Original Research Article

Estimation of stature from finger lengths using regression formulae in north Karnataka population, India

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Abstract

Background: Estimating the stature is of prime importance while establishing the identity of a person. There are numerous studies conducted to establish the identity of a person along with other parameters such as age, sex, race, etc. **Aims:** The present study is conducted with an aim to examine the relationship between the stature and finger lengths of north Karnataka population. **Settings and design:** The study population included 100 males and 100 females in age ranging from 21 to 35 years hailing from North Karnataka. Left handed subjects and those with skeletal deformity were excluded from the study. **Materials and Methods:** Stature was noted using anthropometer rod and individual finger length was taken from distance between the proximal phalangeal ridge to the most forward projecting point on the tip of fingers using vernier calipers. **Statistical analysis used:** SPSS software was used to deduce Linear regression equations formulae for stature estimation from the finger lengths. **Result:** among males, except for thumb length all other finger lengths exhibited positive correlation with stature. Among females right hand finger lengths exhibited better correlation with stature than the left hand finger lengths. **Conclusion:** All the finger lengths showed positive correlation with stature of an individual. Linear regression equations calculated for each finger length can be used in by forensic experts in medicolegal cases.
Key Words: Human Anatomy; Anthropology; Stature; North Karnataka;

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INTRODUCTION

Identification of an individual is the main objective of forensic investigations.[1] Examination of fragmented and mutilated body parts retrieved from crime scenes has been used by forensic anthropologists to procure personal information about the victims. There is increase in the number of mass disasters causing mass deaths from natural and manmade calamities. Disasters like floods, tsunamis, earthquakes, plain crashes, train crashes, terrorist attacks usually demands the identification of victims from fragmented and dismembered human remains. In today's world, identification of an individual has a pivotal role in the court of law in relation to various crimes such as rape, murder, child trafficking etc. Stature is considered to be one of the criteria for personal identification and one of the 'big fours' (age, sex, race and stature) of forensic anthropology.[2] Estimation of stature especially from bones is a tedious and overwhelming process which involves cleaning and preparation of bones. Due to this reason Forensic anthropologist are using percutaneous measurements instead of direct measurements of the bone.[3] There have been many works on stature estimation from various body segments. But there are only a handful of studies in this region of North Karnataka. Again, less heed has been given on estimation of stature from individual finger lengths. Thus the present study aims at estimating stature from finger lengths that will aid in forensic medico-legal work. Statistical method adopted: All the

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measurements were analysed by using SPSS software [4]. The results were presented separately for males and females. Initially the data was summarised into Mean, Standard Deviation for all the parameters. To study the relationship of finger lengths with the stature, the Pearson Correlation Coefficient (r) and value of significance (p) was estimated. Linear Regression Equations were derived to estimate stature of unknown from individual finger lengths.

CORRELATION COEFFICIENT:

The relationship or association between two variables is called correlation. The extent or degree of relationship between two set of figures is measured in terms of a parameter called Correlation Coefficient. It is mathematically estimated by a formula and is denoted as Pearson's Correlation 'r'.

- If r = 0 : there is no correlation
- If r = -1 : there is perfect negative correlation
- If r = +1 : there is perfect positive correlation
- If r = 0-0.1 : trivial correlation
- If r = 0.1-0.3 : small correlation
- If r = 0.3-0.5 : moderate correlation
- If r = 0.5-0.7 : high correlation
- If r = 0.7-0.9 : very high correlation
- If r = 0.9-1 : near perfect correlation

MATERIALS AND METHODS

Source of data:

200 healthy adult population, 100 males and 100 females residing in Bijapur district are selected from among those volunteering for the study, only after obtaining informed consent.

Method of collection of data:

Stature is measured using anthropometer rod. Finger length is measured using Vernier caliper. All the measurements are taken before noon to avoid diurnal variation as the stature is maximum in morning and decreases by 1.5-2.0 cm by the end of the day.

Inclusion criteria:

Male and female age range between 21 to 35 years and all being healthy are considered in the present study.

Exclusion criteria:

- Subjects with skeletal abnormalities, deformities and endocranial disorders.
- Persons with amputated fingers will be excluded from the study.

Measurements:

1. **Stature:**
   It is measured as vertical distance from the vertex to the floor. Measurement is taken by making the subject stand erect in anatomical position on a horizontal resisting plane with bare footed. Shoulder blades and buttocks are touching the wall. Anthropometer is placed in straight vertical position in front of the subject with head oriented in eye-ear-eye Plane (Frankfurt Plane). The movable rod of the Anthropometry is brought in contact with vertex in the mid saggital plane.
2. Finger length: The subject is asked to place the hand on a flat table and the distance between the proximal phalangeal ridge to the most forward projecting point on the tip of fingers was noted.[5]

Photo 1: measurement of finger length

RESULTS

Table 1: Minimum, Maximum, Mean, Standard Deviation (SD) and Range of Height measurements included in present study.

	Min. (in cm)	Max. (in cm)	Mean (in cm)	SD	Range (in cm)
Females	145	169	154.34	5.49	24
Males	160	184	171.73	5.01	24

Table 2: Mean, Standard Deviation (SD), Regression Coefficient (r) and Significance value (P) for Finger length of Right hand (R) among males study population.

Fingers	Mean(cms)	SD	r	P
R.Thumb	5.6	0.6	0.08	0.1
R.Index	7.4	0.7	0.39	0.003
R.Middle	8.3	0.8	0.47	0.001
R.Ring	7.9	0.8	0.42	0.001
R.Little	6.0	0.4	0.32	0.002

Table 3: Mean, Standard Deviation (SD), Regression Coefficient (r) and Significance value (P) for Finger length of Left hand (L) among males study population.

Fingers	Mean(cms)	SD	r	P
L.Thumb	5.7	0.50	0.07	0.1
L.Index	7.3	0.69	0.47	0.001
L.Middle	8.2	0.72	0.44	0.001
L.Ring	7.8	0.79	0.41	0.001
L.Little	6.0	0.50	0.30	0.003

Table 4: Mean, Standard Deviation (SD), Regression Coefficient (r) and Significance value (P) for finger length of Right hand (R) among females population.

Fingers	Mean(cms)	SD	r	P
R.Thumb	5.8	0.50	0.1	0.2
R.Index	6.5	0.53	0.5	0.001
R.Middle	7.2	0.54	0.58	0.001
R.Ring	6.7	0.53	0.53	0.001
R.Little	5.4	0.59	0.5	0.001

Table 5: Mean, Standard Deviation(SD), Regression Coefficient(r) and Significance value(P) for finger length of Left hand (L) among females population.

Fingers	Mean(cms)	SD	r	P
L.Thumb	5.7	0.52	0.16	0.04
L.Index	6.5	0.63	0.24	0.001
L.Middle	7.2	0.54	0.29	0.001
L.Ring	6.6	0.54	0.23	0.004
L.Little	5.3	0.54	0.23	0.003

Table 6: Regression Equations for calculating Stature (in cms) from finger lengths of Males included in the study.

	Right hand	Left hand
Height =	173.4+0.08 x right thumb length	173.7+0.09 x left thumb length
Height =	143.6+0.33 x right index finger length	136.5+0.43 x left index finger length
Height =	137.9+0.36 x right middle finger length	136+0.38 x left middle finger length
Height =	143.38+0.31 x right ring finger length	142.2+0.33 x left ring finger length
Height =	142.9+0.41 x right little finger length	145.3+0.37 x left little finger length

Table 7: Regression Equations for calculating Stature (in cms) from Digit lengths of Females included in the study.

	Right hand	Left hand
Height=	94.05+1.07 x right thumb length	145.6+0.18 x left thumb length
Height=	91.002+1 x right index finger length	141.8+0.22 x left index finger length
Height=	81.7++1.02 x right middle finger length	140.8+0.21 x left middle finger length
Height=	90.4+0.97 x right ring finger length	138.9+0.26 x left ring finger length
Height=	106.7+0.9 x right little finger length	142.9+0.24 x left little finger length

DISCUSSION

Tyagi K *et al..*[5], Danborno B *et al..*[6], , Verghese AJ *et al..*[7] , Rastogi P *et al..*[8], Shivkumar AH *et al..*[9] , Pramod Kumar *et al..*[10] and are the among few workers to correlate stature and finger length in various populations . In a study conducted by Rastogi P. *et al..* (2009) on 500 subjects in Manipal, it was proved that the middle finger length was significantly correlated with stature of an individual with correlation coefficient value of 0.696 in males right hand, 0.679 in males left hand, 0.549 in females right hand and 0.504 in females left hand. It was also concluded that there exists no statistical significant variation in measurements of right and left hand of an individual.[8] Pramod Kumar (2008) conducted a study on 200 medical students and staff of Mysore district (100 male and 100 female). The calculations revealed statistically significant correlation between stature and Ring finger length of both the hands. Pearson correlation for stature ad finger lengths was higher in females than males.[10] In the present study, mean height in males was found to be 171.73 + 5.01cms and in females, height was 154.34 +5.49 cms.(table 1) All the finger lengths of both right and left hand showed positive correlation with stature of an individual Among males, right and left thumb lengths had trivial correlation with stature of an individual. (r = 0.08 for right thumb length, r

= 0.07 for left thumb length). Rest of the finger lengths showed moderate correlation (r = 0.3-0.5) with stature. (table 2 and table 3) Even among females, right and left thumb length revealed trivial correlation and small correlation with the stature. Right hand finger lengths showed very high correlation (r = 0.5 – 0.7). Left hand finger lengths showed small correlation (r = 0.1 – 0.3) with stature. (table 4 and table 5) Linear regression equation were calculated for individual finger lengths.(table 6 and table 7)

CONCLUSION

A quantitative relationship between stature and various body dimensions are successfully established by researches in Forensic Anthropometry. The relationship can be of immense importance in various medicolegal cases. The anthropometric measurements differ in different sex and ethnic groups which are determined by genetic and environmental factors suggesting the need for different normograms for various populations. These type of studies are of anthropological importance. If the study is repeated on the same population group after several years, it will help to identify the micro evolutionary changes. It also helps in forensic analysis in establishing the identity of the person in question, where stature is one of the primary characteristics of identification.

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