



## A9 Application and Evaluation of Adult Morphological Sex Traits Using the Subadult Innominate

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**Learning Overview:** After attending this presentation, attendees will understand the age at which adult morphological sex traits of the innominate can be applied to subadults without compromising accuracy.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by showing that the innominate can be used to estimate the sex of individuals younger than previously thought possible.

Sex estimation is arguably the most important parameter of the biological profile, as accurate estimates of age, ancestry, and stature are often contingent on sex. Morphological evaluation of the ventral arc, subpubic contour, and medial aspect of the ischio-pubic ramus, as originally described by Phenice and later modified by Klales et al., has shown to consistently provide accurate estimates of sex when applied to adults.<sup>1,2</sup> However, Phenice has warned against applying these traits in individuals younger than 20 years of age.<sup>1</sup> Further, it is fairly ubiquitous among anthropologists that sex indicators are not valid and/or sex estimation is not applicable in individuals less than 18 years of age. Indeed, attempts to estimate sex in subadults have routinely yielded low classification accuracies and, therefore, it is advised against, especially in forensic contexts, for fear of misidentification. Unfortunately, this has led to a paucity of research on the subject and stagnation in contributions to this area of the field.

To evaluate the performance of these three traits when applied to subadults and to determine the age at which adult levels of accuracy are achieved, the Klales et al. method was applied to a sample of 301 individuals aged between 8.29 and 20.96 years using Multi-Slice Computed Tomography (MSCT) postmortem scans.<sup>2</sup> Age cohorts were created using two-year intervals for individuals 11 years and older, and a three-year age cohort was created for individuals aged 8.29 to 10.9 years to help increase the comparatively small sample sizes for younger individuals. Fisher's exact test with Monte Carlo simulation was used to test for sexual dimorphism in trait score frequencies between subadult males and subadult females for each trait in each age cohort. To determine at which age trait score frequencies are comparable within the sexes (e.g., subadult and adult females), subadult score frequencies for each cohort were compared to adult score frequencies previously reported in a comprehensive global study.<sup>3</sup> A Kruskal-Wallis test was applied and if rejected, a Dunn's test with Holm's stepwise adjustment was used to determine which age cohorts differed.

Significant differences in score frequencies between subadult males and females were observed for all traits and all age cohorts ( $p < 0.001$ ) with the exception of subpubic concavity for the 8 to 10.9 year cohort ( $p = 0.827$ ). Score frequencies between subadult and adult males differed in all cohorts, but only for the medial aspect of the ischio-pubic ramus ( $p \leq 0.018$ ). Differences in score frequencies between subadult and adult females were more common than in males and significant differences were observed in all traits in all cohorts ( $p \leq 0.01$ ), with some exceptions in older cohorts. Subadult accuracy rates for combined sexes showed an extreme bias toward male classification for the 8 to 10.9 year and 11 to 12.9 year cohorts, with males achieving perfect accuracies and females achieving 55.6% and 66.7% accuracies, respectively. A notable change was observed in the 13 to 14.9 year cohort, with males achieving an accuracy of 92.9% and females achieving an accuracy of 86.4%. By 15 years, both sexes in all remaining cohorts classified at rates at or above 90%, with sex biases switching to favor female classification. The accuracies achieved by 15 years are comparable to those obtained for adults, and sex biases in favor of female classification are consistent with results observed in adults.<sup>2,3</sup>

The results of this study suggest that adult morphological sex traits of the innominate can be used to estimate sex in individuals as young as 13 years, though comparable performance of the indicators are not observed until 15 years of age. The findings suggest sex can be estimated prior to individuals reaching skeletal maturity, which is minimally five years younger than previously advised. While these results are encouraging, it is recommended that more research be conducted to corroborate these findings before widespread application of the Phenice/Klales et al. methods to subadults in forensic casework.<sup>1,2</sup>

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### Reference(s):

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3. Kenyhercz M.W., Klales A.R., Stull K.E., McCormick K.A., Cole S.J. Worldwide population variation in pelvic sexual dimorphism: A validation and recalibration of the Klales et al. method. *Forensic Sci Int*, 2017;277:259.e1-259.e8.

### Sex Estimation, Innominate, Subadults