

A19 The Iliac Crest as a Skeletal Indicator of Puberty and Guide to Subadult Sex Estimation

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Learning Overview: After attending this presentation, attendees will understand how the iliac crest can serve as a skeletal indicator of puberty and can aid in determining when morphological sex traits of the pelvis can be applied to immature remains with accuracy rates similar to those observed in adults.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by providing an approach to subadult sex estimation that is independent of age at death.

Morphological traits of the pelvis, including the ventral arc, subpubic contour, and medial aspect of the ischiopubic ramus, have long been known to provide the most accurate sex estimates from the human skeleton. Currently, these traits are considered “adult” traits, and consequently are typically only applied in individuals estimated to be around 18 years of age and older. However, since these traits are associated with pubertal changes to the female pelvis, they should be applicable in individuals prior to adulthood. Recent research has shown that these pelvic traits attain accuracies as high as 86.4% by 13 years of age, and accuracy rates comparable to those observed in adults (> 90%) are attained by 15 years of age.¹ Despite these encouraging results, the application of these traits in subadults requires age to be estimated, which could result in compounded errors if the age estimate is incorrect. Further, it is difficult to incorporate an age range into sex estimation methods.

To avoid the need for age to be known when estimating sex from the subadult pelvis, the current study uses a skeletal maturity indicator associated with puberty, the iliac crest, to determine when during ossification and fusion sex can be accurately estimated. Ossification of the iliac crest is associated with menarche in females.^{2,3} As menarche can occur at various ages, the use of this indicator removes the need to accurately estimate age and/or the progression of puberty. Therefore, it is predicted that the absence, ossification, and fusion of this epiphysis could indicate whether or not sex estimation should be attempted in immature individuals. To determine stage of iliac crest development and sex estimation accuracy, a total of 232 individuals (m = 120, f = 112) aged between 8.29 and 20.92 years were assessed using Multi-Slice Computed Tomography (MSCT) postmortem scans from the Subadult Virtual Anthropology Database. The sample was divided into four groups dependent on stage of iliac crest development, which was evaluated as follows: Stage 9 = iliac crest is absent, Stage 0 = iliac crest is present but unfused, Stage 1 = iliac crest is partially fused, and Stage 2 = iliac crest is completely fused. Sex estimation accuracies were calculated for each group and each sex using the Klales et al. method.⁴

Sex estimation accuracies for subadult males ranged between 93.3% and 100% for all iliac crest development stages. This finding was expected, since male pelvises generally exhibit male morphology throughout life, with changes in morphology being more associated with females resulting from downstream effects of puberty. Female accuracy for Stage 9 (8.29–13.47 years) was poor, with only a 12% accuracy rate being achieved. Accuracy increased dramatically for females in Stage 0 (10.80–19.93 years), with 81.5% being correctly classified. Female accuracies for Stages 1 (14.48–20.08 years) and 2 (13.17–20.92 years) were 100%. The combined sex accuracy for individuals exhibiting partial or complete fusion of the iliac crest (Stages 1 and 2) was 98.3% (m = 96.7%, f = 100%).

The results of this research illustrate that the iliac crest can serve as a skeletal indicator of puberty, which can serve as a guide for practitioners in deciding whether sex estimation is possible in immature skeletal remains. Specifically, sex estimation should not be attempted in subadults prior to iliac crest ossification. However, sex estimation can be confidently estimated when fusion of the iliac crest has commenced. This approach is convenient since both the maturation and sex indicators are present on the same skeletal element, as well as accurate, since it does not rely on a correct age-at-death estimate.

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Reference(s):

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Sex Estimation, Juvenile, Puberty