Journal of Forensic and Legal Medicine 32 (2015) 34–38

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/jflm

Original communication

Sex differences in fingerprint ridge density in a Turkish young adult population: A sample of Baskent University

Hale Oktem [a,*], Ayla Kurkcuoglu [a], Ismail Can Pelin [a], Ayse Canan Yazici [b], Gulnihal Aktaş [c], Fikret Altunay [c]

[a] Department of Anatomy, Faculty of Medicine, Baskent University, Ankara, Turkey
[b] Department of Biostatistics, Faculty of Medicine, Baskent University, Ankara, Turkey
[c] Faculty of Medicine, Baskent University, Ankara, Turkey

ARTICLE INFO

Article history:
Received 17 October 2014
Received in revised form
27 January 2015
Accepted 15 February 2015
Available online 21 February 2015

Keywords:
Dermatoglyphics
Fingerprints ridge density
Sex determination
Turkish population

ABSTRACT

Fingerprints are considered to be one of the most reliable methods of identification. Identification of an individual plays a vital part of any medico-legal investigations. Dermatoglyphics is a branch of science that studies epidermal ridges and ridge patterns. Epidermal ridges are polygenic characteristics that form intrauterine 10–18 weeks and considered fully developed by the sixth month of fetal growth. Fingerprints are permanent morphological characteristics and criminal detection based on fingerprints is based on the principle that no two people can have identical fingerprints. Sex determination from fingerprints has been examined in different population. In this study we aimed to study fingerprint ridge density in Turkish population sample of Baskent University students. Fingerprints were obtained from 118 women, 88 men a total of 206 students aged between 17 and 28 years old by means of simple inking method. Fingerprints from all right and left hands fingers were collected in three different area of each. The ridges on fingerprints were counted diagonally on squares measuring 5 mm × 5 mm on radial, ulnar and inferior areas. The fingerprint ridge density in radial, ulnar and inferior areas and between sexes was compared statistically Mann Whitney U test and Friedman test. The ridge density was significantly greater in women in every region studied and in all fingers when compared to men. The fingerprint ridge density in the ulnar and radial areas of the fingerprints was significantly greater than the lower area. Fingerprint ridge density can be used by medico-legal examination for sex identification.

1. Introduction

The reflections of dermal papillae in epidermis are called as crista cutis, and the cristae situated in palmar and plantar regions and fingertips are called as toruli tactiles. Dermatoglyphics is the discipline that studies the ridges and their organization on the skin.[1–3]

Fingerprints are the impressions left by the epidermal ridges of human fingers. Morphological characteristics of fingerprints remain unchanged throughout the life. Since they are unique for each individual, and may be easily available in the crime scene, they are commonly used for personal identification in forensic medicine. For forensic anthropologists, the density of the ridges are as important as their morphological characteristics for an accurate identification of the person. Personal identification made by fingerprints is based on the fact that no two persons have exactly the same fingerprints.[4] Thus, dermatoglyphics is commonly used by the investigators for personal identification, and accepted as one of the most reliable methods in forensic medicine. Fingerprints are important for morphological, biological, genetic, and anthropological aspects as well as forensic medicine. Personal identification based on fingerprints is a frequently used, successful and universal method.[1,2,5–10] Fingerprints have forensic interest for identification of lost people, criminals hiding their identities, and the corpses with loss of body integrity.[4] Although fingerprint analysis is of first priority in forensic crime scene analysis; hair, bristles, blood, and semen found in the crime scene are also used for identification purposes.[11]

* Corresponding author. Department of Anatomy, Faculty of Medicine, Baskent University, 06530 Baglıca Ankara, Turkey. Tel.: +90 312 2341010 1526 (office), +90 5422926448 (mobile); fax: +90 312 2341180.
E-mail address: haleoktem@yahoo.com (H. Oktem).

http://dx.doi.org/10.1016/j.jflm.2015.02.011
1752-928X/

Epidermal ridges are polygenic features that appear in 10–18th weeks of intrauterine life, they are considered as fully developed by the sixth month of fetal growth, and do not change thereafter. Environmental and genetic factors play role during their development. The density of the lines remains stable once the development is complete.[7]

The studies showed that dermatoglyphics may be used for the diagnosis of some medical and genetic diseases.[8,10,12,13]

Not only the morphological characteristics, but also the density of the ridges are important for forensic anthropologists for an accurate identification. The number and the characteristics of the ridges are examined for comparing different fingerprints, or for comparing a new fingerprint with an old one. The ridge density is determined by two parameters; ridge width and distance between the ridges.[8,14] Sex determination from fingerprints has been studied in different populations. A number of studies have investigated the relation of fingerprint density with gender. Applicability of fingerprint ridge density in gender determination is based on the fact that women tend to have finer ridge detail on their fingers, therefore they have more ridges compared to men.[9,13,15–17]

In this study, we aimed to study fingerprint ridge density in a Turkish population, Baskent University students (gender determination compared with the other populations).

2. Methods

This study was conducted on a total of 206 individuals, 88 men and 118 women, aged between 17 and 28 years. The mean age was 20.15 ± 1.96 years for the men, and 19.49 ± 1.76 years for the women. All subjects were the students of different Faculties in Baskent University.

Simple ink-staining method was used for identifying fingerprints. Black ink, an inking pad, a magnifier, a sheet of white paper, and a sheet of acetate paper were used. Presence of hypersensitivity and disturbed skin integrity were taken into consideration.

The fingerprints were obtained using the method suggested by Cummins and Midlo. First, the subjects washed their hands, and the right I, II, III, IV, V and left I, II, III, IV, V fingers' distal phalanges were stained using the inking pad, including radial and ulnar sides of each finger, and distal joint lines. The fingerprints of all fingers were taken on an A4 paper.[18]

The fingerprint ridge density was determined under the magnifier in 3 regions (radial, ulnar, inferior regions of each finger) of the fingerprint, determined by Acree's method. During determination of ridge density in those regions, 5 × 5 mm squares (25 mm^2) drawn on the acetate paper were used. The number of the ridges were counted along the diagonal line of the square. By this way, the fingerprint ridge density was determined by calculating the number of the ridges in this square of 25 mm^2.[15] We positioned radial and ulnar squares by placing their medial-inferior corners onto the center of the finger. The inferior square was positioned by placing one of its corners over the intersection of first joint line with the center line (Fig. 1).

The normality of the distribution of the variables was analyzed with Shapiro–Wilk test. The homogeneity of the group variances was analyzed with Levene test. The medians of two independent groups' parameters that did not fulfill the prerequisites for the parametric tests were compared with Mann Whitney U test. The medians of three independent groups were compared with Friedman test. The correlations among the variables were analyzed with Dunn test. $P < 0.05$ was regarded as statistically significant. The analysis of the data was performed using SPSS 17.0 (SPSS Ver. 17.0, Chicago IL, USA) statistical package program.

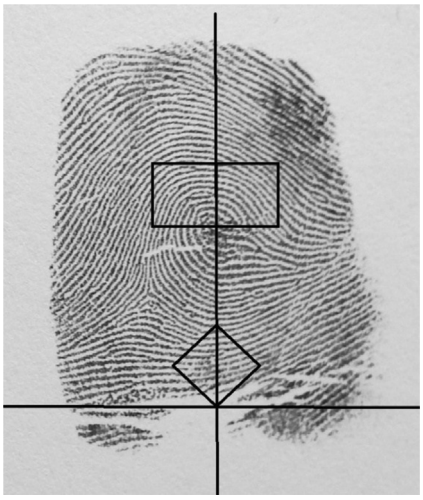

Fig. 1. Epidermal ridge count in radial, ulnar and inferior fingerprint areas.

Our study was approved by Baskent University's Institutional Review Board (KA 14/18), and supported by Baskent University Research Fund.

3. Results

For men and women, the descriptive analyses of each finger's fingerprint densities in ulnar, radial, and inferior regions are presented in Tables 1 and 2. The ridge density was significantly greater in women in every region studied (ulnar, radial and inferior) and in all fingers when compared to men. Even though gender difference was observed in all three regions, the most obvious difference was observed in the radial region, both in right and left hands ($p < 0.001$). When the fingerprint ridge densities of ulnar, radial, and inferior regions were analyzed, it was seen that the ridge densities were similar in the ulnar and radial regions, and those densities were significantly greater than the density of inferior region in all fingers, both in the men and women.

The smallest fingerprint ridge density was six, and the greatest was 23 in all three regions, when both men and women were taken into consideration.

The ridge density was greatest on the radial regions of ring and little fingers while it was greatest in the inferior region of the thumb. No significant differences were observed among the fingers for the ulnar region.

The distribution of mean ridge density was observed in all regions in both men and women. It was apparent that fingerprint ridge densities of all regions were greater in women when compared to men. The mean ridge densities were determined in all regions of all fingers both in men and women. It was found that the mean ridge densities were much greater in the women in all three 25 mm^2 areas studied.

When each finger was analyzed individually for gender differences of fingerprint ridge densities, statistically significant differences were observed between genders ($p < 0.001$) in the radial, ulnar and inferior regions in both hands. The most significant difference between the genders was seen in the radial region while the difference was the least significant in the inferior region. However, the differences were significant in all three regions studied in both hands ($p < 0.001$).

Fingerprint ridge density was higher in the ulnar region when compared to the radial region in men whereas the opposite was true in the women. In men, the ridge density of the ulnar region