# Finger Pattern Size and Palmar Traits Distribution in Blood Cell Typing

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## ABSTRACT

**Background:** Dermatoglyphics parameters are genetically determined and have been a genetic blueprint to understand certain gene expression phenotypically. **Objectives:** This study was designed to establish dermatoglyphic characteristics that are specific for blood type identification. **Materials and Methods:** Conventional blood typing method using antigen-antibody complex reaction was carried out to categorize the subjects into, blood types A, B, AB and O Finger and palmar dermatoglyphic data was obtained using convectional ink method. Finger pattern intensity, pattern distribution, ridge counts and palmar parameters were measured. These were done by counting and classifying ridge patterns, pattern configuration and ridge densities. **Results:** Dermatoglyphic parameters observed in blood type A showed large pattern sizes while blood group AB had small patterns sizes as measured by the total finger ridge counts. Blood type O and A demonstrated increased digital ridge counts on digits D1 and D4 on the left and right hands while blood type AB significantly showed lower digital ridge count on D1 with associated lower pattern intensity. 2D:4D ratio across the blood types was insignificantly distributed. Blood type B and O showed significant distribution of palmar pattern II and III with associated double radial based crease (DRBC). High degree of symmetrical arrangement observed in the axial tri-radius (T), however, TII Position characterized the B and O blood group. **Conclusion:** This study demonstrated the dermatoglyphics parameters specific for different blood grouping among undergraduate students of the College of Health Sciences, Osun State University, Nigeria.

**Keywords:** Finger traits, Palmar traits, Blood typing, Forensic Anatomy, Genetics traits, Hereditary

## INTRODUCTION

Dermatoglyphic involves scientific examination of the ridges configurations on the fingers, palmar surfaces, toes and soles. [1, 2] Dermatoglyphics has its application in pediatric medicine, genetic research, criminology and anthropology[3]. Dermatoglyphics parameters are unique; it does not change after formation in the womb, until decomposition in the tomb after death. This uniqueness rooted on the facts that no two individual have the same dermatoglyphics characters. [1]

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Viswanathan *et. al*. [4] also related the uniqueness of dermatoglyphics among which include; it is not under the influence or modification by environmental factors, it is non-adaptive in characters, not subjected to high rate of mutation once it is formed and it can be identified without subjective bias. Similarly, biometric refer to parameters for measuring and analyzing a person's physiological or behavioral characteristics. These characteristics are unique to individuals hence can be used in verification and identification purposes, such characters including Face, Fingerprint, Voice, Hand Geometry, Iris, Retina, Voice, DNA, and Gait.[5] Biometrics authentication is used in identification and authentication of individuals. Biometric parameters are the distinctive, measurable characteristics used to label and describe individuals. [6] Biometric parameters are categorized as physiological and behavioral characteristics. Physical anthropological characteristics includes; body morphology; fingerprint, palmar configurations, facial recognition, DNA finger printing, colour of the iris, retina and body scent. Dermatoglyphics features formed during intrauterine period and once formed remain unique for individual and persistent throughout life. These dermatoglyphics traits found its uses in medico-legal issues, mass screening of genetically altered body system, population description and in forensic science, forming essential tool for criminal investigations.

Blood grouping method is a reliable conventional method of identification and biometric measure. There are about nineteen major groups of blood system that have identified, and vary in their frequency of distribution, among them only ABO and rhesus groups are major importance in health and disease condition[7].

ABO system is classified as A, B, AB, and O blood types according to present antigen in plasma. The inheritance mode observed in dermatoglyphics patterns is a polygenic system, similar to the genetics of ABO blood typing mode of inheritance.[7,8] As part of the physiological constituent of the body, some red blood cells have a particular antigen; a protein known as the Rhesus D (RhD) antigen. If this is present on the blood, the blood cell type is RhD positive but if it is absent the blood cell type is RhD negative. Therefore, the different blood cell types that exist include; A RhD positive (A+), A RhD negative (A-), B RhD positive (B+), B RhD negative (B-) , O RhD positive (O+) , O RhD negative (O-), AB RhD positive (AB+), AB RhD negative (AB-). This research work aimed at investigating finger and palmar dermatoglyphics distribution of the undergraduate students, in College of Health Sciences, Osun State University, Osogbo, Nigeria in relation to the blood cell types..

## MATERIALS AND METHODS

### Subjects

A total number of seventy (n=70) undergraduate students of the College of Health Sciences, Osun State University, Osogbo, Nigeria, consist of Anatomy, Physiology, Nursing and Public Health Students of the College of Health Sciences Osun State University were randomly selected and employed in the study.

### Subject Consents

All subjects were informed about the purpose, nature and benefits of the study before written informed consent were obtained. The informed/voluntary consent of the subjects is absolutely essential and was obtained according to Nuremberg code of research ethics using human subject.

### Finger Prints

The ink was applied evenly on the finger and placed on plain capturing sheet to obtain a complete imprint of the finger print surfaces; ink was moderately applied on the finger of both hands using cotton wool, excess ink was removed with a clean and dry cotton wool, impressions of the fingers were collected by rolling the fingertip on the space designed for this on the A4 paper, from one side to the other for complete imprints.

### Quantitative Analysis

Dermatoglyphics characteristics were measured and described quantitatively by counting the number of tri-radii or ridges within a pattern and measuring

distances or angles between specified points for analysis using different parameters include: finger Ridge Counts (right and left,), Total Ridge Counts (TRC) and Absolute Ridge Counts (AFRC) and Pattern Intensity Index (PI), both hands, Palmar pattern, Position of Axial Tri-radius, and Palmar crease.

**Determination of Blood Grouping**

**Collection of Venous Blood (Venipuncture)**

Subjects were allowed to sit comfortably on a chair, the tourniquet was tied around the upper arm about 2 inches above the elbow and the subjects were asked to close and open fist a few seconds so that the vein become engorged. The site with cotton swab was rubbed and allows drying. The ante-cubital vein (Medial basilic vein) in the left hand was located when the elbow was steadied. The skin over the vein was stretched downwards with the thumb. The syringe and needle was inserted under the skin with a firm but smooth thrust, at an angle of 30º to the horizontal place of the arm. The needle was gently pushed along the vein and punctured from the side, a few meters ahead of the skin puncture, when the blood appears in the syringe, the syringe and needle steadied with left hand and plunger was draw gently back with right hand until enough blood (3-4ml) fill the syringe. The tourniquet was released and needle was gentle removed from the vein. A cotton swab was passed in position with the subject's arm flexed till bleeding stops.

**Blood Group**

A white tile was marked A, B and O using a glass marked pencil. Pipette was used in adding one drop of blood on each side of the well tile. Using another pipette one drop of anti-sera A, anti-sera B and anti-sera AB were added to A, B, and O labeled on the tiles, respectively. Blood group A is determined by mixing the anti-sera and blood in each tile and gently rotating the well tile. Each mixture was ensured even spread over to an area of about ¾ inch in diameter over the tile. However, it was ensured that all anti-sera are not mixed together. The reaction on the tile was well observed for any agglutination of red blood cells. Agglutination reaction on side A only, was labeled the blood type A, agglutination reaction on side B only, was labeled blood type B, agglutination reaction on both sides, was labeled blood type AB and no agglutination reaction on either side, was labeled blood type O.

**Statistical Analysis**

All data obtained in this study were subject to both descriptive and inferential statistic using the statistical software Graph pad prism version 5 statistical package for estimation of Mean, Standard error of mean and Percentage. Statistical tools that were used include analysis of variance (ANOVA) for quantitative data.

## RESULTS

**Table 1: Finger Ridge Counts in Blood Typing**

| | Blood Gp O | Blood Gp A | Blood Gp B | Blood Gp AB | P-value |
|---|---|---|---|---|---|
| TFRC | 112±5.3 | *141±7.8 | 100±13 | *88±19 | 0.4635 |
| AFRC | 137±7.9 | *140 ±12 | 128±21 | *91±21 | 0.5329 |

Blood group A as shown in table 1; revealed highest total finger ridge count on all the digits relative to the blood group AB, B and O. Absolute finger ridge counts in the different blood typing shows blood group A with the highest mean value relative to other blood cell type. Blood group AB had lowest mean absolute finger ridge counts in all the different blood typing examined. Digital ridge counts on the right hand showed digit 1 (D1) has significantly highest mean in blood groups O and A, table 2.

**TABLE 2: Right Total Ridge Counts in Blood Typing**

| | BLD GP O | BLD GP B | BLD GP A | BLD GP AB |
|---|---|---|---|---|
| D1 | 13±0.94 | 11.45±1.5 | 13.15±1.6 | *3.00±3.0 |
| D2 | 11±0.88 | 12.05±0.9 | 11.00±1.5 | *7.00±3.5 |
| D3 | 11±0.85 | 11.00±1.0 | 10.54±1.6 | 10.67±1.3 |
| D4 | 12±0.59 | 12.50±0.7 | 11.38±1.3 | 13.00±3.5 |
| D5 | 11±0.71 | 11.55±0.6 | *8.69±1.6 | *12.33±0.3 |
| P-Value | < 0.0001 | < 0.0001 | < 0.0001 | < 0.0001 |

*Abbreviations: BLD GP=Blood group * Significant difference*

Digit 4 (D4) expresses highest significant mean counts in the blood groups B and AB. Therefore, D1 with the higher ridge counts in blood A and O could serve as a significant indicator for matching of the blood typing, while D4 could be specific for blood group B and AB.

Blood group O, A and AB showed highest mean ridge counts on left D4 as shown in table 3, while blood group B had highest mean ridge count on left D1. This indicate that, D4 the ring finger, among the subjects with blood typing O, A and AB, have larger pattern of ridge counts while the smaller pattern size observed across the D2 and D5 respectively in blood typing B and A on the left hand.

**Table 3: Left Total Ridge Counts Blood Typing**

| | BLD GP O | BLD GP B | BLD GP A | BLD GP AB |
|---|---|---|---|---|
| D1 | 11.85±1.0 | 12.05±1.5 | 9.85±1.6 | *4.67±4.6 |
| D2 | 10.88±0.7 | 10.10±1.2 | 8.77±1.5 | 8.33±4.1 |
| D3 | 11.26±0.8 | 11.40±1.0 | 8.69±1.5 | *8.00±4.3 |
| D4 | 12.79±0.7 | 11.75±1.1 | *10.77±1.7 | 13.00±1.5 |
| D5 | 10.06±0.8 | *9.8±0.86 | 8.92±1.5 | *8.00±4.0 |
| P-Value | < 0.0002 | < 0.0001 | < 0.0001 | < 0.0048 |

*Abbreviations: BLD GP=Blood group * Significant difference*

Blood group O showed significant higher pattern intensity relative to other blood cell typing as reveled in the table 4, blood group AB showed insignificant pattern intensity and by implication blood group O had higher distribution of tri-radius across the digits. Insignificant differences in 2D:4D ratio across the blood cell typing was recorded, however, blood group A relatively showed highest mean 2D:4D, this could be a good indicator for the blood group A.

**Table 4: Pattern Intensity and 2D:4D in Blood Group Typing**

| | Pattern Intensity Mean±SEM | 2D:4D Right Mean±SEM | 2D:4D Left Mean±SEM |
|---|---|---|---|
| BLD A | 10.31±1.25 | 0.94±0.009 | 0.94±0.010 |
| BLD B | 10.90±0.62 | 0.90±0.009 | 0.90±0.006 |
| BLD AB | *8.33±2.02 | 0.91±0.003 | 0.91±0.013 |
| BLD O | *11.15±0.4 | 0.91±0.007 | 0.93±0.006 |
| P-VALUE | 0.4797 | 0.1137 | 0.0147 |

** Significant difference*

## Palmar parameters

**Table 5: Distribution of the blood group Typing and palmar pattern**

| | Right | | | | | Left | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | CL | I | II | III | IV | CL |
| A | | 4.7 | 12.5 | | 1.6 | | 1.9 | 12.96 | | |
| B | 1.6 | 6.25 | 23.4 | | 6.25 | 1.9 | 5.6 | 25.9 | | 3.7 |
| AB | | | 3.1 | | | | | 3.7 | | |
| O | | 10.9 | 26.6 | 1.6 | 1.6 | | 12.96 | 27.8 | | 5.6 |

*Abbreviations: BLD GP=Blood group*

Blood group A, had lower prevalence of pattern II and III on the right palm and higher pattern II and III on the left palm. There is also present of central loop among blood group A on right palm, but absent on left palm table 5. Lower prevalence of pattern I, II, III, with associated higher prevalence of central loop were observed in blood group B particularly on right palm. Higher prevalence of pattern I, II, III on the left palm and lower prevalence of central loop observed in blood group B. In blood group AB there is lower prevalence of pattern III on the right palm and higher prevalence of left palm. There is lower prevalence of pattern II, III and central loop on the right palm and higher on the left palm among the blood group O. There is absent of pattern IV among the blood group O on the left palm and absent on the left palm.

Table 6: Distribution of the Blood Group Typing and Palmar Creases

| | Right | | | Left | | |
|---|---|---|---|---|---|---|
| | SRBC | DRBC | TRBC | SRBC | DRBC | TRBC |
| A | | 14 | 10 | | 10 | 4 |
| B | | 20 | 14 | | 22 | 12 |
| AB | | 4 | | | | 4 |
| O | | 26 | 12 | | 30 | 18 |

There is higher prevalence double radial base crease in blood typing A and O, however, blood typing B and AB expressed lower prevalence. Triple radial based crease showed higher prevalence in blood typing A. There is higher prevalence of triple radial base crease among male in blood group O on table 6.

**Table 7: Distribution of the blood group Typing and position of Axial Tri-radius**

| | Right | | | Left | | |
|---|---|---|---|---|---|---|
| | T | TI | TII | T | TI | TII |
| A | 13.5 | 3.8 | 1.9 | 13.5 | 3.8 | 1.9 |
| B | 26.9 | 9.6 | | 26.9 | 9.6 | |
| AB | 3.8 | | 1.9 | 3.8 | | 1.9 |
| O | 30.8 | 7.7 | 1.9 | 30.8 | 7.7 | 1.9 |

Higher prevalence of triple radial base crease in blood group O, while Axial tri-radius highly expressed in blood typing B and O. In blood group O, there is higher prevalence of t on left palm as shown in table 7.

## DISCUSSION

Dermatoglyphics has found its uses in medico-legal cases such as dispute of paternity and in the personal identification of the individuals, particularly in criminal investigations. [9] This study investigated the use of dermatoglyphics traits in blood typing such as the conventional approach widely used in the

classification of blood cell typing. ABO typing is carried out by testing red blood cell (RBC) or the A and B antigens and the serum for the A and B antibodies. Red blood cells or erythrocytes are differentiated from each other on the basis of their surface antigen structures. It was Karl Landsteiner who first discovered [10] the ABO blood group (BG) system in 1900 and rhesus (Rh) later. [10]

Blood group A and O had higher ridge count on D1 (first digit), the thumb could be a significant mean of identification of the blood type A and O, particularly on the right hand and while on the left hand ridge count is significantly highest D4. Blood group B could be identified using D2 on the right with the significantly higher ridge counts and D1 on the right hands repetitively. 2D:4D showed in this study non significant trait across the blood group. Total finger ridge count showed that blood group A could be identified, with the highest mean value in blood group A. This is in total agreement with the report of Kshirsagar et al. [11] total finger ridge count (TFRC) was higher in blood group A.

Kshirsagar et al., [11] also reported high frequency of loops, moderate of whorls and low of arches in individuals with ABO, Rh blood groups. Frequency of whorls was higher in O blood group and low in AB blood group. Whereas percentage of arches was highest in AB blood group and lowest in B blood group. Bharadwaja and colleagues [12] found high frequency (51.8%) of loops, followed by whorls (35.8%) and arches (12.3%).

Mattison *et. al.* [17] noted that deviations in palmar crease patterns could be indicative of insults during fetal development, this is because once its formation is completed by the first trimester during the development, its remain unchanged, palmar pattern (I, II, III, IV and CL) showed, blood group O with highest prevalence II, III, IV and CL respectively on both right and left palm. In blood typing patterns in palmar crease (DRBC and TRBC), blood group O have higher prevalence double radial based crease (DRBC) respectively on both right and left palm respectively. Tay, [13], reported polygenic mode of inheritance of the palmar crease with very high heritability and further demonstrated the importance of the genetic contribution of palmar crease in identification and genetic origin. The mode of inheritance of ABO blood typing similarly followed the same pattern as observed in this study along with the findings of Plato et. al.[14] Gupta et. al. [15] Kimura, [16] Mattison *et. al*. [17], and Wahl *et.al*. [18], all noted; classified palmar creases reliable genetics tools in determining the genetic origin and personal identification. The similar trend of observation was noted in position of axial tri-radius (t, t' and t''), blood group O have higher prevalence of t (30.8%) tri-radius

Saranya *et. al*. [20], showed that 38% of the subjects have O blood group followed by A, B, and AB, while 96.77% of subjects demonstrated Rh-positive and 3.23% showed Rh-negative, they noted that whorl predominant in A+, arch in A−, arch in B+, while all the three patterns; arch, loop, and whorl were equally distributed in B−, loop was in AB+, loop was maximum in O. This is in line with Singh et al., [21] and Mahajan, [22],and with Kshirsagar *et al. [23]* They all showed highest percentage of loops in AB blood group in correlation to findings in this study

## CONCLUSION

This study has revealed association in the pattern of palmar and finger print and ABO blood typing. Dermatoglyphics characteristics specific for each of the conventional blood typing has been linked and are relevant in blood type determination and confirmation as well as genetics counseling.

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Not applicable.

**Author contributions**

DJB drafted the work and revising it critically for important intellectual content. OOO, GKA conceived, and designed of the work and was also responsible for acquisition of data. SAA also performed in the acquisition of data, and final approval of the version to be published. JOF, DAP analyzed and interpreted the data for the work. OBA analysed and ensured that questions related to the accuracy or integrity of any part of the work were

appropriately investigated and resolved.

**Data availability**: The data used to support the findings of this study are available from the site publicly.

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**Conflict of interest:** None declared.

**Ethical approval:** The study was approved by the Institutional Ethics Committee.

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