

Correlation Between the Stature and Hand Print Dimensions in Chennai Population.

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ABSTRACT

Personal identification plays an important role in medical - legal, and criminal investigations. The stature estimation is used for formulating a biological profile during the process of personal identification because stature is one of the major characteristics for the identification. Especially in mutilated and amputated limbs or body parts found at crime scenes. Sometimes handprints are the only evidence left at the scene; in those cases, anthropometric measurements of the handprints are used to estimate the stature. Hand prints are easily left at the crime scene. The present study aims to focus on the correlation between stature and handprint dimensions in the Chennai population. The stature and handprints were obtained from fifty males and fifty females who lived in Chennai, aged between 18 and 30 years. Following the measurement of stature, seventeen hand parameters were measured on the hand prints. The obtained data were analysed using (SPSS) statistical package for social science version 29.0, including descriptive statistics, regression analysis, and Pearson correlation coefficients, are used to determine the correlation between the stature and handprint measurement. This analysed data would obtain statistically significant means, and the suggested approach would be used in a crime scene investigation for estimating stature for the identification process.

Keywords: anthropometric measurements, biological profile, hand prints, Pearson correlation, stature estimation

INTRODUCTION

Forensic science is the application of scientific knowledge in the field of crime investigation or to examine the evidence that might be presented in the court of law. In India, forensic science is rapidly emerging, that includes numerous subfields, including forensic engineering, forensic odontology, forensic serology, forensic anthropology, and more. Forensic anthropology is the sub – field of forensic science, it is the study of human remains. The role of forensic anthropologist has evolved in this era; they are not only analyze the skeletal remains. They also do the analysis of living individuals and body parts of the cadavers for the identification process, which could help to narrow down the investigation process. The forensic anthropologist must include the ability to formulate a Osteobiography, including sex, age, ethnicity and stature. (1)

Anthropologists, medical scientists and anatomists for over a hundred years have used anthropometric techniques for stature and bone length estimation from unknown body parts and skeletal remains. These

techniques would help to determine the relationship between the various body dimensions (hand, foot, etc.) or bone length and stature of the subjects. This relationship can be utilized in some scenarios, such as the absence of complete evidence. (2)

Forensic anthropologist concentrates more on the human variations to determining the biological profile of unrecognized identities. Formulating a biological profile, stature reconstruction plays an important role that can provide useful data towards narrowing the potential identities.(3)

In that stature estimation plays an important role in the identification of an unknown dead body. Stature of a person is natural height in an upright position. Stature measurements are taken from the distance between the foot to the highest point of the head, which are taken without any footwear on the foot or accessory on head. Estimated stature is one of the biological parameters that may be compared with antemortem records to include or exclude possible identification of missing persons. The stature estimation can help to, identify the subjects in terrorism attacks, accidents and natural disasters involving mass fatalities.

Since 1899, pearson regression equation is widely used for determine the relationship between the stature and long bones. The development in the field of forensic anthropology required new procedures and alternative approaches for the evaluation of stature. (4)

There are two major methods of stature estimation in forensic investigations

- **Anatomical method** – it involves the direct reconstruction of stature by measuring and adding together the lengths or heights of a series of contiguous skeletal elements from the skull through the foot. The method should provide the most accurate estimation in living individuals.
- **Mathematical method** – it uses regression formula based on the correlation of individual skeletal elements to measure the stature. (5,6)

In some cases, the only evidence that may be available at the scene of crime is in the form of impressions from hand and feet.in these types of cases, the prints did not have the sufficient ridge characteristics to establish the identity. Many times, impressions of any of the phalanges or only the outline of the palm may be available. In these cases, the only possibility is to measure the outlines of the impression to estimate stature of the unknown person. (7)

Long bones were extensively used for this purpose: but long bones are often recovered in various states of fragmentation in forensic and archeological practice. Therefore, the excellent tables relating long bone measurements to stature might not help. So, the use of other methods becomes necessary for estimating stature in forensic investigations involving disarticulated or incomplete fleshed human remains. (8)

The past 20 years, many studies are conducted in the forensic anthropology to estimate the stature from different parts of the body (hand, foot, bones, etc.) The aim of the present study is to assess the reliability and accuracy of using measurements of hand impressions/ prints for the estimation of stature.

The prints are most commonly available at the crime scene. Hand prints are considered as an important element to estimate the stature. Several numbers of studies have presented the relationship between stature and hand and hand print among different population. The measurements of hand and hand prints showed the positive correlation with stature. (9)

The present study aims to the develop regression equation between measurements of hand print / impressions and stature.

REVIEW OF LITERATURE

1. Estimation of stature from hand impression, a nonconventional approach and this study was done by

Nasir Ahemad and Ruma Purkait (2011) saugor university, India. The study aims to focus, the stature can be estimated from the hand impressions. This study they collect samples from 503 men in Madhya Pradesh, the subject was ranged in 18 to 35 years. The hand prints are collected using ink and paper. Stature was measured by an anthropometer. These data were analyzed by using SPSS version 11.0 and the linear regression formula were calculated for various combinations to reach the best estimation. Testing the practical utility of these method on latent prints of 137 samples, statistically insignificant result was obtained. The present study is successful in reconstructing the stature from hand impressions, the studies in real life scenarios are suggested the method to be standardized for stature estimation.

2. The study of correlation between palm length, palm width and hand length with stature in the students and this research work was conducted by Abhishek Rai, Prachi Pawar, Mukund Khandelwal, et.al., (2023) from Vedantaa Institute of medical science and research center, Maharashtra, India. This study aims to determine the correlation between the hand dimensions and stature among the student population in Maharashtra at the age group of 20 – 23 years old. The samples are obtained at 101 males and 98 females. The stature was measured by using measuring tape and the hand dimensions are measured by using vernier caliper. Then the data was analyzed by SPSS version 12 and the linear regression formula was calculated. This study says that, the stature can be successfully estimated by only if the hand length or width measurement is available.
3. Estimation of stature from hand and handprint dimensions in a western Australian population this work was treated by Nur – Intaniah Ishak, Naomi Hemy, Daniel Franklin (2011). The aim of the study, is to access the reliability and accuracy of using anthropometric hand measurements for the estimation of stature and also focus on whether the stature can be estimated from the measurements of hand print impressions. They conducted this study as a comparative study. For this study the samples are obtained from 91 male and 101 female adult individual. Stature and hand dimensions are measured by anthropometric measurements. Seven measurements are taken on each hand and the same measurements are taken for hand impressions also. Data was analyzed by using SPSS 19.0 for determine the regression equation for stature estimation. This study shows the measurement error and reliability are well within accepted standards. This study provides the new standards for the estimation of stature in western Australin population.
4. Estimation of stature from hand and handprint measurements among some Egyptians using flatbed scanner which was done by Nagla M Salama (2013). This study, focus on the reliability and accuracy of using hand and handprint measurements for stature estimation among Egyptian. This study conducted on 100 males and 100 females in the age group of 21 to 45 years. For this research, they using flatbed scanner to scan the hand and then the scanned image converted into handprint impression image. Stature of each subject is recorded. The data was analyzed by using the SPSS to determine the correlation coefficient of two variables. Through this research they observed that, hand length showed the highest correlation with stature. The correlation coefficients are higher in females among males.
5. Stature estimation using hand and handprint dimensions among Malaysian population and this study was conducted by Nur Atirah G, Khairulroazidah M (2018). This study aims to focus estimated stature from hand and handprint dimensions among Malaysian population. The study conducted on 200 male and 200 female in the age group of 20 – 60 years old. The stature of each subject was measured in a standing position using stadiometer. Eight anthropometric measurements of both the hands were taken by using digital caliper and the palm prints are taken by using a ink and paper. The eight anthropometric

measurements taken by using digital caliper. All the measurements were recorded. The data was analyzed by using SPSS to determine the correlation between the stature and hand length. This study shows that the more correlation coefficient was higher in females compare to males. This study concluded as, the hand length is an important element for stature estimation because the strongest correlations were found between stature and hand length.

6. Estimation of stature from hand and phalange length which was done by Dr. O. P. Jasuja (2004). The study aims to focus the stature can be estimated from the hand and phalange length among the Punjab university students in the age group of 18 – 60 years old. Stature can be measured by using stadiometer. Hand length and phalange length was measured by using sliding caliper. Palm prints are taken by using ink and paper. The impressions are measured by using transparent scale. Data was analyzed by using SPSS. The significant statistical correlation is present among the stature and hand length measurements. The regression equation has been derived from these measurements and concluded that stature can be estimated from print measurements with a standard error of estimate ranging from 4.033 to 5.127 cm.
7. Stature reconstruction from hand print dimensions in an adult Nigerian student population this study was handled by Nandi Michael Ebe, Ibeabuchi Nwachukwu Mike, Olaleye Andrew, et.al., (2018). This study aims to focus, reconstruct the stature from handprint dimensions. For this study they obtained samples from the Nigerian adult population in the age group of 18 – 36 years old and it contains 230 sample in that, 100 males and 130 female subjects was chosen. Height was measured for every individual. The hand prints are taken using ink and paper. The data was analyzed by using SPSS software version 20. This study shows that the strong association between the stature and handprint variables. The research concludes that, the derived equations can only applicable for an adult Nigerian population.
8. Estimation of stature from hand and handprint dimensions – positional variations in real crime scene situations and this research work was done by Kewal Krishan, Tanuj Kanchan, Magdy A. Kharoshah (2015). The aim of the study is, estimation of stature from handprint and palm prints may easily available at the crime scene this study utilize the prints recovered from the scene may help in the identification of the criminal. This study deals with the different dimensions of handprints at various positions for stature estimation. In this paper they told some real crime scene situations. In that they told, about the latent prints and the using appropriate methods to developed the prints, then the measurements are taken that prints. These measurements are compared with the previous records or criminal profile identify the individual. The stature estimation from handprints is help to sort out the particular individual from pool of criminals.
9. Hand and handprint measurements in the estimation of stature in a Sri Lankan Population was carried out by Nanayakkara. D, Nawarathna,L.S, Nandsena. S, et.al., (2021). This study was conducted to generate the sex – specific simple and multiple regression models for the estimation of stature using hand and handprint measurements in Sri Lankan population. The sample comprises 51 males and 66 females in the age range of 20 to 26 years old. Lin’s concordance correlation coefficient of reproducibility test was conducted prior to the data acquisition. Statistical analysis was performed using the SPSS version 21. The result of the study was, all the hand and hand print measurements showed significantly positive correlation with stature in both sexes. The highest stature prediction accuracy was shown by the multiple regression models derived from hand measurements.

10. Gender and height estimation from hand and handprint sizes in the Turkish Population this research work was done by Hacı Keles, Selim Cinaroglu, Fatih Cicek, et.al., (2023). The aim of this study is to determine the height and gender of the Turkish population with hand and hand print morphometric measurements. The sample size of the study consists of 600 Turkish population in the age group of 18 to 58 years old. 21 anthropometric measurements of hand and handprints were taken for each individual. The data obtained in the study were analyzed with the SPSS version 23. The regression equation was derived. It was determined that, men had higher values than women in all hand and handprint measurements. This research concludes that, hand and handprint measurements to determine height and gender.
11. Development of formulae to determine living stature using handprint and anthropometry of Tagalog people in the Philippines this work was treated by Tharmar Nataraja Moorthy, Ivan Nikkkimor Lao Dinglasa, Myrtati Dyah Artaria (2023). The study aims to focus on to develop the formulae for determining living stature using the handprints anthropometry of Philippines people. This study consists of 180 men and 180 women in the age group of 18 – 55 years old. Stadiometer is used to measure the height and digital caliper is used to measure the handprint. The data were statistically analyzed using regression analysis in IBM SPSS statistics for windows, version 26.0. The result of this analysis produced equations for determining stature using all the length measurements of the handprints. The study concluded the regression equations are used for determining stature based on the handprint measurements.
12. Estimation of stature from hand dimensions in Bengalee population, west Bengal, India this work was conducted by Amitava Pal, Sujaya De, Payel Maity, Prakash C, Dhara, et.al., (2015). The study aims to focus to determine the standard formulae for stature estimation from hand dimensions in Bengal population. The sample size of the study consists of 1662 adult Bengalee women aged between 20 – 40 years old. The measurements of hand and stature was taken by using standard anthropometry techniques. The data were analyzed using SPSS version 20.0 for determine the regression formulae for stature estimation. The derived equations were applied to the control group and the percentage difference between true stature control and estimated stature from 0.01% to 0.15%. The correlation coefficients between stature and all variables shows the positive and statistically significant. The hand length and palm length showed a better correlation with stature. This study concluded that, the hand dimensions can be used for stature estimate.
13. Estimation of stature from hand measurements and hand prints in a sample of Saudi population this study was treated by Maryna Kornieieva, Azza H. Elelemi (2016). This work aimed at studying the ethnic peculiarities of the population of Saudi Arabian population and to estimate stature using the measurements of hand and handprints. This study comprises, 200 subjects its include both the gender with in the age group of 17 – 26 years. Stature was measured by using stadiometer and the hand measurements are taken by using the sliding caliper. The data were analyzed with SPSS 11.0 software. According to this study, the stature and dimensions of the hand and handprints, were significantly higher correlation rate among males among then females. Statistical analysis, paired sample T – test, Pearson correlation analysis, and regression analysis were performed. This study concluded that obtained regression equations have a 1- 4 cm deviation when used for the stature estimation in the population from which the data have been obtained.
14. Predictive role of hand and foot dimensions in stature estimation this work was done by Abdi Ozaslan, Beytullah Karadayi, Melek O. Kolusayin, Ahsen Kaya, Huseyin Afsin (2012). This study aims to focus

on the stature can be estimation from hand and foot dimensions such as hand length, hand breadth, wrist breadth, foot length, foot breadth, and ankle breadth and it's also aimed to predict most useful variables and to perform formulas originated from those variables significantly correlated to stature. For this study was conducted on 356 volunteers having the age range of 20 - 51 years old people were lived in Turkey. Stature was measured by using Frankfort plane. Hand dimensions are measured by using standard measuring tape and sliding caliper. Foot dimensions are measured by using sliding caliper. The measurements obtained were statistically analyzed using SPSS 14.0. The result obtained through this research is males having more significant correlation was detected between all variables and stature. The best correlation coefficient was determined an individual for stature estimation as follows: in hand – hand length and in foot – foot length. The multiple linear regression formulas for stature estimation in both male and females living inn Turkey were gained from all variables.

15. Stature estimation from hand prints: a study in Rajasthan this work was conducted by Sangeeta Dey, Vijeta Choudhary and A.K. Kapoor (2015). This study aims to formulated regression equation to predict the stature from hand length and hand breadth in Rajasthan population. This study comprises 204 samples, who lived in Udaipur District at Rajasthan in the age group of 18 – 60. Ink method was used for obtained handprints. Stature of each individual was measured by using Anthropometer. The obtained data were analyzed by using SPSS software. It has been observed that hand length has come out as a better predictable variable in stature estimation. It can be said that stature estimation was gender specific in present study as it indicates that the parameters are more effective predictor in stature estimation for females than males.
16. Estimation of stature from hand dimensions: a study on sub-adult female Bengalee Hindu caste population, west Bengal, India this work was done by Kusum Ghosh, Diptendu Chatterjee, Arkopala Bose, and et.al., (2023). So many research works are done to estimate stature from hand and handprint dimensions but they are do in the adult population. Regression equation derived for adult population is not suitable for sub – adult population so that this study aims to focus on stature estimation from hand dimensions in sub adult population. This study conducted on 399 school going children in the age group of 10 to 14 years old. Stature and hand measurements are measured by standard anthropometric techniques the collected data were analyzed by SPSS. The regression formulae derived to estimate stature from hand dimensions in the sub – adult Bengalee.
17. Estimation of stature from hand and foot dimensions in a Korean population this work was handled by Wonjoon Kim, Yong Min Kim, Myung Hwan Yun (2018). This study aims to focus on, stature can be estimated from the hand and foot dimension in Korean population. The measurements includes hand length, hand breadth, foot length and foot breath and the measurements are taken by using standard anthropometric techniques. This study comprises 5195 samples. The obtained data was analyzed by SPSS 23.0 Software. The result showed that males had the highest correlation between the stature and hand dimensions.
18. Estimation of stature from handprint anthropometry of Malaysian Chinese for forensic investigation this work was conducted by T. Nataraja Moorthy and Tee Yi Yin (2016). The study aims to focus on, to determine the regression equation to estimate stature from hand print anthropometry of Malaysian Chinese. This study consists of 200 samples and the age ranged between 18 – 58. The collected data were analyzed by PASW statistic version 22. The linear regression equation was derived. This study shows that the males have the more significant correlation coefficient among then females.

19. Stature prediction model based on hand anthropometry this study is treated by Arunesh Chandra, Pankaj Chandna, Surinder Deswal, Rajesh Kumar Mishra, Rajender Kumar (2015). This study aims to focus on, the stature can be estimated from hand dimensions and the regression equation derived for stature estimation. For this study the sample size is 1540 right - handed industrial workers of Haryana in the age group of 18 – 62 years old. The measurements are taken by using standard anthropometric measurements. The data were analyzed by SPSS version 17 and it shows the positive correlation between the stature and upper limb dimensions. This result of this research indicates that stature can be determined using hand dimensions.
20. Stature estimation from hand anthropometric measurements in Bangladeshi population this work was done by Md. Asadujjaman, Md. Babor Ail Molla, Sk. Nahid Al Noman (2019). The study aims to focus on to determine the standard formula for estimating stature in Bangladeshi population from hand anthropometric measurements. This study comprises 150 males and 150 females in the age group of 18 – 60 years. The measurements are taken by using standard measuring tape and sliding caliper. The obtained data were analyzed by SPSS version 23. This study concluded that the estimation of stature from hand measurements is possible and reliable. Multiple regression models are more reliable than simple linear regression model.
21. Estimation of stature from hand dimensions of north and south Indians this work was conducted by Prateek Rastogi, K.R. Nagesh, K. Yoganarasimha (2008). The aim of the study is to predict the stature of a person using hand length and breadth. The study was conducted on 500 medical students aged between 20 -30 years old. The measurements are taken by standard anthropometric measurements. The obtained data were analyzed by using SPSS Version 11 and the t- test was performed. Multiple regression equation gives the better result then liner regression equations. This study concluded that hand length gives more accuracy result of stature estimation.
22. Estimation of stature from upper limb measurements of Sudanese adults this work was done by Altayeb Abdalla Ahmed (2012). The aim of the study was to assess the relationship between the upper limb dimensions and stature in Sudanese adults and to develop regression formula to estimate stature from these dimensions. The study comprises 200 subjects aged between 25 – 30 years old. The obtained data were analyzed by individual t- test, sex – specific simple and multiple linear regression models were used to estimate stature. This research shows that the positive correlation between the stature and hand dimensions and it concludes that multiple linear regression gives the better result for stature estimation. This study provides new forensic standard for stature estimation from hand dimensions in Sudanese adult population.
23. Estimation of stature from hand measurements in Thais this study was handled by Piti Laulathaphol, Montip Tiensuwan and Suda Riengrojptak (2013). This study aims to focus on the relationship between the stature and hand measurements and derive regression equation for estimation of stature from hand measurements in Thais population. The sample consisting of 100 subjects in the age group of 18 -26 years old. The measurements are taken by using stadiometer and sliding caliper. The collected data were analyzed by using SPSS version 18.0. This study shows that all the hand measurements of both sexes exhibits, positive and statistically significant correlation coefficients with stature. This study concludes that hand length measurements is the best element for stature estimation.
24. Prediction of stature from hand measurements this work was done by Adel Kamel Abdel Malek, AFAF Mohamed Ahmed, Sawsan ABDEL AZIZ EL Sharkawi and Nahed ABD EL Maksoud ABD EL HAMID (1989). This study aims to focus on the relationship between the stature and hand dimensions

- and to derive the formula for estimating stature from hand measurements in Egypt. The samples for this study is taken from 166 individuals in the age group of 18 – 23 years old, those who living in upper Egypt. The data were statistically analyzed to assess the relationship between the stature and hand measurements. Multiple regression equation was used for estimated stature.
25. Estimation of stature from hand dimensions in North Saudi population, medicolegal view this work was handled by Mahrous Abdelbasset Ibrahim, Athar Mohamed Khalifa, and et.al., (2020). The study aims to setup standard formula to estimate stature from hand dimensions in north Saudi. The study consists of 350 subjects in the age group of 20 – 30 years old. Stature and nine hand measurements are taken for this study. The obtained data were analyzed by SPSS version 22 .0. this study says that multiple linear regression equation was more reliable in stature prediction. This study provides the regression equation for stature estimation in adult Saudi
 26. Estimation of stature from hand and handprint measurements in a monoethnic Maldivian population this work was done by Ishan Mohamed, Mohamed Saleem, Mohamed Huri, Salina Hisham and et.al., (2020). This study aims to focus to evaluate stature from hand and handprint measurements in Maldives population, samples for this study is 191 males and 193 females. The measurements are taken using standard anthropometric measurements. The data were analyzed by SPSS 20.0. This study concluded that simple linear regression model provides more effective results and the hand length of hand and hand print measurements gives more significant results for estimating stature in Maldives populations.
 27. Stature and sex estimation from handprint measurements in population of Sharkia Governorate this study was treated by Somaya Tawfik Mohamed Aidy, Wafaa Fawzy Hussein, and et.al., (2020). This study aims to assess the feasibility of handprint measurements in estimation of stature and sex in the Sharkia Governorate. This study sample consist of 127 subjects. Hand prints are taken by using scanner and 21 measurements are taken. The data were analyzed by SPSS 20.0. this study concluded that the hand print measurements have the sexually dimorphic characteristics and the stature and sex can be estimated from handprint measurements.
 28. Use of hand and its corresponding print dimensions in stature estimation this work was done by Shrouk Mohmed Ali, Rania Kamal Hashish, Rehab Ibrahim Abdel – Karim, and et.al., (2022). The study aims to develop predictive regression equation for estimating stature from and hand and its corresponding print dimensions. The sample of the contains 150 participants, stature and seven dimensions of each hand and its corresponding print also measured for each subject. The data are analyzed. Then it's concluded that right hand and handprint dimensions have the strong correlation between the stature and this study proves that hand and its corresponding prints are used for estimating stature.
 29. Stature estimation from handprint measurements: an application to the medicolegal investigation this work was handled by Md. Asadujjaman, Md. Golzer Hossain, Md. Sohel Rana, and Md. Zahidul Islam (2021). This study aims to estimate the stature from different handprint measurements in Bangladesh population. This study comprises 200 samples. The stature and seven anthropometric measurements are taken by using standard anthropometric measurements. The were analyzed by SPSS 23.0. The result of this study shows that the right - hand print of women had most reliable variable for stature estimation. It concluded that the handprint measurements are used for stature estimation.

METHODOLOGY

3.1 Aim

The aim of the study is to analyse the correlation between the stature and hand print dimensions in Chennai population.

3.2 Problem statement

The research is conducted to estimate stature from hand impressions. Stature estimation plays an important role in the identification process. Previous work conducted in this field was to estimate stature from long bones, hand and foot dimensions. Hand impressions are easily left at the crime scene, so this study aims to utilize the hand impressions to estimate stature. This work could be helpful in forensic investigation to estimate the stature of an adult Chennai population.

3.3 Objective

- To measure the stature of the subjects
- To collect the hand print impressions from the willing subjects.
- To measure the eighteen parameters in hand impressions.
- To determine the correlation between the stature and hand impressions.

3.4 Need and significance of the study

Estimated stature from hand impressions is used to identify the unknown person, which helps to narrow down the investigation process. This study can be used in the field of forensic science to determine the stature of a person through hand prints. This study aims to determine the correlation between the stature and hand prints in adult Chennai population.

3.5 Ethical consideration

- Informed consent from all participants.
- Confidentiality of information (height, hand prints and other personal information)
- Voluntary participation.

3.6 Materials and methods

3.6.1 Research design

This study predominantly employed a quantitative research methodology.

3.6.2 Universe of the study

The research focus on the people, who lives in Chennai in the age group of eighteen to thirty years old.

3.6.3 Sampling method

The research employed a probability sampling in that, I'm using stratified sampling technique to select the participants. It's specifically targeting 18-30 years old peoples who lives in Chennai.

3.6.4 Sample size

The stature and hand prints were obtained from fifty males and fifty females, aged between 18 – 30 years old in Chennai population.

3.6.5 Inclusion criteria

The people selected for this study is, who are all between the age of 18 – 30 years of both gender (male and female) in Chennai, state of Tamil Nadu.

3.6.6 Exclusion criteria

The subjects exclude for this study, who all are under the age of 18 years and above the age of 30 years old. People who all are having hand deformity, injuries and scars in the palm region.

3.6.7 Sample collection

After taking informed consent from all the participants, the data collection procedure was started. The stature and hand impressions are collected from selected population.

3.6.8 Tools and techniques

Palm prints are collected using ink pad and a clean sheet of paper. Palm prints are taken after applying ink on both the hands of the subjects and ask them to place their hands on a clean sheet of paper. The hand impressions are measured by using measuring scale. It contains seventeen measurements.

The stature also measured for the same individual by using standard measuring tape. The stature of the person was measured from the horizontal floor to the vertex (highest point of the head) when the subject was standing in an Erect posture.

3.7 Data analysis

The data were subjected to statistical analysis using the statistical package for social sciences version 29.0 The data analysis includes descriptive statistics, regression equation and Pearson correlation

3.8 Limitations

- Difficulties in obtaining samples from 18 – 30 years old people in Chennai.
- Stature is measured by using measuring tape due to a lack of resources. So the measured stature has little variation from the actual stature.
- Participants may have been facing some difficulties while collecting the hand prints using an ink pad and flat surface paper.
- The accuracy of handprint measurements may be questionable because the hand print dimensions are measured using measuring scale.

Parameters	Side	No pf samples	Mean	Medium	Mode	Std. deviation	Minimum	maximum
stature	-	50	158.016	158.600	157.0	5.3335	144.3	169.0
Hand length	Left	50	16.508	16.600	15.4	.8298	15.0	18.9
	Right	50	16.466	16.500	16.5	.7663	14.8	18.2
Hand breadth	Left	50	7.334	7.300	7.2	.3978	6.4	8.3
	Right	50	7.354	7.300	7.3	.3950	6.4	8.3
Palm length	Left	50	9.050	9.100	9.5	.4983	7.8	10.5
	Right	50	10.620	9.100	9.5	11.3201	7.8	89.0
Thumb distal	Left	50	2.798	2.800	2.7	.1932	2.3	3.3
	Right	50	2.790	2.800	2.8	.2063	2.4	3.3
Complete thumb	Left	50	5.598	5.550	5.3	.3628	4.9	6.5

	Right	50	5.645	5.600	5.5	.3604	4.9	6.5
Index distal	Left	50	2.150	2.100	2.1	.1607	1.8	2.5
	Right	50	2.168	2.200	2.0	.1531	1.9	2.5
Index distal + middle	Left	50	4.382	4.400	4.6	.2701	4.0	4.9
	Right	50	4.392	4.400	4.4	.2473	4.0	4.9
Complete index	Left	50	6.684	6.600	6.5	.3899	5.9	7.4
	Right	50	6.686	6.700	6.8	.3747	6.0	7.4
Middle distal	Left	50	2.260	2.300	2.3	.2148	1.7	2.9
	Right	50	2.260	2.300	2.3	.2148	1.7	2.9
Middle distal + middle	Left	50	4.870	4.900	4.6	.3278	4.1	5.6
	Right	50	4.870	4.900	4.7	.3190	4.2	5.6
Complete middle	Left	50	7.484	7.500	7.9	.4501	6.7	8.7
	Right	50	7.476	7.500	7.8	.4552	6.7	8.7
Ring distal	Left	50	2.284	2.250	2.2	.1742	2.0	3.0
	Right	50	2.296	2.300	2.2	.1628	2.0	2.7
Ring distal + middle	Left	50	4.690	4.700	4.5	.2712	4.2	5.4
	Right	50	4.708	4.700	4.7	.2610	4.2	5.4
Complete ring	Left	50	8.046	6.850	6.4	8.0861	6.2	64.0
	Right	50	6.888	6.800	6.4	.4019	6.3	8.0
Little distal	Left	50	2.034	2.000	2.0	.1423	1.7	2.4
	Right	50	2.032	2.000	2.0	.1406	1.7	2.4
Little distal + middle	Left	50	3.824	3.800	3.7	.2512	3.4	4.4
	Right	50	3.826	3.800	3.6	.2284	3.4	4.4
Complete little	Left	50	5.606	5.600	5.5	.3449	5.0	6.3
	Right	50	3.826	3.800	3.6	.2284	3.4	4.4

Table 1: Shows the descriptive statistics of female palm prints.

Table 2: Shows the Pearson Correlation Coefficient and significance with stature and measured parameters of female left palmprints.

S. no	Parameters	No of samples	Side	Pearson correlation	Significance
1.	Hand length	50	Left	.480	<0.001
2.			Right	.509	<0.001
3.	Hand breadth	50	Left	.345	.006
4.			Right	.305	.016
5..	Palm length	50	Left	.306	.004
6.			Right	-0.175	.113
7.	Thumb distal	50	Left	.406	.002
8.			Right	.359	.005
9.	Complete thumb	50	Left	.206	.076
10.			Right	.271	.029
11.	Index distal	50	Left	.381	.003

12.			Right	.374	.004
13.	Index distal + middle	50	Left	.478	<0.001
14.			Right	.473	<0.001
15.	Complete index	50	Left	.517	<0.001
16.			Right	.512	<0.001
17.	Middle distal	50	Left	.217	.065
18.			Right	.296	.018
19.	Middle distal + middle	50	Left	.232	.005
20.			Right	.330	.010
21.	Complete middle	50	Left	.471	<0.001
22.			Right	.471	<0.001
23.	Ring distal	50	Left	.370	.004
24.			Right	.370	.004
25.	Ring distal + middle	50	Left	.449	<0.001
26.			Right	.449	<0.001
27.	Complete ring	50	Left	.443	<0.001
28.			Right	.449	<0.001
29.	Little distal	50	Left	.325	.011
30.			Right	.325	.011
31.	Little distal + middle	50	Left	.446	<0.001
32.			Right	.446	<0.001
33.	Complete little	50	Left	.333	.009
34.			Right	.333	.009

Parameters	Side	No pf samples	Mean	Medium	Mode	Std. deviation	Minimum	maximum
stature	-	50	172.146	170.000	170.0	8.4963	153.0	192.0
Hand length	Left	50	18.148	17.950	17.7	.9558	16.7	21.2
	Right	50	18.100	17.850	17.7	.9727	16.4	21.2
Hand breadth	Left	50	8.012	8.100	7.9	.8300	3.5	9.3
	Right	50	8.122	8.100	7.8	.5793	6.5	9.8
Palm length	Left	50	9.740	9.650	9.0	.5743	9.0	11.4
	Right	50	9.724	9.700	9.7	.5770	8.8	11.3
Thumb distal	Left	50	3.062	3.100	3.1	.2364	2.3	3.5
	Right	50	3.026	3.000	3.0	.2380	2.3	3.5
Complete thumb	Left	50	6.316	6.200	6.0	.4859	5.5	8.0
	Right	50	6.318	6.200	6.0	.4826	5.5	8.0
Index distal	Left	50	2.338	2.300	2.3	.1828	2.0	2.7
	Right	50	2.376	2.300	2.3	.1836	2.0	2.9
Index distal + middle	Left	50	4.812	4.750	4.7	.3237	4.2	5.6
	Right	50	4.812	4.800	4.8	.3629	4.1	5.7

Complete index	Left	50	7.418	7.300	7.3	.4910	6.6	8.7
	Right	50	7.308	7.300	7.3	.8071	2.9	8.9
Middle distal	Left	50	2.458	2.450	2.4	.1896	2.0	2.8
	Right	50	2.452	2.400	2.3	.1854	2.2	2.8
Middle distal + middle	Left	50	5.378	5.400	5.2	.3430	4.7	6.5
	Right	50	5.352	5.300	5.2	.3547	4.6	6.7
Complete middle	Left	50	8.400	8.350	8.1	.5360	7.5	9.8
	Right	50	8.364	8.300	8.3	.5416	7.5	9.9
Ring distal	Left	50	2.488	2.450	2.3	.2282	2.0	2.9
	Right	50	2.482	2.500	2.4	.2154	2.1	3.0
Ring distal + middle	Left	50	5.236	5.200	5.6	.3724	4.7	6.5
	Right	50	5.228	5.200	4.9	.3849	4.5	6.5
Complete ring	Left	50	7.780	7.700	7.8	.5686	6.7	9.6
	Right	50	7.740	7.700	7.7	.5813	6.4	9.5
Little distal	Left	50	2.292	2.300	2.3	.2009	1.9	2.7
	Right	50	2.286	2.300	2.3	.1818	1.9	2.8
Little distal + middle	Left	50	4.272	4.200	4.5	.3470	3.7	5.4
	Right	50	4.244	4.200	4.1	.3477	3.6	5.4
Complete little	Left	50	6.340	6.200	6.0	.4911	5.5	8.0
	Right	50	7.138	6.250	5.9	5.6160	5.4	45.9

Table 3: Shows the descriptive statistics of male palmprints.

Table 4: Shows the Pearson correlation coefficient and significance with stature and measured parameters in male palmprints

S. no	Parameters	No of samples	Side	Pearson correlation	Significance
1.	Hand length	50	Left	.737	<0.001
2.			Right	.767	<0.001
3.	Hand breadth	50	Left	.320	.012
4.			Right	.331	.009
5.	Palm length	50	Left	.695	<0.001
6.			Right	.736	<0.001
7.	Thumb distal	50	Left	.433	<0.001
8.			Right	.382	.010
9.	Complete thumb	50	Left	.350	.006
10.			Right	.386	.003
11.	Index distal	50	Left	.482	<0.001
12.			Right	.505	<0.001
13.	Index distal + middle	50	Left	.619	<0.001
14.			Right	.644	<0.001
15.	Complete index	50	Left	.591	<0.001

16.			Right	.379	.003
17.	Middle distal	50	Left	.522	<0.001
18.			Right	.475	<0.001
19.	Middle distal + middle	50	Left	.595	<0.001
20.			Right	.558	<0.001
21.	Complete middle	50	Left	.583	<0.001
22.			Right	.589	<0.001
23.	Ring distal	50	Left	.650	<0.001
24.			Right	.584	<0.001
25.	Ring distal + middle	50	Left	.684	<0.001
26.			Right	.641	<0.001
27.	Complete ring	50	Left	.603	<0.001
28.			Right	.629	<0.001
29.	Little distal	50	Left	.589	<0.001
30.			Right	.652	<0.001
31.	Little distal + middle	50	Left	.665	<0.001
32.			Right	.674	<0.001
33.	Complete little	50	Left	.678	<0.001
34.			Right	.483	.006

MAJOR FINDINGS

Female handprint findings:

- Hand length, Index distal + middle, complete index, complete middle, ring distal + middle, complete ring, little distal + middle, shows the P value <0.01, hence it depicts highest level of significance.
- Hand breadth, thumb distal, index distal, middle distal, middle distal + middle, ring distal, little distal shows the significant level of correlation between the stature and the mentioned parameters.
- Palm length, complete thumb, complete little shows a P value >0.05 hence there is no significant.

Male handprint findings:

- Correlation between the stature and hand length, palm length, thumb distal, index distal, index distal + middle, complete index, middle distal, middle distal + middle, ring distal, ring distal + middle, complete ring, little distal, little distal + middle, left complete little shows the P value <0.01 which depicts the strongest correlation with stature.
- Right – complete thumb shows the P value <0.05 hence the significant level of correlation.
- Hand breadth, left complete thumb, right complete little shows the P value >0.05 hence its no significant level.

According to this study, the correlation between the stature and measured hand prints parameters shows the significant level of correlation so that it can be used to calculate regression equation for stature estimation from hand prints among the Chennai population.

Males have larger hand dimensions than females. Males have the most significant level of correlation between the stature and the handprint dimensions when compared with females.

DISCUSSION

Sex, age, ancestry and stature are the four main attributes used in forensic investigation for identification of unknown person or unidentified bodies or remains. Stature estimation plays an important role in identification of dismembered body parts or remains. Anthropometric techniques are commonly used by anthropologist and medical scientists to estimate body size for the purpose of identification. There has been a little attempt to use complete or partial hand impressions left at the scene of crime for estimation of stature. Fewer studies based on prints measurements have been reported.

The present study was utilized only the handprint dimensions for estimating stature and it did not use the exact hand dimensions. A similarly study was conducted by Nandi Michael Ebe, Ibeabuchi Nwachukwu Mike, et.al., in which stature was reconstructed from handprint dimensions in adult Nigerien population. In the present study adults in Chennai population was assessed to determine the correlation between the stature and hand print dimensions to develop a population- based equation for stature estimation. In the present study, males show higher mean values in all measurements i.e., stature, hand length, hand breadth, palm length, thumb distal, complete thumb, etc., than females

Also, the hand breadth in males, palm length in females were statistically not significant with regards to hand print measurements. In this study, with regards to hand measurements, it was observed that stature significantly correlated with all variables in both gender except palm length in females and hand breadth in males.

Variables such as Hand length, index distal + middle, complete index, complete middle, ring distal + middle, complete ring, little distal + middle has a strongest correlation significant with stature in females. The correlation between the stature and hand length shows the most significant in both males and females. Similarly, stature estimation from handprint measurements: an application to the medicolegal investigation was a study was conducted by Md. Asdujjman, Md. Golzer Hossain and et.al., and this study concludes that the hand length was the most reliable parameter for stature estimation.

Stature estimation from handprint dimensions among Malaysian population it was a study conducted by Nur Atirah G and Khairulmazidah M in which authours used handprint dimensions for estimating stature. The findings of the study is that hand length has the most reliable correlation coefficient with stature when compare to other measured parameters.

Correlation between the stature and hand length, palm length, thumb distal, index distal, index distal + middle, complete index, middle distal, middle distal + middle, complete middle, ring distal, ring distal + middle, complete ring, little distal, little distal + middle, left complete little shows the strongest significance in males.

In this study, males showed a higher correlation coefficient then females in all other studied variables except for hand breadth.

CONCLUSION

The result of this study indicates that handprint measurements provide accurate and reliable means of stature estimation. Fifty males and females from the Chennai population have been studied for their stature and inked palm prints were obtained to measure hand dimensions. It shows a statistically significant correlation is present between the stature and the mentioned variables. Hand length and complete index can be considered as the most needed criteria in estimating stature of a person, because it shows a strongest correlation with stature in both sexes. A similarly, study was conducted by Mohrous Abdelbasset, Athar Mohamed Khalifa, Hassan Abdelraheem Hassan, and et.al., in which stature was estimated from hand and

hand print dimensions in North Saudi Population.

This emphasizes the significance of generating population specific standards to estimate stature.

Consequently, the study is useful to find the stature of unknown individuals, when the hand impression is found.

This study represents the significant correlation between the stature and palmprints dimensions. It will assist in medicolegal situations in establishing personal identification while only handprints or mutilated hands are found.

RECOMMENDATION

- The present study is limited by its relatively small sample size; it's recommended that further studies involving larger samples of different ethnic groups in the Chennai population are desired.
- Research on other populations is also recommended to confirm whether it could be equally applicable elsewhere.
- The present study also suggested that regression equations for stature estimation could be developed for other age categories and different kinds of populations.

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