Height prediction from ulnar length in Chabahar: a City in South-East of Iran

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Abstract: Introduction. Height estimation from the remaining skeleton has a great importance for personal identification in forensic medicine and anthropometric studies. This study emphasized the height estimation from ulnar length in Chabahar population.

Objective. One of the most important items in individual identification is estimation of the height from the size of various parts of the body. The aim of this study was to formulate a linear regression equation for the estimation of the stature of the person from the length of ulna in Chabahar, a city in the southeast of Iran, aged between 20 and 50 from the length of their ulnar bone.

Materials and methods. This study was performed in Chabahar on 200 (100 males and 100 females) right-handed individuals aged between 20 and 50 years from March to July 2015. The height was measured from the vertex to the heel and the length of the ulna as a percutaneous bone was measured from the apex of the styloid process to the olecranon process of the left hand. The facts were analyzed by SPSS software. The prediction of a considerable relation among the variables was determined by the Pearson’s Correlation coefficient.

Result. After analyzing the data statistically, it was revealed that there is a significant relation between the height and ulna length (p < 0.05). The correlation coefficient for the left ulna was found to be 0.59 in males and 0.57 in females. Supportive regression equations and scatter-plot diagrams could successfully interpret the height from the ulnar length in the study population.

Conclusion. The ulna as a percutaneous bone is able to be used for the prediction of the height. The ulna length offered precise and reliable method in predicting the height of an individual.

Key Words: ulna, stature, height, personal identification.

The prediction of the stature by anthropometric study from bony parts of the human body has been considered by anthropologists, anatomists and forensic medicine specialists. An indirect estimation can be acquired by correlating the stature with other skeletal parameters, when the stature of an individual cannot be predicted directly, as in hospitalized patients, patients with deformity of vertebral column or limb defects. In addition, to determine identity of the injured cadavers with amputated limb brought to the forensic medicine stature is one of the essential parameters. An appropriate guide for selection of an equation for evaluation of height could be used by the measurement of length of long bones such as tibia, fibula and ulna [1-4]. The ulna has simply recognizable surface landmarks that make the measurements achievable; therefore, it can indirectly be used to formulate the stature [5-6].

Stature is one of the factors in the description of a person and that can be affected by sex, race, age, type of weather and status of nutrition [7]. Telekka et al. (1950) studied the limb bones and expressed in each racial group, the estimation of stature requires its own formula [8].

Particularly because percutaneous measurement of bones such as the ulna and tibia could be made, estimation of stature has been linearly regressed with the length of these bones [6]. The linear regression equation
of the stature based on length of the ulna has a specific advantage over length of tibia, since it can be helpful in the situation when there are deformities of the lower limbs, associated with the deformities of the trunk.

Lundy JK et al. (1985) discussed the regression equation and anatomical technique of estimating the living height from the long extremity bones [9]. The inquiries of different researchers have proposed the linear regression of the height of an individual with the percutaneous length of ulna [10-11]. There are a few studies conducted on ulna in the other countries [10, 12] but to reveal the effect of race on the factors of personal identity needs more studies. Thus, this study was conducted in Chabahar a city in the southeast of Iran.

MATERIALS AND METHODS

This study was performed in the Chabahar a city in the southeast of Iran. A total of 200 individual (100 males and 100 females) aged between 20 and 50 years were evaluated, because ossification of the ulna complete at the age of 20 and bones of ladies above 50 years may be subjected to menopausal erosion [13]. In this study all of the individuals were right-handed and the measurements were performed on the left arm. The left arms of the individuals with right hand were selected due to insignificant bilateral variation in males and females [14].

The individuals with any deformity or amputated left upper limb in either of the upper limbs were not incorporated in the study. Informed consents were taken from each individual before incorporating them into our study.

The height from the vertex to the heel with bare foot was measured for each individual, in anatomical position while back of the shoulders, and heels were in contact with the wall. The height of each individual was measured from the floor level with the measuring tape.

The length of ulna was measured while the forearm was flexed at the elbow from the tip of the olecranon process to the tip of the styloid process with a centimeter tape line with an accuracy of 0.5 cm. The measurement was taken and repeated for three times and the mean was recorded (Table 1).

All data was analyzed by using the SPSS software, version 16. The prediction of a considerable relationship among the variables was determined by the Pearson's Correlation coefficient. The correlation between the dependent variable (y) and an independent variable (x) was determined by simple linear regression, with the regression coefficient (b): the model of the regression equation was \( y = a + bx \) and a confidence interval of 95 percent which was equal to 1.96 standard deviation similar to every equation; was accepted and the standard error of regression (SE) was calculated. The ultimate equation model was \( y = (a + bx) \pm (1.96 \times SE) \).

RESULT

Scatter-plot graph correspond to the relationships between the dependent variable are demonstrated in Figure 1. Descriptive statistics of height, left ulnar length in both genders was shown in Table 1, and correlation coefficient between the stature and left ulnar length in both genders was illustrated in Table 2.

Regression formulas to estimate the stature from ulnar length was achieved as below:

**Female:** Estimated Height (cm) = 97.63 + 2.47 x Left ulnar length (cm) ± 2.52;

**Male:** Estimated Height (cm) = 128.05 + 1.64 x Left ulnar length (cm) ± 5.48;

**Total:** Estimated Height (cm) = 81.89 + 3.13 x Left ulnar length (cm) ± 4.37.

DISCUSSION

Different studies have been performed to estimate the stature from remains of body for example long bones, sternum, scapula, and ulna [6, 15-19]. Researches that have been performed to investigate the relative between long bones and height have revealed the consequence of environment, nourishment, genetics, sex and age [7]. Due to the effect of some factors such as race
and sex on length of ulna and height, this investigation was done on 200 individual (100 males and 100 females) between 20 and 50 years of age in Chabahar.

In the present study, mean of height and length of ulna were higher in males. It is owing to the fact that union of epiphyses of the bones takes place sooner in girls. On the other hand, bone in boys continues to grow two more years than girls [20]. The mean length of the ulna was 29.17 cm in males and 26.47 cm in females. The correlation coefficient between height and length of the left ulna was 0.59 in males and 0.57 in females. Our findings confirmed previous research findings; predicted the stature from ulna length as were reported by Gauld LM et al. predicted the stature of Australian from ulna length [5]. A study which was done by Nagesh KR et al. discussed the regression equation of estimating the stature from the percutaneous length of long bones in the South Indian population [21]; furthermore, Barbosa VM et al. used percutaneous ulnar length to predict height in English and Portuguese populations [22].

The stature of each person increases up to a particular age until puberty, and then decreases after a particular age by reason of vertebral column erosion, therefore the addition of a wider variety of age groups could overcome its restrictions for its applicability of run the regression model.

This study was done on people in Chabahar, because anthropological studies have not been done on this area of the country and on the other hand there is an anthropology museum in the city that will make possible more studies between anthropometric characteristics of the people in the past and the present.

**Conclusion**

The ulna is able to be used for the prediction of the height. The ulna length offers precise and reliable methods in prediction the height of an individual. The regression formula derived in this study can be used for forensic medicine, anthropologists, anatomists and archeologists.

**Conflict of interest.** The authors declare that they have no conflict of interest concerning this article.

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**References**


