STATURE ESTIMATION FROM HAND DIMENSIONS IN STAFF OF B.L.D.E. UNIVERSITY, AGED 25-50 YEARS

By

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In partial fulfillment of the requirements for the degree of

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LIST OF ABBREVIATIONS USED

FLH – Female left hand

FRH – Female right hand

HB – Hand breadth

HL – Hand length

HS – Highly significant

LH – Left hand

LHB – Left hand breadth

LHL – Left hand length

MLH – Male left hand

MRH – Male right hand

P – Pooled data

PLH – Pooled left hand

PRH – Pooled right hand

r – Correlation coefficient

RH – Right hand

RHB – Right hand breadth

RHL – Right hand length

SD – Standard deviation

SPSS – Statistical package for social scientists

ABSTRACT

Background

Stature is one of the most significant and useful anthropometric parameter that determine the physical identity of an individual. Identification of human remains is a crucial problem and is of immense importance to forensic scientists, anatomists, human biologists and anthropologists for determination of stature from fragmentary remains. The purpose of this study is to analyze the anthropometric relationship between dimensions of the hand with stature and to device regression formulae to estimate height from hand dimensions.

Objectives

- To study the relationship of personal stature with hand length and hand breadth among the staff aged 25 to 50 years belonging to north interior Karnataka working in B.L.D.E. University.
- To device a formulae using regression analysis to predict the stature of the individual using their hand length and hand breadth.

Methods

300 subjects (males and females) aged between 25 to 50 years were included in this study. Hand length and hand breadth of both hands were measured using sliding caliper and height was recorded using measuring tape. Data was analyzed using SPSS v 17 software.

Results

The statistical analysis revealed that there was a positive correlation between stature and various parameters studied and this was found to be statistically highly significant. The right hand length had the highest correlation coefficient (0.7506) and the least correlation coefficient was found with left hand breadth (0.6112). Linear regression equations to calculate the stature were obtained for each of the hand dimensions separately.

Conclusion

To conclude, the present study provides us with regression equations for four different parameters that can be used for stature estimation in population of north interior Karnataka. Another key finding of our study is that the right hand length is the most reliable and accurate hand dimension to estimate stature in population of north interior Karnataka.

Keywords: Stature, hand length, hand breadth, sliding caliper, correlation, north interior Karnataka, regression equation.

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INTRODUCTION

THIS LIVING HAND, NOW WARM AND CAPABLE
OF EARNEST GRASPING, WOULD, IF IT WERE COLD
AND IN THE ICY SILENCE OF THE TOMB,
SO HAUNT THY DAYS AND CHILL THY DREAMING NIGHTS
THAT THOU WOULDST WISH THINE OWN HEART DRY OF BLOOD
SO IN MY VEINS RED LIFE MIGHT STREAM AGAIN,
AND THOU BE CONSCIENCE - CALMED - SEE HERE IT IS -
I HOLD IT TOWARDS YOU

Personal identity means determination of the individuality of a person. Stature is one of the most significant and useful anthropometric parameters that determines the physical identity of an individual and occupies a relatively significant position in the anthropometric research. Identification of an individual is a matter of concern and prime importance, as the frequency of crimes are increasing these days.

Growth-the vital process is measured by measuring the height of a person.[1] Height is sexually dimorphic and statistically more or less normally distributed. Height, like other phenotypic traits, is determined by genetic and environmental factors. Noticeable growth is said to stop at 18 years in females and 20 years in males.[2]Stature prediction occupies a central position both in anthropological research and in the identification necessitated by the medico-legal experts.[3]

Identification of human remains is a crucial problem and is of immense importance to forensic scientists, anatomists, human biologists and anthropologists for determination of stature from fragmentary remains. Estimation of stature from the incomplete skeletal decomposing human remains has always been a challenge for forensic experts and has obvious significance in the 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.[4]There are inter-racial and inter-geographical differences in measurements and their correlation with stature.[5] What is true for one race or one region or a particular ethnicity may not be true for the other due to differences in nutrition, climate, socio economic status and levels of physical activity. Anthropometry constitutes the means of giving quantitative expression to the variations which different individuals or traits

exhibit. Although many formulae for stature estimation from long bones have been proposed, there is concern regarding the accuracy of the use of population specific formulae on other human populations.[6]

These measurements can be used as a basis for estimating age-related loss in stature and as an alternative measure to stature when stature cannot be measured directly due to deformities like kyphosis, lordosis and scoliosis, contracture or missing legs. In these cases the original stature can be estimated by multiplying the dimension of the body segments of those sexes or ethnic groups with respective multiplication factor.[7]The multiplication factor can be obtained by deriving a ratio of the stature to the measurement of the body segment taken.

A majority of old methods of estimating stature are limited to measuring whole limb bone and correlating living stature and limb bone length. But few studies are reported in which an attempt has been made to estimate stature from fragmentary or mutilated parts of the body.[8]The significant body segments for estimation of stature are length of foot, hand, hand with forearm, arm, upper extremity, length of head, distance between sternal notch and pubic symphysis, etc. Crown to rump and rump to heel ratio is also a significant dimensional relationship.[9]Estimation of stature has been achieved from measurements of these body segments with varying degree of accuracy. All such calculations depend on the fact that these segments exhibit consistent ratios comparative to the total height of a person and these ratios are associated to age, sex and race.

Morphology of the human hand is greatly influenced by collective effects of heredity and the lifestyle of man. It governs the size and shape of hand thereby making it an exclusive data for establishment of human identity. Several studies in the

past have dealt with estimation of stature from dimensions of hand and have documented that these parameters can be used for stature estimation. However, studies related to stature estimation by hand dimensions in north interior Karnataka individuals have not been done.

In the present study hand dimensions of residents of north interior Karnataka working in B.L.D.E. University is used to estimate stature. The purpose of this study is to analyze the anthropometric relationship between dimensions of the hand with stature and to device regression formulae to estimate height from hand length and hand breadth.

OBJECTIVES OF THE STUDY

- To study the relationship of personal stature with hand length and hand breadth among the staff aged 25 to 50 years belonging to north interior Karnataka working in B.L.D.E. University.
- To device a formulae using regression analysis to predict the stature of the individual using their hand length and hand breadth.

REVIEW OF LITERATURE

Anatomy and Embryology of Hand

Anatomy

The hand is the region of the upper limb distal to the wrist joint. It is subdivided into three parts:

- The wrist
- The metacarpus
- And the digits (five fingers including the thumb)

The five digits consist of the laterally positioned thumb and, medial to the thumb, the four fingers-the index, middle, ring, and little fingers.

There are three groups of bones in the hand:

- **The eight carpal bones** are the bones of the wrist. The carpal bones of the wrist are arranged in two rows. In the proximal row are the scaphoid, lunate, triquetral and pisiform. The four bones of the distal row the trapezium, trapezoid, capitate and hamate. Distal row articulates with the proximal row by the midcarpal joints. The bones of each row articulate with eachother by the intercarpal joint that extend proximally and distally by the S- shaped midcarpal joint.
- **The five metacarpals** (I to V) are the bones of the metacarpus.
- **The phalanges** are the bones of the digits-the thumb has only two, the rest of the digits have three.[10]

Embryology

At the end of the fourth week of development, limb buds become visible as out-pocketings from the venterolateral body wall. The forelimb appears first followed by the hind limb 1 or 2 days later.[11]The tissue of the limb bud is derived from two sources: mesoderm and ectoderm. The limb bud elongates by proliferation of mesenchyme within them.

At 6-week old embryos, the terminal portion of the limb buds becomes flattened to form the hand. Mesenchymal tissue in the hand plates condenses to form digital rays. These mesenchymal condensations outline the patterns of digits and fingers. The intervals between the digital rays are occupied by loose mesenchyme. Soon the intervening region of the mesenchyme breakdown, forming notches between the digital rays.

As the tissue breakdown progress, separate fingers are formed. Limb muscles are derived from the mesenchyme originating in the somites. Nerves and blood vessels grow into the limb buds after the muscles have formed.

Initially, the developing limb buds are directed caudally; later they project ventrally, and finally rotate on the longitudinal axis.[12]

Anthropology

Anthropology is derived from two root words, ‘anthrops’ meaning man and ‘logos’ meaning study.

Anthropology is the scientific study of the physical, social and cultural, developmental and behaviour of human beings since their appearance on this earth.[13]

It is traditionally divided into 4 specialities:

- Biological (Physical) anthropology
- Cultural anthropology
- Anthropological linguistics
- Archaeology

Physical anthropology has been defined as the study of man’s biological behaviour in time and space. Physical anthropology includes:

- Human genetics
- Human paleontology
- Ethnology
- Anthropometry
- Biometry

Physical anthropology is the first and the oldest speciality. The goal of physical anthropologists was to find scientific evidence that would allow the human population to be classified into unambiguous set of biological attributes.[14]

The ideas of human origin and evolution occurred to some of the ancient Greek and Roman thinkers.

Aristotle is the first authority to use the word anthropology. Hippocrates and Vesalius contributed towards physical anthropology. Buffon was regarded as the father of anthropology.

Blumenbach is considered to be the father of physical anthropology. He made the systemic study to classify mankind into groups on the basis of craniological materials.

Of the scientists who made notable contributions towards the understanding of the physical aspects of man, mention may be made of Tyson (1650-1708), Garengot (1688-1708) and John Ray (1628-1707).[15]

Anthropometry

Anthropometry as defined by Juan Comas is the "systematic techniques for measuring and taking observations on man, his skeleton, the skull, the limbs, trunk, etc. as well as the organs, by the most reliable means of scientific methods".

In recent years anthropometry has made a rapid progress, opening new magnitudes to deliver the need of the modern man including the pursuit of new knowledge. Anthropometry is a typical and traditional tool of biological (physical) anthropology. The ultimate goal of anthropometry is to help in achieving personal identity in case of unknown remains.[16]

Although anthropometry is as old as ancient Egypt and Greece the word 'Anthropometry' was first used in the seventeenth century by German physician, Johann Sigismund Elsholtz for his graduation thesis titled "Anthropometria". He also invented the anthropometer.[17]

The scientific anthropometry however began with Johann Friedrich Blumenbach (1752-1840) who laid foundation of craniology. He classified mankind into different races on the basis of skull form as seen from above. He distinguished 3 types (a) Square (b) Long and (c) Laterally compressed.

In the same century Peter Camper studied the facial form and developed the facial profile angle to measure the extent of prognathism. Charles White developed measurements of long bones- Osteometry and worked on the upper limb of the Chimpanzees, Negros and Europeans.[18]

Anthropometry was further developed by scholars like, Broca, Flower and Turner. PaulPierre Broca (1824- 1880) founded the Anthropological Society in 1859, the Revued' anthropologie in 1872 and the School Of Anthropology in Paris in 1876.[19]Brocas publications include definition of landmarks techniques of measurements and names of instruments to be used. He also invented the first anthropometer. Flower invented the sliding caliper with the curved arms on one side and straight arms on the other, which has come to be known as the Flowers caliper.[18]

In 1874, H Von Ihering pointed out weakness in Brocas methods. The need for standardization of techniques became necessary. Consequently craniometric conferences were held at Munich (1877) and Berlin (18880). His proposal was accepted at the 13th General Congress of the German Anthropological Society held in

Frankfurt in 1882 under the name of 'Frankfurt Agreement'. In 1884, a close associate (Paul Topinard) of Broca also suggested some changes in techniques. In this way, two different schools in anthropometry emerged, The German School and The French School. All this resulted in a lot of confusion. Collignon made one of the first attempts in this direction in 1892, But without success.[18]

The use of anthropometry in the field of forensic science and medicine dates back to 1882 when (Alphonse Bertillon) a French police expert invented a system of criminal identification based on anthropometric measurements. His system was based on three fundamental ideas- The fixed condition of the bone system from the age of twenty till death; the extreme diversity of dimensions present in the skeleton of one individual compared to those in another; the ease and relative precision with which certain dimensions of the bone structure of a living person can be measured using simply constructed callipers.[18]

In, 1906, in Moscow "International Agreement on Craniometry" was approved by special committee.[18]

In 1912, The German Congress approved the International agreement for unification of measurements on the living subjects.[18]

In 1932, several suggestions were made on different aspects of anthropometry by the International Committee, of which Vallois was the chairman. The committee ventured to suggest that a standardized anatomical nomenclature be used in definition, and best instruments be used for specified purpose.[18]

In 1935, The American Association of Physical Anthropologists formed an advisory committee on anthropometric interests, with Hooton, Hardlicka, Schulz,

Terry and Todd as its members. They reviewed certain definitions and nomenclature of some controversial measurements and suggested guide-lines.[18]

In, 1950 Viking Fund organized a seminar of a group of physical anthropologists under the direction of Washburn to learn about technical innovation in physical anthropology. It was suggested that statistics should be adopted for specific problems. The utility of making use of computers and other statistical machines was also discussed and emphasized.[18]

In 1960, at the VI International Congress of Anthropological Sciences held at Paris it was decided to form a co-ordinating committee for standardization in anthropometry.[18]

In 1971, Andersen automated the anthropometric instruments like Herpenden anthropometer and Holtanin caliper. He also designed anthropometer and stadiometer. Prahl- Andersen and her colleagues reported an accuracy of +/- 2% for all measurements except for skin fold thickness, which were accurate upto +/- 5%.[18]

In 1977, Snyder et al. developed Michigan anthropometric processor (MAP) which collects and processes both anthropometric and demographic data.[18]

Anthropometry in India

Physical anthropology had an early start in India. Shoortt J, Ouchterlony and Elliot (1868) were the pioneers in this field. Risley was the first to collect systematic data on various Indian populations. Eicksted, Trueston were few others who collected anthropometric data on different Indian population. The credit of making systematic study of the racial elements in Indian populations goes to Guha, who collected the

anthropometric data on scientific basis and also helped in establishing the study of physical anthropology in general in India. In 1946, he succeeded in establishing the 'Anthropological Survey of India'.

In 1965, at the University Grants Commission, under the chairmanship of Biswas, Indian people like Ruggeri, Eickstedt, Guha, Karvve, Mujumdar and others formed a committee to specify the instruments.[18]

Books on Anthropometry

The credit of making an attempt to produce a complete text book on anthropometry goes to Rudolf Martin, 1914. Until today 'Martins Text Book of Anthropology' remains monumental and store house of knowledge for all students of anthropology. His student Stephanie Oppenheim Martin in 1928 improved the book in the 2nd edition and Saller further revised it and expanded it (1957).

In 1918, Wilder published 'A Laboratory Manual of Physical Anthropometry' in English. In 1919, Hardlicka prepared a volume on anthropometry.

In 1938, Mollison and in 1948 Vallios also improved anthropometric techniques. In 1947, Hardlickas anthropometry was revised by Stewart. In 1960, Montagu prepared a hand book on anthropometry.

The hunt for new avenue continues. Anthropometrists at work in different laboratories of the world on different topics are constantly devising new instruments as well as improving the old ones. Radiographic and photographic techniques have also been developed.[18]

Divisions of Anthropometry

Anthropometry may be divided into the following subgroups:

- **Somatometry:** Measurement of living body including head and face.
- **Osteometry:** Measurement of skeletal long and short bones.
- **Craniometry:** Measurement of the skeletal brain cavity (Neurocranium) and face (Splanchnocranium).[18]

Applications of Anthropometry

- **Industrial purpose:** Today, anthropometry plays an important role in industrial design, clothing design, ergonomics and architecture where statistical data about the distribution of body dimensions in the population are used to optimize products. Changes in life styles, nutrition and ethnic composition of populations lead to changes in the distribution of body dimensions (e.g. the obesity epidemic), and require regular updating of anthropometric data collections.

- **Forensics & criminology:** Anthropometry has a role in personal identification and helps in identifying criminals.

- **Medicine and Surgery:** Anthropometry is used in nutritional survey, in correction of defects of body and in cosmetic surgery. Fetal age and fetal well-being can be assessed.

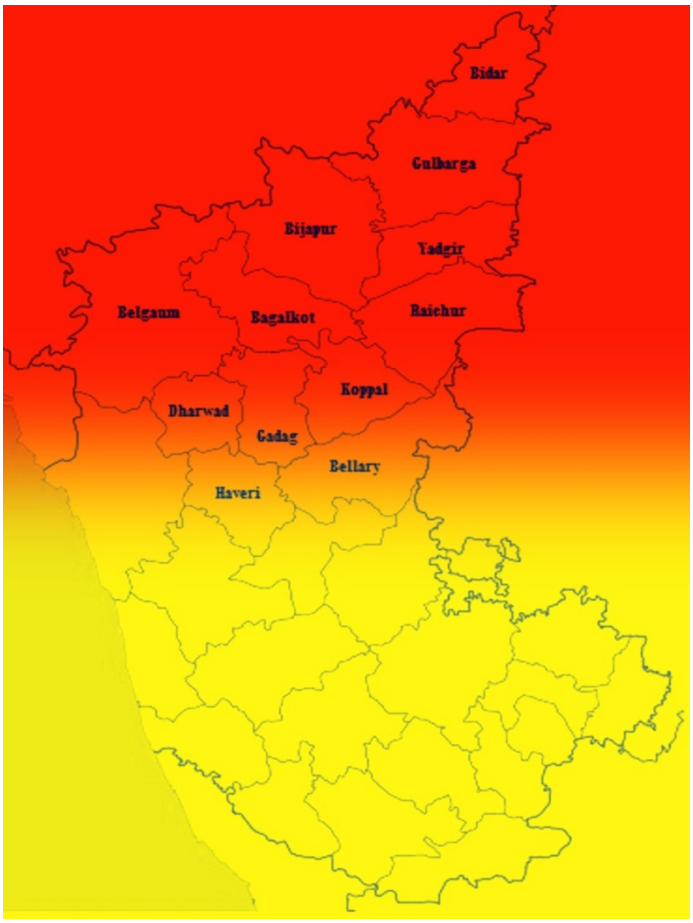
- **Defence and Sports:** Anthropometry is used in recruitment of soldiers and to monitor training of sports person.

- **Scientific Investigations:** Academic anthropologists investigate the evolutionary significance of difference in body proportion between populations whose ancestors lived in different environmental settings.[20]

Introduction of the Study Population

North Karnataka is an arid plateau from 300 to 700 metres (980 to 2,300 ft) elevation in the Karnataka state of southwest India. It is drained by the Krishna River and its tributaries the Bhima, Ghataprabha, Malaprabha, and Tungabhadra. North Karnataka lies within the Deccan thorn scrub forests ecoregion, which extends north into eastern Maharashtra.

North Interior Karnataka(based on meteorological zones) comprises of the following districts; Belgaum, Bidar, Bijapur, Bagalkot, Haveri, Gadag, Dharwad, Gulbarga, Koppal, Bellary, Yadgiri and Raichur Districts.



North Karnataka is known for its freedom fighters, social reformers, Hindustani musicians and figures in literature, law, science and technology.

Religion: People of different religions have co-existed peacefully in North Karnataka; Hinduism, Christianity, Jainism, Sikhism and Islam are the religions of North Karnataka.

Cuisine: Wheat and jowar rottis (unleavened bread made with millet) are popular. The following are typical items in a vegetarian Northern Karnataka; Rotti/ Bhakri, Rice, Saaru, Happala and kosambari, Badanekaayi gojju/enne-gai/ tumbu-gai, kempu khaara, belepalya, mosaru bajji or raitha and raw salads. Hubli-Dharwad is known for its dharwad pedha, Mirchi Bhaji and girmit. Gokak is known for its Gokak karadant (a dry fruits food), Gokak Jawardosa is also a famous food in that area.[21]

According to Charaka height of an average man should be 84 anguls.[22] The Vitruvian Man is a drawing created by Leonardo da Vinci circa 1490. According to Leonardo's notes, the length of the hand is one-tenth of the height of a man.[23]

Pearson used Rollet's data to create regression formulae for estimating stature. He used only long bone lengths of the right side, unless they were missing, in which case he used the left. Pearson contributed greatly to the advancement of stature estimation, and discussed the applicability of using a stature estimation equation on more than one population. He stated, "The individual variation being greater than the ethnic is not a valid argument for applying a formula based on the observation of one local race straight away to a second". Just because there exists greater variation within races than between them, does not mean stature estimation equation can be widely applied to different races.[24]

According to Dupertuis and Hadden, Pearson's formulae were derived from measurements of populations that were particularly short in stature. They decided it was necessary to create new formulae representative of taller populations. They were, like Pearson, unsure if formulae derived from one race would be applicable to other races. Dupertuis and Hadden calculated their new formula using cadavers of tall Euro Americans and African Americans from what is now the Todd osteological collection, currently housed at the Cleveland Museum of Natural History. They found that using two or more long bone lengths is more reliable than just one, and that using bones from the lower extremity is more accurate than using bones from the upper limb. They also discovered, just as Pearson did, that estimation formulae apply best to the population from which it was derived.[25]

If the recovered remains are relatively complete, than a method such as Fully's technique, developed in 1956, might be applicable.[26]

It was also opined more than 50 years ago that regional studies on stature estimation were very much needed due to racial and ethnic variations present in different regions of the world.[27]Studies have subsequently been initiated in many countries to obtain equations for predicting stature from hand length and hand breadth in different ethnic groups.

In 1961, Charnalia VM measured foot length and foot breadth of 541 adult males and females of different caste and tribes of the Pondicherry state and correlated with stature. Stature had a highest correlation with foot length (0.46) than with foot breadth (0.33). [28]

In 1984, Bhatnagar DP did a study based on a sample of 100 normal healthy Punjabi males from Patiala, Punjab, India. Each subject was studied for three anthropometric measurements: stature, hand length and hand breadth. The data were studied for somatometry pertaining to height, hand length and hand breadth.[29]

In 1984, Saxena SK did a study based on the measurement of 100 Nigerian adult male medical students of the Jos Medical School, Nigeria, between the ages of 20-30 years. The results showed that there are significant correlations between the stature of an individual and hand length, hand breadth and sole length.[30]

In 1990, Abdel-Malek studied a sample of 166 normal adult males and females from different colleges of Assiut, representing those living in Upper Egypt. They were studied for measurements of stature, hand length and hand breadth. The data were statistically analysed in order to assess the relationship between stature and

hand measurements. The correlation matrix of the study indicates close similarity of the relationship between stature and hand measurements in both sexes and in both sides.[31]

In 1990 Philip A studied footprints and foot outlines of 618 human subjects of age 20 and 32 years. The study revealed a significant correlation between the measurements. The correlation coefficient of first three toes to stature (0.83 to 0.85) is marginally better than the correlation coefficient of the last two toes (0.82 to 0.84).[32]

In 2002, Abdi Ozaslan et al. estimated stature from measurements of different body parts like trochanteric height, thigh length, leg length and foot length. They suggested that estimation of living height could be made possible using various dimensions of the lower extremity.[33]

In 2004, Jasuja OP et al. studied 30 male and 30 female Jat Sikhs for their stature, hand length and phalangeal length. In addition inked palm prints were also obtained to measure hand length and phalangeal length from print. It was found that no significant difference exists between hand length and palm print length. Statistically significant correlation is present among the stature and these measurements.[34]

In 2004, Gauld LM et al. studied 1144 males and 1199 females, aged 5years 4 months to 19 years 7 months from Melbourne schools. Height, arm span, ulna, forearm, tibia and lower leg lengths were measured. Prediction equation for height based on ulna length and age in years were developed using linear regression and they concluded that ulna measurement is reproducible and precisely predicts height in school-age children.[35]

In 2005, Sanli SG estimated the relationship between hand length, foot length and stature using multiple linear regression analyses based on a sample of male and female adult Turks residing in Adana. Measurements of hand length, foot length and stature were taken from 155 adult Turks (80 male, 75 female) aged 17-23 years. All possible (simple and multiple) linear regression models for each of males, females and both genders together were tested for the best model. The multiple linear regression model for both genders together was found to be the best model with the highest values for the coefficients of determination R2 = 0.861 and R2 adjusted = 0.859, and multiple correlation coefficient R = 0.928.[36]

In 2005, Sunil et al. established a significant correlation of height with hand length in both sexes by studying 75 males and 75 females aged between 18 to 22 years, studying in various colleges of Delhi. Measurements of right side were found to be greater than the measurements of left side, but the difference was marginal and statistically insignificant.[37]

In 2006, Jibonkumar et al. did a study to investigate the correlation between stature and different facial measurements (Total Facial Height, Physiogonomic Facial Height, External Bi-Ocular Breadth, Inter-Ocular Breadth, Breadth of Bizygomatic Arch, Bi-Gonial Breadth) among 199 males of the Kabuis of Imphal valley. The age of the individuals was between 18 to 45 years. The highest correlation was found between stature and Bi-gonial breadth with 'r' value of 0.365.[38]

In 2007, Patel SM et al. measured foot length and body height of total 502 students between 17 to 22 years of age and indicated that there is a strong bond between height and foot length and if either of the measurement is known, the other

can be calculated. In their study the correlation coefficient between height and foot length is +0.65 in males and +0.80 in females which is most significant.[1]

In 2007, Agnihotri AK measured foot length and stature of 250 medical students (125 males and 125 females) aged 18 to 30 years. General multiple linear regression model was highly significant ($p< 0.001$) and validated with the highest values for the coefficients of determination $R_2= 0.769$ and multiple correlation coefficient r=0.887. Right foot length, sex and age explained for about 77% variation in stature.[39]

In 2007, Krishn K et al. reported diurnal variation of stature in three adults and one child. The measurements of stature were recorded four times in a day for 56 days in all the subjects i.e. at 0600 hours, 0800 hours, 1800 hours and at 2200 hours. A maximum mean daytime loss of stature up to 2.81 cm was observed.[40]

In 2008, Chikhhalkar et al. conducted a cross sectional study to evaluate a possible correlation between stature of an individual and 6 parameters: hand length, hand width, foot length, foot width, forearm length and knee ankle length individually in 300 local population of Mumbai, in the age group of 19 to 23 years. It was found that all the 6 parameters showed correlation with stature but at different degrees. Forearm length showed highest degree of correlation (r=0.6558) followed by foot length (r=0.6102). Knee to ankle length showed the lowest degree of correlation (r=0.2086).[5]

In 2008, Agnihotri AK et al. conducted a study amongst 250 medical students (125 male and 125 female) aged 18-30 years. Stature, hand length and hand breadth were measured. A general linear regression model was found to be best explanatory in both males and females, however, amongst the curvilinear models; the exponential

model emerged as the 'best' in explaining stature of the individual. Left hand length alone explained very significantly ($P<0.001$).[41]

In 2008, Sen J made an attempt to understand the relationship between stature and feet dimensions. Measurements of stature, foot length and foot breadth were recorded from 350 adult Rajbanshi and 100 adult Meche individuals (age range: 18-50 years) residing in different villages located in the Darjeeling District of West Bengal. The results of the present study indicate that female Rajbanshi individuals exhibit shorter stature and smaller feet than their male counterparts. Using ANOVA, it is determined that there was significant differences ($p<0.05$) in stature, foot length and foot breadth between sexes. Using paired t-test, it is further observed that bilateral variation was significant ($p<0.05$) within sexes with respect to foot length, but not with foot breadth ($p>0.05$). Stature, foot length and foot breadth were positively and significantly correlated with each other ($p<0.01$).[42]

In 2008, Danborno B et al. obtained data from 250 males (mean age 24.50 ±2.82) and 150 females (mean age 22.22 ± 1.99), students of the Ahmadu Bello University, Zaria, Nigeria. Height, length and width of hand and foot were measured following standard protocols. In all anthropometric parameters measured males were significantly ($p<0.001$) higher. Significant relationships were established between hand and foot lengths in both sexes. Multiple linear regression analysis of hand and foot lengths generated predictive equations with statistically significant ($p<0.001$) ability for height prediction.[43]

In 2008,Tanuj Kanchan et al. examined the relationship between stature and foot dimensions among 200 Gujjars, a North Indian endogamous group. Stature, foot length and foot breadth were measured and statistically analysed, bilateral variation

was insignificant for all measurements except foot breadth in males ($p<0.01$). Sex difference were found to be highly significant for all the measurements ($p<0.01$). The correlation coefficient between stature and foot dimensions was found to be positive and statistically highly significant.[44]

In 2008, Kewal Krishn et al. conducted a study on 996 Gujjars of North India in the age group of 18 to 30 years. Stature and five cephalo-facial measurements (maximum head length, maximum head breadth, horizontal circumference of head, bigonial diameter and morphological facial length) were taken on each subject. The results indicated that all the cephalo-facial measurements were strongly and positively correlated ($p<0.001$) with stature. The measurements of cephalic region had strong correlation with stature than those of facial region.[45]

In 2009, Illayperuma I et al. conducted a study on 140 male and 118 female medical students aged between 20 to 23 years for prediction of personal stature based on hand length. The difference of the hand length between the genders were found to be highly significant and a positive correlation coefficient of +0.58 for males and +0.59 for females between height and hand length was observed and was statistically significant.[46]

In 2009, Laila SZH et al. carried out a descriptive cross sectional study on 150 Bengali adult Muslim females aged 20 to 25 years. Multiplication factors were derived which when multiplied with the hand length gave some estimated stature which correlated with the measured stature.[7]

In 2009, Chavan SK et al. conducted a study among 100 male and 100 female adults between the age group of 20 to 60 years, born in Maharashtra. Percutaneous tibial length and height were taken for establishment of regression formulae. On

computing the data they found that a significant positive correlation exists between the stature and percutaneous tibial length.[47]

In 2009, Bhavana et al. recorded stature, femur length, tibial length, fibular length, foot length and foot breadth of 503 male and 508 female Shia Muslims aged between 20 to 40 years. Analysis of data revealed that Shia males are taller than Shia females. The tibial length among the males exhibited the overall highest value of correlation with stature (r=0.765) and lowest value of standard error of estimate while among females femur length exhibited the highest value of correlation (r=0.742) with stature. Foot length exhibited the least correlation with stature in case of both males and females.[48]

In 2010, Hossian S carried out a study on 100 Christian Garo adult females aged between 25 to 45 years. Hand length, hand breadth and stature were recorded and data was statistically analysed. Significant positive correlation was found in case of hand length with the stature. There was positive correlation (r=0.17, p=0.09 and r=0.15, p=0.12) between the stature and breadth of the right and left hand.[49]

In 2010, Illayperuma I conducted a study on 258 medical students (140 males and 118 females) of the Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka, with age span of 20-23 years. The ulna length and height of the individual was measured. The findings of the study indicated significant differences of the ulna length between the genders. A positive correlation between height and ulna length were observed in both sexes and it was statistically significant.[6]

In 2010, Kumar S et al. conducted a study to estimate stature by anthropometric examination of forearm and hand on 200 male medical students aged between 18 to 25 years. The mean stature was 164.97 cm with a standard deviation of

5.52cm. The mean length of forearm and hand was found to be 45.47 and the multiplication factor was calculated as 3.899cm.[9]

In 2011, Kaur M et al. conducted a study to estimate stature from upper arm length of 400 individuals in the age group of 17 to 25. They determined that stature and arm length are positively and significantly correlated with each other ($p<0.001$). They derived linear regression equations for estimation of stature reliably and accurately.[50]

In 2011, Umesh S R et al. carried out a study in 55 male and 52 female students of M R Medical College, Gulbarga between the age group of 19 to 26 years belonging to Hyderabad- Karnataka region. The result of their study indicated that the percutaneous length of ulna can be efficiently used for estimation of stature.[51]

In 2011, Waghmare VKR et al. carried out a study on 200 male adult individuals. The mean stature and mean length of right and left hand were 159.01 (S.D. 6.78) cm, 16.92 (S.D. 0.91) cm and 16.46 (S.D. 0.93) cm respectively. The study showed significant ($p< 0.001$) positive correlation between the stature and hand lengths.[52]

In 2011, Ahemad N et al. obtained stature and bilateral hand impressions from 503 men of central India. Seventeen dimensions of hand were measured on the impression. Linear regression equations derived showed hand length followed by palm length are best estimates of stature.[53]

In 2011, Krishn K et al. conducted a study on 149 young females from North of India aged between 3 to 18 years. Stature, length of foot from each toe, foot breadth at ball and foot breadth at heel were measured. The results indicated

statistically significant difference ($p<0.05$) between left and right feet in both the foot breadth measurements. Foot length measurements did not show any statistically significant bilateral asymmetry. The correlation between stature and all the foot measurements was found to be positive and statistically significant ($p < 0.001$).[54]

In 2011, Ozaslan A et al. conducted a study to estimate stature from bi-acromial (BAB) and bi-iliocristal (BICB) measurements. 216 males and 121 females volunteered for the study. Sex differences were found to be highly significant for all the measurements. Best correlation was examined in males for BAB ($r=0.42$), but for BICB there was a very weak correlation in both males and females. When both variables were studied, relation with stature in males reached to $r=0.43$.[55]

In 2011, Vidya CS et al. estimated stature using footprint measurements among 200 subjects (100 males and 100 females) aged 20 to 30 years belonging to Southern Karnataka. Accuracy of determination of height from foot parameters is highest for right foot length ($R=0.883$) in males and ($R=0.817$) in females respectively followed by left foot length, left foot breadth and right foot breadth.[56]

In 2011, Rani M et al. measured stature, foot length and foot breadth of 150 males and 150 females aged between 18 to 22 years. Statistical analyses indicated that bilateral variation was insignificant ($p<0.01$). Sex differences were found to be highly significant for all the measurements ($p<0.01$). The highest correlation coefficient between stature and foot length in males and foot breadth in females indicated that the foot length provides the reliability and accuracy in estimating stature of an unknown male and female.[57]

In 2012, Wankhede KP et al. conducted a study on 260 male and 210 female medical students (central Indian population) aged between 18 to 24 years to estimate

stature from maxillo-facial anthropometry. They observed that in males the total facial height had greater correlation with stature (r=0.19) and had standard error of ±6.68cm. In females, nasal height had greater correlation with stature (r=0.19) and had a standard error of ±5.78cm.[58]

In 2012, Devi KVS et al. carried out a study on 74 male and 106 female medical students of Vinayaka Mission's Kirupananda Variyar Medical College, Salem. Stature, hand length, hand breadth and palm length were recorded and analysed statistically using SPSS 12th version. A correlation was established between stature and hand dimensions in the form of correlation coefficient and regression equation. Hand length of left hand showed highest degree of correlation (r=0.809) and breadth of left hand showed lowest degree of correlation (r=0.581).[4]

In 2012, Khanapurkar S et al. conducted a study on 1000 healthy, Maharashtra Medical students in the age group of 19 to 22 years, to estimate stature using multiple regression analysis using multiple parameters viz. foot length, hand length and head length. All the parameters correlated significantly with stature but foot length in both sexes depicted higher correlation coefficients with stature (r=0.850) than any other parameter. They also concluded that multiple linear regression analysis is better over simple linear regression analysis for estimating stature.[59]

In 2012, Mansur DI et al. carried out a study to establish the regression equation and correlation coefficient between individuals height and mean foot length. The study was conducted on 440 medical students aged between 17to 25 years studying in Kathmandu University School of Medical Sciences, Dhulikhel, Nepal. They found a significant correlation between height and foot length (r=0.703,

$p<0.01$). The regression equation for height and foot length was found to be $Y= 3.179 X+87.65$, where X is the foot length and Y is the height.[60]

In 2012, Lalit K studied 100 males and 100 females between the age of 21 to 30 years, from Uttarkhand (India) population. Their thumb length and height were measured. The results showed a significant correlation between length of thumb and height of the individuals in both sexes. Linear regression equation for stature estimation was calculated. It was therefore concluded that if the thumb length is known, then height of the individual can be predicted and vice versa.[61]

In 2012, Pandhare SR et al. conducted a study on 576 male and 544 female children of age group ranging from birth to 5 years. Height, inferior extremity length and foot length have been evaluated for sexual dimorphism as well as subjected to statistics to study the correlation of inferior extremity length and foot length with that of height. It was determined that there was significant differences ($p<0.05$) in stature, inferior extremity length and foot length between sexes. These parameters were positively and significantly correlated with each other ($p<0.01$).[8]

In 2012,Tang J estimated the relation between stature and hand dimensions of 400 healthy adults aged between 20 and 25 years, of a Han population of Southern China. The mean values of the stature were 170.49 and 159.72 cm in the men and the women, respectively. The statistically significant differences between the right- and the left-hand dimensions were not observed in the men, whereas the bilateral differences were statistically significant in female hand dimensions. The correlation coefficients were found to be statistically significant for the hand dimensions in both the sexes. The hand length showed higher correlation coefficients than the hand breadth in both sexes. Linear and multiple regressions were developed in this study;

multiple regressions showed higher correlation coefficients than linear regressions. Two regression models could be used to estimate the stature from the hand dimensions in this population.[62]

In 2012, Basnet KS, conducted a descriptive cross sectional study on 165 Nepalese adult Musahar females of Aurahi Village of Mahottari district, Nepal to predict the stature from their hand length. Stature and length of both right and left hands were taken, it showed significant ($p<0.001$) positive correlation between the stature and hand lengths.[63]

In 2012, Akhlaghi M aimed to estimate the stature from upper limb anthropometry. Height, left upper limb, left arm, left forearm, length and breadth of the left hand, and length of the left second to fifth fingers were measured on 100 right-handed Iranian medical students aged between 21 and 26 years. After analysing the data, it was shown that there is a meaningful relation between the stature and upper limb dimensions ($p < 0.05$), [correlation coefficients ranged from 0.310 to 0.696 in males and 0.299 to 0.735 in females].[64]

In 2012, Krishan Kdid a study based on a sample of 246 subjects (123 males and 123 females) from North India aged between 17 and 20 years. Four anthropometric measurements; hand length, hand breadth, foot length and foot breadth taken on the left side in each subject were included in the study. Multiplication factors were calculated and linear regression models were derived for estimation of stature from hand and foot dimensions. Derived multiplication factors and regression formula were applied to the hand and foot measurements in the study sample. The results indicate that the range of error in estimation of stature from regression analysis method is less than that of multiplication factor method thus,

confirming that the regression analysis method is better than multiplication factor analysis in stature estimation.[65]

In 2013, Ibegbu AO et al. Studied anthropometric characteristics (height, age, weight, hand length and body mass indices) of 600 normal Nigerian school children aged between 5 to 10 years of Gbagyi tribe of Abuja. The results showed some significant differences between the anthropometric parameters and a significant correlation (≤ 0.001) between height and hand length, and other parameters in both males and females. The study indicated that height could be predicted using these parameters among Gbagyi school children.[66]

In 2013, Hansi B et al. conducted a study to estimate correlation between the head length and stature. 50 male and 50 female school students of Bulandshahr region in Uttar Pradesh, aged between 6 to 10 years were considered for the study. A positive correlation was observed between head length and height with correlation coefficient of +0.16 in males and +0.61 in females.[3]

In 2013, Shivakumar AH et al. examined 100 males of Karnataka, in South Indian population in age ranging from 17 to 22 years. The co-relation coefficient between stature and right middle finger length was estimated and found to be positive and statistically highly significant ($p<0.01$). The highest correlation coefficient is – (+0.35).[67]

MATERIALS AND METHODS

Source of Data

The study was conducted on staff (teaching & non-teaching) aged between 25 to 50 years belonging to north interior Karnataka, working in B.L.D.E. University's Shri B.M.Patil Medical College, Hospital and Research Centre. All subjects were healthy and free from any apparent symptomatic deformity of hand and spine.

Method of Collection of Data

Sample size: 300 staff (males and females) aged between 25-50 years working in B.L.D.E.U's Shri B.M. Patil Medical College, Hospital and Research Centre.

Methodology: The purpose and procedure of the study was explained to all the staff and their oral consent was taken. All the measurements were taken in a reasonably well lit room, at a fixed time between 10 am to 1 pm to avoid diurnal variation, as the stature varies during different timings of the day by 1.5-2cms, being less in the evening.[68,69] All measurements were taken by me to avoid inter - observer variations in measurement.

Stature (standing height), hand length and hand breadth was measured using materials such as measuring tape, sliding caliper and right angled device.

Hand length and breadth was taken independently on right and left sides of each individual using sliding caliper.

Hand length: It is the projected distance between the distal crease of wrist to the tip of middle finger, when the hand is held straight and stretched in supine position.

Hand breadth: It is the distance between the most prominent point on the lateral aspect of head of 2nd metacarpal to the most prominent point on the medial aspect of head of 5th metacarpal, when the hand is held straight and stretched in supine position.

Stature: It is measured as the vertical distance between the vertex and the floor. Measuring tape was kept fixed on the wall. Measurement was taken by making the subject stand erect on a horizontal resting plane, bare footed with shoulder blocks and buttocks touching the wall. Palms and hands were turned inwards and fingers kept pointing downwards. Height was recorded with a right angled device.

All the measurements were recorded thrice to avoid measuring errors and mean was calculated for accuracy.

Instruments used: Many instruments have been devised by the anthropologists for taking accurate measurements on the living as well as on the skeleton.

- **Sliding caliper:** It consists of a 25 cm long straight bar. It has 12.5cm long arm fixed at one end and there is a sliding sleeve with 12.5 cm long parallel to the first one. The arms are projected to an equal distance on both sides of the scale. They end in sharp points on one side and have blunted ends on the opposite. The sharp ends are used for taking measurements on the skeleton whereas the blunt ends are used for measuring the living.
- **Measuring tape:** 2 standard measuring tapes, each measuring 150 cm (total height of 300 cm) were fixed to the wall one above the other and were used to measure vertical height.

Inclusion criteria:

Healthy staff of B.L.D.E.U's Shri B.M.Patil Medical College, Hospital and Research Centre aged between 25 to 50 years belonging to north interior Karnataka.

Exclusion criteria:

Individuals who were malnourished and/or suffering from symptomatic deformity of hand or spine were excluded from the study.

Statistical analysis:

Data was analysed using SPSS v. 17 software. Data was presented in the form of mean, SD and graphs. Statistical tests such as correlation of regression were used to determine the relationship between the various anthropometric measurements.

Duration of study:

November 2011 to April 2013.

Figure 1: Measurement of height

Figure 2: Sliding calipers

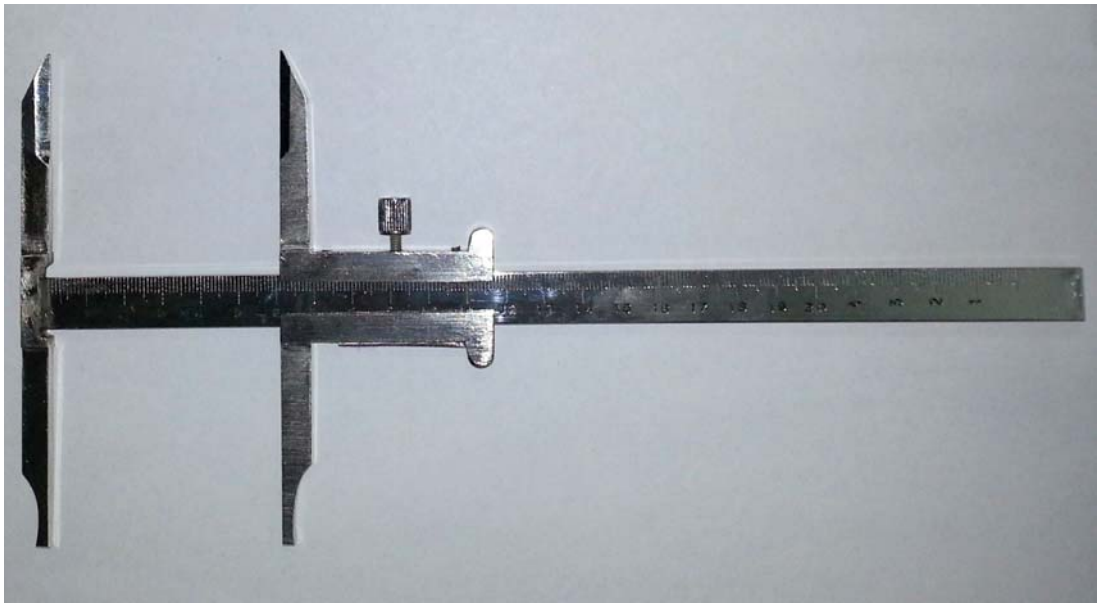


Figure 3: Measurement of hand length

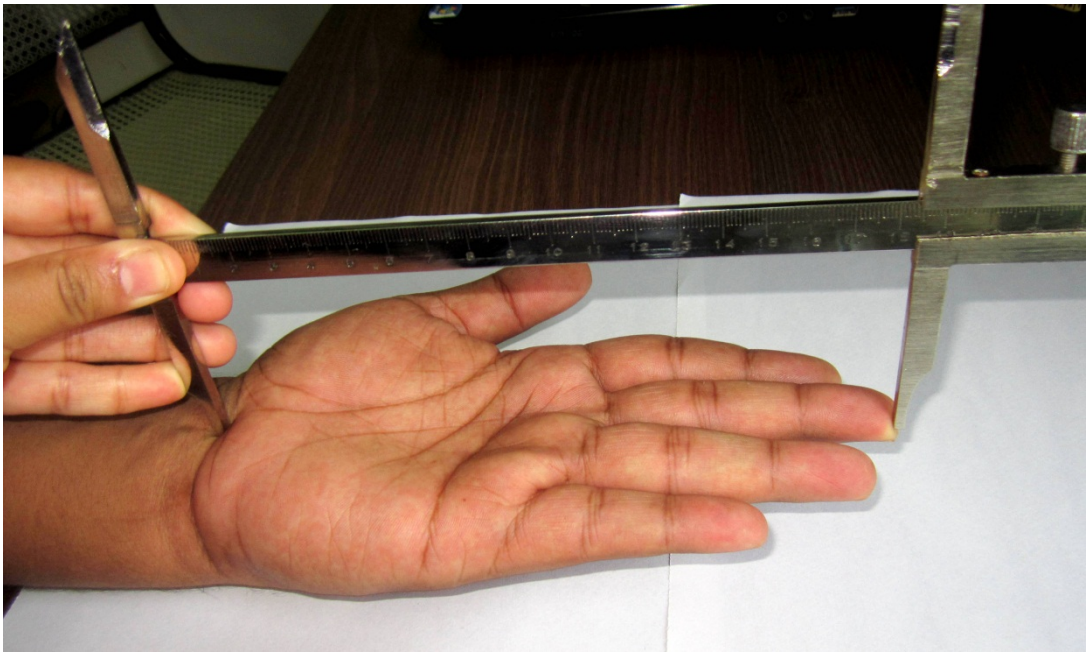
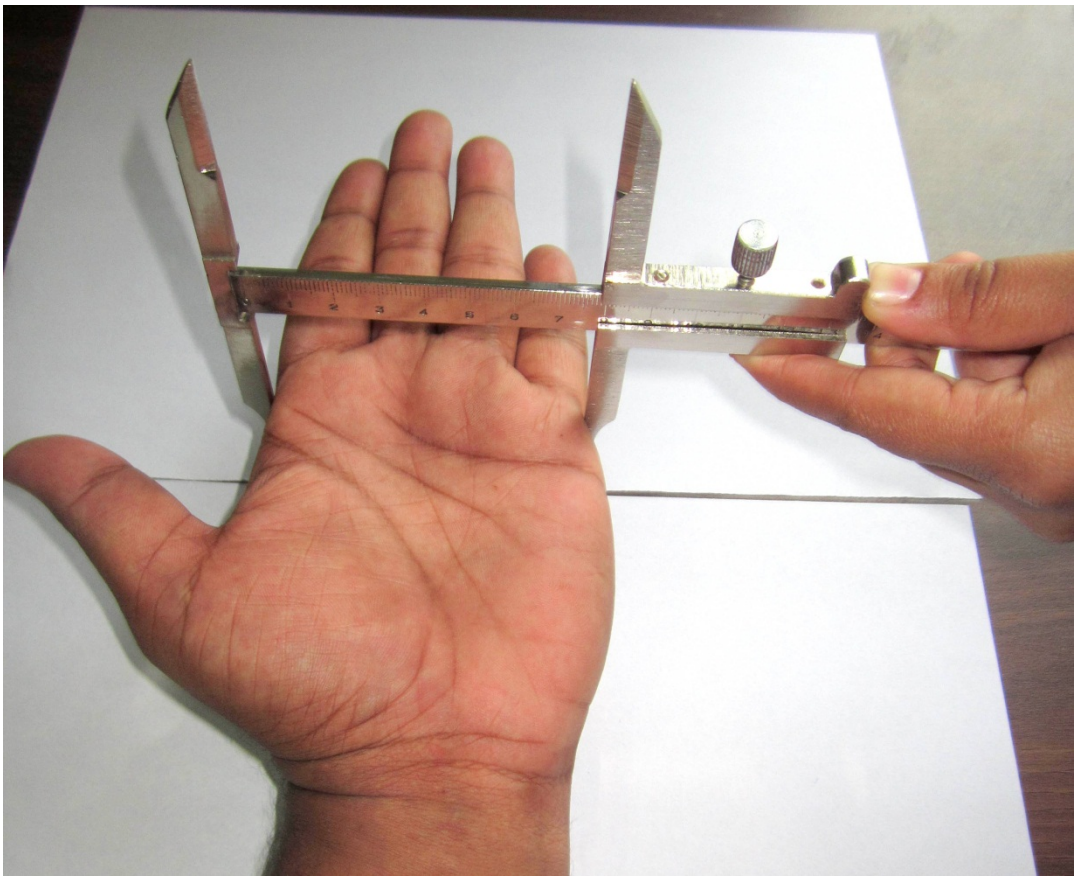


Figure 4: Measurement of hand breadth



RESULTS

A cross-sectional study was carried out on 300 north interior Karnataka individuals. The study population included males and females, aged 25 to 50 years. The stature, hand length and hand breadth of the individuals were assessed and an attempt was made to correlate hand length and hand breadth with stature and derive regression equations to calculate stature from hand length and hand breadth.

Initially for summarizing the data, the range, minimum, maximum, mean and standard deviation were estimated and presented.

The prediction function was derived through linear regression for each of the hand dimensions with the stature. The presentation provides the values of constant and correlation coefficient.

Table 1: Sex distribution of the study subjects

Sl.No.	Sex	Frequency	Percent
1	Male	209	69.7
2	Female	91	30.3
Total		300	100.0

The study group included individuals of both sex. Of the 300 individuals in the study group, 209 (69.7%) were males and 91 (30.3%) were females.

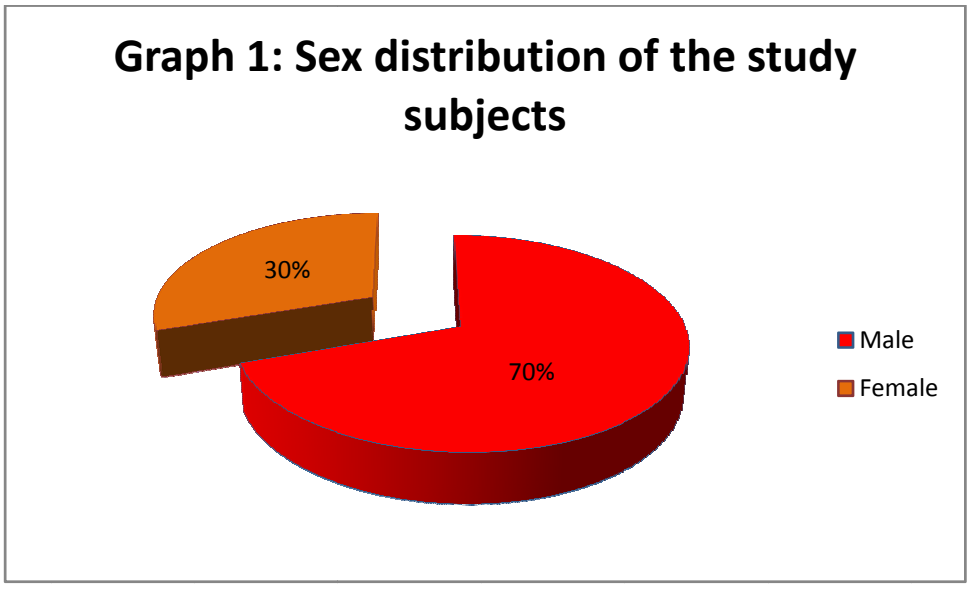


Table 2: Age distribution of the study subjects

Sl. No.	Age	Frequency	Percent
1	25-30	120	40
2	31-35	33	11
3	36-40	31	10.3
4	41-45	50	16.6
5	46-50	66	22
Total		300	100.0

The study group included the individuals aged between 25 to 50 years. Majority [120 (40%)] of the individuals belonged to age group between 25- 30 years. 33(11%) individuals belonged to age group between 31-35 years. 31(10.3%) individuals belonged to age group between 36-40 years. 50(16.6%) individuals belonged to age group between 41- 45 years and 66(22%) individuals belonged to age group between 46- 50 years.

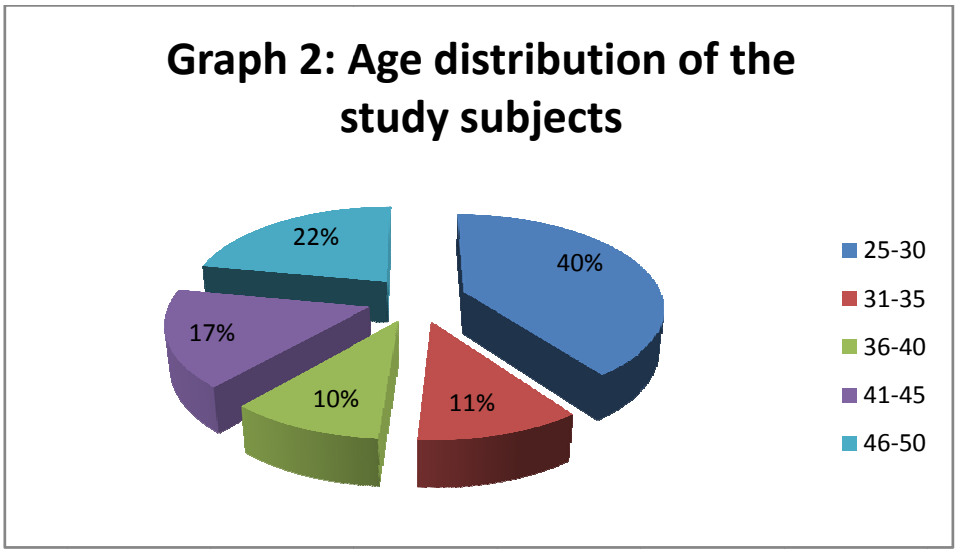


Table 3: Birth place distribution of the study subjects

Sl. No.	Birth Place	Frequency	Percent
1	Bijapur	262	87.3
2	Bidar	5	1.7
3	Gulbarga	11	3.7
4	Gadag	4	1.3
5	Bagalkot	6	2.0
6	Dharwad	3	1.0
7	Koppal	2	0.7
8	Raichur	2	0.7
9	Haveri	1	.3
10	Belgaum	4	1.3
11	Bellary	0	0
12	Yadgiri	0	0
Total		300	100.0

The study group included individuals from different districts of north interior Karnataka. Majority [262 (87.3%)] of the individuals belonged to Bijapur district, 5 (1.7%) individuals belonged to Bidar, 11(3.7%) individuals from Gulbarga, 4 (1.3%) from Gadag, 6 (2.0%) from Bagalkot, 3 (1.0%) from Dharwad, 2 (0.7%) from Koppal, 2 (0.7%) from Raichur, 1(0.3%) from Haveri and 4 (1.4%) from Belgaum. None of the study participants were from Bellary and Yadgiri districts.

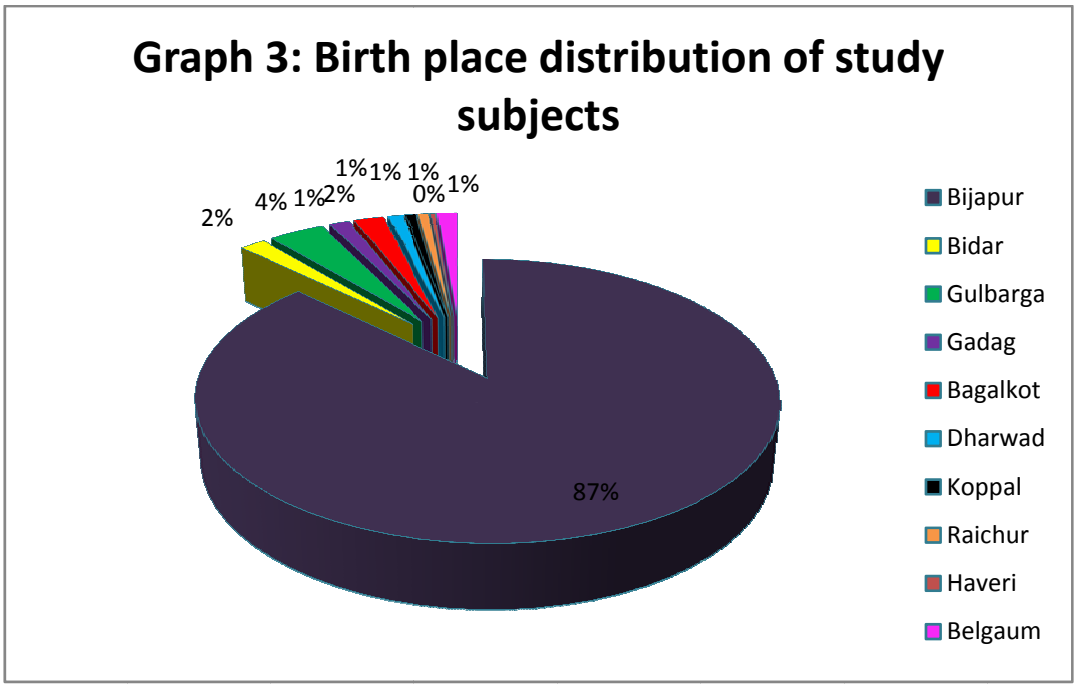
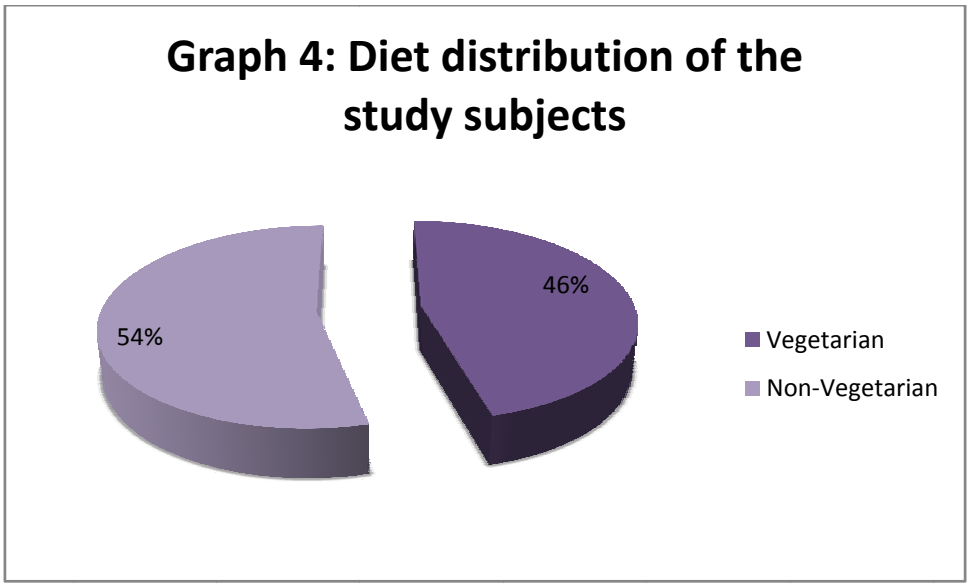

Graph 3: Birth place distribution of study subjects
2%
4%
1%
1%
2%
1%
1%
0%
1%
87%
Bijapur
Bidar
Gulbarga
Gadag
Bagalkot
Dharwad
Koppal
Raichur
Haveri
Belgaum

Table 4: Diet distribution of the study subjects

Sl. No.	Diet	Frequency	Percent
1	Vegetarian	138	46.0
2	Non-Vegetarian	162	54.0
Total		300	100.0

The study group included 138 (46.0%) individuals who were vegetarians and 162 (54.0%) individuals who were non vegetarians (mixed).



Mean

It is the most commonly used estimate of average. It is calculated by adding up all the values of a variable and dividing the sum by the number of values.

Standard deviation

It is the most important measure of variation. It is calculated by finding the square root of the mean of the deviation from mean squared. When the number of subjects in the sample is too big, the frequency method is found more suitable.

Table 5: Descriptive statistics of age and height of the study group

	Age	**Height (cm)**
Mean	36.32	162.979
Median	35.00	-
Standard Deviation	9.051	8.4183
Range	25	47.0
Minimum	25	140.0
Maximum	50	187.0

The mean age of the study subjects was 36.32 with a standard deviation of ± 9.051. The age of the study group ranged from 25 to 50 years.

The mean height of the study subjects was 162.9cm with a standard deviation of ± 8.418. The height of the study subjects ranged from 140cm to 187cm.

Table 6: Descriptive statistics of hand parameters studied

	Right hand length (cm)	Left hand length (cm)	Right hand breadth (cm)	Left hand breadth (cm)
Mean	17.780	17.806	7.719	7.664
Median	17.800	17.800	7.800	7.700
Standard Deviation	0.9855	0.9822	0.5351	0.5323
Range	5.9	5.9	2.8	2.7
Minimum	15.1	15.4	6.3	6.2
Maximum	21.0	21.3	9.1	8.9

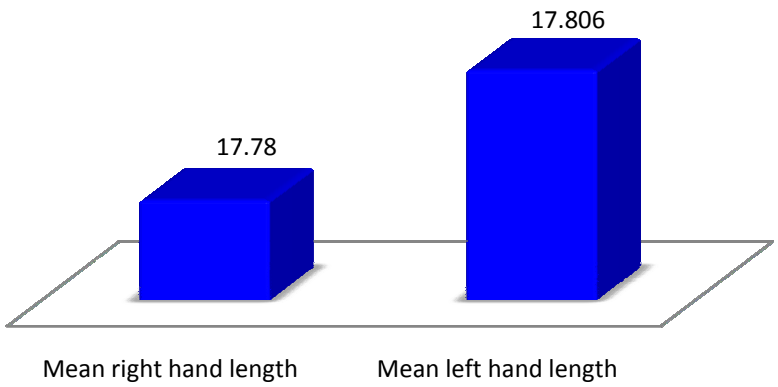
The mean right hand length in the study subjects was 17.780 cm with a standard deviation of ±0.9855. The range of right hand length varied from a minimum of 15.1 cm to maximum of 21cm.

The mean left hand length in the study subjects was 17.806 cm with a standard deviation of ±0.9822. The range of left hand length varied from a minimum of 15.4 cm to a maximum of 21.3 cm.

The mean right hand breadth in the study subjects was 7.719 cm with a standard deviation of ±0.5351. The range of right hand breadth varied from a minimum of 6.3 cm to a maximum of 9.1 cm.

The mean left hand breadth in the study subjects was 7.664 cm with a standard deviation of ±0.5323. The range of left hand breadth varied from a minimum of 6.2 cm to a maximum of 8.9 cm respectively.

Graph 5: Comparision between mean of right and left hand length



Graph 6: Comparision between mean of right and left hand breadth

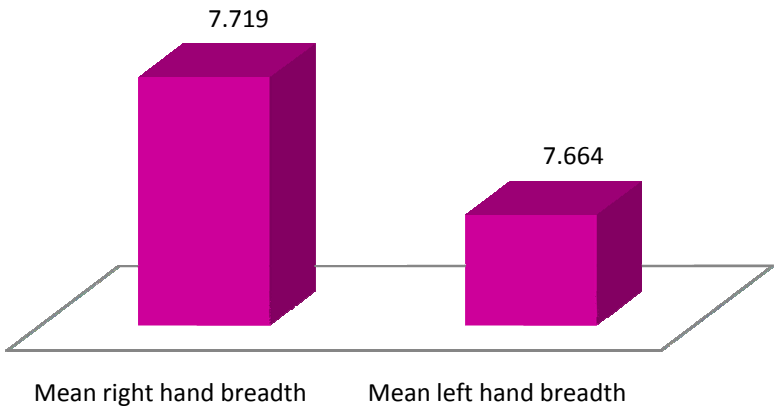


Table 7: Mean ± SD of hand dimensions and height in males and females of the study group

Measurements	Males (n=209)		Females(n=91)	
	Right (Mean±SD)	Left (Mean±SD)	Right (Mean±SD)	Left (Mean±SD)
Hand length	18.146±0.8 (16.0-21.0)	18.170±0.847 (16.2-21.3)	16.935±0.768 (15.1-18.8)	16.968±0.727 (15.4-18.7)
Hand breadth	7.952±0.425 (6.8-9.10)	7.892±0.429 (6.6-8.9)	7.185±0.348 (6.3-7.9)	7.139±0.341 (6.2-8.0)
Height	166.166±7.097 (144-187)		155.775±6.611 (140-175)	

In males the Mean±SD of right hand length was 18.146±0.8 and Mean±SD of left hand length was18.170±0.847.

In females the Mean±SD of right hand length was 16.935±0.768 and Mean±SD of left hand length was 16.968±0.727.

In males the Mean±SD of right hand breadth was 7.952±0.425 and Mean±SD of left hand breadth was7.892±0.429.

In females the Mean±SD of right hand breadth was 7.185±0.348 and Mean±SD of left hand breadth was 7.139±0.341.

Correlation

Correlation gives the degree and direction of relationship between two variables. Correlation between the stature of individual and various study parameters was observed and correlation coefficient calculated.

The relationship or association between two quantitatively measured or continuous variables is called correlation. The extent or degree of relationship between two sets of figures is measured in terms of another parameter called correlation co-efficient. It is mathematically estimated by a formula and is denoted by Spearmans correlation ‘r’.

Classification of Correlation Co-Efficient

Up to 0.1	Trivial Correlation
0.1-0.3	Small Correlation
0.3-0.5	Moderate Correlation
0.5-0.7	Large Correlation
0.7-0.9	Very Large Correlation
0.9-1.0	Nearly Perfect Correlation
1.0	Perfect Correlation

Significant Figures

+ Suggestive Significance (p value: $0.05 < p < 0.10$)

*Significant (p value: $0.01 < p \leq 0.05$)

** Strongly Significant (p value: $p \leq 0.01$)

Table 8 shows that the p value of all the hand dimensions versus stature was highly significant ($p < 0.0001$) in north interior Karnataka population.

Table 8: Table showing correlation between mean height and various parameters studied

Correlation Coefficient Between	Spearmans 'r'	p
Mean Height And Right Hand Length	r = 0.7506	p < 0.0001 HS
Mean Height And Left Hand Length	r = 0.7341	p < 0.0001 HS
Mean Height And Right Hand Breadth	r = 0.6189	p < 0.0001 HS
Mean Height And Left Hand Breadth	r = 0.6112	P < 0.0001 HS

Since the data was not normally distributed, Spearman's correlation for skewed data was applied to find the r value.

The right hand length versus stature correlation coefficient in north interior Karnataka individuals was 0.7506.

The left hand length versus stature correlation coefficient in north interior Karnataka individuals was 0.7341.

The right hand breadth versus stature correlation coefficient in north interior Karnataka individuals was 0.6189.

The left hand breadth versus stature correlation coefficient in north interior Karnataka individuals was 0.6112.

The right hand length had the highest correlation coefficient (0.7506) and the least correlation coefficient was found with left hand breadth (0.6112).

Regression

The word regression means prediction. It is a method to estimate or predict the value of one character (variable) from the knowledge of the other character (variable). This is possible when the two characters are linearly correlated. The variable to be estimated is called dependent variable and the variable which is known is called the independent variable. This is done by finding another constant called regression coefficient. This coefficient gives an amount of change in the dependent variable, for every unit change in the independent variable. The mathematical equation from which the dependent variable can be predicted is called the Regression Equation.

Regression equations were calculated for the various combinations to reach the best possible estimate of stature.

Table 9 shows the regression equations to calculate stature from right hand length, left hand length, right hand breadth and left hand breadth in north interior Karnataka population. The equations have a constant and a multiplication factor in the form of "Stature= Constant + Multiplication factor X hand dimension (Rt. Hand length/ Lt. hand length/ Rt. Hand breadth/ Lt. hand breadth)". The multiplication factor is first multiplied with the hand dimension and then added to the constant to get the stature.

Table 9: Linear regression equation for the prediction of stature by hand dimensions in north interior Karnataka individuals

Hand dimensions	Linear Regression Equation
Right Hand Length	Stature (S)= 46.163+[6.5712*RHL]
Left Hand Length	Stature (S)= 45.659+[6.589 *LHL]
Right Hand Breadth	Stature (S)= 85.26+[10.068*RHB]
Left Hand Breadth	Stature (S)=85.96+[10.05*LHB]

RHL= Right hand length, LHL= Left hand length, RHB= Right hand breadth, LHB= Left hand breadth. Stature (S) in cm and hand dimensions in cm.

The regression equation to estimate stature in north interior Karnataka individuals from right hand length is: S =46.163+ [6.5712*RHL]

The regression equation to estimate stature in north interior Karnataka individuals from left hand length is: S =45.659+ [6.589*LHL]

The regression equation to estimate stature in north interior Karnataka individuals from right hand breadth is: S =85.26+ [10.068*RHB]

The regression equation to estimate stature in north interior Karnataka individuals from left hand breadth is: S =85.96+ [10.05*LHB]

DISCUSSION

The results of the present study show that the dimensions of the hand can be effectively used for estimation of stature by law enforcement agencies and forensic scientists. The only precaution to be taken into consideration is that these formulae are applicable solely to the population from which the data has been collected, due to inherent population variation in these dimensions, which may be attributed to genetic and environmental factors like climate, nutrition, etc.

The present study is unique in its sample selection. The sample was drawn from the north interior Karnataka population aged between 25 to 50 years. Hand length and hand breadth of both the hands were measured in the study population. Linear regression equation was derived for each of the hand dimension with stature. Very few studies of similar nature have been conducted in the past.

All parameters showed statistically highly significant positive correlation with stature in the present study. The presence of a positive correlation between the study variables and the stature facilitates formulation of regression equation which can be successfully utilized for stature estimation in north interior Karnataka population.

Table 10: The stature (S) in males and females of different study groups according to previous studies and the present study

Sl. No.	Study	Study group	S in males Mean±SD in cm	S in females Mean±SD in cm
1	Ilayperuma I et al.[6] 2010	Galle, Sri Lanka Males & females	170.14±5.22	157.55±5.75
2	Jasuja O P et al.[34] 2004	Jat Sikhs, Punjab Males & females	175.2±5.24	159.7±5.17
3	Waghmare V K R et al.[52] 2011	Maharashtrian males	159.01± 6.78	-
4	Sunil et al.[37] 2005	Delhi Males & females	169.0±7.8	158.0±5.8
5	Laila S Z H et al.[7] 2009	Bengali Muslim females	-	156.02±6.13
6	Devi K V S et al.[4] 2012	Salem Males & females	173.49 ± 6.2	160.48 ± 6.38
7	Chikhalkar B G et al.[5] 2010	Mumbai Males & females	P= 167.265±8.494	
8	Hossain S et al.[49] 2010	Garo community, Bangladesh females	-	152.79±5.62
9	Present study	North interior Karnataka Males & females	166.166±7.097	155.775±6.611

S= Stature, SD= Standard deviation, P= Pooled data

The table 10 shows the mean stature of males and females of different groups seen in previous studies and the mean stature of males and females in the present study.

The table shows that there is wide variation in mean stature between same sex groups of different study groups. The stature depends on several factors which include genetic and environmental factors. This is the reason for wide variation in mean stature amongst individuals of same sex belonging to different population groups.

The study done by Waghmare V K R et al.[52] included only males and the studies done by Laila S Z H et al.[7] and Hossain S et al.[49]included only females. This is in contrast to the present study which included both males and females.

The mean stature of both males and females in our study is lower compared to the studies done by Ilayperuma I et al.[6], Jasuja O P et al.[34], Sunil et al.[37], Devi K V S et al.[4] and Chikhalkar B G et al.[5]. However the mean stature for males in our study is higher compared to the study done by Waghmare V K R et al.[52] The mean stature of females in or study is higher compared to the study done by Hossain S et al.[49] but lower compared to the study done by Laila S Z H et al.[7]

Table 11: The hand length (HL) in males and females of different study groups according to previous studies and the present study

Sl. No.	Study	Study group	HL in males Mean±SD in cm	HL in females Mean±SD in cm
1	Ilayperuma I et al.[6] 2010	Galle, Sri Lanka Males & females	19.01±0.86	17.62±0.93
2	Jasuja O P et al.[34] 2004	Jat Sikhs, Punjab Males & females	19.80±0.73 (RH) 19.793±0.76 (LH)	17.51±0.81(RH) 17.47±0.80 (LH)
3	Waghmare V K R et al.[52] 2011	Maharashtrian males	16.92±0.91 (RH) 16.46±0.93 (LH)	-
4	Sunil et al.[37] 2005	Delhi Males & females	19.6±1.3(RH) 19.5±1.2(LH)	18.2±1.0 (RH) 18.1±1.0 (LH)
5	Laila S Z H et al.[7] 2009	Bengali Muslim females	-	16.39±0.79 (RH) 16.34±0.80(LH)
6	Devi K V S et al.[4] 2012	Salem Males &females	19.05±0.8 (RH) 19.14 ±0.9 (LH)	17.6 ±0.8 (RH) 17.58 ±0.8 (LH)
7	Chikhalkar B G et al.[5] 2010	Mumbai Males & females	P= 18.938±1.88	
8	Hossain S et al.[49] 2010	Garo community, Bangladesh females	-	16.39±0.72 (RH) 16.33±0.67 (LH)
9	Present study	North interior Karnataka Males & females	18.146±0.8 (RH) 18.170±0.847 (LH)	16.935±0.768(RH) 16.968±0.727(LH)

HL= Hand length, SD= Standard deviation, RH= Right hand, LH= Left hand, P= Pooled data

Table 12: The hand breadth (HB) in males and females of different study groups according to previous studies and the present study

Sl. No.	Study	Study group	HB in males Mean±SD in cm	HB in females Mean±SD in cm
1	Devi K V S et al.[4] 2012	Salem Males & females	8.48 ± 0.6 (RH) 8.25 ± 0.6 (LH)	7.58 ±0.6 (RH) 7.36 ±0.5 (LH)
2	Chikhalkar B G et al.[5] 2010	Mumbai Males & females	P= 7.537±0.714	
3	Hossain S et al.[49] 2010	Garo community, Bangladesh females	-	7.22±0.38 (RH) 7.18±0.37(LH)
4	Present study	North interior Karnataka Males & females	7.952±0.425 (RH) 7.892±0.429 (LH)	7.185±0.348 (RH) 7.139±0.341(LH)

HB= Hand breadth, SD= Standard deviation, RH= Right hand, LH= Left hand, P= Pooled data

Tables 11 and 12 show the values of mean hand length and hand breadth observed in different study groups.

Variations were also noted in the hand dimensions in the same sex groups belonging to different study populations. All the anthropometric parameters are determined by genetic and environmental factors and hence are known to vary between ethnic groups.

The mean hand length of males and females in our study is lower compared to the studies done by Ilayperuma I et al.[6], Jasuja O P et al.[34], Sunil et al.[37]and Devi K V S et al.[4] The mean hand length of males in our study is higher compared to the study done by Waghmare V K R et al.[52] The mean hand length of females in our study is higher compared to the findings of the studies done by Laila S Z H et al.[7] and Hossain S et al.[49]

The mean right and left hand breadth in males and females of our study is lower compared to the corresponding findings of studies done by both Devi K V S et al.[4] and Hossain S et al.[49]

Table 13: The correlation coefficient (r) and regression equation to estimate stature (S) from hand length (HL) in different study groups according to previous studies and the present study

Sl. No.	Study	Study group	r	Regression equation
1	Ilayperuma I et al.[6] 2010	Galle, Sri Lanka Males & females	0.58 (M) 0.59 (F)	M: 103.732+[3.493* HL] F: 93.689+[3.625*HL] P: 60.807+[5.637 *HL]
2	Jasuja O P et al.[34] 2004	Jat Sikhs, Punjab Males & females	0.652 (MRH) 0.586 (MLH) 0.577(FRH) 0.575 (FLH)	M:069.513+[5.223*RHL] 084.742+[4.491*LHL] F: 130.95+[1.612*RHL] 130.03+[1.660*LHL]
3	Waghmare V K R et al.[52] 2011	Maharashtrian males	0.76 (MRH) 0.75 (MLH)	-
4	Sunil et al.[37] 2005	Delhi Males & females	-	M:86.93+[4.25*RHL] 85.84+[4.32*LHL] F: 77.42+[4.56*RHL] 80.94+[4.40*LHL]
5	Laila S Z H et al.[7] 2009	Bengali Muslim females	0.68 (FRH) 0.68 (FLH)	-
6	Devi K V S et al.[4] 2012	Salem Males & females	0.767 (PRH) 0.809 (PLH)	M: 90.7+[4.345*RHL] 91.55 +[4.284*LHL] F: 82.540 +[4.428*RHL] 65.805 +[5.387*LHL] P:48.678 +[6.437*RHL] 47.115 +[6.516*LHL]

7	Chikhalkar B G et al.[5] 2010	Mumbai Males & females	0.5902 (P)	P=116.892872+[2.665389 *HL]
8	Hossain S et al.[49] 2010	Garo community, Bangladesh females	0.51 (FRH) 0.49 (FLH)	-
9	Present study	North interior Karnataka Males & females	0.7506(PRH) 0.7341(PLH)	46.163+[6.5712*RHL] 45.659+[6.589*LHL]

S= Stature, HL= Hand length, r= Correlation coefficient, M= Male, F= Female, RHL= Right hand length, LHL= Left hand length, P= Pooled data, MRH= Male right hand, MLH= Male left hand, FRH= Female right hand, FLH= Female left hand, PRH= Pooled right hand, PLH= Pooled left hand

Table 14: The correlation coefficient (r) and regression equation to estimate stature (S) from hand breadth (HB) in different study groups according to previous studies and the present study

Sl. No.	Study	Study group	r	Regression equation
1	Devi K V S et al.[4] 2012	Salem Males & females	0.607 (PRH) 0.581(PLH)	M:150.271+[2.740*RHB] 157.303+[1.962*LHB] F: 130.636+[3.938*RHB] 133.146+[3.714*LHB] P:106.871+[7.419*RHB] 107.252+[7.583*LHB]
2	Chikhalkar B G et al.[5] 2010	Mumbai Males & females	0.6004(P)	P=113.561732+[7.139216 *HB]
3	Hossain S et al.[49] 2010	Garo community, Bangladesh females	0.17 (FRH) 0.15 (FLH)	-
4	Present study	North interior Karnataka Males & females	0.6189 (PRH) 0.6112(PLH)	85.26+[10.068*RHB] 85.96+[10.05*LHB]

S= Stature, HB= Hand Breadth, r= Correlation coefficient, M= Male, F= Female, RHB= Right hand breadth, LHB= Left hand breadth, P= Pooled data, FRH= Female right hand, FLH= Female left hand, PRH= Pooled right hand, PLH= Pooled left hand

Tables 13 and 14 show the correlation coefficient (r) and the regression equations to estimate stature from hand length and hand breadth in various study groups.

Right hand length had the highest correlation coefficient in males and females in study done by, Jasuja O P et al.[34]

Waghmare V K R et al.[52], showed that right hand length of male Maharashtrians had higher correlation coefficient than left hand length.

Study done by Laila S Z H et al.[7], showed that both right and left hand length of females had equal correlation coefficient. Hossain S et al.[49], in their study implied that right hand length of females were highly correlated in estimating stature than the left hand length.

Devi K V S et al.[4], in her study showed that left hand length had higher correlation coefficient which was in contrast to the present study.

Overall, most of the studies imply that right hand length in the particular population has a higher correlation coefficient. This is similar to the findings of the present study.

Devi K V S et al.[4] and Hossain S et al.[49] showed that the right hand breadth had a higher correlation coefficient than left hand breadth and this was similar to the present study.

So on considering all these findings on the whole, hand length may be considered to be of greater value than hand breadth to estimate stature when the sex is known or unknown (pooled data). In a given situation where it is possible only to take one of the measurements due to availability of only a part of the hand, both HL and

HB are of equal importance as stature will have to be estimated approximately from that measurement.

The regression equation to calculate stature from hand length and breadth in various study groups is shown in table 12 and 13. By substituting the value of hand length or breadth in the formula the stature can be estimated or vice versa, i.e., by substituting the value of stature in the equation, hand length or breadth can be estimated approximately.

CONCLUSION

To conclude, the present study provides us with regression equations for four different parameters that can be used for stature estimation in population of north interior Karnataka. It is however, important to note that these equations cannot be used for other Indian population groups as the anthropometric measurements of every ethnic group depend on a plethora of factors.

Another key finding of our study is that the right hand length is the most reliable and accurate hand dimension to estimate stature in population of north interior Karnataka. This should be taken into consideration when options of measuring all hand dimensions are in the offering.

All parts of the body show biological correlation. This fact can be utilized to estimate the size of one part of the body using the other part. The same principle holds good to estimate stature from body parts.

The procedure of measuring hand dimensions and to use them in appropriate regression equations to determine the stature is simple and is an important tool for stature estimation. These type of studies are of medico-legal importance, as the first step in forensic analysis is establishing the identity of the person, in case of fragmented or mutilated remains, this method is useful in estimating stature. These studies are also of anthropological importance as it helps to know the differences between different population groups. If the same study is conducted on the same population group after several years, it will help to identify the micro evolutionary changes.

SUMMARY

This study was taken up with the aim of finding out whether there is any correlation between stature and hand dimensions in north interior Karnataka population.

A cross sectional study was carried out on 300 staff of B.L.D.E. University belonging to north interior Karnataka. The study subjects included both males and females aged 25 to 50 years. Stature, right hand length and breadth, left hand length and breadth of the individuals were measured. Data was collected at a fixed time of the day to avoid diurnal variations.

Stature was measured as the vertical distance between the floor and the vertex using measuring tape. Dimensions of hand like; hand length and hand breadth were measured independently on right and left side of each individual using a sliding caliper.

The statistical analysis indicated that there was a positive correlation between stature and the various hand parameters studied and this was found to be statistically highly significant.

The highest correlation coefficient was seen between right hand length and stature (0.7506) and lowest for left hand breadth and stature (0.6112).The significant positive correlation between the study variables and the stature indicates that these variables can be successfully used to predict stature. Linear regression equations to estimate stature from the various hand dimensions were derived. The study was compared with previous similar studies conducted on other population groups.

The present study is the first ever documented anthropological work on the population of north interior Karnataka.

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B.L.D.E.U 's SHRI B.M. PATIL MEDICAL COLLEGE,

HOSPITAL AND RESEARCH CENTRE, BIJAPUR – 586103,

KARNATAKA

PROFORMA

Name:

Sex:

Age:

Birth Place:

Diet: Vegetarian (V) /Non Vegetarian (NV)

Date:

Place:

SOMATOMETRIC MEASUREMENTS IN CENTIMETRES

	I Reading	II Reading	III Reading	Mean
Height (Stature)				
R.H.L.				
L.H.L.				
R.H.B.				
L.H.B.				

KEY TO MASTER CHART

Sex:

1	Male
2	Female

Birth place:

1	Bijapur
2	Bidar
3	Gulbarga
4	Gadag
5	Bagalkot
6	Dharwad
7	Koppal
8	Raichur
9	Haveri
10	Belgaum

Diet:

1	Vegetarian
2	Non vegetarian

MASTER CHART

Sl No.	Sex	Age	Birth Place	Diet	Height mean	Right Hand Length Mean	Left Hand Length Mean	Right Hand Breadth Mean	Left Hand Breadth Mean
1	1	25	1	2	165.5	17.7	17.1	8	7
2	2	44	1	2	154	17.1	16.9	7.4	7.4
3	2	45	2	2	144	16	15.7	6.6	6.7
4	2	28	3	2	147	16.2	16.1	6.6	6.6
5	1	40	1	1	173.5	18.2	18.6	8.9	8.8
6	2	32	1	1	149	17	17.1	6.8	7
7	1	38	1	2	176.5	19.4	19.6	8.4	8.3
8	1	49	1	2	166	18.3	18.3	7.8	7.8
9	2	30	1	2	147	15.7	16	7.3	7.3
10	1	44	1	1	172	19.1	19.2	8.4	8.3
11	1	33	1	2	165.5	18.3	18.5	7.7	7.4
12	1	50	1	1	144	16.8	16.4	7	7
13	1	50	1	1	170	18.7	18.7	8.7	8.6
14	1	25	1	1	164	17.6	17.7	8	7.6
15	1	25	4	2	171	18.9	18.8	8.5	8.6

16	2	25	3	2	164	17.8	18	7	7.1
17	2	25	1	1	158	16.7	16.8	7.3	7.3
18	2	25	1	2	159	16.8	17	7.6	7.5
19	2	25	5	2	154	15.3	15.6	7.2	7.1
20	2	35	1	1	147	15.2	15.4	6.4	6.5
21	2	37	1	2	156.5	17	17.5	7.9	8
22	2	38	1	2	156.6	16.2	16.1	7.3	7.4
23	1	25	1	1	169	18.3	18.3	8.2	8.2
24	1	25	2	1	172	17.9	18.5	8	7.8
25	1	46	1	1	170	18.6	18.8	8.5	8.6
26	1	29	4	2	163	18.1	18.2	7.4	7.6
27	1	50	1	2	158	18.1	18.4	7.9	7.6
28	1	30	6	1	176	19.1	19.2	8.1	8.2
29	1	25	1	2	169	17.9	18	8	8.1
30	1	49	1	2	156	17.8	17.6	8.4	8.4
31	1	34	1	2	160	17.5	17.5	8.2	8
32	1	29	1	2	167	18.5	18.7	8.7	8.6
33	1	25	1	2	166	17.7	17.3	8.2	8.1
34	1	26	1	2	171	18.1	18.3	7.8	7.9

35	1	43	1	1	166	17.2	17.2	7.1	7.2
36	2	46	1	2	151	15.8	15.9	7.1	6.8
37	1	26	5	1	165	17.7	17.2	7.7	7.5
38	1	50	1	1	168.5	19.1	19.4	8.2	8.4
39	1	27	3	2	180.5	20.2	20	8.7	8.9
40	1	27	3	2	168.2	17.4	17	7.6	7.5
41	1	37	1	2	161.7	17.6	17.3	7.9	7.7
42	1	37	1	1	167.3	19.2	18.7	8.8	8.7
43	1	25	3	1	171.9	19.1	19.1	8.6	8.4
44	1	26	4	2	182.3	19.2	19.7	8.1	8
45	1	45	5	1	173	18.5	18.6	8	8.2
46	1	45	1	2	163.1	16.8	16.8	8.1	8.2
47	1	32	1	2	167	18	18.2	8	8.3
48	1	43	1	2	164.5	18.5	18.4	7.6	8
49	1	50	1	1	164	17.7	17.3	7.4	7.3
50	1	29	1	1	169.5	18.3	18.8	8.5	8.4
51	2	47	1	1	165.5	17.7	17.6	7.1	6.8
52	2	41	7	2	165	18.2	18.1	7.6	7.5
53	1	50	1	1	152.9	16.2	16.2	7.3	7.2

54	1	30	1	2	157.5	18	18.2	7.8	8
55	2	34	1	1	161.5	18.2	18	7	7.1
56	2	33	3	1	162.5	17	16.6	7.4	7.6
57	1	50	1	2	157	17.4	17.2	7.3	7.5
58	2	37	1	2	152	16.9	16.8	7.4	7.2
59	2	45	1	2	147	16.5	16.3	7	7
60	1	41	1	2	168.2	17.6	17.5	8.2	8.3
61	2	30	5	1	160	17.2	17.4	7.1	7
62	2	30	1	2	150	15.2	15.5	6.5	6.8
63	1	43	1	2	169.5	18.3	18.5	8.3	8.4
64	1	42	1	2	173	17.3	17.8	7.9	8.3
65	1	42	1	1	154	16.3	16.2	7.4	7.5
66	1	32	1	1	159.5	18.4	18.6	8.3	8.2
67	1	45	1	2	164	17.9	17.8	8.4	8.2
68	1	39	1	2	159.5	16.4	16.5	7.3	7.2
69	1	29	1	2	173	18.7	18.1	7.5	7.6
70	1	25	1	2	166	17.6	17.4	7.8	7.6
71	1	32	1	2	183	18.8	19.1	8.1	7.9
72	1	28	1	2	176	19.1	18.8	8.4	8.7

73	1	49	1	1	164	17.9	17.8	7.5	7.6
74	1	50	1	1	176	19.5	19.2	9	8.8
75	1	40	1	1	165	17.3	17.6	8.2	8.1
76	1	37	1	1	167	17.6	17.9	8	7.9
77	1	27	8	1	169	18.5	19	8.5	8.4
78	1	25	8	1	173	19.2	19.1	7.3	7.1
79	1	46	1	2	152	17.3	17.5	7.9	7.8
80	1	26	1	1	187	18.5	18.4	8.1	8
81	1	28	1	2	164.5	16.5	16.4	7.2	7.3
82	1	26	1	2	173	18.9	19	8.4	8.6
83	1	50	1	1	171.7	18.2	18.7	8.2	8.3
84	1	25	1	2	171	19.5	19.2	8.5	8.1
85	1	25	1	2	170	18.5	18.2	7.8	7.7
86	2	46	1	1	167	18.2	18	7.7	7.4
87	2	28	1	2	155.6	17	16.8	7.2	7.1
88	1	50	1	2	167	19	19.1	7.8	7.7
89	1	50	1	2	180.3	19.8	20.1	8.2	8.1
90	1	48	1	1	165.8	18	18.4	8	7.7
91	1	34	1	2	169.1	18.9	18.8	8.2	8.1

92	1	43	5	2	170.2	17.6	17.8	7.7	7.5
93	1	50	1	2	163	18.1	18.4	8	7.6
94	1	25	1	1	167	16.8	16.7	7.8	7.7
95	2	42	1	2	150	15.1	15.6	7	6.6
96	2	45	1	2	157	17.1	17.1	7.5	7.2
97	1	25	1	1	170.4	17.1	17.3	7.2	7.3
98	2	27	3	2	160.4	16.8	16.8	7.4	7.6
99	1	42	1	2	169.8	19.4	19.4	7.8	7.7
100	1	28	1	1	157	17.6	17.5	7.8	7.6
101	1	46	1	1	161	19	18.9	7.8	8
102	1	48	1	2	158	18.4	18.3	7.4	7.6
103	1	40	1	1	167	18.1	18	8.6	8.3
104	1	40	1	1	165.7	19.3	19.2	7.7	8
105	2	49	1	1	162.6	18.8	18.5	7.5	7.4
106	1	49	1	1	161.2	17.8	18	7.8	7.7
107	1	26	1	2	166	18.3	18.6	8.1	8.1
108	1	45	1	1	175.2	18.7	19	8.2	7.9
109	1	45	1	1	181.4	20	20.1	8.5	8.2
110	1	41	4	1	154	17.2	17.5	7.3	7.2

111	1	28	1	1	156	18.1	18	8	7.8
112	1	39	1	2	172.8	17.5	17.6	8	7.8
113	1	25	1	2	164	17.9	18.2	8.4	8.8
114	1	28	9	2	170	18.8	18.8	7.7	7.5
115	1	30	1	1	151	16	16.2	7.7	7.7
116	1	34	1	2	172.5	18.1	17.9	8	7.9
117	1	29	1	2	169	18.8	19	8	7.8
118	1	30	1	2	165	18.9	18.8	8.4	8.3
119	1	28	1	1	175	19.9	19.4	8.3	8.2
120	1	27	1	2	159.5	18.3	18.4	7.7	7.7
121	2	40	1	2	153.2	17.1	17.3	7.3	7.1
122	1	28	1	2	171	19.9	19.6	8.5	8.6
123	2	25	1	2	157	17.3	17.3	7	7
124	1	25	1	1	159	18.1	17.8	7.5	7.6
125	1	41	1	2	169.2	19.2	19	8.7	8.3
126	1	34	1	2	161	17.5	17.6	8.3	8.1
127	1	35	1	2	153.9	17.2	17.4	7.8	7.8
128	2	28	1	1	160.3	17.6	17.2	7.2	7.1
129	1	40	1	2	176	18.2	18.3	7.8	7.6

130	1	25	6	2	172	18.8	18.9	8.1	7.9
131	2	25	1	1	148	16.5	16.6	7.2	7
132	1	31	1	2	166	17.3	17.2	7.2	7.1
133	1	50	1	1	161	17.6	17.6	7.6	7.7
134	1	30	1	1	169.5	18.4	18.3	8.5	8.2
135	1	42	1	1	163	18.3	18.3	7.9	8
136	1	26	1	2	170	18.3	18.1	8.1	8
137	1	27	1	2	161	17	17.3	8	8.1
138	1	25	1	2	152	17.9	18	7.8	7.7
139	1	28	1	2	155	16.2	16.5	7.6	7.5
140	2	48	1	1	147	16.7	16.6	7.1	7
141	2	48	1	2	157.5	16.6	16.5	7.1	6.8
142	1	40	1	2	162.6	17.1	17.8	7.8	7.6
143	2	42	1	2	142.2	16.6	16.6	6.5	6.4
144	1	26	3	1	165.1	17.7	17.2	7.4	7.2
145	2	26	1	1	150	15.6	15.7	7.2	7
146	2	30	1	2	155	17.5	17.4	7.2	7.3
147	1	25	1	1	168	17.8	18	7.5	7.8
148	1	32	1	2	169	18.1	18.3	8.4	8.2

149	1	27	1	2	153	18.1	17.8	7.7	7.5
150	1	40	1	2	161	17.8	17.5	8	8
151	1	30	1	1	155.5	16.5	16.2	7	6.8
152	1	32	1	1	164.5	18.3	18.8	8	8.1
153	1	48	1	1	163	16.9	17	7.5	7.4
154	2	27	1	1	147.3	17.3	17.6	7.6	7.2
155	2	43	1	2	146	16.2	16.3	7.1	7
156	1	30	1	2	171	17.6	17.5	8.2	7.8
157	2	26	1	1	152	16.1	16	6.3	6.2
158	1	50	1	2	160	17.7	18.3	7.9	7.8
159	1	42	1	1	176	19	19	8.1	7.8
160	1	40	1	2	182	21	21.3	8.9	8.8
161	1	40	1	1	155	16.1	16.5	7.4	7.3
162	1	50	1	1	160.2	18.9	19.4	8.2	8.2
163	1	50	1	2	163	17.1	17.3	7.5	7.1
164	1	47	1	1	171	18.5	18	8.1	8
165	1	50	1	1	164	18	17.8	7.4	7.3
166	1	26	1	2	153	17	17.1	7.2	7
167	2	26	1	1	158	16.8	16.8	7	7.2

168	1	42	1	1	168	18.2	18.4	7.7	8
169	1	44	1	1	157.5	17.3	17.5	7.6	7.7
170	1	33	1	2	161	17.9	17.7	7.4	7.3
171	2	27	1	2	146	15.8	15.5	6.5	6.9
172	1	38	1	2	174.2	18.8	18.8	8.1	8.1
173	2	32	10	2	156.1	16.6	16.8	7.4	7.1
174	2	25	1	1	168	18	17.9	7.2	6.9
175	1	28	1	2	177	19.1	19	8.3	8.1
176	2	26	2	1	153.6	16.8	16.9	6.8	6.8
177	1	50	1	2	169.9	19.5	19.4	8	8.1
178	2	29	1	1	157.4	16.7	16.9	7.1	7.1
179	2	35	10	1	153.5	17.1	17.2	7	6.9
180	1	25	1	1	165.3	19	18.8	8	7.8
181	2	42	2	1	154	18	17.8	7.7	7.5
182	2	32	1	2	158	17.1	17.2	7	6.8
183	2	26	1	1	157.5	16.6	16.5	7.3	7.1
184	2	27	1	1	161.5	17.3	17.1	7.2	7.3
185	1	50	1	2	164.8	18.1	17.9	7.7	7.6
186	1	25	1	1	158	18	18.1	8.2	8

187	1	25	1	1	153	17.4	17.9	8.1	7.7
188	1	48	1	1	163.6	17.8	17.6	8.4	8.3
189	2	38	1	2	160	18.8	18.7	7.6	7.4
190	2	45	1	2	143	16	16.1	7.2	7
191	1	50	1	2	159.8	17	17.2	8	8
192	1	27	1	2	175	18.3	17.9	7.9	8
193	1	30	1	2	165	17.7	17.9	7.3	7.3
194	2	40	1	2	157	18.2	18.2	7.3	7
195	1	35	1	2	156	18	17.8	7.4	7.6
196	1	25	1	1	155.9	17	17	7.6	7.7
197	2	42	1	1	156	16.3	16.6	7.4	7.4
198	1	48	1	1	162.5	17	17.2	6.8	6.6
199	2	48	1	2	149.2	16.2	16.2	6.9	7.2
200	1	49	1	2	165.2	18.9	19	8.2	8
201	1	33	1	2	161.6	18.6	18.8	8.1	8.3
202	1	31	1	1	156	18.1	17.6	7.6	7.4
203	2	30	1	2	151.7	16.2	16.4	7.1	7.1
204	2	47	1	2	158	17.2	17.5	7.7	7.8
205	1	50	1	2	177.5	19.2	19.2	8	7.9

206	1	30	1	2	166.6	18.3	18.4	7.1	7.3
207	2	25	1	2	147.4	16.4	16.4	6.7	6.3
208	1	47	1	2	169	17.6	17.8	8.2	8
209	2	28	1	2	160	17	16.9	7	7.2
210	2	25	1	2	158.6	17.8	17.7	7	7.3
211	2	25	1	1	161.6	16.9	16.7	6.6	6.8
212	2	30	1	1	149.7	17.2	17	6.3	6.5
213	1	25	7	1	177	18.3	18.4	7.9	7.4
214	1	42	1	2	165	17.7	17.8	7.8	7.4
215	1	49	1	1	151.3	16.7	16.6	7.1	7.1
216	2	32	10	1	154	16.3	16.4	7	6.9
217	1	30	5	2	172.8	18.8	18.9	8.2	8.1
218	2	27	3	1	155	17.3	17.4	7.5	7.6
219	1	32	1	2	160.9	18.5	18.6	8.2	8.2
220	2	38	1	2	156.4	18	18.1	7.5	7.6
221	2	44	1	1	167.6	17.1	17.3	7.1	7
222	2	43	1	1	155.5	16.1	16.4	7.2	7.2
223	1	28	1	2	183	18.9	18.9	8.5	8.4
224	1	48	1	1	166.8	18.3	18.3	7.3	7.3

225	2	26	1	1	170.5	17.3	17	7.5	7.5
226	2	25	1	1	164.8	17.6	17.8	7.6	7.4
227	1	45	1	1	161.2	17.6	17.6	8	7.9
228	1	45	1	1	167.6	19.2	19.4	7.8	7.5
229	1	44	1	2	172.2	19.1	18.6	8.2	8.2
230	1	36	1	2	174	19	19	7.7	7.5
231	1	45	6	1	170.6	18.1	18.4	7.6	7.4
232	1	50	1	1	167	18.3	18.4	8	8
233	1	50	1	1	159.5	17.1	17.2	7.4	7.3
234	1	42	1	2	158	18.3	17.9	7.3	7.5
235	2	26	1	1	175	18.4	18.3	7.1	7.2
236	2	43	1	1	149	15.9	16	7	6.9
237	2	48	1	2	140	16.4	16.1	7.5	7
238	1	31	1	2	165	18.6	18.6	8	7.9
239	2	50	1	2	161.5	17.2	17.4	7.8	7.7
240	2	38	1	2	160	17.2	17.4	7.5	7.3
241	2	50	1	1	154	17.4	17.6	7.4	7.2
242	1	46	1	2	169.2	18.7	18.8	8	8
243	1	30	1	2	177	18.2	18.3	8	8

244	1	39	3	2	166.2	17.9	18	8	8
245	2	28	1	2	161.5	17	16.8	6.8	6.7
246	2	43	2	1	152.7	16.9	17	6.9	7
247	2	25	1	2	160.2	17.5	17.3	7	7.1
248	1	50	1	2	174	19.4	19.7	8.5	8.4
249	2	26	1	1	153.6	17	17.1	7.1	7
250	2	27	1	1	156.1	17.4	17.4	7.3	7.4
251	1	28	1	1	170.2	18.4	18	8.2	8.2
252	1	50	1	2	169.8	18.9	19.2	8	8
253	1	48	1	2	162.6	18.2	17.9	7.6	8
254	1	50	1	2	156.7	17.8	18	8	8.1
255	1	25	1	1	161.9	17	17	7.5	7.6
256	1	30	1	2	175	18.6	19.2	8.9	8.6
257	1	39	1	2	170.2	18.7	18.5	8.1	8.3
258	1	26	1	2	170.6	18.8	18.4	7.8	8.1
259	1	40	1	2	160	17.2	17.3	8	8
260	1	42	1	2	167	18.2	18.1	8	8
261	1	49	1	2	160	17.5	17.6	8.1	8
262	1	45	1	1	157.5	18.6	18.4	8.2	7.9

263	1	50	1	1	167.5	18.5	18.3	8.3	8.3
264	2	45	1	1	165	17.4	17.7	7.6	7.7
265	1	46	1	1	162.5	17.1	17.2	8	8
266	1	33	1	1	160	17.1	17	7.2	7
267	1	48	1	1	175	19.6	20	8.2	8
2698	1	41	1	1	154.5	17.4	17.4	8	8
269	1	45	1	1	162.5	18.3	18.1	8.1	7.9
270	1	48	1	2	163.8	17.1	17.4	7.1	7.3
271	2	29	1	1	160	17.7	17.8	7.7	7.5
272	2	35	1	1	154	17.5	17.3	7.1	7
273	1	50	1	1	170.2	18.7	18.3	7.2	7.4
274	1	28	1	2	165	17.6	17.5	8.1	8.1
275	1	31	1	2	163	18.1	18.1	8.1	7.9
276	1	36	1	1	161.7	17.1	17.3	8	7.6
277	1	32	1	1	172.7	19.4	19.3	8	8
278	1	50	1	1	164.7	18.2	18	8.4	8.3
279	1	26	1	2	159.4	18.5	18.9	9.1	8.8
280	1	32	1	2	166	19.1	19.3	8	7.8
281	1	50	1	1	161.5	18.3	18.2	7.5	7.4

282	1	50	1	1	164.8	17.6	17.9	8.4	8.3
283	2	25	1	2	153.8	16.9	17.1	7.6	7.7
284	2	43	1	2	155.7	17.2	17.4	7.4	7.4
285	1	31	1	1	167.7	17.6	17.5	8.2	8.1
286	1	26	1	2	172.5	19.2	19	8	8.1
287	1	48	1	1	168.8	18	17.8	7.9	8.1
288	2	28	1	2	155.4	17.2	17.3	7.5	7.3
289	2	30	1	2	164.8	17.4	17.5	7.6	7.7
290	1	36	1	2	172	18.5	18.6	8.3	8.4
291	1	32	3	1	166.3	18	18.2	7.8	7.8
292	2	36	1	1	154.9	16.6	16.8	7.3	7.4
293	1	43	1	2	173.7	18.9	18.8	8.6	8.4
294	1	29	10	1	165.1	18.1	17.9	7.8	7.8
295	2	41	1	1	155	17	17.1	7.2	7.2
296	1	25	1	2	167	17.8	17.8	8	8
297	1	29	1	1	164	17.5	17.6	8.2	8.2
298	2	30	1	1	163	17	17	6.8	6.8
299	1	27	1	2	170	18.9	18.9	8.4	8.4
300	2	42	1	1	152	16.8	17	7.6	7.6

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INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 20-10-2011 *at* 10-30 am *to scrutinize the Synopsis/Research projects of postgraduate/undergraduate student/Faculty members of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis/Research project has been accorded Ethical Clearance.*

Title "Stature estimation from hand dimensions in staff of BLDE University Aged 25-50 years"

—x—x—x—

Name of P.G./U.G. student/Faculty member Dr. Sahana. B.N.
Dept of Anatomy

Name of Guide/Co-investigator Dr. S.D. Desai, Prof & HOD, Anatomy

DR.M.S.BIRADAR,
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Chairman
Ethical Committee
BLDEA'S Shri. B.M. Patil
Medical College
Bijapur-586103

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.