Microexcavation. Photo Credit: The BAKOTA Project

Using Cremains Weight from Bronze Age Hungary as an Indicator of Sex

by Pranavi Ramireddy[1], Jaime Ullinger[2] and László Paja[3]

[1]Hampshire College, [2]Quinnipiac University, [3]University of Szeged

Overview:

Determining sex using classical anthropological methods such as examining morphological and metric traits is often difficult or impossible with cremated human bone (cremains) due to fragmentation and post-depositional damage. Previous studies have shown a relationship between cremains weights and sex using modern samples (Bass and Jantz 2004, Gonçalves 2013, Van Deest 2011,). In our study, total cremains weights were analyzed to see if sex could be determined from adult urns. Results show that sex determination using archaelogical cremains weights did not match the results of sexing based on morphological and metric traits when available. These inconsistencies provide questions for future research, such as: why is sexing by cremains weights giving the opposite results from what is expected? Why are some weights so low? What other factors might account for the variability in cremains weights in our sample?

Site and Samples:

Cremated human bone was measured in 13 human burials excavated from the Békés 103 Bronze Age cemetery located in southeastern Hungary by the Bronze Age Körös Off-tell Archaeology (BAKOTA) project. A total of 68 burials have been excavated to date. In this study, a sub-sample of 12 urns and one scattered cremation with no more than one individual each were selected for analysis.

Photograph of a well preserved cremation urn burial in-situ at the Békés 103 cemetery. Photo credit: The BAKOTA Project.

Methods:

Cremains weight and volume were measured for each burial, then fragmentation index (FI) was calculated by dividing weight in grams (g) by volume in milliliters (mL) (Harvig and Lynnerup 2013). Based on weight, a mean sectioning point was used to differentiate males from females. The sectioning point was determined by taking the mean of all weights and supposing that weights below this point were female, and above this point were male (Van Deest 2011). This categorization as male or female was then compared to morphological and metric information.

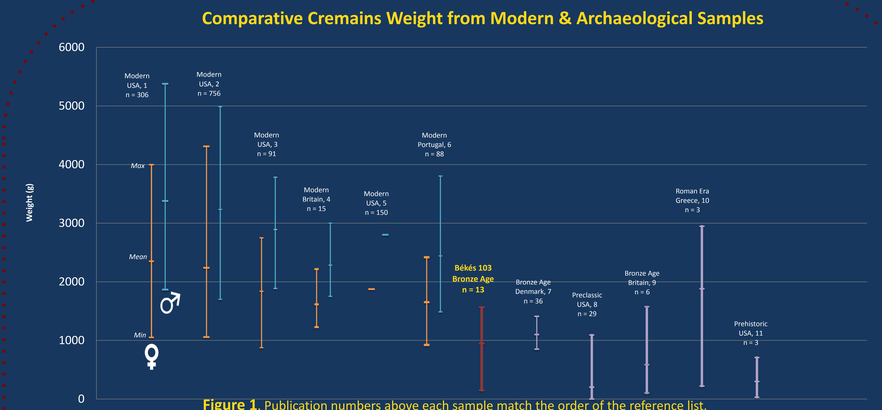

Figure 1. Publication numbers above each sample match the order of the reference list.

Results:

- Overall, cremains weights from Békés 103 burials are lower than modern samples, but similar to archaeological assemblages.
- HB 4, 16, 17, 40, and 46 are considered outliers because their weights are below 600g (rows highlighted in orange). In all but one case (HB 46), the preservation of these burials was categorized as "poor" due to post-depositional disturbances.
- Burials identified as males due to morphological traits have lower weights than burials identified as females (by trait). This is the opposite pattern of what we expected based on studies of modern cremains weights.
- Burials 6 and 8 have low fragmentation indexes (0.35 and 0.34) indicating a lower degree of fragmentation as compared to the other burials.

HB #	Burial Type	Preservation	Sex by trait	Sex by Weight	Weight (g)	Volume (mL)	FI (g/mL)
HB 04	scattered cremation	poor	U	F	571	915	0.62
HB 06	urn	very good	F	M	1238	3535	0.35
HB 08	urn	good	F	M	1222	3612	0.34
HB 09	urn	good	U	M	1122	1465	0.77
HB 16	urn	poor	U	F	147	265	0.55
HB 17	urn	poor	U	F	375	639	0.59
HB 28	urn	very good	F (?)	M	1418	2837	0.5
HB 41	urn	very good	U	M	1640	3299	0.5
HB 54	urn	good	F	M	1564	2705	0.58
HB 46	urn	very good	M	F	572	930	0.62
HB 47	urn	good	U	M	986	1919	0.51
HB 40	urn	poor	M	F	667	935	0.71
HB 45	urn	very good	F	M	1198	2604	0.46
Minimum					147	265	0.34
Mean					946	1924	0.52
Maximum					1564	3612	0.77

Table 1. Summary of findings for each human burial examined.

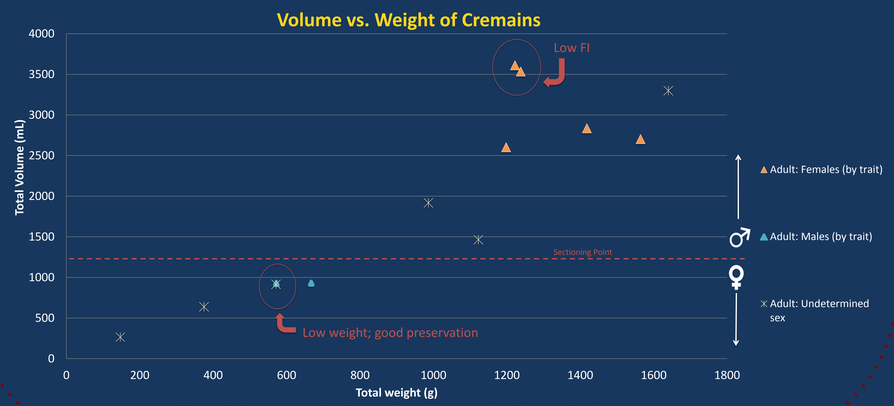

Figure 2. Fragmentation index of each human burial examined.

Discussion & Conclusions:

In this study, we expected that the Van Deest method of sexing by cremains weight using a sectioning point would yield similar results to sexing by trait. However, we found the opposite trend in cases where we were able to compare our results using morphological traits. When cremains weights were compared to volume measurements, two of the female burials had lower Fragmentation Indexes (FI) indicating that the overall degree of fragmentation is lower than the rest of the burials in the sample. Interestingly, the overall FI values from our sample are lower than those measured in previous studies of prehistoric cremains (see Harvig et al. 2014). Future analyses of FI values both within the cemetery population of Békés 103 and between other Bronze Age sites may help elucidate regional patterns in the way cremated bodies were prepared for burial. Additionally, burials that appear to have anomalous FI values can be compared to other burial treatments to look for possible relationships. Finally, while most of the burials that had low weight measurements were poorly preserved indicating that taphonomic processes likely explain this pattern, one burial (HB 46) had a low weight but was very well preserved. Future research and a larger sample size may help us determine whether this anomalously low weight reflects cultural factors in how the deceased was treated as part of the mortuary ritual (e.g., a secondary burial or only partial placement of body parts in the urn)(see table below).

Factors That Impact Cremains Weight During Life	Factors That Impact Cremains Weight During Death	Factors That Impact Cremains Weight Post-Burial
Sex	Preparation of body (paints, clothing, person conducting)	Erosion, trampling, farming, scavengers, chemical leeching
Age at death	Location of cremation (pit, pyre, material of surface)	Modern researchers' technique
Body weight	Full body or parts of body included in final placement	Availability of minerals to fossilize bone
Injuries	Temperature, length of fire, oxygen concentration	Soil acidity, post-depositional disturbance by people
Differences in regional populations	Primary deposit and secondary deposit	Rootlets, salts, rare earth elements, microorganisms

References:

1. Bass W.M., Jantz R.L., 2004. Cremation Weights in East Tennessee, *Journal of Forensic Sciences*, 56(5):1-4
2. Van Deest, T. L., Turhon, M.A., Bartelink, E.J. 2011. A Re-examination of Cremains Weight: Sex and Age Variation in a Northern California Sample. *Journal of Forensic Science*,56(2): 344-349
3. Warren M.W., Maples W.R., 1997. *The Anthropometry of Contemporary Commercial Cremation*, *Journal of Forensic Sciences*, 42(3): 417-423
4. McKinley J.I., 1993. Bone Fragment Size and Weights of Bone from Modern British Cremations and the Implications for the Interpretation of Archaeological Cremations. *International Journal of Osteoarchaeology*, (3): 283-287
5. Sonek A. The weight(s) of cremains. Proceedings of the 44th Annual Meeting of the American Academy of Forensic Sciences; 1992 Feb 17-22; New Orleans, LA. Colorado Springs, CO: American Academy of Forensic Sciences, 1992.
6. Gonçalves, David., Cunha, Eugénia., Thompson, Tim J.U. 2013. Weight References for Burned Human Skeletal Remains from Portuguese Samples. *Journal of Forensic Sciences*, (58) 5: 1134-1140.
7. Harvig L., Lynnerup N., 2013. On the Volume of Cremated Remains –a Comparative Study of Archaeologically Recovered Cremated Bone Volume as Measured Manually and Assesed by Computed Tomography and by Stereology. *Journal of Archaeological Science*, (40) 2713-2722
8. Cerezo-Román, Jessica I., "Pathways to Personhood: Cremation as a Social Practice Among the Tuscon Basin Hohokam" in Transformation by Fire The Archaeology of Cremation in Cultural Context. University of Arizona Press. 2014
9. Clough, S, 2006. Cremated human remains report from the Bronze Age site at Cassington West, Oxfordshire, UK. Oxford Archaeology, unpublished specialist report.
10. Ubelaker, D.H., and J.L. Rife. 2007 The practice of cremation in the Roman-era cemetery at Kenchreai, Greece: The perspective from archeology and forensic science. *Bioarchaeology of the Near East* 1:35-57.
11. Reinhard Karl J., Shipman Jeff H., 1978. Prehistoric Cremations From Nogales, Arizona. The Kiva, 43(3-4): 231-252
12: Harvig L., Runge T.M., Lundø B.M., 2014. Typology and Function of Late Bronze Age and Early Iron Age Cremation Graves-a Micro-Regional Case Study. *Danish Journal of Archaeology*, 3:1, 3-18.

Acknowledgments:

We would like to thank the National Science Foundation, all of the participants of the BAKOTA project, and Dr. Julia Giblin for making this work possible.