

Regression Formulae for the Reconstruction of the Stature of Hopewellian and Middle Mississippi Amerindian Populations

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Abstract

Formulae in the form of regression equations for the reconstruction of stature from the lengths of long bones are available for Central Europeans, American Negroes, Chinese, Indians of southern Mexico, and a few other populations. Since there is considerable variability in bodily proportions in different varieties of Man an interracial formula is unsatisfactory when applied to specific groups, especially those that tend to represent the extremes of the range. In order to provide a reliable formula for the reconstruction of stature of prehistoric Indians of the Middle West, regression formulae for both sexes have been worked out for a Middle Mississippi population dated ca. 1200-1450. The applicability of this formula to members of a Hopewellian population, which occupied the Illinois Valley about 2000 years ago, is also discussed.

The statistical method most appropriate to the reconstruction of stature from long bone measurements is one developed by Karl Pearson in 1898-1899. Pearson, a professor of mathematics, showed that "if we know an organ A, then the most probable value of an organ B is that given by the regression formula for the two organs." Such a regression equation is a linear function presupposing a normal or at least "linear" correlation. All reconstruction formulae not based on the theory of correlation are insufficient.

Pearson's method was utilized by Stevenson (7), Mendes-Correa (5), Munter (6), Breiting (1), Telkka (8), Dupertuis and Hadden (2), Trotter and Gleser (9), and Genoves (3). Each of these authors had considered the possibility of using other statistical methods for the reconstruction of stature, but after deliberation it was found that Pearson's method was indeed most applicable. This statistical method, therefore, was also employed in the present paper.

One question of great import was raised in each of these studies, that is, to what extent might a formula for estimation of stature apply to an individual, a race, or a group of races? It is the consensus that reconstruction of stature should be attempted only through use of a formula derived from that specific population to which the formula or formulae will be applied. Of all of the studies following Pearson's, only Mendes-Correa, working with the Portuguese, felt that Pearson's formulae would apply to the specific population with which he worked, although Stevenson especially set out to prove that Pearson's formulae were inter-racially applicable. After an analysis of the factors which seemingly influence the constants in the formulae, Stevenson came to the conclusion that it is practically impossible to pre-determine the inter-racial applicability of the formulae. In general, the smaller the group, variety, race, etc. to which the formulae will be applied, the more necessary a formula derived specifically for that population.

The present study, therefore, is a derivation of regression formulae for reconstruction of stature which may be applied to a series from a

Middle Mississippi population. Some comment will then be made as to the possible applicability of these formulae to a Hopewell series.

To initially devise a formula for stature reconstruction one must have a cadaver length or equivalent measure of stature to determine the relationships of long bone length to total stature. Gottfried Kurth (4) determined that the grave length *in situ* may be used as a measure of total stature when the skeleton is extended. Where the grave length is available, the proportion of trunk to extremity is preserved. Kurth does note shiftings in the grave, especially affecting the skull. But the vertebral column, lodged as it were between the skull and the pelvis, keeps its proper proportions. Kurth shows that the difference in skeletal length and cadaver length, accounted for by the missing soft tissues of the former, is 2 cm., irregardless of sex. That is, the cadaver length is 2 cm. greater than the skeletal length. As the cadaver length is also 2 cm. greater than the living height, the grave length and the living height may be equated.

The materials employed in the present study were a series of skeletons from Dickson "Mound" in Fulton County, Illinois. The Dickson Cemetery, F-34, is located on the edge of a bluff overlooking the valley of the Spoon River, which empties into the Illinois River a few miles to the Southeast opposite the city of Havana. The skeletal material under consideration is representative of a cemetery and village site belonging to the Spoon River Focus, Monks Mound Aspect, Middle Phase, Mississippi Pattern. Although the site is in the form of a crescent-shaped mound, it actually is a cemetery, for the extended burials were made in pits. Later additions were added to the surface and covered with soil so that the mound grew at least ten feet in height over the estimated 250 year period during which it was used for burials by the Spoon River Focus group.

Systematic excavations have been carried on at site F-34 by Dr. Don Dickson since 1927, leaving the remains *in situ* under the roof of a permanent building. It has been estimated that the entire cemetery originally contained close to 1600 skeletons, of which approximately 350 are presently under the roof of the exhibit.

The earliest developments of the Middle Mississippi culture may date back to A.D. 500. Good-sized villages were in existence by A.D. 900, and by around A.D. 1200 the occupants of site F-34 had become a stabilized population. The main use of the cemetery falls into the climactic period of the culture, that is, between 1220 and 1450.

Work on the exposed skeletal material, such as the numbering of the individual skeletons, reconstruction of some of the crania, and the anthropometric description of the skulls of the adult males, was begun by the senior author as early as 1930. Subsequently he devoted about a month in the field to determining the sex, age at time of death, and measuring the femoral and tibial lengths, as well as stature of the individual in the grave. These data form the nucleus of this study.

Unfortunately the measurement of the stature of the individual in the grave was greatly limited due to the inaccessibility of some of the remains. Many of the skeletons are superimposed on one another,

and further excavations would have detracted from the exhibit value of the site. In addition to the inaccessibility of some of the skeletons, the exclusion of children, adolescents and the aged, along with any cases which manifested pathological conditions, decreased the size of the sample still more.

The two length measurements utilized in this study are the greatest length of the femur between the highest point on the head and a plane tangent to the two condyles, and the greatest length of the tibia taken between the superior articular surface of the lateral condyle and the medial malleolus. In order to obtain an accurate "grave length" of the individual, whenever necessary, a correction was made for the forward tilt of the head, and flexion of the legs or bending of the trunk. Accurate "grave length" was available only for 19 males and 28 females. Nevertheless, on the basis of the study of the long bones of over 1000 individuals of the Spoon River Focus population, we can be fairly confident that this limited number probably constitutes a representative sample of a Middle Mississippi people.

In order to include the reduction in stature concomitant with age, a correction was made in all grave length measurements for all individuals over 30 years of age. Trotter and Gleser have stated that on the average after the 30th year the stature of the individual decreases 6 mm. per year.

The regression equations computed by the junior author are as follows:

Males

$$\begin{aligned} S &= 1177.29 \text{ mm.} + 1.134 F \text{ mm.} \\ &= 1117.34 \text{ mm.} + 1.489 T \text{ mm.} \\ &= 1100.56 \text{ mm.} + 0.706 (F+T) \text{ mm.} \end{aligned}$$

Females

$$\begin{aligned} S &= 1091.76 \text{ mm.} + 1.201 F \text{ mm.} \\ &= 876.81 \text{ mm.} + 2.018 T \text{ mm.} \\ &= 828.49 \text{ mm.} + 0.992 (F+T) \text{ mm.} \end{aligned}$$

Where S = stature, T = tibia, and F = femur

In comparing the regression lines obtained from the experimental data with regression lines appearing in reports published by Pearson, Breiting, Dupertuis and Hadden, and Genoves, the most striking phenomenon is the consistently flatter slope for the experimental data. It is also evident that mean differences occur in the samples. The formulae from the present study differed more from the published formulae than the latter differed from each other.

The present authors feel that this difference was not particularly due to the small sample size of the present study. It has been seen that the difficulty in obtaining a large sample was the securing of accurate grave length measurements. The grave length was taken only for those individuals in which it was obvious that the obtained measure would be accurate. Therefore, the small sample may be as accurate as, or even more accurate than, a larger sample which might

include grave length measurements which were somewhat doubtful. As the formulae from the present study are accurate for the sample from which they were derived, and assuming that the sample itself was typical of Middle Mississippi populations, they should be reliable for other Middle Mississippi populations.

In comparing a series from a probable ancestral Illinois Hopewell Indian population which probably was ancestral to the Middle Mississippi series, it was found that there are no statistically significant differences in the long bone lengths of the lower extremities of the two groups. The values for the 40 Hopewellian females are so close to those from the Middle Mississippi values that their long bone lengths can be said to be identical. The comparison of 55 Hopewellian males to the Middle Mississippi males showed a greater trend toward significance; such differences, however, never did reach the level of statistical significance. Unfortunately, grave lengths or comparable measures of stature were not available for the Hopewell series. The formulae for the determination of stature for the Middle Mississippi populations can be applied to the Hopewell series only if there is also no significant difference in stature, i.e. if there is no proportional difference in the stature/long bone ratios. Without a statural measure as a control, a final conclusion must be held in abeyance, although direct common ancestry of the two populations would support the assumption that their bodily proportions are the same. Therefore, until a statistically adequate sample of Hopewellian grave lengths are obtained, the formulae given in this paper are the best available.

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