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Correlation between Fingerprint Patterns and Sex, Genotype, Intelligence Quotient, and Handedeness among Nigerian Senior Secondary School Students

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Abstract:

Introduction and Background: Fingerprints – a naturally occurring feature in humans that appear as carvings, are so unique to each person that 'no two people have the same fingerprints'. They have been studied as far back as centuries ago and even till date and are basically classified into: arch, loop and whorl. Methods: In this work, the relationship between sex, blood groups, handedness and intelligence quotient (IQ) of 296 senior students of a secondary school in Ibadan, Oyo State, Nigeria, vis-à-vis their fingerprint patterns was studied using the ink method: The fingerprints were impressed on the questionnaires provided, required information bordering on the aforementioned parameters was provided and IQ test attempted. All the parameters were then analyzed in relation to the fingerprints. The percentages determined were fed into Microsoft Excel 2010 for statistical analyses and further presented as bar charts. The IQ scores were categorized based on the Wechsler scale. Results: Subjects with average intelligence had the highest number of all the fingerprint types. Males had fewer arches, more loops and fewer whorls than females. Genotype AA and blood group A were the most dominant in the blood grouping and they exhibited the highest number of arches, loops and whorls. Similarly, highest number of all the fingerprint types was observed in right-handed subjects. The ranking order of fingerprints in the overall population sample was: loops > whorls > arches. Conclusions: This research has been conducted as an instigator for fingerprints to be innovated and further applied, especially in Nigeria.

Keywords:

Fingerprint, Whorl, Loop, Arch, Genotype, Blood Group, Handedness, Intelligence Quotient (IQ)

1. Introduction

Often times, the word 'dermatoglyphics' is believed to simply imply the 'scientific study of fingerprints'; when in fact, it entails much more than that. It is described, on a more extensive note, as the 'formation of naturally occurring raised skin ridges present on the hairless surfaces of certain body parts; namely palms, fingers, soles and toes'. Dermatoglyphics has its root from the ancient Greek words; derma meaning skin, glyphe meaning carving. However, reference to this term here will be restricted to the aspect of fingerprints only [27,33]. Fingerprints have been 'assumed' by scientists, to enable traction while picking up and handling objects; until recently, when the validity of this assumption was questioned [2].

Fingerprints constitute a part of fetal development; in which chance, environment, and heredity play key roles. Patterns made by the prints are usually durable and can be inherited, despite their peculiarity. There are even various classifications of fingerprints that have evolved over time, pending their discovery and applications.

Fingerprints have long ago been described as the oldest and most accurate method of identifying people [34]. The discovery of its importance can be dated as far back as centuries ago; till date, even more discoveries are still being made. It all started out when people began to realize that fingerprints had a kind of uniqueness that was peculiar to each individual. This little discovery is the one that opened the door to many breakthroughs in many areas of science and life.

Many scientists have continued further research on dermatoglyphics in relation to several elements like inheritance, racial variation, twinning, multiple intelligence; and medical disorders like breast cancer, schizophrenia, leukemia and chromosomal defects such as Down's syndrome [19].

Several attempts had been made by criminals to intentionally mutilate fingerprints by cutting the prints with knife and plastic surgery [12,29], carving out fingertips and burning them with sulphuric acid [25,36]. Some even went to the extent of surgically grafting skin from another part of the body over fingertips [32,35]. In each case, the small part left untouched gave them out. Indicating that, indeed fingerprints are very permanent. Interestingly, with the advent of facial recognition software, the criminals are easily identifiable [30].

There is usually a decrease in skin elasticity as one advance in age. The same goes for the fingerprints. "The ridges get thicker; the height between the top of the ridge and the bottom of the furrow gets narrow, so there is less prominence", making it quite difficult to properly capture their prints [12).

Dermatoglyphic studies among various ethnic groups in Nigerians have shown a consistent descending order of loops, whorls and arches [1,8,9,13,16,23]. Some of the offshore studies performed also followed the same order of patterns [4,10,17) .

Various workers had established some relationship between fingerprints and sex [22], and blood group [5,9], but there seems not to be any documented work on correlation between fingerprints and handedness, and IQ.

The main purpose of this project is to discover whether or not fingerprints have a substantial correlation with the IQ and other parameters like sex, genotype, blood group as well as handedness.

2. Methodology

2.1. Study Area and Sample Size

This study was performed in a secondary school – St. Brigid's Secondary School. This school is located in an area called Mokola in Ibadan, the capital city of Oyo State, Nigeria. The cross-sectional survey at the school St. Brigid's Secondary School; involved 305 normal students. This includes 158 boys and 147 girls. The age range of the subjects is 13-18 years. Since the fingerprints were obtained bilaterally (from all fingers on both hands), there was a total of 3050 fingerprints. However, on careful examination of the collected samples, 90 fingerprints (obtained from 9 subjects) were considered invalid for the following reasons:

5 of the samples (with 50 fingerprints) had smudged finger impressions.

3 of the samples (with 30 fingerprints) were too faint to be analyzed.

1 of the samples (with 10 fingerprints) contained fingerprints that were not fully impressed, making it quite difficult to name.

So, only 296 students (151 boys and 145 girls) gave valid and analyzable samples, totaling 2960 fingerprints.

2.2. Inclusion and exclusion criteria

The study was conducted only on the senior secondary school students, that is, SSS1-SSS3 students. Also, it was ensured that the participants did not have any form of defect on their hands (fingers), whether due to injury, disease or congenital anomaly.

Those excluded from the study, were mainly those who fall outside the category of the 'senior secondary school students'; for instance, the staff and the junior students of the secondary school (that is, JSS1-JSS3). The volunteer students were all examined, and those with any form of injury (e.g. scarred finger, bandaged finger) or abnormality of the finger (brachydactyly, syndactyly, polydactyly) had to be taken out.

2.3. Technique for Data Collection

Random sampling method was employed for the whole process of fingerprint collection. Also, the survey method is a descriptive one. During the research, focus was majorly on the senior secondary students (SSS1- SSS3) of the school.

2.4. Dermatoglyphic Method of Data Collection

To acquire the 'characteristics' of the students as pertaining to the research, an adequately-structured and equally pretested questionnaire was devised for this purpose; each of which was serially numbered.

The framework of the questionnaire was such that it had two sections: Sections A and B. Section A requested the demographic, biological and other information about these students; including the sex, age, genotype, blood group and handedness of the subject(s). For each hand (right and left hands), a row with 5 named columns for each of the fingers; was provided; with potential spaces for the names of the finger patterns. The inked fingers were to be impressed in the spaces created.

On the other hand, Section B (titled Intelligence Quotient) contained twenty questions, each with 4 options. These were obtained from an online IQ website (at Free-IQTest.net). The aim of these questions is to test for the intelligence quotient of the subjects, which would be calculated from the scores obtained.

2.5. Calculation of IQ Score

The answers from the attempted IQ test were assessed. It is the total score obtained (i.e., the raw score) that was used to calculate the IQ score [The raw scores obtained ranged from 1– 13]. This was done by calculating the mean and standard deviation of all the raw scores.

Mean= ∑xf/ n

Standard Deviation= √{∑f(x– ẍ)²/ n}

Standard Score (*z*) was calculated using ***[x – ẍ]/ Standard deviation***. Then the values obtained were inserted respectively into the formula: ***IQ score = 15z +100***. After this was done, the IQ scores obtained were classified based on the Wechsler scale (28).

2.6. Fingerprint Collection

The commonest method of taking fingerprints − the ink method was employed. The interested students were made to wash their hands with soap and water, and then towel dry. An inkpad and several questionnaires were supplied. The participant(s) inked each finger. Then, they took turns impressing them one-by-one in the tables of the questionnaires provided, with all ten fingers from both hands. They washed their hands with soap and water afterwards, before applying ethanol swabs to remove any ink stain that may be remaining.

2.7. Data Analysis

After the questionnaires were gathered, the information obtained were categorized and manually sorted out. The fingerprint patterns were properly observed with the aid of a magnifying lens and named accordingly based on the classification below:

Arch: Plain arch and tented arch.

Loop: Plain loop, central pocket loop (types: right and left pocket loop) and double loop.

Whorl: Plain whorl and central pocket whorl.

Each student's IQ was calculated from the scores they each got on the test; which were then grouped. All the frequencies for the grouped data were converted to percentages. The percentages related to fingerprint types were fed into the software for statistical analyses − Microsoft Excel 2010 and further organized into charts.

3. Results and Discussion

A total of 2960 fingerprints were analyzed, from 296 human subjects − 151 males and 145 females (multiplied by ten (10) fingers). They all fingerprinted on the columns provided in the questionnaires, and then filled in where necessary.

Table 1. *Distribution of fingerprint patterns among the total population sample.*

	Arch	Loop	Whorl	Total

	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
Right hand	274	9.26%	802	27.09%	405	13.68%	1481	50.03
Left hand	277	9.36%	811	27.40%	391	13.21%	1479	49.97

From the Tables above, it can be observed that loops (54.49%) have the highest frequency; followed by whorls (26.89%) and then arches (18.62%). Arches and loops are more on the left hand, while whorls are more on the right hand.

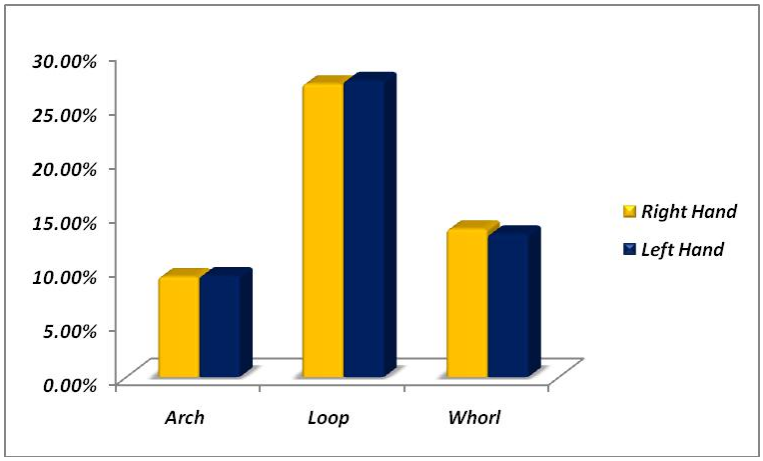

Figure 1. *Fingerprint patterns of right and left hands in total population sample.*

In males, loops are the highest-occurring (57.42%) while arches are the least occurring (17.75%). Arches are highest on the thumb and index finger (3.91%) and least on the little finger (2.58%). Loops are highest on the little finger (13.31%) and least on the index finger (10.53%). Whorls are highest on the ring finger (5.96%) and least on the little finger (3.91%). Females have the highest number of loops on their little finger (12.83%) and the least on the index finger (8.69%). Whorls are highest on their index finger (6.41%) and least on their little finger (4.90%). Arches are the highest on the index finger (4.41%) and lowest on the ring finger (3.45%).

Table 2. *Percentage of fingerprint patterns in male and female subjects in the total population sample.*

Sex	Arch	Loop	Whorl
Males	9.05%	29.29%	12.67%
Females	9.56%	25.20%	14.22%

Compared to females, males have fewer arches, more loops; and fewer whorls.

Table 3. *Percentage frequency of fingerprint patterns in total population sample based on genotype.*

Genotype	Arch	Loop	Whorl
AA	13.04%	41.22%	18.21%
AC	0.14%	3.18%	0.27%
AS	5.07%	8.11%	7.87%
CC	0.10%	0.44%	0.27%
CS	0	0	0
SS	0.27%	1.55%	0.27%
Total	18.62%	54.50%	26.89%

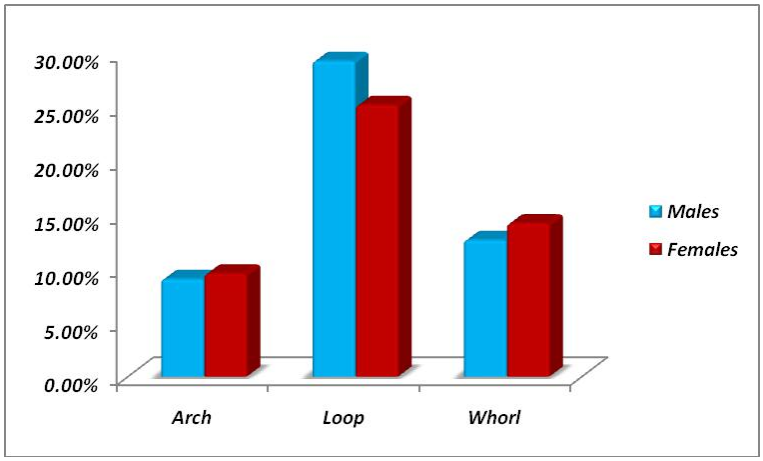

Figure 2. *Percentage of fingerprint patterns of males and females in total population sample.*

From the table above, no subject was obtained with the genotype CS. All the other genotypes have the highest fingerprint type as loop. Subjects with AA have the highest number of loops. Next are the subjects with AS, AC, SS and then CC. AA has the highest number of arches (13.04%); followed by AS (5.07%), SS (0.27%), AC (0.14%) and CC (0.10%). AA likewise has the most whorls (18.21%); followed by AS (7.87%). AC, CC and SS have the same number of whorls (0.27%). AC has higher number of arches (0.14%) and loops (3.18%) than CC (0.10%; 0.44%). SS have higher number of arches (0.27%) than both AC (0.14%) and CC (0.10%). SS (1.55%) has more loops than CC (0.44%), but less loops than AC (3.18%). The genotypes all have their fingerprint patterns in descending order of loops, whorls and arches; except in subjects with SS, where there are equal number of arches and whorls.

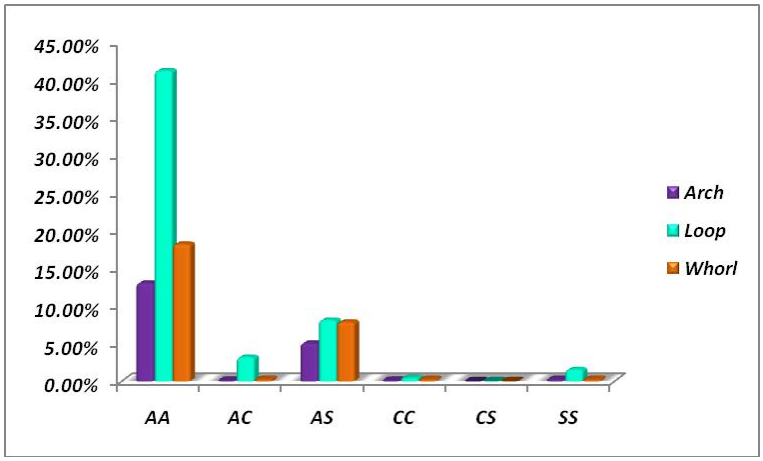

Figure 3. *Percentage frequency of fingerprint patterns in total population sample based on genotype.*

Table 4. *Percentage frequency of fingerprint patterns in total population sample based on blood group.*

Blood group	Arch	Loop	Whorl
A	6.59%	21.55%	9.76%
B	3.78%	9.12%	6.11%
AB	3.78%	9.63%	4.46%
O	4.46%	14.19%	6.55%
TOTAL	18.61%	54.49%	26.88%

Blood group A has the highest number of arches (6.59%), loops (21.55%) and whorls (9.76%); followed by blood group O (4.46%, 14.19% and 6.55% respectively).

Blood groups B and AB have the same number of arches (3.78%). But, there are more whorls in B (6.11%) than AB (4.46%) and more loops in AB (9.63%) than B (9.12%). Loops remain the most in all the blood groups.

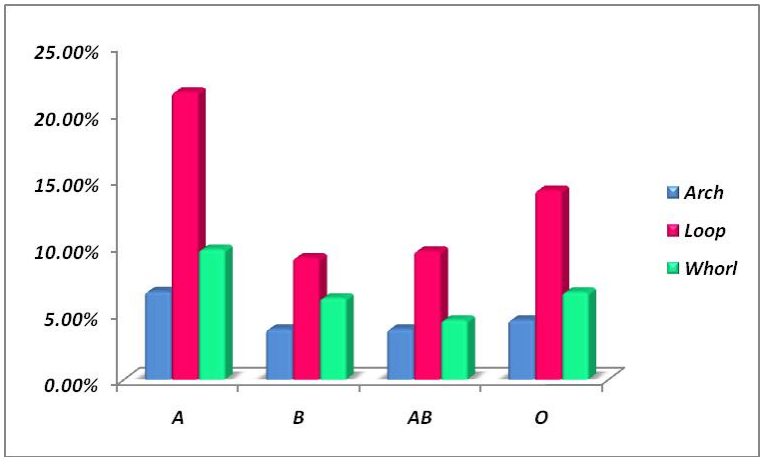

Figure 4. *Various fingerprint patterns of blood groups in total population sample.*

Table 5. *Percentage of Fingerprint Patterns in Relation to Handedness in Total Population Sample.*

Handedness	Arch	Loop	Whorl
Right-Handed	11.89%	33.95%	13.95%
Left-Handed	2.43%	9.97%	3.75%
Ambidextrous	4.29%	10.57%	9.19%
TOTAL	18.61%	54.49%	26.89%

Loops are the highest in all the right-handed subjects (33.95%); next are the ambidextrous subjects (10.57%) and then the left-handed subjects (9.97%) with the least number of loops. This same pattern applies in the other fingerprint types − whorls and arches.

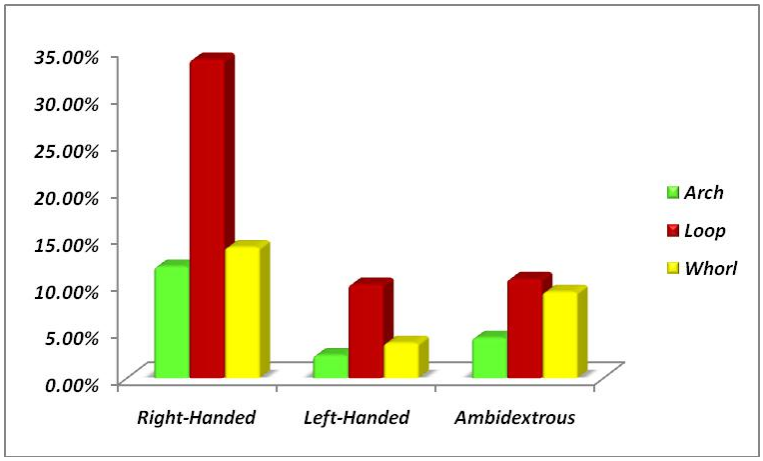

Figure 5. *Percentage of fingerprint patterns in relation to handedness in total population sample.*

Subjects with average intelligence have the highest number of arches, loops and whorls; followed by those with high average intelligence. Subjects with borderline intelligence have more arches and loops and fewer whorls than those with low average intelligence. Subjects with superior intelligence have the least of arches, loops and whorls.

Table 6. *Percentages of fingerprint patterns in subjects with various intelligence categories.*

Intelligence category	Arch	Loop	Whorl
Borderline Intelligence	2.87%	7.23%	3.18%
Low Average Intelligence	2.60%	6.99%	3.65%
Average Intelligence	6.49%	22.60%	10.44%
High Average Intelligence	4.90%	12.64%	6.86%
Superior Intelligence	1.76%	5.03%	2.77%

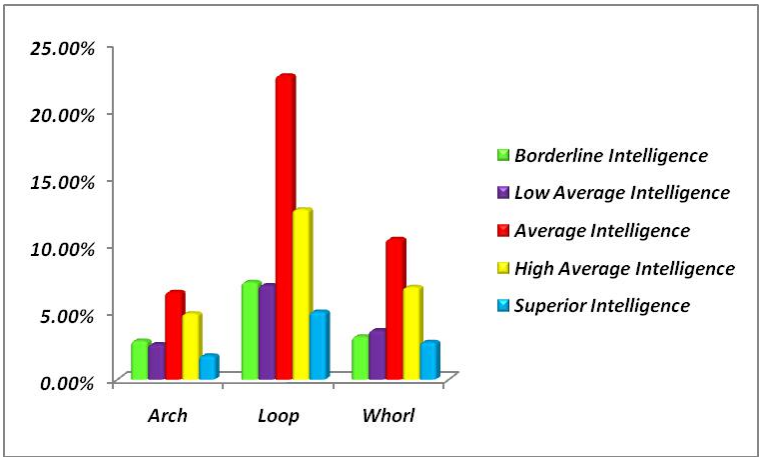

Figure 6. *Percentage of fingerprint patterns obtained from subjects with various intelligence categories in total population sample.*

It has been established over the decades that fingerprints are more than just 'mere impressions' made by the 'fingers'. In fact, their studies over time have shown that they delve deep into a realm that unleashes vast benefits found to be relevant in fields concerned with crime, forensic science, medicine, and so on; and even quite a number of other yet-to-be-discovered applications. These fingerprints actually have more to say than they let on; a relatively meager number have noticed enough to want to tap into any more available uses; in form of innovations. This is actually a key factor as to why this research work has been executed [26,33].

Hence, the results obtained here will be further 'discussed' in comparison with results from other various dermatoglyphic researches, based on the aforementioned parameters considered; under the following headings:

Judging based on the overall survey made, it has been observed that loops have the highest frequency this is as presented in Table 1 and graphically presented in Figure 1 .loops with a frequency of 54.49% ; followed by whorls (26.89%) and then arches (18.62%).. . Most preceding dermatoglyphic studies are similar to this [9,10,23]. Also, there were contrasting results where fingerprint patterns were in this manner: Whorls > Loops > Arches [3,6,7,11,14,15,21].

Table 2 Figure 2 of the results indicates that Compared to females, males have fewer arches, more loops; and fewer whorls this is similar to previous research of Ekanem et al. (9) and Ujaddughe et al. [24] this also is quite similar to Reddy's work on finger dermatoglyphics of the Bagathas of Araku Valley, India. However, the results of this research is hereby different from the reports of Taye et al. [22] and Mohammed (16) where they reported that the males had more whorls, fewer loops and arches than the females.

As seen in Table 3, Figure3 and Table 4, Figure 4 respectively; AA is the most frequent genotype found in the population sample. AA has the highest number of

arches, loops and whorls; followed by AS.AC has more loops than the rest. AC, CC and SS have the same number of whorls. AC has higher number of arches and loops than CC. SS have higher number of arches than both AC and CC. SS has more loops than CC, but less loops than AC. There is no distinct correlation between a person's fingerprints and the genotype. Blood group A had the highest number of subjects, followed by O, B and then AB. Blood group A had the highest number of loops this results is in contrast to the reports of Bharadwaja et al. [5]. where loops were of high value in O group; although a similar results was obtained for genotype AB, where we have the least loops. [18,20].

The right-handed subjects have the highest number of arches, loops and whorls; followed by the ambidextrous subjects and then the left-handed subjects this is noted in Table 5, Figure 5 there were no earlier report on the relationship between fingerprint patterns and handedness.

In Table 6, Figure 6, we reported that; the highest number of arches, loops and whorls were observed in subjects with average intelligence; followed by those with high average intelligence. Those with borderline intelligence had more arches and loops and fewer whorls than those with low average intelligence. Subjects with superior intelligence have the least of arches, loops and whorls. So, subjects with average and superior intelligences had the most and least numbers of all fingerprint patterns, respectively no earlier reports related to this were found.

4. Recommendations

The rate at which researches are recently ongoing in the direction of dermatoglyphics is quite impressive. However, all hands still should remain on deck in this aspect. Derrmatoglyphic research should still be supported in any way possible. Chances are much higher that if this is so, a ground-breaking discovery or even discoveries will be made; that will positively shapen the course of history.

In the light of this research, the following recommendations are made:

Researchers should employ the use of fingerprint sensor devices in future researches. These devices are more advantageous than the 'ink method'. Apart from the fact that these devices do not stain the fingers, the use is less time-consuming and less tedious, making it easier to analyze and classify fingerprint patterns.

When carrying out dermatoglyphic researches in relation to medical information like blood groups, genotypes, etc.; if possible, they should be confirmed by carrying out the necessary tests, of course with the individual's consent or they should be obtained from reliable sources. Although it may be quite laborious, this will make patterns drawn in relation to the information obtained, more accurate.

Errors are sometimes inevitable, but they can be reduced in conditions where the medical information obtained is sure. Obtaining such information from the subject alone may not be all that correct, since the person may just be guessing and this tends to reduce the viability of research performed.

In subsequent dermatoglyphic researches conducted in relation to a criterion like intelligence quotient (IQ), it is noteworthy that IQ does not necessarily 'determine' one's success in life; it is just one of the components of the 'qualities' that make up a person's life and contribute to his/her success. So, it would be much better if asides IQ, a multi-quotient test is performed; this may comprise other related factors like emotional quotient (EQ), spiritual intelligence (SQ), physical intelligence (PQ),

communication quotient (Com. Q), creativity quotient (CQ), adversity quotient (AQ), moral quotient (MQ), etc. That is, a test that can analyze most if not all of an individual's life is what is advisable. This will provide a more detailed analysis of the correlation (if any) between these factors and fingerprints.

5. Conclusions

From this study, it can be deduced that there indeed is a correlation between fingerprints and the considered parameters. It has been established in this study in corroboration with previous ones that loops are the most common fingerprint pattern in this part of Africa. Loops resultantly cut across all the factors; and are the link between fingerprints and sex, genotype, blood group, handedness and intelligence quotient.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Ethical Approval and Consent to Participate

Ethical procedures were put into consideration names; age and sex of the subjects were not included in the Table1. An official letter was obtained from the Faculty of Basic Medical and Health Sciences, Department of Anatomy of Bowen University; giving a go-ahead with the research work.

Author Contributions

Ojo, Gideon B; conceived the idea for the research, designed the methodology and supervised the data collection and analysis. He proof read the manuscripts and made necessary corrections.

Adedokun, Precious O; Designed the questionnaire, collected the data needed from the subjects and analysed the data.

Adedokun, Musiliu O; put the write up together and also helped in the collection and analysis of the data.

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