Secular Change in Morphological Pelvic Traits used for Sex Estimation

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Secular Change

- Changes in the skeletal structure of Americans within the last two centuries have been well documented in the anthropological literature, especially in regards to stature, weight, and cranial form.
- Given the nature of secular change, questions have arisen regarding the applicability of methods developed with historic samples for use with modern populations, especially in forensic contexts.

Research Goals

- Evaluate secular changes in the expression of morphological pubic bone traits used for sex estimation in forensic anthropology and examine their utility for modern forensic cases if secular change is occurring.
- Phenece (1969) traits, as described by Klales et al. (2012)
  - subpubic concavity/contour (SPC) (Fig. 1)
  - ventral arc (VA) (Fig. 2)
  - medial aspect of the ischio-pubic ramus (MA) (Fig. 3)

Scoring

- Traits were ordinally scored on a scale from one to five by two experienced observers using the Klales et al. (2012) revised method.

Samples

- Historic: Hamann-Todd Osteological Collection (HT)
  - most individuals born during second half of 19th C
  - n = 170 (83 ♂, 87 ♂)
- Modern: William M. Bass Donated Collection (UT)
  - individuals born during 20th C (most after 1940)
  - n = 129 (53 ♂, 76 ♂)

Methods

- Calculate score frequencies for each trait.
- Freeman-Halton exact test for significant differences in score frequencies between temporal periods
  - residual converted to a z-score
  - compared to critical value (1.96 for alpha = 0.05)
- Ordinal logistic regression (OLR) for classification accuracy between temporal periods

Results

- Score frequencies (Table 1)
  - Medial aspect (Table 1)
    - HT: had more high scores, UT had more low scores
    - both samples had higher scores, UT slightly more variable
  - Subpubic contour (Table 2)
    - HT: had variable scores, UT had low scores (98.1% had score of 1 or 2)
    - HT: had mostly higher scores, UT more variable
  - Ventral arc (Table 3)
    - HT: had variable scores, UT had low scores (94.3% had score of 1 or 2)
    - HT: had higher scores, UT slightly more variable

Discussion & Conclusions

- Significant secular changes are occurring in the expression of all three traits.
- Score frequencies between temporal periods
  - Males consistently had higher ordinal scores (robust expression) and were less variable than females in both temporal samples
  - Modern females less variable than historic females and clustered within the gracile score categories (scores 1 or 2)
  - Similar to pattern found by Stull et al. (2013) using a modern African population.

Analysis of the residuals

- Morphologically more gracile or “feminine” female pubic bone through time
  - Parallel metric studies which suggest an increase through time in pubis length
  - Males (HT) had higher scores, UT slightly more variable
  - Females (HT) had variable scores, UT had low scores (98.1% had score of 1 or 2)
  - HT: had mostly higher scores, UT more variable

- Are the Phenece (1969) traits and revised Klales et al. (2012) method still applicable to modern forensic cases given that they were developed using historical samples and given that secular change has occurred in trait expression? Yes
- Multiple validation studies using modern populations achieved comparably high classification accuracy (Table 4)

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