H95 Sex Determination From Tarsal Dimensions

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After attending this presentation, attendees will understand the benefit of using tarsal dimensions for differentiating sex in European Americans.

This presentation will impact the forensic science community by outlining the results of a validation study using tarsal dimensions to differentiate sex in modern European Americans. This presentation will outline the most successful equations for estimating sex, as well as introduce error rates for use in forensic contexts.

Sex differentiation is an integral aspect of the biological profile. When available, the pelvis and cranium are highly successful at sex differentiation. However, postcranial metric analyses provide valuable substitutes when the pelvis or cranium is unavailable. In 2012, Harris and Case published a sex differentiation method using dimensions from all seven tarsals of modern European Americans.[1] The study presented 42 equations (univariate and multivariate) for 18 separate measurements of the tarsals with accuracies as high as 93.6%. The study documented significant asymmetry in both male and female tarsal dimensions, and thus presented separate equations for the left and right sides, with the right side dimensions having the highest reported accuracies.

The current study proposed to test the Harris and Case equations on a modern European American sample from the Texas State Donated Skeletal Collection housed at the Forensic Anthropology Center at Texas State Univeristy-San Marcos (FACTS) in order to fulfill the best practices guidelines as outlined by the Scientific Working Group for Forensic Anthropology (SWGANTH). The sample (N=41) consists of 24 adult males and 17 adult females ranging in age from 19 to 102. The measurements were taken following Harris and Case using a standard osteometric board. A small subsample (n=5) was measured twice by a single researcher and by two additional researchers to evaluate intra- and interobserver error. Accuracy was calculated for males, females, and the pooled sample as a percentage based on the number of correct classifications for each equation on the left and ride sides. Observer error was calculated using the measure of Mean Absolute Difference (MAD).

The results show accuracy rates ranging from 59-90% in the pooled sample, 58-100% in the female sample, and 52-96% in the male sample. For the pooled sample, the highest accuracy (90%) was calculated from the univariate equation for talus length from the right side. For the female sample, the highest accuracies (100%) were calculated from the right side for the univariate equations using talus height and cuneiform I length, as well as the multivariate equation using the cuneiform 1. For the male sample, the highest accuracy (96%) was calculated for the univariate equations based on talus length. The intra- and inter-observer error MAD measures ranged from 0 to 0.70mm.

While the resultant accuracy rates did not always agree with those previously reported, the original pattern of the right side equations performing better than those based on the left side did remain. In agreement with the Harris and Case study, the talus measurements did perform best on this sample. Among the univariate equations of the pooled sample, the talus length correctly classified each individual with the highest level of accuracy (91%) followed by the talus height. For the whole bone equations of the pooled sample, the cuneiform 1 from the right side correctly classified each individual with the highest accuracy (87%). For the equations that used multiple tarsals, the equation that used cuneiforms 1, 2, and 3 classified each individual correctly with the highest accuracy (87%). In addition, the observer error rates were minimal, suggesting high repeatability of the described measurements.

Overall, the equations performed well on the sample. The high levels of accuracy achieved (over 90%) for the pooled sample suggest that this is a viable approach to sex differentiation in European Americans when differential preservation or recovery limits the availability of skeletal material for analysis. This presentation will also discuss the difficulties associated with tarsal measurements, the effects of instrument choice for metric analysis, and the application of the equations to individuals of other biological races.

Reference:

1. Harris SM, Case T. Sexual dimorphism in the tarsal bones: Implications for sex determination. J Forensic Sci 2012;57:295-305.

Sex Estimation, Tarsals, Metrics