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### A109 Estimation of Stature From the Foramen Magnum Region in an American Population: A Validation Study

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After attending this presentation, attendees will understand how new univariate and multivariate linear regression formulas were developed for the American White population for the determination of stature from the foramen magnum region.

This presentation will impact the forensic science community by providing a new method to estimate stature using the foramen magnum area for the American White population. While the traditional long bone methods are better for stature estimation, this new technique does provide a reasonable stature estimation range. Thus, if only the cranium is found, a complete biological profile can be assessed.

In forensic cases, complete human remains are not always found, making the ability to estimate stature from bony elements other than long bones important. This validation study focused on Cui's and Zhang's method for the estimation of stature using the foramen magnum region developed for China's Northern and Southern male populations.<sup>1</sup> This study addresses two main research questions: (1) can Cui's and Zhang's regression formulas for Chinese persons of unknown birthplace be used to significantly estimate stature in an American White population; and if not, (2) can new linear regression equations be developed for American White males and females in order to estimate stature within a reasonable margin of error?

Using Cui's and Zhang's 11 parameters from the foramen magnum area and William Bass Donated Skeletal Collection at the University of Tennessee, Knoxville, modern crania from American White females ( $n=137$ ) and American White males ( $n=135$ ) were measured. Age at death varied between females (29 years to 89 years old) and males (26 years to 96 years old). Tests indicate that the regression formulas for Chinese persons of unknown birthplace estimated stature better for females than males, but not significantly. Thus, new simple linear regression formulas representing univariate and multivariate equations were created for American White females and males.

American White females had an interval of Standard Error Of Estimation (SEE) of  $\pm 6.32\text{cm}$  to  $\pm 6.53\text{cm}$ , with an SEE of  $\pm 5.66\text{cm}$  to  $\pm 5.95\text{cm}$  for males. Correlation coefficients between stature and measured parameters were different in males and females, except for the Maximum Interior Distance (MxID) between condyles. Blind tests using 40 cranial measurements not used in the creation of the new regression formulas were tested on the new equations for males ( $n=18$ ) and females ( $n=22$ ). When estimated stature is not adjusted for age at death, 77% of total female test cases had their estimated stature fall between 0cm to  $\pm 10\text{cm}$  of their recorded stature, and 92% of total test cases fell between the 0cm to  $\pm 15\text{cm}$  interval. The same percentages occur when age at death is used to adjust estimated stature in the female test cases; however, this is slightly different for males. When age at death is not used to adjust estimated stature, 72% of total male test cases had their estimated stature fall between 0cm to  $\pm 10\text{cm}$  from their recorded stature; when the adjustment is made, a 2% increase is seen with 74% of total cases occurring in the same cm range. In addition, 93% of total male cases had their non-adjusted estimated stature fall between 0cm to  $\pm 15\text{cm}$  from their recorded stature; when the adjustment is made, a 2% decrease is seen with 91% of total test cases falling in the same cm range. In addition, inter- and intra-observer tests for reliability conducted showed that only the MxID parameter was poorly reliable when measured with an inter-observer ICC<sub>2,1</sub> of 0.254.

In conclusion, this validation study found that the foramen magnum region could not significantly be used to reliably estimate stature; however, in cases where only the cranium is found, it can be used with some accuracy as it is the only cranial method available for the American White population.

#### Reference(s):

1. Cui Y., Zhang J. Stature estimation from foramen magnum region in Chinese population. *J Forensic Sci*, 2013;58(5):1127-1133.

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#### Stature Estimation, Cranium, Foramen Magnum