



Stature estimation using minimum Armamentarium in Himachali population: A Cross sectional study on Odontometry and skull Anthropometry.

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Abstract:

Background: When the body has been mutilated or fragmented in case of mass destruction and disasters, it is common to have head or extremities to get separated from the trunk. In relation with forensic odontology, an estimate must have been made to correlate osteometry along with odontometry in determining gender and race.

Aim: To investigate the relationship between stature of a person with the diameter of the skull, the circumference of the skull, combined mesio-distal width of the maxillary anterior teeth, the length of the maxillary central incisor as well as with the length of foot using minimum and easily available armamentarium.

Materials and Methods: The study was conducted in 100 subjects (50 males and 50 females) who visited the department of Oral Medicine and Radiology of from June, 2019 to August, 2019 for diagnostic and treatment purposes. Hundred model casts of patients were made to measure the width of the maxillary anterior teeth and the length of the maxillary central incisor. The circumference of the head, the diameter of head (distance from glabella to inion) the length of the foot and height were measured with the help of non- stretchable measuring tape. The selected parameters were measured and then correlated to estimate the stature from anthropometric and odontometric data of the skull by using linear regression analysis.

Results: The selected parameters on linear regression analysis were found to be statistically significant for estimation of stature. Highly significant correlations were found between the stature, the head diameter and the length of foot in males.

Conclusion: The present study showed that linear regression equations from the skull and odontometrics parameters can be used to estimate the stature. However longitudinal studies with larger sample size and appropriate apparatus should be done to substantiate the results in a specific population.

Keywords: Foot length, Forensic dentistry, head anthropometry, odontometry, minimum armamentarium, stature estimation.

Introduction:

Human Rights Declaration by United Nations states that every free born person has the right to be identified even after death.[1]

Anthropology is the study of humans and cultural anthropology and biological anthropology are its main subdivisions. Forensic anthropology is a branch of biological anthropology which deals with the application of osteology, archeology for the identification of skeletal and fragmentary human remains.[2]

Anthropometry consists a of series of systematised measuring techniques that expresses quantitatively the dimensions of the human body including skeletonized remains and it is a highly objective, simple, quick and reliable technique that can be used for the identification of individuals linked to a crime scenes or mass disasters. In the identification of human

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remains -Somatometry, Craniometry, Cephalometry, Odontometry and Osteometry are the different tools used in anthropometry and these tools has been proved to be valid.[2]

Vital process like body growth is recorded by measuring the stature of a person, i.e, a total length of certain long bones and appendages of the body. In medico-legal forensic examination, stature is an important biological parameter. Many a times highly decomposed or mutilated bodies or fragmentary remains of skull are brought for medico-legal examination.[3]

Many studies[4-6] have been conducted in the past for stature estimation from various body parts like upper and lower limbs, trunk, vertebral column, long and short bones, hands, foot and footprints. Various studies[1-7] in the past have been done in estimation of height using permanent tooth morphometrics and the variables used were tooth labio-lingual width, crown length, tooth length, mesio distal width and their correlation with the cephalo- facial measurements.[1]

There is a definite and proportional biological relationship of height with all body parts such as long bones, the vertebral column, skull, dental morphometrics for stature estimation. This relationship helps forensic experts to calculate height from dismembered, mutilated and fragmentary body parts in forensic examination. [3,8-11]

With this background, this study was done to investigate the relationship of height of a person with the diameter of skull, the circumference of skull, combined mesiodistal width of maxillary anterior teeth, length of maxillary central incisor as with the length of foot in a small group of Himachali population with the statistical aid of regression analysis of these variables. The study was aimed to provide identification of deceased individual by height in forensic investigations concerned with skeletal and dental human remains using minimum armamentarium as may be available in the remote areas.

Material and Methods:

The study was conducted in 100 subject (50 males and 50 females) who visited the department of Oral Medicine and Radiology of Shimla from June, 2019 to August, 2019 for diagnostic and treatment purposes. The subjects were resident of Himachal Pradesh since 2 generations.

The subjects were informed regarding the study and the informed consent was obtained. The institutional ethical committee certificate was obtained before the conduct of study.

Inclusion Criteria:

1. AGE: 20 to 30 year old patients.
2. A complete set of fully erupted teeth, periodontally healthy, non- carious, intact and satisfactorily aligned maxillary teeth.

Exclusion Criteria:

1. History or clinical evidence of cleft palate, crown restoration, orthodontic treatment, trauma, or oral destructive habit and other congenital anomalies affecting .
2. History or clinical features suggestive of endo-cranial disorders, metabolic disorders, developmental disorders or history of prolonged illness.

The following dimensions of the subjects were recorded:

1. Height:

The height of the individual was measured between vertex and the floor, when the person is standing erect and bare feet, in anatomical position and the head in the Frankfort horizontal plane and shoulder blocks and buttocks touching the vertical limb of the instrument using a measuring tape adhered to the wall. Height was measured to the nearest centimeters (cm).

2. Head Diameter:

Antero-posterior diameter of the head (DH) was measured using a non-stretchable measuring tape (calibrated in millimeters). Supra-orbital ridges were palpated and the midpoint was marked. Similarly, the deepest point on the external occipital protuberance was marked and the distance between the two was measured (calibrated in millimeters) measured to the nearest centimeters (cm).

3. Head Circumference:

Maximal fronto-occipital circumference was measured by placing a non stretchable plastic tape (calibrated in millimeters) just on the occipital prominence and the supra-orbital ridges while viewing the subject laterally also to ensure proper placement of the tape. In cases of some

hairstyles in males, we drew the tape tightly and compressed the hair as much as possible. In cases of females, the subjects were asked to lift their hair in the occipital area and the tape was placed against the skin and not over the lumps of hair.

4. Foot Dimensions:

The foot dimensions were measured independently on left and right side of each individual using digital Vernier caliper, (Mitutoyo Digital Vernier Caliper, 0-200 mm calibrated) with foot placed on a horizontal flat surface, while the subject was standing. The left foot was selected for measurements as per recommendation of the International Agreement for paired measurements at Geneva. The maximum foot length was measured from acropodion. (It is the most forwardly projecting point on the head of the 1st or 2nd toe whichever is larger when the subject stands erect) to pterion. (It is the most backwardly projecting point on the heel when the subject is standing upright with equal pressure on both the feet).

5. Mandibular Width:

The mandibular width was measured between both mandibular angles with the help of digital vernier caliper.

6. Mesio-distal Width of Maxillary Anterior Teeth:

One hundred alginate (irreversible hydro colloid material) impressions of the participants were made, and casts were poured with dental stone carefully, to record all the surface details. The greatest MD crown widths of the maxillary anterior permanent six teeth were measured between the anatomic contact points of each tooth on either side of the jaw, using digital vernier caliper with very fine tips, to obtain values of significance.

7. Length of Tooth:

The length of the tooth i.e of maxillary central incisors was measured from the incisal edge to the cervical edge of the tooth on maxillary casts using digital vernier caliper.

All the above measurements were taken in afternoon between 2:00 pm and 4:00 pm and measured in centimeters.

The derived linear regression formula has been applied for validation in same group of population on 10 males and 10 females.

Observation and Results:

The data collected was collected by two observers independently and entered in MS Excel spreadsheet and subjected to statistical methods. Inter observer variation was checked by student *t-test*. The Pearson's correlation coefficient and the linear regression equation were calculated between height and different variables. [Table 1 and 2]

Height against diameter of the head:

When height was correlated with the head diameter, using regression model, *Pearson's correlation coefficient value* of 0.931567 was found in males and 0.15906 in females. [Table 1] and determines height up to 0.7% ($R^2 = 0.007$) in males and 0.25% in females ($R^2 = 0.025$). (as shown in figure 2 and 3) The mean absolute error of ± 4.557 was found in case of males and ± 5.711 in females. (Table 3.)

Height against head circumference:

When height was plotted against the head circumference, a *Pearson's correlation coefficient value* of -0.04609 was found in males and 0.2713 in females (as shown in Table 1.) and determines height up to 0.2% ($R^2 = 0.002$) in males and 0.47% in females ($R^2 = 0.047$) (as shown in figure 4 and 5). The mean absolute error of ± 4.798 was found in case of males and ± 7.913 in females. (as shown in Table 3.)

Height against mesio-distal width of Anterior Teeth:

Then, height was correlated with the combined MD width of the anterior teeth, a *Pearson's correlation coefficient value* of 0.1160 was found in males and -0.05389 in females. (Table 1) and determines height up to 0.13 % ($R^2 = 0.013$) in males and 0.2% in females ($R^2 = 0.002$) (as shown in figure 6 and 7). The mean absolute error of ± 4.768 was found in case of males and ± 6.35 in females. (Table 3)

Height against Length of Central Incisor:

When height was plotted against the Length of Central Incisor, a *Pearson's correlation coefficient value* of 0.2728 was found in males and 0.1098 in females (Table 1) and determines height up to 0.74 % ($R^2 = 0.074$) in males and 0.11 % in females ($R^2 = 0.011$). (figure 8 and 9) The mean absolute error

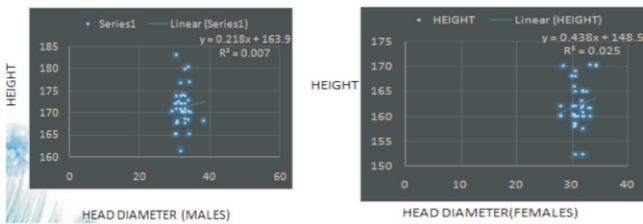


Figure 2 and 3. (Scatter diagram showing relationship between the stature and the head diameter in males and females)

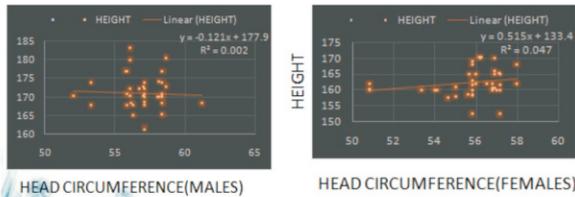


FIGURE 4 and 5. (Scatter diagram showing relationship between the stature and the head circumference in males and females.)

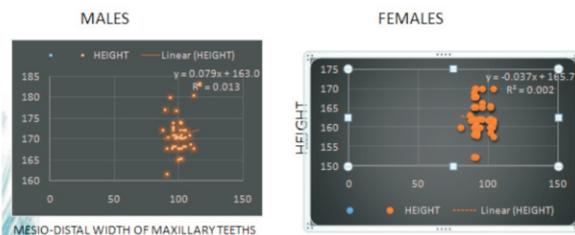


FIGURE 6 and 7. (scatter diagram showing relationship between the stature and the mesio-distal width of anterior maxillary teeth in males and females)

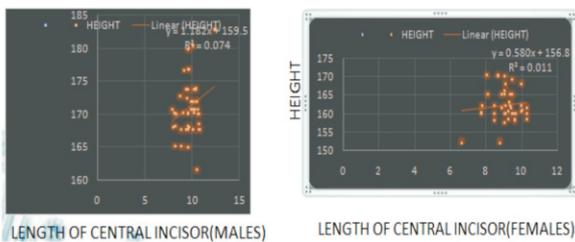


Figure 8 And 9. (scatter diagram showing relationship between the stature and the length of right central incisor in males and females)

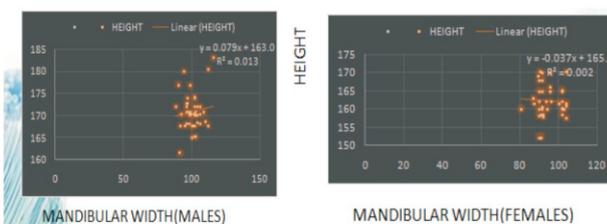


FIGURE 10 and 11.(scatter diagram showing relationshipbetween the stature and the mandibular width in males and females)

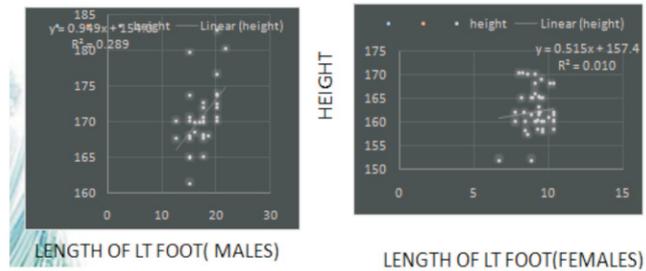


Figure 12 And 13.(scatter diagram showing relationship between the stature and the length of left foot in males and females)

Discussion:

In forensic odontology, age gender, height and race are the valuable parameters of a deceased individual. [12] Stature estimation is most commonly done with the help of long bones, however, in case of decomposed or fragmentary bodies, it becomes difficult. [13] Structures of the skull region and teeth are resistant to decomposition and can be used for stature estimation. [14]

Studies for stature estimation done by Krishna and Kumar from cephalo-facial measurements and found that head circumference, maximum head breadth and head length give better measurement of stature estimation. [15] Study done by Krishan *et al.* estimate the stature from cephalo-facial measurements in North Indian population and found a strong and positive correlation with stature ($p < 0.001$). [16] Study done by Akhter *et al* and they found a significant positive correlation of Head circumference with the stature ($P = 0.005$) in a sample size of 100 Bangladeshi Garo adult female. [17] Another study done by Mahesh Kumar *et al.* using cephalo – facial measurements and found that maximum head length were also used to estimate the stature of a person. [18] Study done by Glaister *et al.* and found that head length was found to be 1/8th of total height of the person. [19] Study done by Chiba *et al.* and they derived linear regression equation for stature from head length. [20] Similar in our study we found a strong Pearson's correlation coefficient value in males with the head diameter and significant correlation in females with head circumference. (Table 1 and 2)

Study done by Chantal Milani *et al.* estimated the stature using the bigonial distance as the parameter and derived a formula. (ELS = (7.076) Go-Go + 98.332 where ELS is the estimated living stature). [21] Another study done by Agarwal

Set *al.* and found that the similar values of the mean stature of the living person and the estimated stature from the equation suggest that the mandibular width may be considered as a reliable parameter for stature estimation.[22] In present study we found significant Pearson's correlation *coefficient value* between mandibular width and stature in males. (as shown in table 1 and 2)

Study done by Garn *et al.* and they found a significant correlation between bucco-lingual and mesio-distal width of permanent maxillary lateral incisor and stature.[23] Study done by Kalia *et al.* in 2008 using Combined mesio-distal width of six maxillary anterior teeth for stature estimation and found only small statistically significant correlation.[14] In our study we found significant Pearson's correlation *coefficient value* between combined mesio-distal width of maxillary anterior teeth and stature. Similarly a significant correlation value between length of right maxillary central incisor and stature was found.(as shown in table 1 and 2)

The study done by Kewal Krishnan *et al.* for stature estimation from foot print and outline dimensions in North Indian population and found a strong and significant correlation between foot length and stature.[24] Another study done by Jitendra kumar *et al.* in state of Haryana and found a strong and significant correlation between stature and foot length. [25] In our study a strong Pearson's correlation *coefficient value* was found between left foot length and stature in males and significant correlation in females. (Table 1 and 2)

The present study was designed to estimate the stature of the deceased individuals in mass destruction or accident prone sites in remote areas where minimum armamentarium is available. There may be a hope of better results and correlation if better method of data collection and larger sample size are used.

Conclusion:

The current study was aimed at finding if odontometry and skull anthropometry can be used as a method of stature estimation in Himachali Population by using minimum armamentarium. On statistical data analysis, it was found that *P-value* (pearson's Correlation Coefficient) of the considered parameters i.e., head diameter (in males) and foot length (in males) shows more significant and positive correlation with stature as compared to other parameters. (as shown in table 2.) Similar during application of derived linear regression

formula for validation on 10 males and 10 females on same population, we found minimum mean absolute error in case of head diameter and foot length in males as compared with other parameters. (Table 3.)

From the present study, it was concluded that linear regression equations from the skull and odontometrics parameters can be used to estimate the stature, however longitudinal studies with larger sample size and appropriate apparatus should be done to get better results in a specific population.

References:

1. Krishan K. Estimation of stature from cephalo-facial anthropometry in north Indian population. *Forensic Sci Int.* 2008; 25:181(1-3):52.e1-6. doi: 10.1016/j.forsciint.2008.08.001.
2. Mathews M L, Yuvraj B K. Estimation of stature from Mandibular Width. *Research J.Pharm. and Tech.* 8(8): August, 2015;Page 1147-1149.doi:10.5958/0974-360X.2015.00204.8
3. Krishna P A, Prakash H M, Kumar A. Stature Estimation from Head Length and Breadth by regression Analysis in Madhya Pradesh Population. *International Journal of Anatomy, Radiology and Surgery.* Jul, 2019;Vol-8(3): AO22-AO24.
4. De Mendonça MC. Estimation of height from the length of long bones in a Portuguese adult population. *Am J Phys Anthropol.* 2000 May;112(1):39-48. doi: 10.1002/(SICI)1096-8644(200005)112:1<39::AID-AJPA5>3.0.CO;2-#. PMID: 10766942.
5. Radoinova D, Tenekedjiev K, Yordanov Y. Stature estimation from long bone lengths in Bulgarians. *Homo.* 2002;52(3):221-32. doi: 10.1078/0018-442x-00030. PMID: 12018118.
6. Bidmos M. Adult stature reconstruction from the calcaneus of South Africans of European descent. *J Clin Forensic Med.* 2006 Jul;13(5):247-52. doi: 10.1016/j.jcfm.2005.11.010. Epub 2006 Jan 25. PMID: 16442334.
7. Steyn M, Smith JR. Interpretation of ante-mortem stature estimates in South Africans. *Forensic Sci Int.* 2007 Sep 13; 171(2-3):97-102. doi: 10.1016/j.forsciint.2006.10.006. Epub 2006 Nov 21. PMID: 17118594.
8. Boldsen J. A statistical evaluation of the basis for predicting stature from lengths of long bones in European populations. *Am J Phys Anthropol.* 1984

- Nov;65(3):305-11. doi: 10.1002/ajpa.1330650310. PMID: 6517157.
9. Holland TD. Estimation of adult stature from fragmentary tibias. *J Forensic Sci.* 1992 Sep;37(5):1223-9. PMID: 1402748.
 10. Campobasso CP, Di Vella G, Introna F Jr. Using scapular measurements in regression formulae for the estimation of stature. *Boll Soc Ital Biol Sper.* 1998 Jul-Aug;74(7-8):75-82. PMID: 10874984.
 11. Mall G, Hubig M, Büttner A, Kuznik J, Penning R, Graw M. Sex determination and estimation of stature from the long bones of the arm. *Forensic Sci Int.* 2001 Mar 1;117(1-2):23-30. doi: 10.1016/s0379-0738(00)00445-x. PMID: 11230943.
 12. Luciana C, Isadora Ads and Rafael GL (2014) Forensic Dentistry: An Overview of the human Identification's Technique of this Dental speciality. *J.Forensic Res* 5:256. Doi 10.4172/2157-7145.1000256.
 13. Kanchankumar P.W, Vaibhav P. Anjankar, Madhukar P. Parchand, N. Y. Kamdi, Sumit T. Patil. Estimation of stature from head length & head breadth in Central Indian population: An anthropometric study. *IntJ Anat Res* 2015;3(1):954-957. DOI: 10.16965/ijar.2015.125.
 14. Kalia S, Shetty SK, Patil K, Mahima VG. Stature estimation using odontometry and skull anthropometry. *Indian J Dent Res.* 2008 Apr-Jun;19(2):150-4. doi: 10.4103/0970-9290.40471. PMID: 18445934.
 15. Krishan K, Kumar R. Determination of stature from cephalo-facial dimensions in a North Indian population. *Leg Med (Tokyo).* 2007 May;9(3):128-33. doi: 10.1016/j.legalmed.2006.12.001. PMID: 17306595.
 16. Krishan K. Estimation of stature from cephalo-facial anthropometry in north Indian population. *Forensic Sci Int.* 2008, Oct 25;181(1-3):52.e1-6. doi: 10.1016/j.forsciint.2008.08.001. PMID: 18799276.
 17. Akhter Z, Banu LA, Alam MM, Rahman MF. Stature estimation from craniofacial anthropometry in Bangladeshi Garo adult females. *Mymensingh Med J.* 2012 Jul;21(3):479-84. PMID: 22828547.
 18. Kumar M, Gopichand VV P. Estimation of stature from cephalo-facial anthropometry in 800 Haryanvi adults. *International Journal of Plant, Animal and Environmental Sciences* April-June 2013; Vol.2, Issue 3.
 19. Glaister. In *Medical Jurisprudence and Toxicology*. 10th Edition. Edinburg E.S. Livingstone Ltd. 195, 80.
 20. Chiba M, Terazawa K. Estimation of stature from somatometry of skull. *Forensic Sci Int.* 1998 Nov 9;97(2-3):87-92. doi: 10.1016/s0379-0738(98)00145-5. PMID: 9871988.
 21. Milani C, Milani R, Panattoni GL. Stature estimation for personal identification using mandibular morphometric parameters in Italian population: a preliminary report. *J Biol Res [Internet].* 2014 Jan.10 [cited 2021 Apr.6]; 87(1).
 22. Agarwal S, Agarwal SK, Jain SK. Correlation Between the Stature and Cranial Measurements in Population of North India. *Acta Medica International.* 2014;1(2):99-102.
 23. Garn SM, Lewis AB, Kerewsky RS. The magnitude and implications of the relationship between tooth size and body size. *Arch Oral Biol.* 1968 Jan;13(1):129-31. doi: 10.1016/0003-9969(68)90043-5. PMID: 5237551.
 24. Krishan K, Kumar R. Determination of stature from cephalo-facial dimensions in a North Indian population. *Leg Med (Tokyo).* 2007 May;9(3):128-33. doi: 10.1016/j.legalmed.2006.12.001. Epub 2007 Feb 15. PMID: 17306595.
 25. Jakhar K.J, Pal V, Paliwal P.K. Estimation of Height from Measurements of Foot Length in Haryana Region. *J Indian Acad Forensic Med,* 32(3).