Improving Nonmetric Sex Classification for Hispanic Individuals

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Introduction

- Recognize the problematic nature of the term "Hispanic" in forensic anthropology
- Increase in the number of Hispanic individuals crossing the U.S.-Mexico border
- Need to identify undocumented border crossers (UBCs) that die during their journey
- Some methods developed with U.S. Whites and Blacks perform poorly with Hispanic individuals and can lead to misclassifications
- Test the need for population specific sex estimation methods

Materials and Methods

Sample

- UBCs from Operation ID* and Hispanics from the Texas State University, San Marcos skeletal collection
- Only individuals with all traits were included (Table 1)

Table 1. Sample size for each method.

Method	Females	Males	Total
Klales et al. (2012)	25	26	51
Walker (2008)	27	27	54

Traits

- Phenice (1969) pelvic traits as described in Klales et al. (2012) (Figure 1)
  - subpubic concavity/contour (SPC)
  - ventral arc (VA)
  - medial aspect of the ischio-pubic ramus (MA)
- Walker (2008) skull traits as found in Buikstra and Ubelaker (1994) (Figure 2)
  - nuchal crest (N)
  - mastoid process (M)
  - supra-orbital margin(SO)
  - glabella (G)
  - mental eminence (ME)

*The demographic information from the UBCs from Operation ID had to be inferred based on a number of variables. Ancestry or geographic descent was based on information that was indicative of a migrant person, including clothing, associated personal effects, foreign currency, written documents, religious and cultural artifacts, and geographic location of the remains upon discovery. Metric analyses also indicated Hispanic or Guatemalan ancestry in a number of individuals (n=10) using FORDISC software. Sex was determined via DNA for a portion of the individuals (n=13). The remaining sex assignments were based on external genitalia (if present), FORDISC results, or from associated artifacts that were indicative of gender, which should be noted does not always correlate with biological sex; however, in some cases it was the only information available to infer sex.

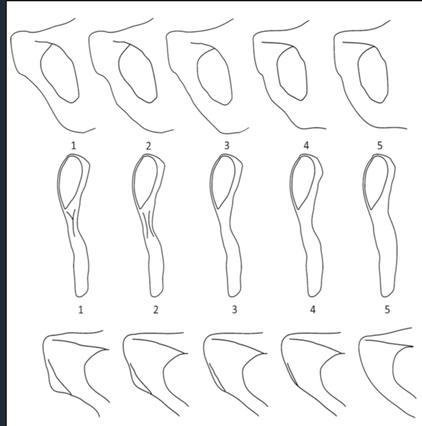

Fig 1. Klales et al. (2012) traits. Top: SPC, Middle: MA, Bottom: VA.

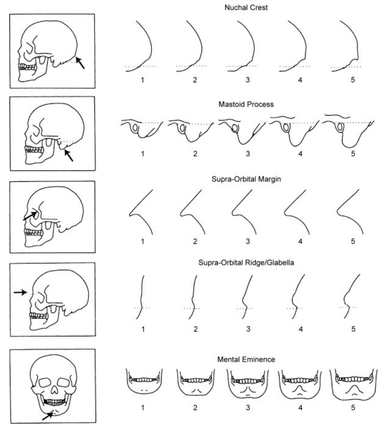

Fig 2. Walker (2008) traits from Buikstra & Ubelaker (1994).

Scoring

- Traits were scored on an ordinal scale from one to five by an experienced observer using the descriptions and illustrations provided by both methods

Analyses

- Frequency distributions were calculated for each trait score by sex and a chi-square test was used to test for significant differences in score frequencies between the sexes
- External validity → scores entered into the equations provided by the original articles

$$-1.375\,(G) - 1.185\,(M) - 1.151(ME) + 9.128$$

$$2.726\,(VA) + 1.214\,(MA) + 1.073\,(SPC) - 16.312$$

- Recalibration → ordinal logistic regression (OLR) for classification accuracy

Results

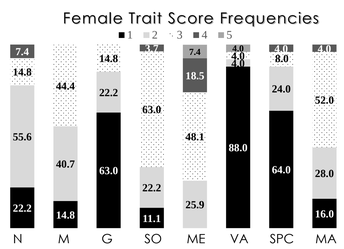

Figure 3. Trait frequencies (%) for females by trait.

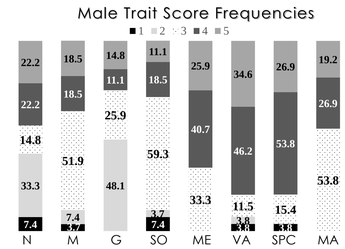

Figure 4. Trait frequencies (%) for males by trait.

- Males and females differed significantly in score frequencies for all traits at the $p < 0.05$ level
- External validity (Table 2)

Table 2. Validation classification accuracy (%) for each method by sex.

Method	Females	Males	Total	Sex Bias
Klales et al. (2012)	96.0	84.6	90.3	11.4
Walker (2008)	70.4	92.6	81.5	-22.2

- Recalibration (Table 3)

Table 3. OLR recalibration classification accuracy (%) for each method by sex.

Method	Females	Males	Total	Sex Bias	Recalibrated Equation
Klales (2012)	92.0	96.2	94.1	-4.2	0.807(VA) + 0.972(SPC) + 1.282(MA) – 8.641
Walker (2008)	77.8	70.4	74.1	7.4	1.217(G) + 0.832(M) + 0.292(ME) – 5.946

Discussion & Conclusions

- Overall, Hispanics are more gracile than U.S. Whites and Blacks
- Original Klales et al. method performs well with Hispanic individuals, while the Walker method performs poorly
- Classification accuracy improved for the Klales et al. (2012) method, but decreased for the Walker (2008) method with recalibration; however, sex bias greatly decreased for both methods with recalibration
- Pelvis displaying higher degree of sexual dimorphism than skull in Hispanics → more appropriate for sex estimation
- Recent research by Klales et al. (2016) has shown that a global equation may be possible to use for the pelvic traits instead of population specific equations

This research was funded by National Institute of Justice grant 2015-DN-BX-K014 entitled *An Interactive Morphological Database for Estimating Sex in Modern Adults*

The goals of the grant are to examine temporal changes, population variation, and the effects of asymmetry on sex classification using the eight morphological traits discussed in this research. Using the data and results from these analyses, a **free, interactive morphological database** will be developed where practitioners can enter, analyze, and compare morphological traits from unknown human skeletal remains to a large modern sample with known demographic data. This will allow sex estimations to be more easily and accurately made in a manner compliant with *Daubert*. The database will be available in the fall of 2017 and will include the data from the research presented here.

At this time I am seeking additional sources of data. To date I have cranial and pelvic data from multiple samples (n = ~2,200), but I am currently seeking additional data to make the program as robust and practical as possible. **If you have collected the Walker (2008) or Klales et al. (2012) scores from any skeletal sample and are interested in contributing to this exciting new database, please contact me** (email below). All contributors will be listed in the database and will be acknowledged in all publications regarding the database. Your data will not be used for research purposes or publications, nor will it be made publicly available without your consent in advance.

Acknowledgements

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For a full list of references or a copy of the poster, contact : Alexandra.Klales@washburn.edu