H51 A Group-Generic Stature Estimation Equation from the Calcaneus and Talus

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After attending this presentation, attendees will learn of a new stature calculation technique based on a group-generic equation from the calcaneus and talus. The sample from which this equation was developed is a composite sample of African and European Americans, and Japanese.

This presentation will impact the forensic science community by verifying the findings of Holland (1995) with an Asian sample: lengths of the calcaneus and talus have a linear relationship with stature compared to major long bones, which are affected by ancestral, sexual, and secular differences. Therefore, when remains are missing or too fragmentary to determine ancestry and sex, and long bones are not available, forensic practitioners have a viable alternative using the calcaneus and talus.

Measurements for the three independent variables: maximum length (MCAL) and posterior length of the calcaneus (PCAL), and maximum length of the talus (MTAL) were obtained following the methods of Holland (1995). African Americans (males: n=85 and females: n=58) and European Americans (males: n=85 and females: n=52) are comprised of individuals from the Hamann-Todd Human Osteological Collection (HTH) and JPAC-CIL, while the Asian sample is represented by Japanese (males: n=69 and females: n=31) individuals from the University of Chiba, School of Medicine (UCSM) and the University of Jikei, School of Medicine (UJSM). All individuals were born during the 19th or early 20th Centuries.

Before the equation was formulated, multivariate normality, multicollinearity, and residual tests were performed using SPSS 15.0. All three variables are highly ($r > 0.7$) correlated with each other; therefore, they were combined (summed) as a single independent variable to avoid the effect of multicollinearity (Adams and Byrd, 2008). Next, Mahalonobis distance was adjusted from the critical value of chi-square distribution in order to achieve multivariate normality. Four outliers were removed as a result. MANOVA was performed to examine the impacts of sex and ancestry on stature.

The results demonstrate that the main effect of both sex and ancestry are statistically significant: Wilks' $\Lambda = 0.589$, $F = (2, 361) = 136.964$, *p-value* < 0.001, multivariate η^2 (partial eta squared) = 0.431 and Wilks' $\Lambda = 0.479$, $F = (4, 722) = 80.309$, *p-value* <0.001, multivariate $\eta^2 = 0.301$ respectively. The interaction of sex and ancestry was not significant; only 0.9% (multivariate $\eta^2 = 0.009$) of variance was explained by these variables. The distributions of the residual plots in all cases appeared random, which indicate that the general model performs equally well for all three groups. The SPSS interaction profile plots demonstrated a nearly parallel relationship among ancestry and sex. The formulated equation (Living Stature (L.S.) = 5.826 * (MCAL+PCAL+MTAL) + 54.062) demonstrate a SEE of 5.24 cm, $r = 0.874$, and $r^2 = 0.763$.

After formulating the group-generic regression equation for estimating stature, 28 control samples consisting of a combination of individuals from the UCSM, UJSM, HTH, and the JPAC-CIL were tested. There were no statistically significant differences between predictions from the group-generic equation and the Holland equations (combined sex and race: African and European Americans): $F (4, 28) = 0.76$, *p-value* = 0.55. While Holland equations using MCAL and MTAL overestimated living stature by an average of 2.01cm and 3.83cm, respectively. Using Holland's (1995) combined sex and race (African and European Americans) for PCAL underestimated L.S. by an average of 0.51cm. Using the new equation presented here which includes three ancestral groups underestimated L.S. by an average of only 0.63cm. These results illustrate that a new group-generic stature equation, which includes Asian samples accurately estimates living stature. These results also support Holland (1995) suggesting the foot elements are more linearly related to stature than other long bones, which have demonstrated an allometric scaling relationship to stature.

Group-Generic Stature, Calcaneus and Talus, Biological Profile

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