Original Article

Fingerprint Pattern and Blood Groups in Twins

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Abstract

Background and Aim: Inherent genetic diversity and other random processes that affect growing embryo are the main factors responsible for the distinguishing nature of physical characteristics of a person. The focus of this study is to quantitatively determine the similarity of fingerprint pattern and blood groups in identical twins as well as in nonidentical twins. **Methods:** A total of 24 pairs of identical twins and 33 pairs of nonidentical twins were selected for the study. The fingerprints of the thumb, index, middle, ring, and little fingers of both hands of 57 pairs of twins were scanned. Due to differences in paper quality and degradation of the print over time, several of these fingerprints are of poor quality, and we selected only 51 pairs. The blood groups of the study population were identified using ABO System of Blood Grouping. **Results:** The results showed that "Arch" type was the most common type of fingerprint pattern present in both identical (42.04%) and nonidentical twins (53.10%). The Loop type was 26.59% and 22.24% in identical and nonidentical twins, respectively. **Conclusion:** All the identical twins shared the same blood group as their respective cotwin except one pair where they had a different type of B+ and O+. The similarity in fingerprint pattern among identical twins were very high than nonidentical twins, and it was statistically significant. Rh+ blood type was the common blood group in twins than Rh−.

Keywords: Dermatoglyphics, genetics, twins

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Introduction

The scientific study of fingerprints (Dermatoglyphics) can be traced back to the early 19th Century when one of the biologists of those time Sir Francis Galton, a cousin of Charles Darwin, published his classic work on fingerprints. The word dermatoglyphics is Greek origin. It is derived from two words "Derma" which means skin and "Glyphe" means to carve. In the study of the fingerprint pattern, scientist utilizes the ridge formations that are present on the palms of the hands and soles of the feet. Dr. Harold Cummins, an American scientist, regarded as the father of American fingerprint analysis termed dermatoglyphics.[1]

The physical characteristics of a person are due to both the inherent individual genetic diversity within the human population which is the sole factor as well as the random processes affecting the development of the embryo.[2] Since two individuals can be arbitrarily close concerning their genetic constitution, a fatalistic interpretation of their identity based on biometrics may need to rely solely on an assessment of differentiation in the traits due to the random process affecting human development. Such an assessment strategy would necessarily rely on biometric samples from individuals who are identical/similar in their genetic constitution.[3]

The degree of variation in a physical trait due to random development process differs from trait to trait. It is challenging to distinguish identical twins based on DNA. Commonly, most of the physical characteristics such as body type, face, and voice are very similar for identical twins and routine identification based on facial and other physical features will fail to differentiate them. It is, however, claimed that identical twins could be recognized based on their fingerprints, retina, thermogram, or iris patterns.[4]

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Karl Landsteiner, from the University of Vienna in 1901, discovered the ABO Blood group system for which he was awarded Nobel Prize In 1930. The gene responsible for the blood group is located chromosome 9 (called as "ABO glycosyltransferase"). So far, 19 major blood groups have been recognized which vary in their frequency of distribution among various races of the human population. The "ABO" and "Rhesus" groups are the widely and commonly used blood group systems for clinical purposes. The "ABO" system is subclassified as A, B, AB, and O blood group types based on the corresponding antigen on the red-cell surface. In Rhesus "D" system, the presence or absence of the corresponding "D" antigen determines the "Rh +ve" and "Rh −ve" factors.[5] This study aims to quantitatively evaluate the similarity of fingerprint pattern and blood groups in identical twins as well as in nonidentical twins. The data obtained in this study was a part of a pilot survey project done among twins of Kodinhi village, Malappuram, Kerala.

Materials and Methods

A cross-sectional study was conducted among the twins of Kodhini village of Kerala in December 2014. After obtaining Ethical approval from the Ethical Committee of Yenepoya University, the study was conducted with the cooperation of the Twins and Kins Association of Kodinhi. The study was a part of an oral health survey and screening programs exclusively conducted for twins. Participants who gave consent for participating in the study were included with an age group ranging from 10 months to 27 years. Participants who did give consent or who were systemically ill during the initial screening procedures were excluded from the study. For children whose age is <7 years, parents were invited to participate in the survey as expert informants to help researchers create information. A total of 57 pairs of twins including one triplet were selected for the study.

A data tool was designed, and a single examiner was trained to collect the relevant data from the study population. The data comprised of sociodemographic details and recording of full handprint with the help of ink pad from the study population. A total of 24 pairs of identical twins and 33 pairs of nonidentical twins were selected for the study. The fingerprints of the thumb, index, middle, ring, and little fingers of both hands of 57 pairs of twins were scanned. Due to some paper, quality difference and degradation of the print over time, several of these fingerprints are of poor quality, and we selected only 51 pairs (22 identical twins and 29 nonidentical twins) of fingerprint including one triplet which was nonidentical. The blood groups identified using antiserum A, B, and D and were recorded in the datasheet. Two examiners who were expert in the fingerprint analysis determined the pattern, and the interexaminer reliability was measured (Weighted Kappa, $\kappa = 0.873$).

Statistical analysis of data

All the obtained data were tabulated accordingly and subjected to statistical analysis. SPSS and STATA software packages were used for performing different statistical tests. The inter-examiner and intraexaminer reliability were measured using interclass correlation coefficient. Descriptive statistical methods including Mann–Whitney test were used for comparing the different patterns of fingerprint and blood groups.

Classification of fingerprint pattern

We have classified the finger patterns into arch type, whorl type, loop type, and complex type [Figure 1] accordingly which was adopted from Henry's System of fingerprint classification.[6]

Results

Our sample included a 22 pair of identical and 29 pairs of nonidentical twins. The age group of the participants ranged from 10 months to 27 years. The fingerprint pattern of all respective fingers (both right and left) was assessed, and the following data were obtained. The results showed that "Arch" type was the most common type of fingerprint pattern present in both identical (42.04%) and nonidentical twins (53.10%). The Loop type was 26.59% and 22.24% in identical and nonidentical twins, respectively. Whereas the "Whorl" type of fingerprint pattern was seen in 18.18% of identical twins and 14.31% of nonidentical twins. The "Composite" type of pattern was seen 13.18% in identical and 10.34% in nonidentical twins [Table 1].

Figure 1: Fingerprint patterns used in the study. (a) Arch, (b) Whorl, (c) Loop, (d) Complex type

Table 1: Frequency of finger pattern types in identical and nonidentical twins

	Type of fingerprint pattern	*n* (%)
Identical twins	Arch	185 (42.04)
	Loop	117 (26.59)
	Whorl	80 (18.18)
	Composite	58 (13.18)
Nonidentical twins	Arch	308 (53.10)
	Loop	129 (22.24)
	Whorl	83 (14.31)
	Composite	60 (10.34)

We also assessed the similarity of fingerprint pattern between identical twins. For this, we used the pattern present in the right index finger and right thumb of cotwins of the identical and nonidentical twins. The results showed that a high correlation in fingerprint patterns in identical twins (r = 0.765 for the right index finger pattern and 0.714 for right thumb finger). In nonidentical twins, the correlation was less (r = 0.281) for the right index finger and r = 0.318 for right thumb finger).

Interestingly, we noticed that most of the participants of this twins study showed a Rh+ blood group type. A total of 48 pairs both identical (21 pairs) and nonidentical (27 pairs). The results are shown in Tables 2 and 3.

Our results showed that all the identical twins shared the same blood group as their respective cotwin except one pair which showed a different type, B+, and O+ respectively, whereas in nonidentical twins only 24 pairs had same blood group. A+ type was seen in 19.04% of identical twins and 18.51% of nonidentical twins. "A−" kind was observed only in nonidentical type. B+ type was seen in 16.66% of identical and 18.51% nonidentical twins. B− type was not seen any of twins. AB+ type was seen in 23.8% of individuals, whereas AB− was 4.76% in identical twins. In nonidentical twins, AB+ type was seen in 25.93%, and there was no AB− type in these pairs. O+ type was the highest blood group noted in both identical twins and nonidentical twins [Table 1]. There was no O− type blood group seen in any of individuals in the study population.

Table 2: Distribution according to type of blood groups in twins

	Type of blood group	*n* (%)
Identical twins	A	8 (19.04)
	B	7 (16.66)
	AB	12 (28.57)
	0	15 (35.71)
Nonidentical twins	A	14 (25.92)
	B	10 (18.51)
	AB	14 (25.92)
	0	16 (29.62)

Table 3: Comparison of Rh factors and blood groups in twins

	Blood group	Rh positive, *n* (%)	Rh negative, *n* (%)
Identical twins	A	8 (19.04)	0
	B	7 (16.66)	0
	AB	10 (23.80)	2 (4.76)
	O	15 (35.71)	0
	Total	40 (95.23)	2 (4.76)
Nonidentical twins	A	10 (18.51)	4 (7.42)
	B	10 (18.51)	0
	AB	14 (25.93)	0
	O	16 (29.62)	0
	Total	50 (92.57)	4 (7.42)

When the Rh factor was taken into account, 93.75% study population showed a Rh+ blood group whereas Rh− was only seen in 6.25% [Table 3]. When the Rh factor was compared between parents (both mother and father) and twins, it was seen that twins had the same Rh+ element as in parents except one twin pair, in which the mother showed Rh− type and father showed Rh+. In the remaining study population of Rh − twins category, both father and mother were found to be Rh−.

Discussion

Fingerprint pattern studies have suggested that there is a high-class similarity in the fingerprints of identical twins. The fingerprint patterns are developed in the 16th week of intrauterine life, and maximum development is attained at 18th to 25th week of intrauterine life. The design, distribution, arrangement, and characteristics of the ridge pattern in a fingerprint are entirely individualistic; it remains unaltered throughout the life from birth to death. One out of every 80 births results in twins, and one-third of all the twins are monozygotic (identical) twins. There have been cases reported where an identical twin was sentenced for a crime that was committed by his/her sibling. This is often termed as "twin fraud" that can mistake the identities of the twins.[4]

The findings of this particular study suggest that there is a high correlation in fingerprint pattern among cotwins of respective identical twins. The fingerprint pattern was recorded by full handprint with the help of ink pad from the study population. This method is simple, and it is the only convenient method available during the study. Our study was an attempt to figure out the similarity and dissimilarity in the fingerprint pattern among the twins of the study population. Monozygotic twins are a consequence of the division of a single fertilized egg into two embryos. The similarity in fingerprint among identical twins can be explained on the basis that identical twins have precisely identical DNA except for the undetectable micromutations that begin as soon as the cell starts dividing. The considerable generic similarity in fingerprints of identical 36 twins is due to that fact they develop from the same DNA.[3,7]

The blood group analysis of this particular study shows that Rh+ was the common type of blood. It is quite evident that blood groups are inherited from our parents in the same way as other genetic traits. Studies have shown that the blood group A+ to be a potential risk factor for the development of oral cancers, esophageal tumors, and salivary gland cancers.[7] Studies claim the possibility of a relationship between ABO blood groups and malignancy.[8] Unfortunately, our study did not find any sample with oral malignancy, and there is a need for a more comprehensive and detailed research among twins to suggest a possible relationship between oral malignancies and blood groups.

When Rh factor is taken into consideration, our study showed that 93.75% of the study population had Rh+ blood type whereas only 6.25% showed Rh− blood type. Although our study showed a significant difference between Rh+ and

Rh−, it is not possible to suggest that Rh+ as common blood group among twins than Rh− as there is a need for detailed study of this aspect to provide a reliable support for this hypothesis.

Conclusion

The similarity in fingerprint pattern among identical twins was very high than nonidentical twins. With the new digital and scanning technology, the design of fingerprints can be scanned at the rate of 1000–1500 dots per inch. This technique provides an image that reveals minute pore patterns on the fingerprint. Our study was a kind of unique one as there were only few studies done in India assessing the fingerprint pattern and blood group analysis in twins involving maximum participants. There is a need for broader research to generate the actual details in term of patterns of fingerprints. Although our results showed that Rh + blood group is the common type of blood group, a thorough and extensive investigation is required for proving the relationship of this factor with the zygosity.

Limitations of the study

Some limitations of our study should be considered, as we did not use a highly specific method for fingerprint analysis. The technique used was simple and we did not use minute details of fingerprint pattern such as local ridge and furrow details. Although similarity exists between the primary fingerprint pattern (arch, loop, whorl, and composite), there can be a difference in ridge and furrow details within the same type between the individuals.[5] An automatic fingerprint identification system should be used to get finer details of finger patterns of individuals.

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Conflicts of interest

There are no conflicts of interest.

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