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Original Article

Study of correlation between Hand Length and Height

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Abstract:

Introduction: Height is important for personal identification. Prediction of height can be done from incomplete skeletal remains or from the mutilated or amputed limbs or parts of limbs in decomposing unknown human remains in cases of murders, accidents or natural disasters. Hand length is a proxy indicator of height. Height can be derived from hand length using regression equation. It is useful in medico-legal cases.

Objective: To find out the relationship between Hand length and Height to show if height could be predicted using hand length measurements.

Methods: The present study was conducted on 245 healthy individuals(178 males and 67 females) with ages between 18-21 years studying in first year in Medical College Kolkata. All the individuals were measured for Height and Hand Length on right and left side. The data thus obtained was computed statistically for deriving the regression equations.

Observation and Results: Regression equations were derived for male and female individuals and for right and left hand separately by which estimation of height is possible using the value of hand length. Height and hand length was more among male individuals than female individuals.

Conclusion: The results indicate that hand length provides precise means of estimating the height of an unknown individual. This study will be useful for anatomists, anthropologists and forensic experts.

Key words: Height, Hand Length, Regression Equations

Introduction:

Height is an useful anthropometric parameter for personal identification of an individual. Growth and nutritional status of an individual can also be assessed from height. Anthropometric relationship between body segments and the whole body is therefore useful for forensic scientists, anatomists, human biologists, anthropologists, nutritionists and physicians. The Vitruvian Man drawn by Leonardo Da Vinci indicate the relationship between body segments and height. According to it the ratio of Hand length and Height is 1:10. Estimation of height from incomplete skeletal and decomposing human remains has always been a challenge for forensic experts in personal identification in the events of murders, air plane crashes, train and road traffic accidents and natural disasters. India is known to be quite unique for human diversity in anthropometry [1]. There are inter-racial and inter-geographical differences in measurements and their correlation with stature[2]. So there is concern regarding the accuracy of the use of population specific formula on other human populations[3]. Height is affected by genetics, environmental factors, onset of

puberty, activity of person, nutritional status etc. Height varies among different sexes, different age groups, different race and different ethnic groups.

Aims and Objectives:

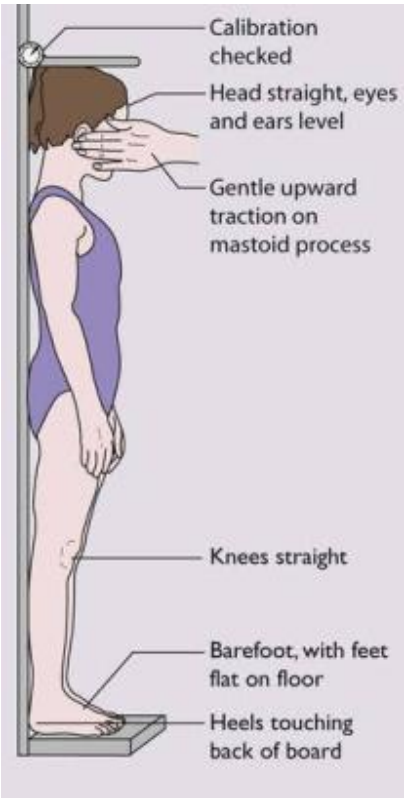
The purpose of this study is to analyze the anthropometric relationship between Hand Length and Height and derive regression equation to estimate Height from Hand length in eastern Indian population.

Materials and Methods:

A descriptive cross sectional study was done over a period of 1 year on 245 first year medical students of Medical College Kolkata, India. Height and Hand length of 178 male and 67 female medical students between 18-21 years of age were recorded after obtaining oral consent. They were without any physical or mental deformity and from different socio-economic background.

The measurements were recorded by the same person to minimize the personal errors in methodology. Furthermore the measurements were taken at a fixed time (11am to 1pm) to eliminate discrepancies due to diurnal variation.

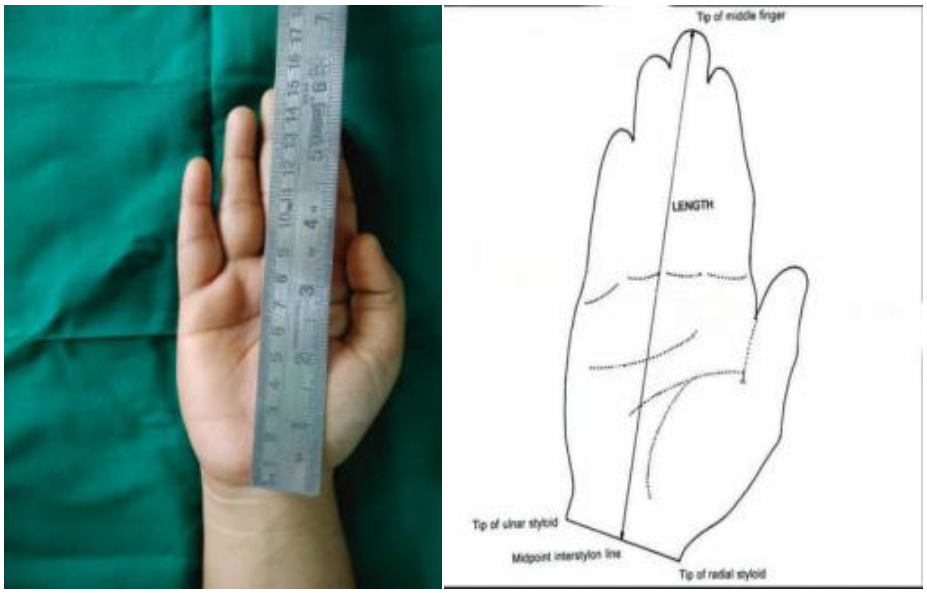
Height measurement: The Standing Height was measured from the sole of the feet to the vertex of the head. Height was measured using a stadiometer with subject standing erect on horizontal resting plane bare footed having the palms of the hands turned inward and the finger pointing downward.



Hand Length Measurement:

Hand Length was taken as the linear distance from the tip of the middle finger (dactylion) to the first wrist crease next to the palm (mid-stylion line). The palm faced upward placed flat on a hard horizontal surface and the fingers

were extended and adducted during measurement[4].Care was taken to see that there was no abduction or adduction at the wrist joint i.e. the forearm was directly in line with the middle finger[5]. Hand lengths were taken independently on left and right side.



Results were analysed using SPSS Statistical Package (Version 26).

Observations and Results:

Table 1: Measurements of Height and Hand length in males

Measurements	Mean Value(cm)	Standard Deviation(cm)	Maximum Value(cm)	Minimum Value(cm)
Height	167.65	6.42	184.40	150.00
Hand Length (Right)	18.31	0.90	20.20	15.40
Hand Length (Left)	18.36	0.89	20.60	15.60

Table 1 indicates that :

a) Mean height of male individuals were 167.65cm with standard deviation of 6.42cm.

b) Mean Left Hand Length of the males was 18.36cm with a standard deviation of 0.89cm whereas mean right hand length of the males was 18.31cm with standard deviation of 0.90cm.

Table 2: Measurements of Height and Hand length in females

Measurements	Mean Value(cm)	Standard Deviation(cm)	Maximum Value(cm)	Minimum Value(cm)
Height	154.84	5.82	171.00	143.70
Hand Length (Right)	16.65	0.80	18.90	15.00
Hand Length (Left)	16.67	0.77	18.90	14.90

Table 2 indicates that :

a) Mean height of female individuals were 154.84cm with standard deviation of 5.82cm.

b) Mean Left Hand Length of the females was 16.67cm with a standard deviation of 0.77cm whereas mean right hand length of the females was 16.65cm with standard deviation of 0.80cm.

Table 3: Regression Equation for the estimation of Height from Hand Length in males

Measurements	**Hand Length(Right)**	**Hand Length(Left)**
Regression Equations	HT=70.154+5.324*HLRT	HT=70.574+5.287*HLLT
Correlation Coefficient (r)	0.744	0.734
P Value	<0.0001	<0.0001
Standard Error of estimate	4.27	4.37

HT=Height, HLRT=Right Hand Length, HLLT=Left Hand Length

Table 4: Regression Equation for the estimation of Height from Hand Length in females

Measurements	**Hand Length(Right)**	**Hand Length(Left)**
Regression Equations	HT=98.142+3.405*HLRT	HT=90.037+3.886*HLLT
Correlation Coefficient (r)	0.468	0.514
P Value	<0.0001	<0.0001
Standard Error of estimate	5.18	5.03

HT=Height, HLRT=Right Hand Length, HLLT=Left Hand Length

Table 3 and 4 shows regression equations for hand length of male and female of both sides respectively. Using these regression equations Scatter Plots have been drawn below as figures 1 to 4 .

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Figure 1: Regression of Height on Right Hand Length for males

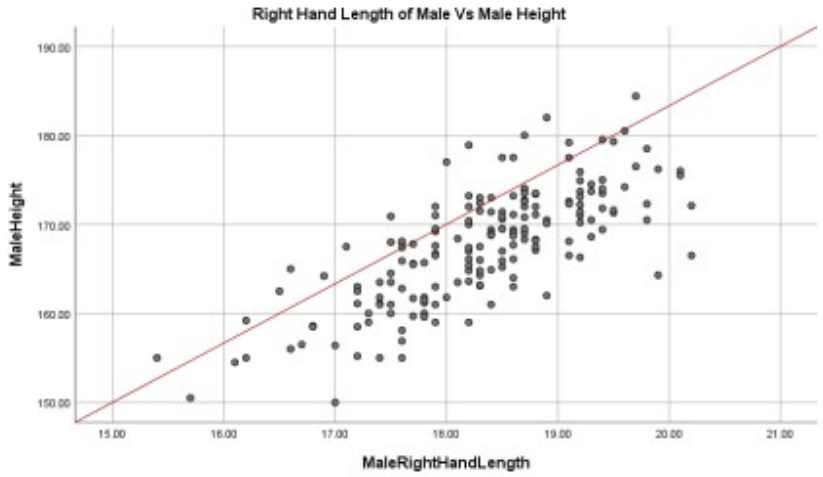

Figure 2: Regression of Height on Left Hand Length for males

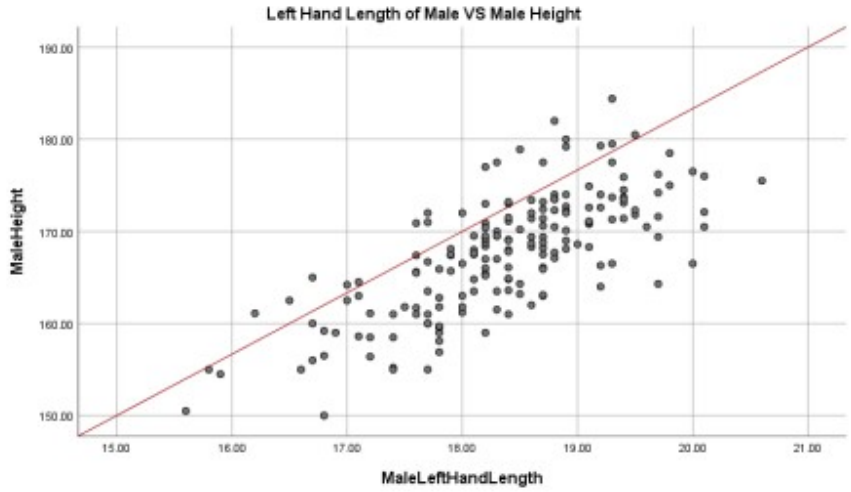

Figure 3: Regression of Height on Right Hand Length for females

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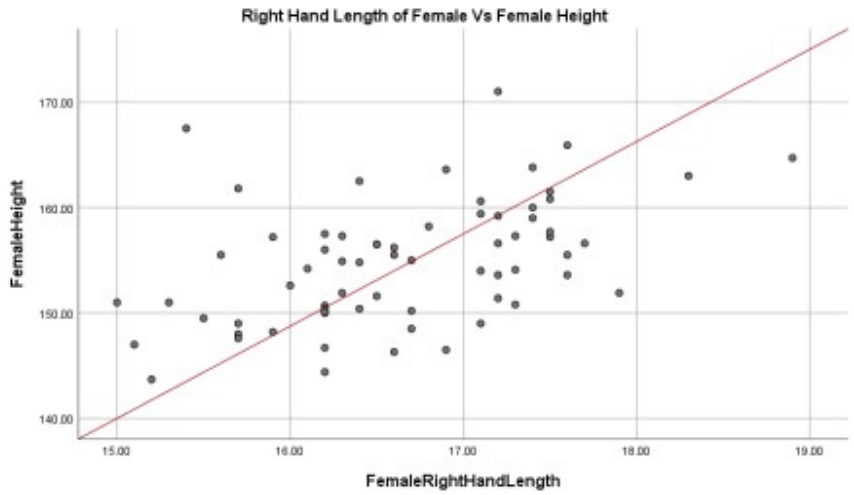
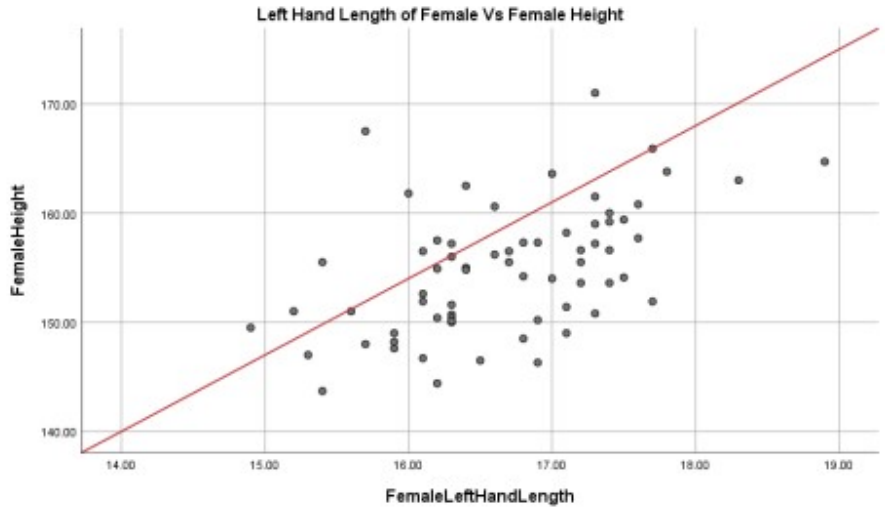


Figure 4: Regression of Height on Left Hand Length for females



Discussion:

In present study Height ranged from 143.7cm to 171.0cm in female individuals with mean of 154.84cm±5.82cm and among male individuals Height ranged from 150.0cm to 184.4cm with mean of 167.65cm±6.42cm.

Hand Length of male individuals ranged from 15.6cm to 20.2cm with mean of 18.31cm±0.90cm on right side and 18.36cm±0.89cm on the left side.

Hand Length of female individuals ranged from 14.9cm to 18.9cm with mean of 16.65cm±0.80cm on right side and 16.67cm±0.77cm on the left side.

In the present study a significant correlation of Height with Hand Length was observed in both sexes and for both right and left hands with 'r' (Correlation Coefficient) value for males 0.744 on right side & 0.734 on left side and for females 0.468 on right side & 0.514 on left side.

Measurements of left side were found to be greater than the measurements of the right side but the difference was marginal and statistically insignificant. Height and Hand Length were more in males as compared to females.

Figure 5: Multiple Bar Diagram represents gender wise comparison of variables

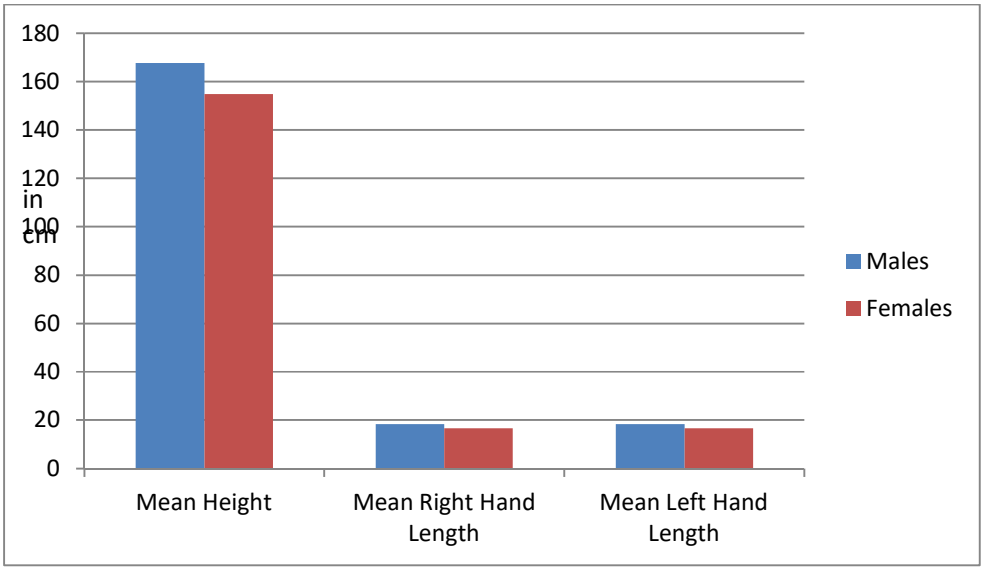


Table5: Different Studies of Correlation between Hand Length And Height

Study	Year	Sample Size	Males	Females	Parameters used
Sunil et al[6]	2005	150	75	75	H,HL
Nanayakkara et al[5]	2009	258	140	118	H,HL
Anwesha Pal et al[3]	2014	235	125	110	H,HL
Jitendra P Patel et al[8]	2014	150	72	78	H,HL
Wakode NS et al[9]	2015	200	94	106	H,HL
Sajad Hamid et al[10]	2015	150	100	50	H,HL
Sahana et al[11]	2015	300	-	-	H,HL,HB
MS Supare et al[12]	2015	400	219	181	H,HL.HB
Subashri A et al[13]	2016	100	40	60	H,HL
Shankar GS et al[14]	2017	220	132	88	H,HL

H=Height, HL=Hand Length, HB=Hand Breadth

A statistically significant positive correlation between Hand Length and Height has been observed in both sexes by Nanayakkara et al and Sunil et al who have concluded that hand length is a precise tool to estimate stature of an unknown person. Anwesha Pal et al have reported a positive correlation between stature and hand length and have found multiplication factor to be a more reliable tool than the regression equation for estimation of Height with the help of hand length in Eastern Indian Population.

Jitendra P Patel et al and Wakode NS et al have reported that hand length strongly correlated with stature and linear regression equations derived can be used for estimation of stature reliably and accurately.

Sahana et al have concluded in their study that the right hand length was the most reliable and accurate hand dimension to estimate stature in population of interior of North Karnataka. MS Supare et al and Subashri A et al have found a strong relationship between the stature and hand length in their study.

Table6: Comparison of Present Study with previous studies:

Study	Year	Sample Size	Parameters Studied	Mean Height(cm) [Male/Female]	Mean Right Hand Length(cm) [Male/Female]	Mean Left Hand Length(cm) [Male/Female]
Nath S et al[15]	1990	302	H,HL	155.87(Female)	17.344(Female)	NM
Seth V et al[16]	2000	204	H,HL	155.87(Female)	17.344(Female)	NM
Sunil et al[6]	2005	150	H.HL	169/158	19.5/18.1	NM
Ilayperuma I et al[5]	2009	258	H,HL	170.14/157.55	19.01/17.62	NM
Chikhalkar et al[17]	2009	300	H,W,FAL,HL,HB,FL,FB	167.26	18.93	18.93
Patel et al[18]	2012	273	H,FL,FB,HL.HB,AS	164.59	17.75	NM
Manpreet Kaur et al[19]	2013	400	H,HL	175.98/160.91	18.80/18.54	NM
Kavyashree et al[20]	2015	294	H,HL,HB	NM	18.81	18.74
Tandon et al[21]	2016	497	H,HL,HB,FL,FB,DL	172.7/157.1	19.3/17.3	NM
Shankar et al[14]	2017	220	H,HL	NM	18.21/18.81	18.35/18.82
Ibrahim et al[22]	2018	350	AS,HL,PL,HB,FL	175.44/158.9	20.11/18.65	20.75/18.6
Charmode SH et al[23]	2019	1000	H,HL,HB	161.88	18.90/17.18	18.96/17.11
Present Study	2019	245	H,HL	167.65/154.84	18.31/16.65	18.36/16.67

H=Height, HL=Hand Length, HB=Hand Breadth, W=Weight, FAL=Forearm Length, FL=Foot Length, FB=Foot Breadth, PL=Palm Length, AS=Arm Span, NM=Not Measured

So mean Height in present study corroborate with mean height of Sunil et al and Chikhalkar et al for male and with Nath S et al, Sethi V et al for female individuals and less than other previous studies.

Mean Hand Length in present study corroborate with Shankar et al, Kavyashree et al, Chikhalkar et al, Charmode SH et al, Manpreet Kaur et al for males & the values are more than Patel et al but less than other previous studies.

For female individuals mean hand length of present study corroborate with Nath S et al and it is less than other previous studies.

By applying the regression equations Height can be estimated within error of 4.27cm and 4.37cm for right and left side respectively in males while in females it is 5.18cm and 5.03cm for right and left side respectively.

Conclusion:

It was observed from the present study that there was a strong positive correlation between Height and Hand Length indicating a statistically significant relationship between the two parameters. But there was no significant difference on right and left sides. The regression equations derived for determination of Height from Hand Length would be beneficial for use in an unidentified fragmentary or mutilated part of upper limb especially hand within the standard error of estimate. However further analysis revealed that Hand Length alone is not sufficient for accurate prediction of Height. Different parameters have been adopted to predict height which include arm-span, half-span, foot length, hand length, knee height, ulna length, finger length etc. In the present study age range of only 18 to 21years were considered and only healthy individuals were included. Hence the data may not be applicable for other age groups especially children or older people or individuals with deformities. Anthropometric measurements in living and deceased individuals may practically differ. Environmental factors, genetic factors, physical activity, nutritional status influence the size of the bones and that in turn affect the height of an individual. This can explain the difference in findings from the different parts of the country(north, south, east, west or central India) or in different race or ethnic groups. The result of this study can be used as baseline information for further population based study in the eastern part of India. This study is useful for anthropologists, forensic experts, nutritionists and physicians for estimating the height of adult individuals of eastern part of India of either sex by using either of hand.

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References:

1. Devi KVS, Udhaya K, Prabaharam J, Sastri D et al. Sexual dimorphism in hand dimensions- an anthropometric study in south Indian adolescents . NIBMS 2012;2(3):263-7
2. Chikhalkar BG, Mangaonkar AA, Nanandikar SD, Peddawad RG. Estimation of stature from measurement of long bones, hand and foot dimensions. J Indian and Forensic med 2010;32:329-31
3. Ilayperuma I, Nanayakkara G, Palahepitiya N. A Model for the length of forearm. Int. J. Morphol 2010;28(4);1081-6
4. Zafar U, Rahaman Su, Hamid N, Ahsan J, Zafar N. Correlation between height and hand size and predicting height on the basis of age gender and hand size. J Med Sci 2017;25(4)425-428
5. Ilayperuma I, Nanayakkara G, Palahepitiya N. Prediction of personal stature Based on the hand length. Galle Medical Journal, Vol 14: No 1,September 2009:15-18
6. Sunil, Dikshit PC, Aggarwal A, Rani M . Estimation of stature from Hand Length . J Indian Acad Forensic Med. 2005;27(4): 216-221
7. Pal A, Aggarwal P, Bharati S, Panda M, Datta I, Roy P. Anthropometric measurements of the hand length and their correlation with the stature in Eastern Indian population. National Journal of medical research. 2014;4(4): 303-305
8. Patel JP, Patel PG, Shah RK, Bhojak NR, Desai JN . Estimation of stature from hand length in Gujrat region . NHL Journal of Medical Sciences . 2014;3(1): 41-44

9. Wakode NS, Wakode SL, Ksheersagar DD, Tajane VD, Jachak AN . Prediction of stature based on measurement of hand length in Maharashtra region . Indian Journal of Clinical Anatomy and Physiology . 2015; 2(3): 131-135

10. Sajad H, Arsalaan FR, Qazi N, Shahnawaz H, Arif M . Association of hand length with height in medical students enrolled in SKIMS Medical College, India . Int J Anat Res. 2015; 3(1): 884-888

11. Sahana BN, BM Bannur, Sangeeta M . Stature Estimation from hand dimensions in north interior Karnataka staff of B.I.D.E. University . International Journal of Health Sciences & Research . 2015; 5(8) : 243-247

12. Supare MS, Pandit SV, Bagul AS . Estiation of stature from hand length and hand breadth in medical students of Maharashtra, India, Int J Health Allied Sci. 2015; 4(3) :154-159

13. Subashri A, MS Thenmozhi . Estimation of stature using hand length in South Indian region . Int. J. Pharm. Sci. Rev. Res. 2016; 40(1) :52-54

14. Shankar GS, Shankar VV, Radhika K, Shetty S . Correlation of Human Height with Hand Length in Indian Individuals. Int. J Anat Res 2017; 5(4.1) : 4478-4481

15. Nath S, Rajni and Chibber S . Reconstruction of stature from percutaneous length of upper and lower extremity segments among Punjabi females of Delhi . Indian J forensic Sci .1990; 4: 171-181

16. Sethi V, Nath S . Estimation of stature through Hand and Foot lengths among Punjabi females of Delhi . South Asian Anthropologist . 2000; 21(2): 67-71

17. Chikhalkar BG, Mangaonkar AA, Nanandkar SD, Peddawad RG . Estimation of stature from measurements of long bones, hand & foot dimensions . J I ndian Acad Forensic Med . 2009; 32(4) : 329-330

18. Patel PM, Tanna JA, Kaleke SD . Correlation between Hand length and various Anthropometric parameters . International Journal of Medical Toxicology and Forensic Medicine . 2012; 2(2) : 61-63

19. Kaur M, Singh B, Mahajan A, Khurana BS, Arora AK, Batra APS . Anthropometric measurements of Hand length for estimation of stature in North Indians . International Journal of Applied Biology and Pharmaceutical Technology . 2013; 4(2) : 251-255

20. Kavyashree AN, Bindurani MK, Asha KR . Determination of stature from hand dimensions in Indian population . Journal of International Medicine and Dentistry 2015; 2(3) : 209-214

21. Tandon R, Yunus SM, Faruqi NA, Asghar A . Measurements of Hand and Foot- A predictor of stature in adult human population of Uttar Pradesh . International Journal of Anatomy, Radiology and Surgery . 2016; 5(1) : 12-15

22. Ibrahim MA, Khalifa AM, Hassan HA, Tamam HG, Hgras AM . Estimation of stature from hand dimensions in North Saudi population, medicolegal view . Saudi J Forensic Med Sci . 2018; 1 : 19-27

23. Charmode SH, Kadlimatti HS, Pujari D . Correlation of Human Height with Hand Dimensions: A study in Young Populations of Central India. International Journal of Human Anatomy . 2019; 1(3) : 36-44

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