Journal of Forensic and Legal Medicine 34 (2015) 55–61

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

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

Original communication

Estimation of stature from handprint dimensions in Egyptian population

Melad G. Paulis*

Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Minia University, Egypt

ARTICLE INFO

Article history:
Received 10 February 2015
Received in revised form
1 May 2015
Accepted 20 May 2015
Available online 29 May 2015

Keywords:
Stature
Hand anthropometry
Handprints
Regression analysis
Egyptians

ABSTRACT

Handprint in the scene of the crime is one of the most valuable clues in identification of the assailant. There are numerous studies on estimation of stature from direct measures of hand dimensions, but using a handprint instead, there is little research on it. So this study tried to focus on handprint as a tool used in estimation of stature. One hundred right male hands and 91 right female hands were scanned, processed via Photoshop program and handprint measurements were taken using a software program. Our results showed that stature could be estimated from handprint measurements by simple and multiple regression equations with standard error of estimate was the lowest in handprint length ±4.54 cm in male and ±5.38 cm in female. It was concluded that handprint from the scene of the crime could be used for the prediction of the stature of the assailant.

1. Introduction

Personal identification plays a vital role in medico-legal and crime scene investigation. In this context, stature is considered as one of the "Big Four" parameters required to assist with the identification of an individual when other lines of evidence are corroborative.[1–3]

There are numerous publications describing anthropometric approaches to estimating stature from different body parts, for example head dimensions,[4–6] lower limb,[7,8] upper limb bone.[9,10] Various studies estimated stature from hand dimensions either directly from fleshy hands,[11,12] or from hand bone.[13,14] Two prints also were used, namely foot and handprint. Footprint has gained more focus for estimation of stature than that of hand print.[15–21] Only a few works were done in the handprint.[3]

In contrast to methods depend on direct measurement from hand in which most cases the complete hand is available, Ahemad & Purkait, 2011[3] stated that handprint left varied with the type of activities the person is engaged in. Also, usually partial impression of the hand is left. Last, landmarks of the hand may be not visible in all cases. These notes make the use of a handprint in the estimation of stature is more difficult, especially with the addition of techniques used discover handprint in the scene of crime.

Finger and palm prints are some of the most valuable clues at the crime scene. Often, the only evidence that may be available at the scene of a crime is in the form of latent impressions of hands. Prints are conclusive evidence. When criminals work, they cannot avoid leaving clues in the form of fingerprints unless they wear gloves or some other form of protection.[22] Stature calculation from theses prints may support height estimation of suspects made by eye-witnesses or narrow down the pool of suspects.[23] Also, in the recent decade, increasing interest has been paid for the reconstruction of the biological identity of individuals who left handprints in the prehistoric caves and rock shelters around the world.[24]

Hence come the importance of more research on estimation of stature from handprint which help in anthropology, medicolegal and crime scene investigations.

The present research was thus, conducted with an aim to find if stature could be predicted from handprint dimensions in Egyptian population sample with the help of a computer program tool in taking these measures.

* Tel.: +20 1222993067.
E-mail address: melad.boulis@mu.edu.eg.

http://dx.doi.org/10.1016/j.jflm.2015.05.007
1752-928X/

2. Materials and methods

2.1. Materials

This study was carried out in the Forensic Medicine and Clinical Toxicology Department and Minia University Hospital, Faculty of Medicine, Minia University from March to September 2014. It was conducted on 191 (100 male and 91 female) volunteers from patients' relatives visiting Minia University Hospital outpatient clinics. Ages of participants were above 18 years old. Several studies have found that there were insignificant differences between right and left hand measures so only right hands of right handed persons were included in this study.[25–29] An informed written consents were taken from all participants and the followed procedures were in accordance with the ethical standards of El-Minia University committee on human experimentation. Only individuals without any medical history of hand, foot and backbone problems were recruited for the study.

2.2. Methods

2.2.1. Handprint acquisition

A flatbed scanner (HP Scanjet 200), retrofitted with a custom mounting box (to standardize light and hand position) and scale was used to acquire images of the hand at 300dpi.[30] Adobe Photoshop (SC6 64bit edition) software package was used in editing the image to obtain the most accurate approximation of a handprint.

2.2.2. Measurements

An anthropometric rod was used for the measurement of stature. Stature was taken according to Habib and Kamal.[25] In brief, the subject stood barefoot on a flat surface. The anthropometer was placed in a straight vertical position in front of the subject with the head oriented in eye–ear–eye plane (Frankfurt plane). Feet axis was parallel or slightly divergent and hands hung down. The movable rod of the anthropometer was brought into contact with the vertex in the mid sagittal plane. The measurements were repeated and the mean measures were recorded (by one observer) in order to avoid inter-observer errors. All measures were recorded in centimeters to the nearest millimeters.

Measurements of handprint were taken by a computer program specialized in measuring distance in images. It is called Klonk Image Measurement version 14.2.1.5. Calibration of the length was done using a scale put in the scanner during handprint acquisition. The program affords option of saving the recoded measurement length directly in excel file so it decrease the time and error if manual manipulation of data was used. The following handprint measures were taken:

Phalangeal length: The phalange length was measured as the distance between the centers of two phalange creases. The distal phalange length was the distance between the most forwarding projecting point on the tip of a finger to the first distal phalange crease (Fig. 1).

Handprint breadth (HB) was measured as the distance from the most laterally projected part of the palm print at the second metacarpal to the most medially projected part of the palm print at the distal transverse crease. Handprint length (HL) was measured as the distance from the baseline of the print (transverse line from the most inferior a point of the medial border of the palm) to the tip of the middle finger[30] (Fig. 2).

Twenty cases of male and female handprints were measured manually and using Klonk Image Measurement software. Results of manual measurement and computerized measurement were compared using t-test. No significant differences were found between the two results in both male and female.

The data were analyzed using the statistical package of social sciences (SPSS) version 22, and regression formulas were calculated for various combinations in order to reach the best estimate possible.

3. Results

Age distribution among the 100 examined male individuals was 34.2 ± 13.95 years while among 91 female participants was 35.1 ± 9.99 years with a range from 18 to 67 years in all participants.

As it appears from Table 1; men are significantly taller than female in the studied sample with a stature mean of male 167.89 ± 5.86 cm while in female 156.96 ± 6.64 cm. All the taken measures show significant differences between male and female (p value < .05). Also, from Table 1; it shows that all measurements of men's handprint are larger than the corresponding females.

Tables 2 and 3 describe the correlation coefficient between stature and different hand and phalanges print measurements in male and female. All measures of male handprint show significant correlations except L3 and T2. The highest correlation is found to be between stature and HL (r = .618). It is followed by M1, I3, and I1 (r = .612, .529 and .503 respectively). As regards female handprint measures; all the measurements give a significant correlation coefficient with stature except L2 and T1 (p value is .693 and .961 respectively). The highest correlation coefficient is between stature and HL (r = .412). All correlation coefficients between stature and anthropometric measurements are higher in male than the corresponding measurements female.

Table 2 illustrates simple linear regression equations for estimation of stature from each individual variable in male participants. Standard error of estimate (SEE) (which reflects the deviation of the estimated stature from the equation from that of the actual one) shows slight differences between different used anthropometric measurements. It is being the highest in R3 (±5.89 cm) and lowest in HL (±4.54).

In a similar manner; in Table 3, equations are developed for each measurement of handprint in female participants. SEE shows the lowest deviation when HL is used in stature estimation (±5.38 cm).

Using multiple regression analysis (stepwise); there is much improvement in estimating stature when using more than one measure. This is true for both male and female handprint measures. Table 4 shows that male stature could be estimated with SEE low to ±1.67 cm when 13 measurements were used. SEE increases when a less number of measurements are used to be ±3.04, ±3.76 and ± 4.19 cm (7, 4 and 2 measurements are used in each case respectively).

As regards stepwise regression analysis in female handprint measurements (Table 4), it gives much improvement in accuracy of estimating stature in comparison with simple regression analysis (Table 4). SEE becomes small as ± 1.84 cm when 7 measurements were used. It increases to ±3.04, ±3.49 and ±4.79 cm when 5, 4 and 3 measurements were used respectively.

4. Discussion

For over one hundred years, handprints have been routinely used by law enforcement agencies throughout the world to identify suspects. This is true in comparing handprint found at the crime scene and the suspect. But when there is no suspect to compare;