

Original Research Paper

Determination of Stature by Palm Length in Central India

¹Atul S. Keche, ²Prakash M. Mohite, ³Harsha A. Keche

Abstract

Different parameters like Age, Sex, Race, Stature etc are used for identification from fragmented remains. Identification of an individual from mutilated or distorted or fragmented remains is a difficult task. Almost every body part bears more or less constant relationship with stature. Similarly palm length also has a definite correlation with stature of an individual. Considering this fact the present study is based on measurement of palm length of boys and girls in the age group of 19-25 years belonging to the same geographical area. Measurements were analyzed statistically. Linear regression equations were derived and multiplication factors (16.94 for males & 17.51 for females) were calculated. The study shows that palm length bears a significant relation to stature and can be an important tool for stature estimation in medico-legal cases & anthropology. Also it can be shown that the measurement and formulae for males and females are different. That is formula which is obtained for one sex cannot be applied to the other sex for getting the desired results.

Key Words: Identification, Palm length, Stature, Multiplication factor, Linear regression

Introduction:

Anthropometry is being widely used in medical sciences for identification. Establishing identity of an individual from mutilated, decomposed & amputated body fragment is important now a days due to natural disasters like earthquakes, tsunamis, cyclones, floods and man-made disasters like terror attacks, bomb blasts, mass accidents, wars, plane crashes, mutilation to conceal identity etc. [1]

The use of anthropometry in the field of forensic science dates back to 1882 when Alphonse Bertillon, a French police expert invented a system of criminal identification based on anthropometric measurements. [2] Different parameters like Age, Sex, Race, Stature etc. are used for identification. Different studies have shown that stature can be estimated from length of long bones, fragmentary remains, spine, metacarpals, metatarsals, skull, scapula etc. [3]

Corresponding Author:

¹Associate Professor,
Dept. of Forensic Medicine,
ACPM Medical College, Dhule, Maharashtra- 424001
E-mail: dratul73keche@rediffmail.com

²Prof. & HOD, Dept. of Forensic Medicine,
JNMC, Sawangi, Wardha- 442004

³Assoc. Prof, Dept. of Anatomy,
ACPM Medical College, Dhule,
Maharashtra- 424001

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Stature is used for constructing a biological profile that assists with the identification of an individual. So far, little attention has been paid to the fact that stature can be estimated from hand impressions left at scene of crime. [4] Every body part bears more or less constant relationship with stature. The relationship between specific body dimensions/proportions can be used to help solve crimes in the absence of complete evidence. [5]

Sometimes even intact hand might be available for examination, where the need arises to derive formula for stature using a portion of hand or at least intact palm. [6]

Also when stature cannot be measured directly due to deformity like kyphosis, lordosis and scoliosis, contractures or missing legs, the original stature of these people can be estimated by multiplying the dimension of hand lengths of these sexes or ethnic groups with respective multiplication factor. [2]

Palm length also has a definite correlation with stature of an individual. Also India is a country with variable geography, race, environment and climatic conditions, which influences the stature. The dominance of hand does not have a significant role to play while estimating stature from palm length or hand length. [7] Considering these facts the present study is based on measurement of palm length of boys and girls belonging to the same geographical area.

Here we have also determined multiplication factor & regression equation for

estimating stature from palm length. Although some studies say multiplication factor are less reliable than regression equations. [8]

This study may prove useful to doctors/ forensic experts to establish stature in mutilated bodies especially when forearm & hand is intact or if forearm and palm is intact and most of the other parts are damaged or in conditions where only a part of the hand is brought for examination.

Materials and Methods:

This was an observational cross sectional study conducted in the department of Forensic Medicine, JNMC, Sawangi (Meghe), Wardha over a period of 2 years. The study group included 230 normal adult (110 males and 120 females) medical students admitted to JNMC, Wardha in the age group of 19-25 years who were born and brought up in central India.

Non-resident Indians, students from other regions, students with bony deformities, students with poorly defined distal flexion crease of forearm and proximal flexion crease of middle finger and left handed persons were excluded from the study. After obtaining informed written consent, physical parameters were recorded.

Stature was measured by stadiometer (vertical metallic height measuring instrument) graduated in centimeters. The subject was in standing posture with bare foot with head in eye-ear-eye (Frank fort) plane. Palm length was measured using Vernier caliper (0-300mm, Photo 1) from midpoint of distal transverse crease of forearm to mid-point of proximal flexion crease of middle finger. (Photo 2)

Photo 1: Vernier Caliper

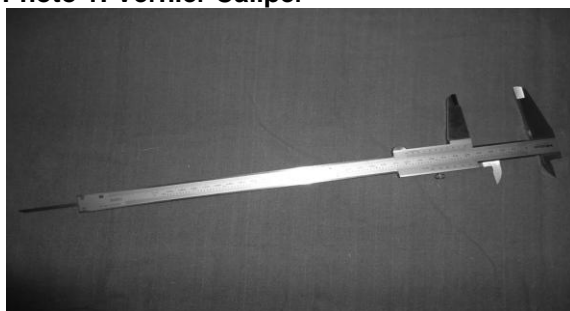


Photo 2: Measurement of Palm Length



The measurements were taken after the supinated hand & forearm were placed on flat, hard & horizontal surface with fingers extended & adducted. [6] Analysis was done using SPSS (statistical programme for social sciences) computer programme version 17.0 to calculate linear regression equations and multiplication factors. All the measurements were taken between 2 to 4 pm and by the same observer to avoid any diurnal & subjective variations.

The significance of results was tested using Z-test. P-value of less than 0.05 was considered as significant. Regression equation, correlation coefficient, range, mean, standard deviation and multiplication factors were calculated.

Observation & Results:

In our study Stature in males varied from 154.10 to 185.00 and stature in females varied from 146.30 to 180.50 cm. Mean height for male was 171.12±6.26 and for female it was 159.43±5.87. By using z-test statistically significant difference was found in height between male and female. (Table 1, Graph 1)

Present study showed that Palm length in males varied from 8.80 to 11.70 and in females varied from 7.80 to 11.10 cm. Mean palm length for male was 10.10±0.54 and for female it was 9.10±0.53.

By using z-test statistically significant difference was found in palm length between male and female. (Table 2, Graph 1)

In this study Significant positive correlation was found between palm length and height in males and in females also, which means that as palm length increases height also increases proportionately. Palm length showed higher degree of correlation with stature in males than in females.

The Correlation coefficient was 0.69 in central Indian males and 0.49 in central Indian females (Table 3, Graph 2, Table 4, and Graph 3). This suggests formula for one sex cannot be applied to estimate stature for the other sex.

Linear regression equations are derived for the estimation of stature for the study group for both the sexes. (Table 3 & Table 4) Estimated height can be calculated by using above line of regression 1 for males and line of regression 2 for females when we know the palm length of the respective person (male/female). Coefficient of determination ($R^2 = 0.49$ for males and 0.24 for females) were determined. Standard error of estimate was 0.41 for males and 0.46 for females.

Multiplication factors are also derived for the estimation of stature for the study group for

both the sexes. Multiplication factor for males is 16.94 and for females are 17.51. (Table 5)

Discussion and Conclusion:

The reviewed literature shows that stature is influenced by many factors like genetics, nutrition, environment, climatic conditions, races, gender, age etc. The acceptance of relationship between stature and other body dimensions has led to many investigations between stature and length or width of particular components.

Such relationships have proved to be extremely useful to forensic scientists, anatomists and anthropologists. In the present study also an attempt was made to find out stature from palm length in the central Indian population. In our study, stature in males varied from 154.10 to 185.00 and stature in females varied from 146.30 to 180.50 cm.

Mean height for male was 171.12 ± 6.26 and for female it was 159.43 ± 5.87 . In the present study males had significantly higher values of stature than females. Similar findings were also shown in other studies. [3, 6-13]

Palm length in males varied from 8.80 to 11.70 and palm length in females varied from 7.80 to 11.10 cm. Mean palm length for male was 10.10 ± 0.54 and for female it was 9.10 ± 0.53 . In the present study males had significantly higher values of palm length than females.

Similar observations were noted by Rastogi et al. [6] This suggests that there is genetic difference between male and female. This also suggests the fact that males are constitutionally taller than females which explains this difference. There by it is also suggested that the formula for one sex cannot be applied to estimate stature for the other sex. [6, 7, 13] This correlates with our study.

In our study we found statistically significant correlation between palm length and stature in males and in females also. In study by Chikhalkar et al, forearm length showed highest degree of correlation with stature. [1] Other studies also showed that hand length is more useful in estimating the stature than hand breadth, foot length or foot breadth. [3, 7]

Study by Sanli et al also showed significant relationship between hand length and stature. [5] Jasuja OP et al has shown that statistically significant correlation exists between hand length or palm print and stature. The prints if available at the scene or actual measurements can be used for stature estimation. [10] In other studies significant correlation was found between hand length & stature. [14]

In our study correlation coefficient was 0.69 in central Indian males and 0.49 in central Indian females. Higher correlation was found between stature & palm length in males than in females. The correlation coefficients between stature and palm length were found to be statistically highly significant.

Same were the findings in the study by Srinivasa Reddy P et al. [15] Study by Rastogi et al showed correlation coefficient ranging from 0.59 to 0.62 in males and 0.63 to 0.68 in females, showing higher degree of correlation between stature and palm length in females. Study by Sanli et al showed higher coefficient of correlation between hand length and stature in males than in females. [5]

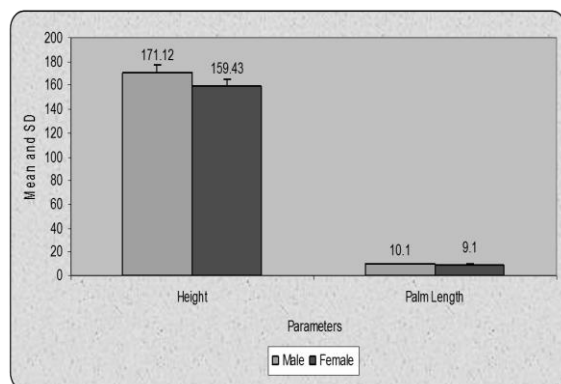
Similar findings were noted by other studies, where they found that when the hand lengths were compared to height, the relationship was stronger in males than in the females. [3, 11, 14] In our study, the multiplication factor for estimation of stature from palm length for females is 17.51 and for males is 16.94. The study conducted by Rastogi et al shows the multiplication factor 16.42 to 16.49 for females and 15.75 to 15.92 for males. Thus multiplication factors are slightly more in our study.

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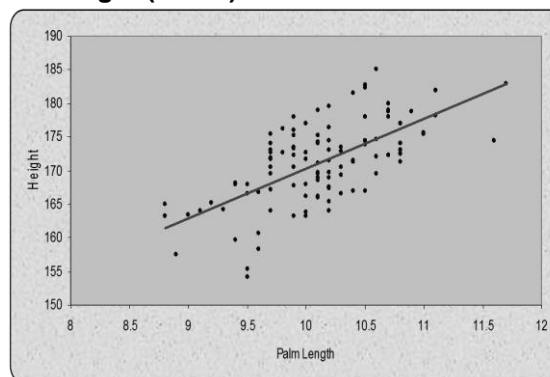
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Graph 1: Gender Wise Comparison of Parameters



Graph 2: Correlation between Palm Length and Height (Males)



Graph 3: Correlation between Palm Length and Height (Females)

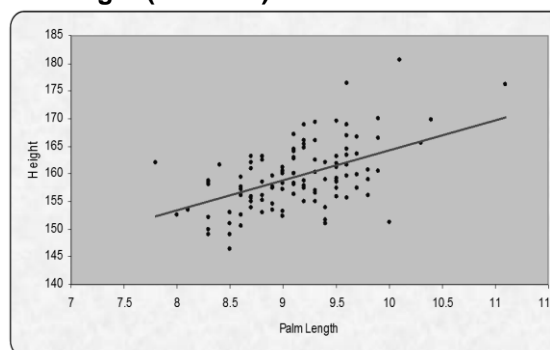


Table 1: Stature in Central Indian Population

Gender	N	Mean	Std. Deviation	Minimum	Maximum	p-value
Male	110	171.12	6.26	154.10	185.00	0.000, S
Female	120	159.43	5.87	146.30	180.50	

Table 2: Palm length in Central Indian Population

Gender	N	Mean	Std. Deviation	Minimum	Maximum	p-value
Male	110	10.10	0.54	8.80	11.70	0.000, S

Table 3: Correlation between Palm Length and Height (Males)

Variable	Mean	Std. Deviation	N	Correlation 'r'	p-value
Palm Length	10.10	0.54	110	-	-
Height	171.12	6.26	110	0.69	0.000 S, p<0.05

- Regression Equation is : Height = 96.34 + 7.39* Palm Length —(1)

Table 4: Correlation between Palm Length and Height (Females)

Variable	Mean	Std. Deviation	N	Correlation 'r'	p-value
Palm Length	9.10	0.53	120	-	-
Height	159.43	5.87	120	0.49	0.000S, p<0.05

- Regression Equation is : Height = 110.05 + 5.42* Palm Length—(2)

Table 5: Multiplication Factor for Palm Length in Central Indian Population

Gender	Multiplication factor	Standard deviation	p-value
Male	16.94	0.70	Z value=5.57, p=0.000,S