

CHAPTER I

INTRODUCTION

Establishment of the identity of the deceased is of the greatest significance to the forensic examiner in situations where cadavers are violently distorted. Identification of victims using dismembered human remains has constantly been a challenge in medico-legal investigation, whether in situations of traumatic calamities where tremendous trauma is involved or in definite situations of murder, where deceased bodies have been dismembered to suppress the identity of the murdered.

Identifying the identity of a person is the major aim of the forensic investigation. It is a challenge in forensic medicine to identify deceased bodies when body dismembered from remaining body parts, such as hands, arms, and feet. The present study has been carried out regarding determination of gender and correlation between stature, and index and ring fingers ^[2] in south Indian population.

In certain situations, such as putrefied, mutilated, or extensively charred body, conventional indicators and routine methods of identification fail to yield results. The situation is worsened when only mutilated and fragmentary remains are available for examination which is not uncommon in today's world due to mass disasters both natural and manmade e.g. earth quakes, cyclones, tsunamis, flood, terror attacks, bomb blasts, accidents and plane crashes etc.^[5].

Stature is one of the most important parameters in the identification of an individual, living or dead. When intact bodies are to be examined, stature estimation does not pose any problem. But when dismembered human body parts are the materials to work with, it is of an even greater challenge for the forensic pathologists. Most methods employ the basic process of comparison. Some studies also related with the estimation of stature from fragmented human remains ^[6] by using different studies conducted on the cephalo-facial, extremities and other body parts.

Many studies were conducted on the estimation of stature based on a principle that every body part bears a more or less constant relationship with height of an individual. Various studies in past have utilized various parts such as upper

and lower extremities including hand and foot dimensions ^[3] for estimation of stature.

Examination of anonymous skeletal and incorporated remnants in legal conditions is covered by forensic anthropology, which mainly focuses on fixing the profile of diversity through assessment of the age, sex, stature and race. Sex identification using anthropometric measurements is a topic that is currently covered in a multitude of studies; including anthropometric measurements of the upper and lower extremities, the long bones of the extremities, hands and feet small bones, as well as other bones of the body ^[7].

The main purpose of investigating the damaged remains is to develop a biological profile that identifies individuals by estimating the age, gender, and stature of the remains. This profile helps to increase the likelihood of identifying the information of the victim's events or disasters ^[8].

Previous studies revealed a significant correlation between stature and fingers length. Various research studies estimated the stature from remaining finger bones. However; few studies were conducted using finger length^[25].

Estimating statures through human remains is based on the principle that there is a linear relationship between statures and various parts of the human body and bones. Previous studies that estimate statures through different parts of the body have been shown to be able to structure an estimation model with reasonable accuracy ^[6].

Aim of this study was to evaluate utility of index and ring finger lengths in estimation of stature and to predict the accuracy of regression models derived from such parameters. Estimating the stature of a person from such fragmented remains forms an important tool of identification in such circumstances.

Hands are the most preferable and shrewd part of the body for anthropometric measurement, comprising hand dimension (hand length and breadth). Hand index which is acquired from hand dimensions could be used to assess variation concerning sex, age and race in forensic and legal sciences. Importance of morphometric and skeletal examination of hand and foot dimensions

in identification was mentioned previously. Studies using hand measurements for sex determination have been performed in several races ^[9].

The situation is more complicated in developing human beings, since the age of the subject is a sensitive identifying element. Males and females have different epiphyseal integration age; fusion of the epiphyses takes place later in males than in females. Valid sex precision in adults has contracted directly on a range of potential murdered consistent that by providing a special priority for age assessment that exactly established on the predicted sex.

The work load of the forensic investigator is usually reduced by half whenever the sex of the suspicious could be concluded from the dimensions of the hand found at the crime scene, thereby explaining the necessity of the ongoing research on identification of sex from hand dimensions.

India is a vast country with varied geographical conditions and stature varies with race, sex, and geographical locations as quoted above. Therefore, present study examines the relationship of the index and ring finger length of right hand with stature in Kerala Population.

CHAPTER II

LITERATURE REVIEW

Izzetduyar et al. (2003) studied “Body height estimation based on tibia length in different stature groups” and they explained long bone length is one of the best known indicators of human stature. Although the long bone length/height ratio differs in tall and short individuals, no detailed study has investigated whether specific formulae should be used to calculate height in different stature groups. This study proposes a new height estimation method. Body height and tibia length were measured in 121 male subjects aged 18.0–34.3 years. Three subgroups were established according to body height (short, medium, or tall), using the 15th and 85th percentiles as cut off levels. The general formula and a group-specific regression formula were used to estimate height in each subgroup. A control group with the same properties as the study group was analysed in the same manner. Particularly with “short” and “tall” subjects, the difference between true height and the height predicted by the group-specific formulae was smaller than the difference observed when the general formula was used. These discrepancies were statistically significant. When estimating height based on tibia length, the individual's general stature category should be taken into consideration, and group-specific formulae should be used for short and tall subjects.

Kewal Krishnan et al. (2007) studied estimation of height from foot length in 17-25 years age group and they examines the relationship between stature and dimensions of hands and feet among Rajputs of Himachal Pradesh – a North Indian endogamous group. The purpose for understanding these examinations was the paucity in the literature of studies that allow the reconstruction of stature from various dimensions of hands and feet amongst Rajputs. Hand length, hand breadth, foot length and foot breadth of 246 subjects comprising 123 males and 123 females ranging in age from 17 to 20 years were taken independently on left and right side of each individual. Statistical analyses indicated that the bilateral variation was insignificant for all the measurements except hand breadth in both the sexes ($P < 0.01$). Sex differences were found to be highly significant for all the measurements ($P < 0.01$). Linear and multiple regression equations for stature estimation were calculated using the obtained variables. The correlation coefficients between stature

and all the measurements of hands and feet were found to be positive and statistically significant. The highest correlation coefficient between stature and foot length and lowest SEE (standard error of estimate) indicate that the foot length provides highest reliability and accuracy in estimating stature of an unknown individual. The regression equations were checked for their accuracy by comparing the estimated stature and actual stature.

Jitender Kumar Jakhar et al. (2011) studied about Estimation of height from measurements of fingers length in Haryana region their study was carried out on the measurements of fingers length and body height of total 103 students between 21 to 32 years of age. The study was carried out in the Department of Forensic Medicine and toxicology at Pt. B.D. Sharma PGIMS, Rohtak, and Haryana State, India. A total number of 103 (52 males, 51 females) medical students state of Haryana were included in the study. Anthropometric measurements were taken by using standard anthropometric instruments in centimetres to the nearest millimetre. All the measurements were taken in a well lighted room. Obtained data was analysed and attempt was made to find out correlation and to derive a regression formula between finger length and height of an individual. A good correlation of height was observed with fingers length and it was statistically highly significant. The results of the present study would be useful for Anthropologists and Forensic Medicine Experts.

Rajesh Vaijnathrao Bardale et al. (2013) studied about Estimation of Stature from Index and Ring Finger Length they established that the identity of person is one of the significant aspects of Forensic investigation. Recently studies were conducted to estimate stature from hand and phalange lengths; however, few studies were conducted using finger lengths. The purpose of present study was to evaluate utility of index and ring finger lengths in estimation of stature and to predict the accuracy of regression models derived from such parameters. The study was carried out on a cross sectional sample of 195 adult students out of which 100 were males and 95 were females. There was significant difference ($P < 0.001$) between stature of male and female subjects. Similarly significant difference ($P < 0.001$) exists between male and female index and ring finger length. A significant correlation was observed between finger length and stature. Pearson correlation between finger length and stature was higher among females than males. The findings of present

study indicate that index finger and ring finger lengths can be used successfully to predict living stature of an individual.

Arun Kumar Agnihotri et al. (2013) they studied about estimation of stature from fragmented human remains by using different studies conducted on the cephalo-facial, extremities and other body parts. The results of this study indicated the significant sexual dimorphism for all measurements and a positive correlation between upper limb measurements and stature, which was highest for ulna length.

G.M. Raju et al. (2014) they studied about Estimation of correlation between middle finger length and stature of females in Southern Indian population and they investigated the ability of estimating stature from right index and ring finger length. The study was carried out by taking the measurement of index and ring finger length of right hand and individual's actual height of 250 medical students (125 males and 125 females) of 18 to 25 years of age. The study was carried out in department of forensic medicine and toxicology at SSIMS & RC Davangere, Karnataka state, India. Obtained data was analysed statistically to establish the relationship between a person's index and ring finger length of right hand and stature. Regression equation and 'P' values were obtained. A moderate correlation was observed between index and ring finger length of right hand and calculated height of an individual which is statistically highly significant.

Mahrous AbdelBasset Ibrahim et al. (2016) they studied sex determination from hand dimensions and index/ring finger length ratio in north Saudi population and they determined sex using human commingled remains is one of the most important components in forensic identification. Getting a reliable and accurate method for sex determination through hand dimensions among Saudi population. A cross sectional study was carried out on 600 volunteers. Hand length, breadth and hand index, also index and ring finger ratio were estimated. The average hand length, breadth and index were found to be 1.3, 0.96 and 2.93cm greater in males than females, respectively ($p < 0.05$), with no significant difference between right and left hand in the same sex. A cut-off point index of 641.23 for the right hand and of 641.30 for the left hand is suggestive of the female sex, while that of >41.23 for right hand and >41.30 for left hand is suggestive of male. The index and ring finger ratio is found to be higher in females than males. Index and ring finger ratio 60.920

for the right hand and 60.913 for the left hand suggestive of male while Index and ring finger ratio <0.920 for the right hand and <0.913 for the left hand suggestive of female.

Chauhan Amit et al. (2018) they studied stature estimation and gender perception from the length of ring finger of the population of national capital region of India, according to their studies identification of an individual has become one of the most paramount aspects of investigation as well as identity in our civilization. Technologists have used extent of traditional methods, even still the identification of a person through minute details is questionable. During an investigation of crime largely the minute details are recovered from the scene, these details are needed to be studied appropriately to observe the clues which could direct towards the suspect or the culprit of the crime. In the present day, an attempt is made for the analysis of individual from the minute details. Skeleton is the frame of bones which are formed of hard tissue, thus can be preserved over a long period of time after death and it is sometimes the only evidence found for the forensic investigation. Skelton remains could provide the details such as the stature, gender and age of the victim. The study of assessment of stature and determination of sex of an individual from ring finger is done for such crucial cases in which unidentifiable or parts of body encountered from a crime scene. We studied the ring finger of the population of national capital region of India ranging from 20–30 age groups and were successfully able to conclude that the suspect could easily be nabbed from ring finger.

Mitra Akhlaghi et al. (2019) they studied The Role of Index and Ring Fingers in Gender Identification and Height Estimation and aimed to determine gender and the correlation between stature, and index and ring fingers in an Iranian population. In this cross-sectional study, 200 Iranian students aged between 18 and 25 years were included (2016-2017). The mean height was 179 cm in males and 164 cm in females. The mean index and ring fingers lengths were 73 mm and 74 mm in males, and 68 mm and 68 mm in females, respectively. The mean sum of index and ring fingers lengths were 147 mm in males and 136 mm in females. Height, index and ring fingers length, and the sum of them significantly differed between genders ($P < 0.0001$). The accuracy of gender determination was 92%, 71%, 73% and 74.5% in terms of stature, index finger length, ring finger length, and the sum of index and

ring fingers length, respectively. The correlation between height and index finger length, as well as the height and ring finger length, were significant in males, females, and total cases ($P < 0.0001$).

Ilseun Rhiu et al. (2019) studied estimation of stature from finger and phalange lengths in a Korean adolescent, they investigated the relationship between the stature and the length of fingers and phalanges in the Korean adolescent population. This study derives a linear regression model for stature estimation from 5 fingers and 14 phalanges. In addition, regression models with the highest prediction accuracy according to gender were derived from various regression models. All measurements were made at once in the morning. Therefore, in order to unify these measurement considerations, adolescents living in Seoul, the capital of South Korea, were selected as subjects. All statistical analyses were performed in R 3.4.4. Gender differences in each length of finger and phalange, and stature were determined by t test. Correlation between stature and each length of finger and phalange was determined through Pearson correlation coefficient. The regression equation was used to estimate stature from the length of each finger and phalange of males and females. The stature was used as a dependent variable and the length of fingers and phalanges as an independent variable.

CHAPTER III
AIM AND OBJECTIVES

AIM:

The aim of this project is to determine the height and sex by using finger length of a person.

OBJECTIVES:

- To determine the relationship of the index and ring fingers to stature.
- To evaluate the utility of index and ring finger length for determination of height.
- To formulate the equation to find height from finger lengths.
- To establish the Pearson correlation between finger length and stature.
- To study the approximation of gender determination from finger lengths.

CHAPTER IV

MATERIAL AND METHODOLOGY

MATERIALS REQUIRED:

- Vernier callipers
- Measuring tape
- Scale
- SPS Software 16
- Calculator

METHODOLOGY:

The present prospective study consists of adult students of GEMS Arts and Science College, Ramapuram, Malappuram District, who were randomly selected from different batches. A total 100 subjects were included in the study, out of which 50 males and 50 females within age group of 18 to 21 years. The subjects included in study were healthy individuals free from any apparent skeleton deformity. Prior to procedure written informed consent was obtained.

Data on age, sex and height were collected and the anthropometric measurements were taken. The length of the index finger (IFL) and ring finger (RFL) of the left and right hand of each subject were measured with the aid of manual Vernier callipers, from the tip of the digit to the ventral proximal crease, where there was a band of crease at the base of the digit, the most proximal crease was used.

Stature was estimated from vertex to the floor with feet axis parallel and head in Frankfort plane. Subjects with injuries or deformities in any of the hands or spine were excluded from the study. All measurements were made in centimetres to the nearest millimetre with digits fully extended. Two parameters were investigated which includes height, and the length of index and ring fingers.

The data was collected, analysed and subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) to know the correlation of the stature with the index and ring finger length separately. The reliability of estimation of stature from the length of index and ring finger was determined with the help of 'P' value and regression equations individually.

CHAPTER V
OBSERVATION

Table 1: Descriptive Statistics of Stature and Finger Length.

Gender	Parameter	Mean±SD	Min.	Max	95% Confidence Interval		P
					Lower bound	Upper Bound	
Male	Age	20.24±0.74	18	21	20.03	20.44	0.058
	Height	171.858±5.09	153	179.5	170.45	173.27	<0.0001***
	IFL	78.7±4.25	69	88	77.52	79.88	<0.0001***
	RFL	84.4±4.15	74	91	83.25	85.55	<0.0001***
	IFL+RFL	163.1±7.53	147	174	161	165	<0.0001***
Female	Age	19.64±1.102	18	21	19.3	19.9	0.058
	Height	156.27±5.34	144	168	155	158	<0.0001***
	IFL	71.12±3.76	66.78	74.23	70.1	72.12	<0.0001***
	RFL	74.4±3.73	71.2	76	73.4	75.4	<0.0001***
	IFL+RFL	145.52±6.87	141	149	144	147	<0.0001***
Total	Age	19.64±1.096	18	21	19.4	19.9	0.058
	Height	164.064±9.39	153	179.5	162	166	<0.0001***
	IFL	74.91±5.52	66	88	73.8	76	<0.0001***
	RFL	79.4±6.38	71	91	78.2	80.7	<0.0001***
	IFL+RFL	154.31±11.38	147	174	152	157	<0.0001***

*centimetre, **millimetre, ***P<0.05 is considered as statistically significant.

Table 2: Showing correlation coefficient and standard error of estimation of right index and ring finger in both males and females.

Gender	Parameters	R-square	Adjusted R-square	S.E.E. (cm)
Male	IFL	0.266	0.256	6.11
	RFL	0.299	0.291	5.96
Female	IFL	0.383	0.375	4.15
	RFL	0.354	0.346	4.25

Table 3: Pearson Correlation (r) between Finger Length and Stature (in cm).

Stature	Male	Significance	Female	Significance
IFL	0.516	P<0.001	0.628	P<0.001
RFL	0.547	P<0.001	0.593	P<0.001

Table 4: Linear Regression Models Calculated to Reconstruct the Stature from Index and Ring Finger (In Cm).

Parameter	Male	Female
IFL	106.69 + 8.80 X IFL	95.46 + 9.090 X IFL
RFL	107.38 + 8.38 X RFL	96.59 + 8.76 X RFL

Fig. 1A-B: Relationship between Index and Ring Finger Length (Cm) & Stature (Cm) in Male

Fig. 1A

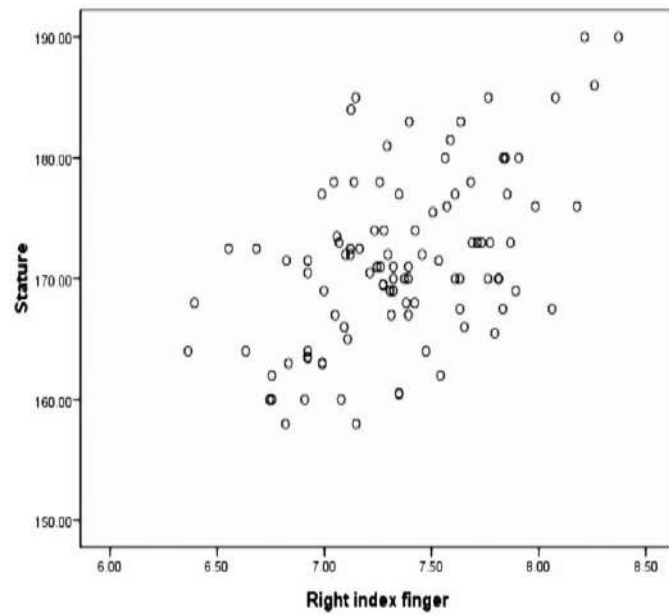


Fig. 1B

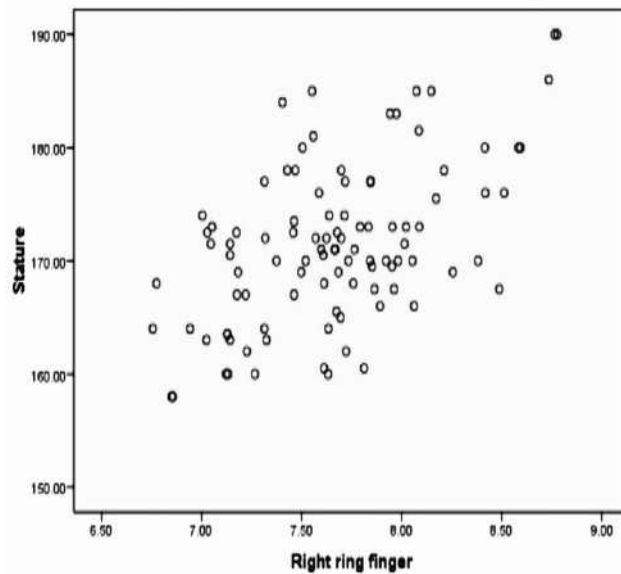


Fig. 2A-B: Relationship between Index and Ring Finger Length (cm) & Stature (cm) in Female

Fig. 2A

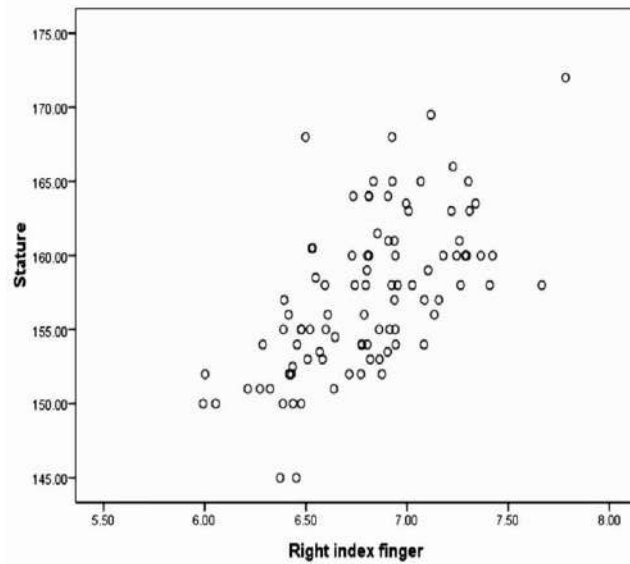
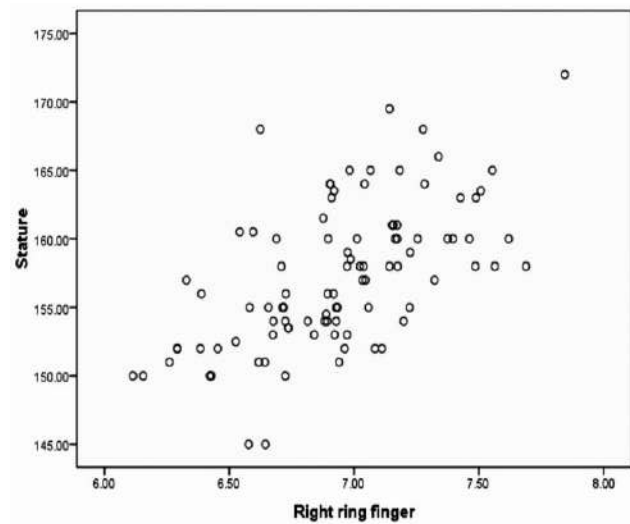


Fig. 2B



CHAPTER VI

RESULT AND CONCLUSION

RESULT:

The mean age of male population was 20.24 years while the mean age of female population was 19.64 years. The Mean±SD height was 164.06±9.398 cm in total cases, 171.86±5.098 cm in males, and 156.27±5.34cm in females, which differed significantly ($P < 0.0001$). (Table 1) The mean height (171.86 cm) of men exceeds the mean height (156.27 cm) of women. The Mean±SD lengths of index and ring fingers were 74.91±5.52 mm and 79.4±6.38 mm in total samples, 78.7±4.26 mm and 84.4±4.15 mm in males, and 71.12±3.76 mm and 74.4±3.73 mm in females, respectively. The descriptive statistics of stature and lengths of right index finger (RIFL) and right ring finger (RRFL) in both sexes showed significant difference ($P < 0.001$) between stature of male and female subjects.

Similarly significant difference ($P < 0.001$) exists between male and female index and ring finger length (Table 1). A significant correlation was observed between length and stature. Pearson correlation between finger length and stature was higher among females than males (Table 3).

Amongst males, correlation was higher between the ring finger length and stature. In females, correlation was higher between index finger and stature. Linear regression equations were derived for reconstruction of stature in males and females (Table 4). The Mean±SD sum of index and ring fingers were 163.1±7.53 mm in males and 145.52±6.87 mm in females; there was a significant difference between genders in this variable ($P < 0.0001$).

The standard error of estimate (S.E.E) was smaller in females (S.E.E. ranged from 4.15 cm to 4.27) in comparison of males (S.E.E. ranged from 5.96 cm to 6.11) (Table 2). The results of our study are encouraging. Statistically significant correlation was noted between index and ring finger and stature.

From the regression models derived in the present study the Standard Error of Estimate in the predicted stature was more in males than the females. In other words the accuracy of stature estimation in females is more than males.

CONCLUSION:

The findings of present study indicate that index finger and ring finger lengths can be used successfully to predict living stature of an individual. The results of present study are however, applicable only when an intact finger is examined.

While comparing the parameters in the given population height, index and ring finger lengths are always higher in males as compared to females and when comparing the parameters amongst sex, it was found that female have higher correlation than males.

This study can help in narrowing down the pool of possible victim matches in cases of identification of height and sex from dismembered remains. The result of the present study would be useful for Anthropologists and Forensic Medicine Experts.

CHAPTER VII

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