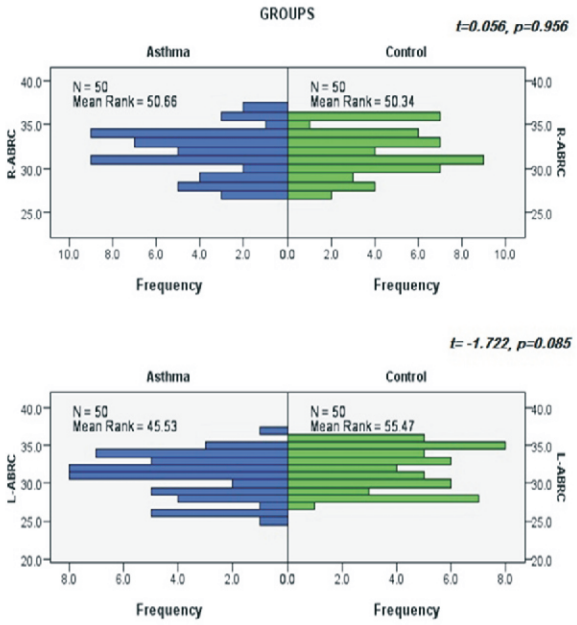


Fig 9: Mann-Whitney U histogram for the left and right ABRC and test of distributional difference between the control and asthma groups.

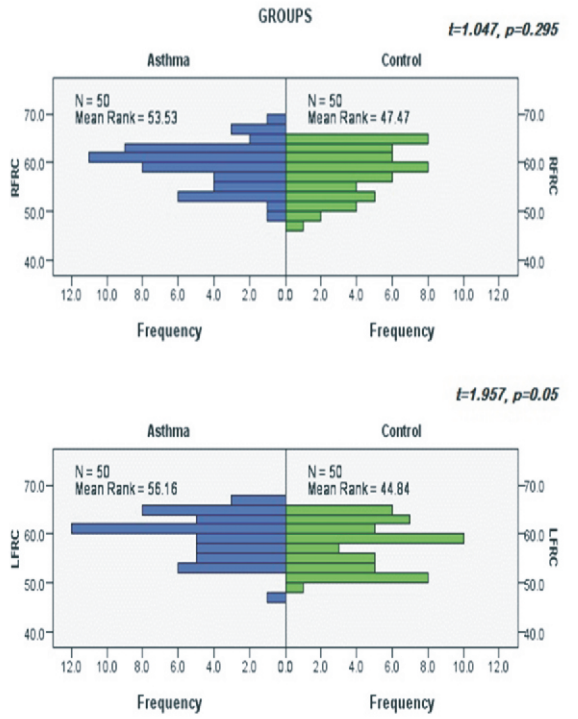


Figure 10: Mann-Whitney U histogram for the left and right FRC and test of difference distributional between the control and asthma groups.

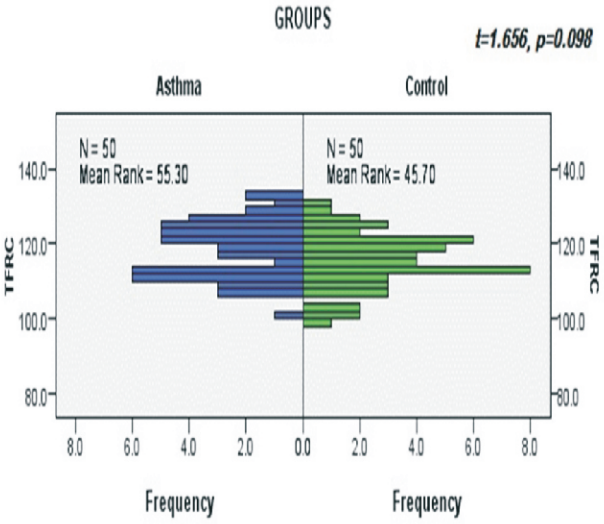


Figure 11: Mann-Whitney U histogram for the TFRC and test of distributional difference between the control and asthma groups.

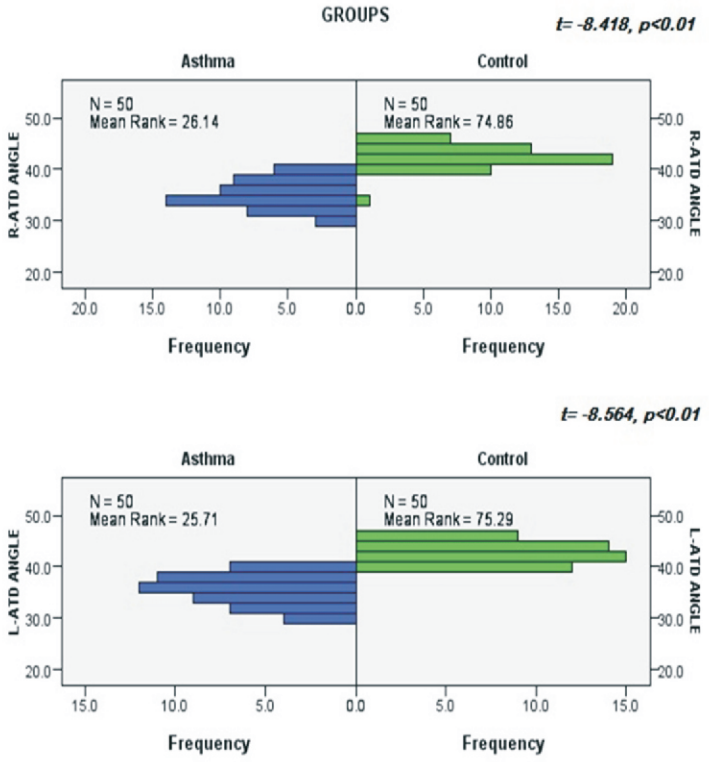


Fig. 12: Mann-Whitney U histogram for the left and right ATD angle and test of distributional difference between the control and asthma groups.

Figure 4 Shows the pattern distribution on the first digit (thumb) of the asthma and control patients. The whorl and ulnar patterns are the most frequent, followed by the arch and radial.

Right Thumb

- Ulnar- higher in control
- Whorl- higher in asthma
- Radial- higher in asthma
- Arch- higher in asthma

Left Thumb

- Ulnar- higher in control
- Whorl- higher in asthma
- Radial- higher in asthma
- Arch- equal

Figure 5 Showsthe pattern distribution on the second digit (index) of the asthma and control patients. The whorl and ulnar patterns are the most frequent, followed by the arch and radial.

Right Index

- Ulnar- higher in asthma
- Whorl- higher in asthma
- Radial-higher in control
- Arch-higher in control

Left Index

- Ulnar- higher in asthma
- Whorl- higher in asthma
- Radial-higher in control
- Arch-higher in control

Figure 6 Shows the pattern distribution on the third digit (middle) of the asthma and control patients. The whorl and ulnar patterns are the most frequent, followed by the arch and radial.

Right Middle

- Ulnar- higher in asthma
- Whorl- higher in asthma
- Radial- higher in asthma
- Arch- higher in control

Left Middle

- Ulnar- higher in control
- Whorl- higher in asthma
- Radial- equal
- Arch- higher in control

Figure 7 Shows the pattern distribution on the fourth digit (ring) of the asthma and control patients. The whorl and ulnar patterns are the most frequent, followed by the arch and radial**.**

Right Ring

- Ulnar- higher in asthma
- Whorl- higher in control
- Radial- higher in control
- Arch- higher in control

Left Ring

- Ulnar- higher in asthma
- Whorl- higher in control
- Radial- higher in control

- Arch- higher in control

Figure 8 Shows the pattern distribution on the fifth digit (ring) of the asthma and control patients. The whorl and ulnar patterns are the most frequent, followed by the arch and radial.

Right Little

- Ulnar- higher in control
- Whorl- higher in asthma
- Radial- higher in control
- Arch- higher in control

Left Little

- Ulnar- higher in asthma
- Whorl- higher in asthma
- Radial- higher in control
- Arch- higher in control

So, this frequency tables show the patterns which are most frequent in both the left and the right digits of the patients.

On the right hand, the whorl and ulnar pattern is more on the bronchial asthma patients, while the arch and radial is more in the control patients.

On the left hand, the whorl and ulnar pattern is more on the bronchial asthma patients, while the arch and radial is more in the control patients.

Table 1: Test of distributional difference in the patterns (Figure 4-8)

The distributional differences of the fingerprint pattern of the control and asthma group was significant for the right 2D (^{2}=9.092, p=0.028) and 5D (^{2}=9.842, p=0.020), while other digits did not exhibit any distributional differences (P>0.05). The pattern distribution for the left digits were not significantly different for both the control and asthma group ($P \geq 0.05$).

Quantitative differences: The Mann Whitney-U test of Figure 9 showed that the mean rank of the ABRC of the right hand was higher in the asthma group, but lower for the left hand; however, the difference was not significantly different (R; t=0.056, p=0.956 and L; t=-1.722, p=0.085).

The Mann Whitney-U testof Figure 10 showed that the mean rank of the right FRC was higher in the asthma group, and the mean rank of the left FRC was also higher; however, the difference was not significantly different (R; t=1.047, p=0.295 and L; t=1.957, p=0.05)

The Mann Whitney-U test of Figure 11 showed that the mean rank of the TFRC was higher for the asthma group; however, the difference was not significantly different (t=1.656, p=0.098)

The Mann Whitney-U test of Figure 12showed that the mean rank of the R-ATD angle is higher in the control group, and also higher in the control group for the L-ATD angle, the difference was significant (R; t= -8.418, p = <0.01; L; t= -8.564, p= <0.01).

DISCUSSION

In the recent past, much work was done in finding out an association between the morphological and the genetic characters in a number of diseases, with the help of certain investigations. Dermatoglyphics is determined by the polygenic inheritance andit is one of such tools which are frequently used in scientific studies. Many workers have demonstrated that dermatoglyphics is an important aid in the diagnosis of and for understanding the genetics of many diseases.

In the present study, many dermatoglyphic parameters were studied and they were found to be statistically significant. Since asthma is a genetically transmitted disease, it was thought that there would be some correlation between asthma and dermatoglyphics, which would be of statistical significance in the patients as compared to the controls. The present study was undertaken to find out the correlation between dermatoglyphics and bronchial asthma. The dermatoglyphic pattern in bronchial asthma was studied under the following headings:

Fingertip patterns: Arches, loops – radial and ulnar, whorls, AFRC and TFRC.

Palmar Characteristic: ATD angle

Cummins and Midlow used dermatoglyphics as a diagnostic aid in medical diseases. Since then it has become a valuable tool in medico-legal, anthropological and genetic studies (7).

Various diagnostic criteria are available for labelling bronchial asthma, such as medical history, family history, physical examination, and laboratory studies like skiagrams, spirometry, and allergy tests. Apart from advances in medical diagnostic procedures, the diagnosis of bronchial asthma is difficult, as patients with asthma are heterogeneous and they present a wide spectrum of signs and symptoms which vary in severity, from patient to patient and from season to season (7).

The present study was aimed to evaluate whether the dermatoglyphic parameters have any diagnostic significance in Bronchial Asthma patients. Indeed, the number of arches and radial loop was lower, the ulnar loop and whorls was significantly higher among Bronchial Asthma patients compared to control group especially in the 2nd and 5th digits on the right hand.

A qualitative and quantitative analysis on dermatoglyphic patterns in patients with Bronchial Asthma was previously reported (8) , in that study, similar to my observations, significantly higher number of ulnar loops and lower number of arches were observed in the Bronchial Asthma group compared to that of the control group. Additionally, significantly higher ATD angles was also reported for the control group compared to that of the asthma patients. However, no significant differences in radial loops (although higher in the control group), TFRC (higher in the asthma group), and RFRC and LFRC (higher in the asthma group) as previously reported in the data analysis.

In another qualitative and quantitative analysis on

dermatoglyphic patterns in patients with Bronchial Asthma Higher values for ATD angle and less TFRC counts are also reported in Bronchial Asthma patients (4) however, I did not observe such differences in my study.

CONCLUSION

Results from the comparison study of finger print pattern in Afro-Trinidadian and Indo-Trinidadian bronchial asthma patients (8) showed that whorls, loops and arches only in III and IV digits were significantly increased when compared with control, in the present study this was also observed except the arches were lower and in the II and V digits. On the contrarary, (2) found decreased frequency of arches in Bronchial Asthma patients than control group, which can also be observed in this present study.

In another study Sahana*et al*., and Singh *et al*., increased frequency of ulnar loop and decreased arches in patients of Bronchial Asthma as compared to control group (8, 10)*et al.,*, this was also observed in the present study.

Conflict of Interests: The authors declares that there is no conflicts of interest regarding the publication of this paper

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