Comparison of Fingerprints Between Genders

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Abstract: Fingerprints are some of the most common sources of physical evidence in forensic science. This study examined the differences and similarities between fingerprints of different sexes to determine if it is possible to infer the sex of a person based on their fingerprint. Participants in this study included students, males and females between the ages of 18-24. Participants were sent out a form which consisted of instructions on how to take their own fingerprints and questions such as their age and sex. These fingerprints were then analyzed for the pattern, number of ridges and other unique features**.** It was observed that factors such as ridge density, ridge count, size of the print differ between genders. This led to the conclusion that fingerprints found in crime science investigations can be compared to fingerprints in databases in order to identity these factors and help infer the gender of the person associated with the print.

Key words: fingerprint, gender, pattern, identification, crime scene

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Fingerprints have been an essential part of crime scene investigations for many years. Once recovered from hidden surfaces, they help uncover links between objects in the crime scene to victims and suspects. A survey of laboratories around the nation found that more than 60% of evidence collected consists of fingerprints and drugs (Campbell 2000). The layout of prints found in crime scene investigations can be affected by gender, age, diseases and medication taken, skin and a variety of other factors (Houck 2016). Not very often are fingerprints found on crime scenes fully visible, it can be a challenging task for investigators to pick up these prints and analyze them (Ezeobiejesi and Bhanu 2017). Although with the advancement in technology and databases that are better than ever, it has become easier to analyze fingerprint patterns and identify distinct characteristics that can play an essential role in forensics. There are various methods to compare fingerprints ranging from local to universal. However, it is challenging to create a metric system to recognition because of factors such as universality, distinctiveness, permanence, collectability (Maltoni *et al.* 2003). There have been a few discoveries that have established techniques to distinguish between fingerprints from different genders. A popular technique that was discovered a few years ago was using amino acids levels in the sweat from prints left behind in crime scenes. It was based off the finding that specific amino acid levels exist twice as much in women as they do in men (Halámek *et al.* 2015). There have also been computerized programs made specifically to determine gender based on fingerprints. Although these methods are not a 100% accurate, they have a fairly high accuracy rate (Rattani *et al.* 2015). The goal

of this experiment was to find distinct patterns in fingerprints of males and females that may help establish a technique to easily distinguish between them.

Materials and Methods

Participants

This study was conducted using an online form which was sent out to students at Texas A&M University between the ages of 18-24. The study was voluntary and there were 12 males and 35 females who took part.

Data Collection

The form that was sent out consisted of a video that demonstrated how participants were to take their own fingerprints, scan them and upload multiple images for analysis. In order to eliminate bias based on different fingers, the participants were instructed to collect prints from their right hand index finger only. To get the best print possible, it was required that the participants roll their fingers in the ink pad then on a piece of paper four times then repeat this motion twice. This resulted in a total of twelve prints per person out of which the best one was selected. The subjects were kept anonymous and were only required to provide their age and gender.

Print Analysis

Out of the twelve prints, the one that was the most clear was selected for analysis. These prints were classified into Arches, Loops, and Whorls and then further classified into Plain Arch, Tented Arch, Ulnar Loop, Radial Loop, Double Loop Whorl, Plain Whorl, Central Pocket Loop and Accidental Whorl. Based on the pattern, the number of ridges was determined along with other distinct features.

Results

In the data collected from males, there were 66.7% loops, 25% whorls and 8.3% arches (Figure 1).

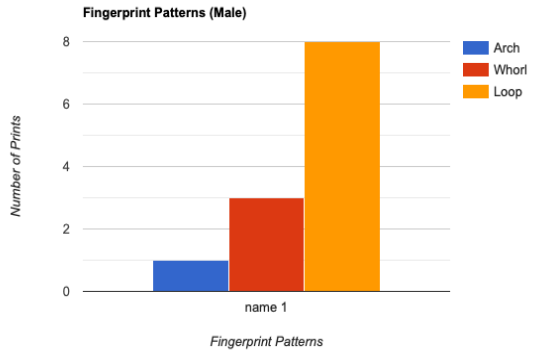

Fig. 1: Number of each fingerprint pattern in males

In the data collected from females, there were 54.3% loops, 37.1% whorls and 8.6% arches (Figure 2).

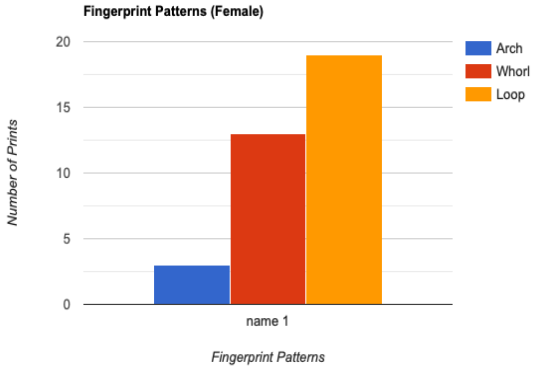

Fig. 2: Number of each fingerprint pattern in females

The mean ridge count in males was 11.75 with a standard deviation of 4.86. The range was from 0-18 (Figure 3).

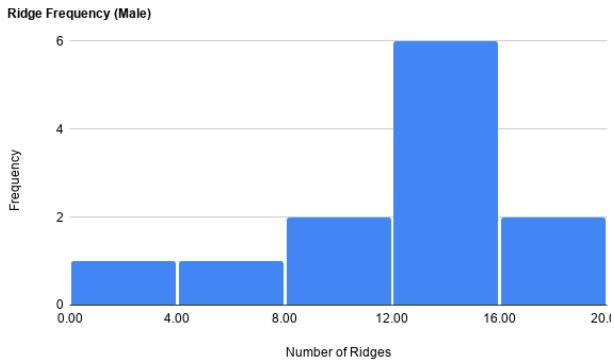

Fig. 3: Distribution of ridge frequency in males

The mean ridge count in females was 12.34 with a standard deviation of 5.48. The range was from 0-24 (Figure 4).

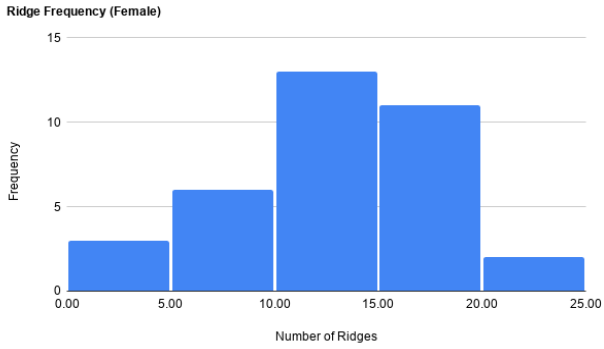

Fig. 4: Distribution of ridge frequency in females

Discussion

There were a few patterns that could be observed in our results. In males, we saw a higher percent of loops compared to females while in females we saw a higher percent of whorls. The percent of arches was roughly the same in both males and females. The mean ridge count was also not very far off between males and females but the data was a lot more scattered in females as seem by the standard devaition. The ridge frequency in males was the highest between 12-16 ridges while in females it was highest between 10-15 ridges with 15-20 being a close second. From this we can infer that men may have fewer ridges compared to females. Another observation that was made during the fingerprint analysis was that in majority of the prints, the width of female fingerprints was shorter than the width of male fingerprints. It was also seen that the ridges were further apart in males than they were in females on some of the prints. On average, males tend to have a larger body compared to females due to which the ridge distribution in their fingerprints is farther apart. From these observations, we can infer that ridge density and fingerprint size can help distinguish between male and female fingerprints to some extent (Champod *et al.* 2017). Research also shows that ridges and patterns can show various biological factors about someone when compared to general patterns from databases (Tom and Arulkumaran 2013). Males are also more likely to have a higher number of minutiae when looking as loops and whorls while women are more likely to have a higher number of minutiae in arch patterns (Thakar *et al.* 2018). Although there is more research required in this field, new techniques are coming about every day that revel not only the gender of a person from their fingerprints, but also race, health, contact with specific materials etc. (Thompson 2015).

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