

# Worldwide Population Variation in Pelvic Sexual Dimorphism



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## Introduction

- Biological profile estimation is an essential component of anthropologist’s role in medico-legal investigations and in bioarchaeological analyses
- Sex estimation is paramount because other parameters (i.e., ancestry, stature, age) are sex specific
- Innominate, specifically pubic bone, is considered the best indicator of sex in adults and is widely used for sex estimation
- Klales et al. (2012) method, a modification of Phenice’s (1969) technique, is currently being used and cited in forensic case reports throughout the U.S. and internationally

Present research tests the validity of the method in multiple national and international samples

## Materials

- The sample of 532 adult innominates is derived from several modern skeletal collections from Thailand, South Africa (S.A.), and various U.S. populations

Sample	n=	Males	Females
U.S. White	242	108	134
U.S. Black	25	15	10
U.S. Other*	19	13	6
Thai	142	97	6
S.A. White	12	5	7
S.A. Black	92	56	36
Total	532	294	238

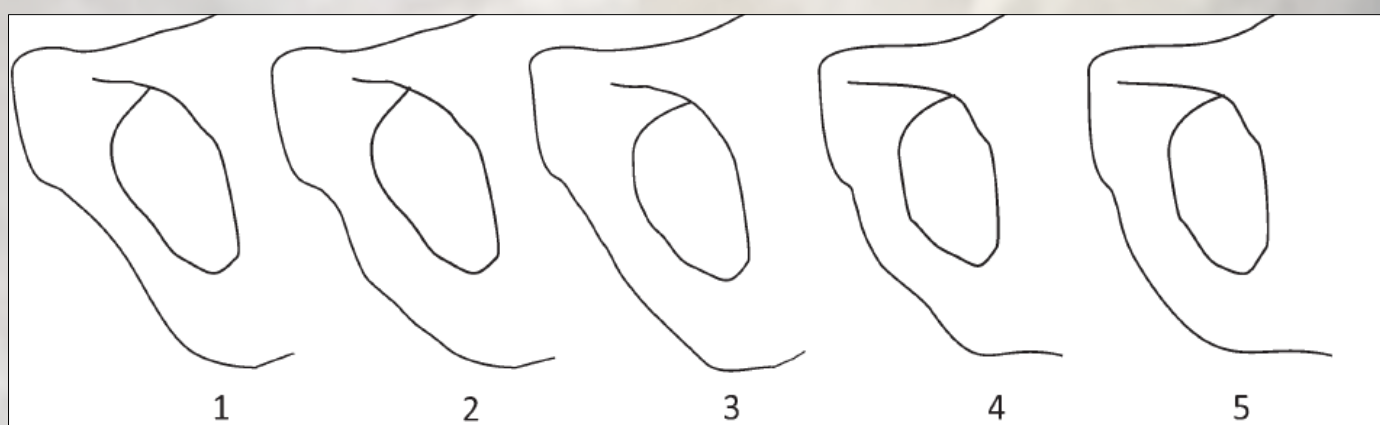
\* U.S. Other is comprised of the following populations with small sample sizes: Native American, Hispanic, and Asian.

## Methods

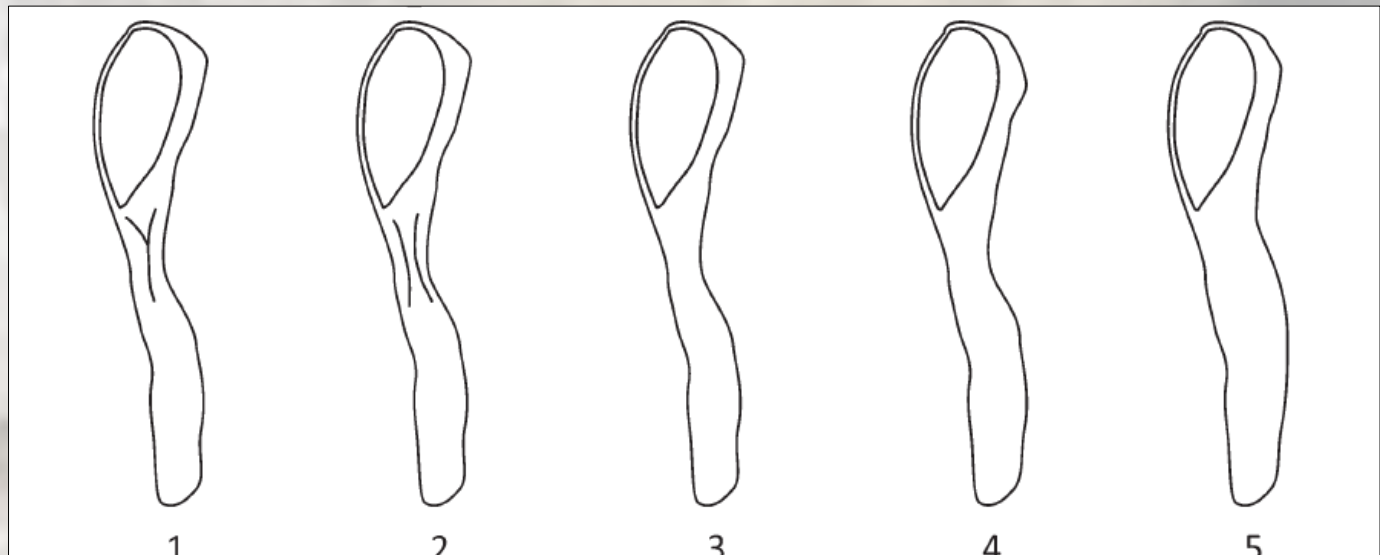
- Experienced observers blindly scored each individual for the three Phenice (1969) traits: 1) subpubic contour (SPC), 2) medial aspect of the ischio-pubic ramus (MA), and 3) the ventral arc (VA) using the modifications and methods of Klales et al. (2012)

Images from Klales et al. 2012, *Am J Phys Anthropol* 149:104-114 and NonmetricPelvisSexing.weebly.com

Subpubic  
Concavity/  
Contour



Medial Aspect  
of the Ischio-  
Pubic Ramus



Ventral Arc



## Statistics

- Classification accuracy and validity tested:
  - using *original* Klales et al. (2012) ordinal logistic regression equation (OLR)

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

pf= 1/(1 + score) and pm= 1-pf / unknown classified into sex with greater probability / female is < 0

- using *sample (population) specific* OLR equations

## Results

- Klales et al. (2012) is a valid method in all groups except the Thai population (**75.9-93.3%**)
- Classification accuracy drastically increases (**97.9-99%**) with sample (population) specific equations

Sample	n=	% Correct Using Original Klales (2012) Equation			% Correct Using Recalibrated Population Specific Equation		
		Females	Males	Total	Females	Males	Total
South Africa	105	95.5	91.8	93.3	100	98.4	99.0
Thai	141	100	64.2	75.9	97.7	98.9	98.6
U.S. Pooled	286	98.7	86.0	92.7	97.3	98.5	97.9
Global	532	98.3	86.0	91.5	97.5	98.3	97.9

## Discussion

- Klales et al. (2012) method is appropriate for use with populations outside of the original sample demographics
  - while population specificity is always recommended, this research suggests that overall sexual dimorphism of the pelvis exceeds population differences
- Using population specific equations nearly eliminates sex bias
  - original equation shows a sex bias towards female in each sample
- Global recalibration equation improves classification in the event of unknown ancestry

### Global Recalibration Equation:

$$1.738(VA) + 1.455(MA) + 2.100(SPC) - 14.553$$

## Acknowledgements

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