H93 Secular Change in Morphological Pelvic Traits Used for Sex Estimation

Alexandra R. Klales, MS, 1515 E Woodbank Way, West Chester, PA 19380*

After attending this presentation, attendees will learn of the secular changes occurring in three popularly used morphological traits of the pubis bone in forensic anthropology for sex estimation.

This presentation will impact the forensic science community by informing attendees about the variation present in trait expression and how these traits have changed through time. Furthermore, the implications for sex estimation methods using these traits will be discussed.

Phenice's technique using three traits of the pubis — the ventral arc, subpubic concavity, and medial aspect of the ischio-pubic ramus — is overwhelmingly the most preferred method of morphological sex estimation in forensic and biological anthropology.[1,2] The original method was created using a historical sample of individuals born in the late 19th and early 20th centuries, as was a subsequent revision of the method including statistical analyses.[3,4] Size and shape changes in the pelvis, and specifically the innominates, between historical and modern samples have been documented using metrics and geometric morphometrics; therefore, morphological trait expressions may also be changing through time.[5-7]

The purpose of this research was to evaluate changes in the expression of the Ventral Arc (VA), the Subpubic Sontour (SPC), and the Medial Aspect of the ischio-pubic ramus (MA), as described by Klales *et al.* by comparing trait scores from a sample of innominates from the Hamann-Todd Osteological Collection (HTH / historical) and the W.M. Bass Donated Collection (UTK / modern).[4] The sample consisted of 136 females (HTH n=83, UTK n=53) and 163 males (HTH n=87, UTK n=76). Each individual was scored on an ordinal scale from one to five for each of the three Phenice traits using the Klales *et al.* method.[4] Previous research revealed no significant differences in trait expression between ancestry groups (Blacks and Whites); therefore, ancestry groups were pooled for each sex, in each temporal sample for all further analyses.[4]

A Fisher Freeman-Halton Exact Test was run to determine if significant differences existed between the two temporal samples for each of the three traits by sex. Significant differences were found for all three traits in females: MA p=0.004; SPC p<0.001; and VA p<0.001. In males significant differences were found in two of the three traits between the HTH and UTK samples: MA p=0.102, SPC p=0.002, VA p=0.008. To determine which specific trait scores produced significant differences between temporal periods, the residual for each trait score was converted into a z-score and compared to the critical value. Analysis of the residuals for the medial aspect revealed greater-than-expected "ultra-feminine" expression (i.e., narrow ischio-pubic ramus with sharp ridge of bone present / score 1) in the modern sample females. Similarly in the modern sample, "ultra-feminine" expression of the subpubic concavity (i.e., well-developed concavity/score 1) and of the ventral arc (i.e., angled arc present with triangular portion of bone inferiorly/score 1) were greater than expected, while the historical sample had lower-than-expected residuals for the same scores. In males, the historical sample had a higher-than-expected "ultra-masculine" expression of the SPC (i.e., large convexity/score 5), while in the modern sample this same score was lower than expected.

Analysis of the residuals reveals a trend toward more gracile females in the modern sample based on greater extreme low score trait expression. In all three traits, the modern females shower greaterthan-expected "ultra-feminine" expression (scores of 1 for each), while in historical males, only the subpubic concavity (score 5 only) had a residual above the critical value. A morphologically more "feminine" appearing pubis region parallels the metric data that shows an increase through time in pubis length, giving the region a more "stretched" appearance.[7] The metric findings likely correspond to a narrower ischio-pubic ramus, a wider area lateral to the symphyseal face, and a greater subpubic concavity. Given the trends, it is apparent that secular change is occurring in morphological traits of the pubis, specifically with morphological expressions associated with females becoming more prevalent through time. Presumably, sex estimation in modern individuals using these traits and the aforementioned methods should have greater differentiation between males and females, with females classifying better given the greater extremes in gracile scores.

References:

1. Phenice TW. A newly developed method of sexing the os pubis. Am J Phys Anthropol 1969;30:297-302.
2. Klales AR. **Current practices in forensic anthropology for sex estimation in unidentified, adult individuals.** P Am Acad Forensic Sci 2013;439-40.
3. Klales AR, Ousley SD, Vollner JM. A revised method of sexing the human innominate using Phenice's nonmetric traits and statistical methods. **Am J Phys Anthropol** 2012**;1:104-14.**

 ** Presenting Author*

4. Delprete HA. Secular changes in the morphology of the modern human pelvis and the implications for human evolution. PhD Dissertation. Rutgers University, New Brunswick, NJ: 2006.
5. Driscoll KRD. Secular change of the modern human bony pelvis: Examining morphology in the United States using metrics and geometric morphometry. PhD Dissertation. University of Tennessee, Department of Anthropology. Knoxville, TN: 2010
6. Klales AR. **Secular change in the human innominate: from the 19th to the 20th century.** P Am Assoc Phys Anthropol 2012.
7. Klales AR. **Secular Change in the Human Innominate: from the 19th to the 20th century.** Proceedings of the 81st Meeting of the American Association for Physical Anthropology; 2012 Apr 11-14; Portland, OR. Portland, OR: American Journal of Physical Anthropology

Phenice, Pelvis, Non-Metrics

 ** Presenting Author*