COMMITTEE ON DIVERSITY

UNDERGRADUATE RESEARCH SYMPOSIUM

AAPA 86TH ANNUAL MEETING

6-8 PM, WEDNESDAY APRIL 19TH, 2017

(5:00 PM – POSTER SETUP, 5:30 PM – PARTICIPANT CEREMONY)

GRADUATE MENTORS

Katie Allen, University at Buffalo--SUNY
Carlos Amorim, Stony Brook University
Eve Boyle, George Washington University
Colin Brand, University of Oregon
Lauren Christopher, Harvard University ♦
Mary Beth Cole, Ohio State University
Noah Dunham, Ohio State University
Lynn Funkhouser, University of Alabama
Carmen Hove, UC Santa Barbara ♦
Mareike Janiak, Rutgers University
Jessica Joganic, Washington University of St Louis
Erin Kane, Ohio State University
Brittany Kenyon, University at Buffalo--SUNY
Myra Laird, New York University
Steven Lautzenheiser, University of Washington ♦
Ignacio Lazagabaster, National Mus. Nat. Sciences
Ingrid Lundeed, University of Texas at Austin ♦
Diana Messer, Mercyhurst University
Christina Nicholas, University of Iowa
Abi Nishimura, Stony Brook University
Kelsey O'Neill, Virginia Commonwealth University ♦
Rachel Perash, Open Range Archaeology ♦
Elle Powell, Johns Hopkins University
Kristen Ramirez, City University of New York ♦
Michael Rivera, University of Cambridge
Alexandra Sheldon, Central Washington University
Nik Short, University of Louisville ♦
Michala Stock, University of Florida
Mary Beth Studebaker-Reed, Boston University

Organized by Cara Wall-Scheffler & Kerry Dore

Program by Marcie Myers

♦ Previous USR participant now serving as graduate student mentor

AAPA COMMITTEE ON DIVERSITY
UNDERGRADUATE RESEARCH SYMPOSIUM
6-8 pm, Wednesday April 19th, 2017

Poster Titles and Authors

1. **Non-specific indicators of stress in a non-adult burial from the community of Homoródszentmárton, Transylvania**. *MARGARET FURTNER, *XIE YISHAN and JONATHAN BETHARD.
2. **A search for significance: spatial analysis of demographic and health markers in Tirup Cemetery**. *GRACE MORGAN.
3. §**Examining the osteological paradox: Frailty in mass graves versus the general population at the Greek colony of Himera**. *JANELLE TYLER, BRITNEY KYLE, APRIL SMITH, STEFANO VASSALO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA.
4. §**Limb joint degenerative joint disease prevalence in German populations from the Little Ice Age (AD 1300-1850).** *ELEANOR WADDLE, *KENDRA WEINRICH and LESLIE LEA WILLIAMS.
5. §**Prevalence of degenerative joint disease and Schmorl's nodes in Little Ice Age German populations.** *KENDRA WEINRICH, *ELEANOR WADDLE and LESLIE LEA WILLIAMS.
6. §**An inside view: Childhood Stress at the Greek Colony, Himera.** *MELISSA CHOWNING, CAREY GARLAND, BRITNEY KYLE, STEFANO VASSALLO and LAURIE J. REITSEMA.
7. §**Growth differences and shape change in six to eight year old humans based on standard metric and 3D coordinate data**. *DANA E. BECKER, *NATASHA A. CASTELLON-HINKLE, LAURA E. CIRILLO, GARY D. RICHARDS and REBECCA S. JABBOUR.
8. **Quantifying developmental stress using growth lines in teeth**. *JENIFER RICHARDS and HEATHER J.H. EDGAR.
9. **Sex differences in enamel hypoplasia and dental caries in the Tepe Hissar skeletal sample in periods of extreme stress.** *ANISSA SPEAKMAN.
10. **Dental stress markers of a medieval Transylvanian population.** *BRITTNEY BLEVINS, DONOVAN ADAMS and JONATHAN BETHARD.
11. **Dental morphology and human evolution: An analysis of the *Homo naledi* dentition.** *TYLER CHRISTIAN THOMPSON, LUCAS DELEZENE and MATTHEW SKINNER.
12. **The use of 3D technologies for dental measurements**. *EVYN E. CAPLES and TERESA V. WILSON.
13. §**Biological distance between flexed and supine burials at the ancient Greek city of Himera using dental nonmetric data.** *JESSICA CZAPLA, BRITNEY KYLE, STEFANO VASSALO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA.
14. **A case study of amputation in Neolithic China**. *KAYLA DOMINGUEZ and JACQUELINE T. ENG.

Poster Titles and Authors

15. §**Engaging in combat: Interpersonal violence in the ancient Greek colony, Himera.** *CAITLIN B. SAWYER, BRITNEY KYLE, NORMA LONOCE, STEFANO VASSALLO, PIER F. FABBRI and LAURIE J. REITSEMA.

16. **Foot structure and function in habitually unshod children.** *PATRICIA M. BROWN, KEVIN G. HATALA, HEATHER L. DINGWALL, BRIAN G. RICHMOND and ROSHNA E. WUNDERLICH.

17. **Analysis of capitate proportions of humans and chimpanzees: Implications for hominid hand evolution.** *NAOMI JOHNSON and MARISA MARCIAS.

18. **Variation in tetrapod pisiform ossification**. *LIA GAVAZZI, PHILIP RENO and KELSEY KJOSNESS.

19. §**Are metacarpals a handy indicators of sex? The applicability of metacarpal metrics in sex determination.** *KASHIQUE A. S. ROBINSON, TRACY K. BETSINGER, JAMIE M. ULLINGER and DANIELLA R. TARQUINIO.

20. **A morphometric study of the human ear**. *ARIANA P. DINDIAL, JULIE D. WHITE, DIEGO A. HERNANDEZ and MARK D. SHRIVER.

21. **Macauley Complex (NY) burials skeletal analysis.** *LÉA BAROUCH.

22. **Premature and trauma-induced sutural fusion in a protohistoric cranium**. *PINA SIMONE, *CORTNEY CONNOR, REBECCA JABBOUR and GARY RICHARDS.

23. §**Analysis of growth disruptions in two burial populations in the Greek colony of Himera.** *ABDUL H. ZAHID, BRITNEY KYLE, NORMA LONOCE, APRIL SMITH, STEFANO VASSALLO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA.

24. **The small but healthy hypothesis: Evidence of skeletal stress and adaptation in Himera, Sicily.** *TESSA J SMITH, BRITNEY KYLE and LAURIE J. REITSEMA.

25. **An osteobiography of an institutionalized individual from 19th century Chicago.** *SHELBY DOUBEK and ANNE L. GRAUER.

26. **Guess who?: A bio-demographic profile of Northern Kentucky University's human skull collection.** *MEGAN MARSHALL, *MICHAYLA LUSTENBERG and MONICA WAKEFIELD.

27. **Copper staining as an indicator of grave inclusions in medieval Transylvanian cemeteries.** *ELIZABETH GUNDERSON and *ALEXANDRA MCKENZIE.

28. **A Transylvanian case study in non-specific stress: Marefalva, Sir-11.** *MAURA K. GRIFFITH, *JESSICA FILIPELI, ANDRE GONCIAR, NYÁRÁDI ZSOLT and JONATHAN BETHARD.

Poster Titles and Authors

29. **European Bog Bodies: From the Iron Age peat bog to the 21st Century.** *SAMANTHA ESTHER BROWN.

30. **Age estimation using cranial suture closure methods on a modern population**. *NATALIE RIVELLO.

31. **Investigating sexual dimorphism in supraorbital ridge development: A two-dimensional geometric morphometric study.** *SIERRA T. HIGGINSON and MIRANDA E. KARBAN.

32. **Varied arch index as a result of childhood footwear.** *ALEXANDRA L.C. MARTIN, STEVEN G. LAUTZENHEISER, ELEN M. FEUERRIEGEL and PATRICIA A. KRAMER.

33. **Effect of load carrying position on peak ground reaction forces during level-surface walking.** *MORGAN ALVERSON, ELEN FEUERRIEGEL, STEVEN LAUTZENHEISER and PATRICIA KRAMER.

34. **Chenodeoxycholic acid and brown adipose tissue activity in response to cold exposure in Chicagoland area adults**. *KAYLIN DONG, *JENNAH THOMPSON-VASQUEZ, STEPHANIE B. LEVY and WILLIAM R. LEONARD.

35. **Hair cortisol measurement and relationships with growth among Amazonian Shuar children**. *TIGEST MEQUANINT, GEETA EICK, SAMUEL S. URLACHER, LAWRENCE S. SUGIYAMA and J. JOSH SNODGRASS.

36. **Assessing cytosine methylation of LINE1 and NR3C1 across multiple human tissues: Implications for paleoepigenetics**. *SANA SABOOWALA, RICK SMITH and DEBORAH BOLNICK.

37. **Building a methodological and interpretative framework for generating an "isotopic profile" to enhance identification of forensic cases**. *DASIA GREEN, *TIMOTHY MARK STEWART, MONET WATSON and RHONDA QUINN.

38. **Diet and behavior among Bedouin from the Ottoman-period cemetery of Tell el-Hesi using stable carbon and nitrogen isotopes.** *BRITTNEY HIGHLAND, *ERIKA DANELLA, LESLEY GREGORICKA and JAIME ULLINGER.

39. **The influence of diet on 87Sr/86Sr ratio differences in archaeological human enamel measured by TIMS and LA-ICP-MS.** *MICHELLE PRIZZI and RHONDA QUINN.

40. §**Assembling a winning army: Strontium isotope analysis of local and non-local soldiers from the ancient Greek battles of Himera (480 BCE, 409 BCE).** *JULIANNE R. STAMER, KATHERINE L. REINBERGER, BRITNEY KYLE, PIER FRANCESCO FABBRI, STEFANO VASSALLO and LAURIE J. REITSEMA.

41. §**Oxygen stable isotope analysis: Examining intermarriage at an ancient Greek colony in Northern Sicily.** *VANESSA C. ALARCIA and LAURIE J. REITSEMA.

Poster Titles and Authors

42. **Diachronic perspectives on human diet variation in Greek, Roman, and medieval Albania**. *RACHEL N. HORTON, LAURIE J. REITSEMA, BRITNEY KYLE and EDUARD SHEHI.

43. **Salivary secretory immunoglobulin A variation between varsity swimmers, varsity cross country runners, and non-athletes.** *CARLYE CHANEY.

44. **Tuberculosis and leprosy cross-immunity hypothesis: Considering the potential role of other Mycobacterial species.** *HALEIGH MITCHELL, JACOB WHITE, MEGAN DUNCANSON and FABIAN CRESPO.

45. §**Single nucleotide polymorphisms in the FGFR3 gene: interpreting cranial, neural, and vascular changes in prehistoric cases of achondroplasia.** *NICOLE APODACA, *SIERRA LEE, REBECCA S. JABBOUR and GARY D. RICHARDS.

46. **Be fruitful and multiply: Fertility and tradeoffs in Latter-Day Saints**. *AMANDA COOK, *CLAIRE HANSON and NANDA GROW.

47. **An evolutionary analysis of gender and reproduction in Latter-Day Saints**. *CLAIRE HANSON, *AMANDA COOK and NANDA GROW.

48. **The evolution of childbirth and the rise of elective cesarean sections.** *EMALINE REYES, KAREN ROSENBERG and WENDA TREVATHAN.

49. **A captive ape society: Social structure and dominance hierarchy analyses at Chimpanzee Sanctuary Northwest.** *JAKE A. FUNKHOUSER, JESSICA A. MAYHEW and JOHN B. MULCAHY.

50. **Fecal glucocorticoids and aggressive behavior among rhesus macaque females.** *MANDY M. JORDAN and JENNIFER DANZY CRAMER.

51. **Bark vs. bite: An assessment of dominance hierarchies using different agonistic behaviors in a Kinda x Grayfooted Chacma (*Papio kindae* x *Papio ursinus griseipes*) Hybrid Group in Kafue National Park, Zambia.** *KYLEN GARTLAND, CRICKETTE SANZ and MONICA MCDONALD.

52. **Stress levels in relation to food restriction in captive *Papio ursinus***. *MARY E. KESTER, TODD. R YOKLEY, JILL E. SCOTT and KALEN MEINE.

53. **The effects of cage size in captivity on physical activity levels in *Propithecus coquereli.*** *DANIELLE R. ORLANDI, *MARK M. MCGOWAN, ROSHNA E. WUNDERLICH and ANTHONY TONGEN.

54. **Investigating the genetic basis for hominoid taillessness**. *SAMANTHA TICKEY, HANNA WEGENER and HOLLY DUNSWORTH.

Poster Titles and Authors

55. Investigating the impact of ingested microbes on chimpanzee gut microbiome composition. *MONICA GUARDADO, EMILY DAVENPORT and GEORGE PERRY.

56. Inferring aspects of the locomotion of extinct primate species via biomechanically informed, morphometric analysis of the ulna. *MACKENZIE NIETO AGUILAR, BERNADETTE PERCHALSKI, GABRIEL YAPUNCICH, ASHLEY GOSSELIN-ILDARI and DOUG BOYER.

57. §Trabecular symmetry in the primate temporomandibular joint. *PATRICIA RAMOS, CLAIRE E. TERHUNE, ADAM D. SYLVESTER and ANDREA B. TAYLOR.

58. Comparisons of length variation of the lower third premolar honing cusp within males and females of the genus *Cercopithecus*. *LUKE D. FANNIN.

59. §Testing hypotheses for the embryonic origins of primate neocortical expansion. *ANJANA KRISHNAMURTHY, ANDREW C. HALLEY and TERRENCE W. DEACON.

60. Comparing post-mortem and osteological measures of primate 2D:4D digit ratios. *ENRIQUE GOMEZ, JOSIE BEAVERS and FRANCES WHITE.

61. Defining the relationship between primate seasonal breeding and climate instability. *MARGARITA HERNANDEZ and JAMES PAMPUSH.

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Inferring aspects of the locomotion of extinct primate species via biomechanically informed, morphometric analysis of the ulna. *MACKENZIE NIETO AGUILAR, BERNADETTE PERCHALSKI, GABRIEL YAPUNCICH, ASHLEY GOSSELIN-ILDARI and DOUG BOYER. Duke University.

Background: Notharctids are euprimates from the Eocene of North America. The nature and variety of locomotor modes used by this group is not fully understood. In this study we aim to add to discussions of notharctid locomotion through comparative analysis of functional morphology of limb bones in extant primates. **Methods:** The ulna was chosen for its potential correlation with variation in forelimb posture, load-bearing, mobility, and muscular strength. We identified six locomotor categories (vertical clinging and leaping, suspensory/brachiation, slow climbing, arboreal quadrupedalism, terrestrial quadrupedalism, and knuckle-walking quadrupedalism) likely to impose different functional requirements on the ulna. We evaluate associations between locomotor category and bone structure, and report results from preliminary analysis of 9 ulnar features in 25 extant primate species (n= 56). **Results:** We found ulna morphological traits measured in this study to distinguish different locomotor modes, allowing the metrics of notharctid ulnae (n= 3) to be plotted into the locomotor group their ulnar morphology most closely resembled. The features of Notharctus ulnae were found to be consistent with those of living arboreal quadrupeds and vertical clingers. **Conclusion:** Despite a separation by almost a million years, *N. pugnax* and *N. tenebrosus* exhibit a range of morphologies similar to that of a typical extant species suggesting no locomotor behavior diversity in notharctids over time.

Funding: NSF BCS 1552848, Duke ASC FRC, NSF BCS 1540421, NSF BCS 1317525, NSF BCS 1440742, BCS 1440558, NSF BCS 1558555

Oxygen stable isotope analysis: Examining intermarriage at an ancient Greek colony in Northern Sicily. *VANESSA C. ALARCIA and LAURIE J. REITSEMA. University of Nevada, Las Vegas, University of Georgia, Athens.

Background: This study addresses residential mobility of individuals interred at the Greek colony site of Himera, Sicily (648-409 BCE), using oxygen stable isotope analysis of human tooth enamel. Co-occurrence of flexed and supine interment styles at Himera hint at intrapopulation cultural differences in this multi-ethnic colony site. **Methods:** To examine whether burial styles were shared among the population, or segregated depending on a person's geographic point-of-origin, we analyzed oxygen stable isotope ratios of 24 adult individuals, testing two null hypotheses: that there are no significant differences in the oxygen stable isotope ratios of skeletons in flexed versus supine graves, and that females and males are equally likely to be local/non-local. **Results:** Fifteen individuals were determined to be local to the area whereas seven were non-locals. Chi-square analysis revealed no significant sex differences (X^2=1.62, p=0.2) and geographic origin appears to be unrelated to interment style (X^2=0.04, p=0.85). **Conclusion:** This mix of local and non-local males and females in both burial styles, along with material culture at the site exhibiting both Greek and

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Sicilian elements, point to intermarriage and hybridity in ethnicity at Himera.

Funding: This research was funded by National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

Effect of load carrying position on peak ground reaction forces during level-surface walking. *MORGAN ALVERSON, ELEN FEUERRIEGEL, STEVEN LAUTZENHEISER and PATRICIA KRAMER. University of Washington.

Background: Modern humans carry loads on a daily basis, and this increases energy expenditure, changes gait kinematics, and increases vertical ground reaction forces (GRF) proportional to the burden. Few studies have attempted to understand the effect of load position on mediolateral and anteroposterior GRFs, where changes in body center-of-mass imposed by the loading conditions may affect GRFs disproportionately. **Methods:** GRFs were recorded by a 3D forceplate (Kistler, Amherst NY) for seven participants (5 females, 2 males) walking at their normal velocity carrying a 10 kg load in five carrying conditions: (i) No load; (ii) Front; (iii) Left Side; (iv) Back; (v) Right Side. Each participant completed 8 trials for each condition. **Results:** Maximum GRFs were determined using a custom-written Matlab (Natick, MA). After adjusting the unloaded condition for the increase in mass of the burden, two-sample t-tests, conducted in Stata (StataCorp, College Station TX), were used to determine whether the loaded conditions increased proportionately. **Conclusion:** The preliminary results indicate that increases in GRFs in the mediolateral and anteroposterior directions are not different from our null hypothesis (all p's> 0.05). Further study is required in order to understand how load position influences, body position, gait biomechanics, and GRFs in humans.

Single nucleotide polymorphisms in the FGFR3 gene: interpreting cranial, neural, and vascular changes in prehistoric cases of achondroplasia. *NICOLE APODACA, *SIERRA LEE, REBECCA S. JABBOUR and GARY D. RICHARDS. University of California Berkeley, University of Pacific.

Background: Achondroplasia is the most common form of dwarfing and shortness of limbs (1/28,000 – 1/48,000 livebirths USA). The condition is caused by one or two SNIPs in the FGFR3 gene. **Methods:** Although partial skeletons complicate diagnoses in prehistoric contexts, achondroplasia is the best-represented chondrodystrophy globally (n=10, plus n=3 possible). In North America six prehistoric achondroplastics are known (50 BCE to 1800 CE). Based on virtual skull and endocranial reconstructions, we delineate cranial and neural morphologies in prehistoric achondroplastics that result from FGFR3 mutations and discuss how these cranioneural changes impacted the lifeways of affected individuals. **Results:** Reference to literature descriptions confirmed a diagnosis of achondroplasia in both cases. Endocranial reconstruction revealed significant vascular changes. These included enlarged internal carotid (endocranial) and middle meningeal arteries and expanded dural sinuses, extensive shunting to emissary sinuses, and narrowed jugular foramina. FGFR3 related increases in neural tissue (>neurons, decreased cellular apoptosis) appear to result

in brain asymmetries (expanded right pre/postcentral gyri, cupped parietal lobes, midsagittal swelling). Cranial reconstruction revealed unexpected variation in chondrocranial components. **Conclusion:** While cases of prehistoric achondroplasia are well known, the extent of anatomical change in these cases has been ignored. Our observations provide new insights into the cascade of impacts resulting from FGFR3-induced cranioneural changes that result in achondroplasia.

Funding: Student Opportunity Funds

Macauley Complex (NY) burials skeletal analysis. *LÉA BAROUCH. SUNY Geneseo.

Background: The Macauley Complex excavations, located along the Genesee River near Geneseo, NY, started in the 1960s under the supervision of Richard N. Maxson, who published several papers on the settlements and artifacts recovered. While the burials are mentioned in the literature and the remains have been submitted for review under the NAGPRA guidelines, little else has been determined about the individuals. The settlements have been dated to be from the Archaic to Late Woodland Period, which provides context to develop further hypotheses about the lives of the people who lived in these settlements. **Methods:** A thorough skeletal analysis of the four recovered burials along with an extensive study of the literature would give insight into the past lives of the group of Native Americans who inhabited these settlements. **Results:** The research is in progress; I will have completed the poster by the time of the conference.

Funding: Geneseo Travel Grant

Growth differences and shape change in six to eight year old humans based on standard metric and 3D coordinate data. *DANA E. BECKER, *NATASHA A. CASTELLON-HINKLE, LAURA E. CIRILLO, GARY D. RICHARDS and REBECCA S. JABBOUR. UC Berkeley, University of the Pacific, San Fransisco.

Background: Ontogenetic studies of ancient humans are carried-out with reference to variably sized sample populations. Depending on sample size and age range studied a decision to subdivide the sample into age groups or use it as a single group may need to be made. Using an age-restricted human sample we compare metric and 3D landmark data to investigate the amount, direction, and significance of growth changes and their impact on sampling choices. **Methods:** We measured 210 dimensions, calculated 36 indices, and collected 194 3D landmarks from 39 skulls (Institute for Craniofacial Study, UOP). The sample comprises 6.0-8.0 year-olds, based on calcification stage. Means, standard deviations, and ranges were employed to explore changes in the x-y data. **Results:** In 3/9 thicknesses, 1/7 subtenses, 39/194 curves, breadths, chords, or lengths, and 9/36 indices the results showed growth changes but these lacked shared extent or directionality. 3D coordinate data were analyzed with Morphologika. Shape was explored using Principle Components Analysis on Procrustes-aligned shape variables. PC1 explains 14.1% of the variance, while PC2-PC3 explain 9.7 and 8.1%, respectively. While age distributions overlapped substantially some directionality based on age was apparent in PC1-PC4. **Conclusion:** Our standard metric assessment showed specific dimensional changes but the

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direction and extent of change varied. A decision was made to group this sample. Alternatively, principle components analysis revealed slight but clear directionality in the growth changes, inclusive of reversals. While both data sets revealed ontogenetic changes the 3D data provided clearer understanding of growth changes and correlations between a wider set of dimensions.

Dental stress markers of a medieval Transylvanian population. *BRITTNEY BLEVINS, DONOVAN ADAMS and JONATHAN BETHARD. University of Louisville, University of South Florida.

Background: This project will investigate dental health during the medieval period in Székely Land, a part of modern day Romania, where individuals of Hungarian ancestry comprise a majority of the population. The study of dental remains of the juveniles and adults can shed light onto diet and overall stress of past populations. Skeletal remains collected from Székely Land show dental caries, wear, abscesses, and calculus that can help us to estimate diet information for the population. **Methods:** This information can be compared to other populations in Europe during the medieval time period to estimate any dietary changes. Also, the dental data can be used to get an idea of the overall stress of the population. A sample of 55 individuals was excavated from 55 burials in Fenyéd, a small settlement located in Transylvania. These individuals ranged from young juveniles to old adults and included individuals of both sexes. **Results:** Though a small sample, this provides a valuable investigation into the lives of a little studied area. A total of 712 teeth were observable for dental stress markers (569 permanent, 143 deciduous). Caries were relatively prevalent in this society with a frequency of 23.88% (21.44% - permanent, 33.57% deciduous). **Conclusion:** This information can lead to more research of this previously studied region of Romania. It can also give us insight on the overall health of this past population.

Foot structure and function in habitually unshod children. *PATRICIA M. BROWN, KEVIN G. HATALA, HEATHER L. DINGWALL, BRIAN G. RICHMOND and ROSHNA E. WUNDERLICH. James Madison University.

Background: The aims of this study are to present ontogenetic data on structure and function in habitually unshod feet and to compare unshod foot structure and function to those of shod children and habitually unshod adults. We ask whether low hindfoot pressures and high hallux pressures seen in adult unshod Daasanach characterize the Daasanach throughout ontogeny or whether these characteristics develop only in the absence of footwear. **Methods:** 73 habitually unshod Daasanach children (3-15 years) from near Ileret, Kenya walked across a plantar pressure mat at self-selected walking speeds. Using RSscan footscan 7 software, we measured foot length, width and arch index as well as dynamic plantar pressure, maximum force, contact area and impulse (force-time integral) for 10 anatomical regions. **Results:** Results show that the habitually unshod child's foot is unlike its adult counterpart, with an average peak pressure ratio 116% higher between the hindfoot and midfoot regions of unshod children despite high midfoot pressures in the youngest children. Daasanach children display patterns of pressure similar to shod children, but unshod children have relatively

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higher hallux pressures, a pattern also seen in Daasanach adults. **Conclusion:** The results of this experiment show that foot shape and function may be initially different in unshod children than adults. The distinctive shape and function of the foot in unshod and shod individuals develops in the context of footwear and potentially other factors such as substrate.

Funding: The funding associated with this research comes from the National Science Foundation grant BCS-092447.

European Bog Bodies: From the Iron Age peat bog to the 21st Century. *SAMANTHA ESTHER BROWN. University of Wyoming.

Background: European Bog Bodies dating anywhere from the Iron Age to the 19th century have been discovered across Northwester Europe particularly in Great Britain, Ireland, and Denmark. **Methods:** Utilizing previously collected data I endeavor to analyze the underlying processes of decomposition and preservation. I also work to analyze the potential cultural patterns associated with the trauma presented by these individuals. **Results:** Based upon previously collected data these individuals represent a unique mix of accidental death and intentional trauma. This intentional trauma points to patterns of interpersonal violence particularly in the repetitious patterns of trauma presented by several Iron Age individuals. **Conclusion:** Previous research seems to contradict earlier findings indicative of ritualized violence. Rather it would appear that these bogs are the site of numerous accidental deaths, as well as ritualized burial sites. In the future I hope to further investigate these individuals particularly the patterns of trauma associated with them.

Funding: McNair research internship

The use of 3D technologies for dental measurements. *EVYN E. CAPLES and TERESA V. WILSON. Louisiana State University.

Background: Dental Anthropologists have been measuring the dimensions of teeth in order to compare populations. With the increased use of affordable 3D scanners, there is an opportunity to gather dimensional data from dental samples for later research. **Methods:** Using the NextEngine scanner, teeth (n=5) were scanned together at a resolution of 16k points/in2. Each tooth was measured individually with digital calipers. The following measurements were performed: mesiodistal crown diameter, buccolingual crown diameter, and crown height. A second set of measurements was performed using the Geomagic Wrap Software. The measurements were performed by selecting points on the scan in the same locations as were taken with the calipers. **Results:** The physical measurements were compared to the measurements of the 3D scan. Using the tooth measurements, the crown module [(mesiodistal diameter + buccolingual diameter) / 2], crown index [(100 x buccolingual diameter) / mesiodistal diameter], robustness index [mesiodistal diameter x buccolingual diameter] were calculated for each tooth. Each of these indices were compared between the digital caliper measurements and the 3D scan measurements. The 3D scan data varied the most across all tooth dimensions, however the results of the indices showed that

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measuring with 3D scans can still yield data with high precision, but lacks in accuracy. **Conclusion:** 3D scanning can be used to more conveniently archive data for future research, however researchers must understand the limitations of a 3D scan versus the actual tooth. More research needs to be done on a greater sample size to fully understand how the precision and accuracy of this kind of data is affected.

Funding: LSU FACES Laboratory

Salivary secretory immunoglobulin A variation between varsity swimmers, varsity cross country runners, and non-athletes. *CARLYE CHANEY. Washington University in St. Louis.

Background: This study examined salivary secretory immunoglobulin A (sIgA) variation between Washington University varsity swimmers, cross country runners, and non-athletes to determine if participation in collegiate athletics affects this measure of the immune system. Past work has only studied salivary sIgA variation by looking at one type of physical activity at a time, which makes comparison of the effects of different types of physical activity difficult. Prior research has found that endurance training increases salivary sIgA secretion rates among elite athletes. **Methods:** We recruited 50 female participants aged 18-22 years with 13-20 individuals per group. Two saliva samples were collected from each participant; baseline and a second sample two weeks after the first when training would have intensified for the athletes. Additionally, participants completed a survey including the Undergraduate Stress Questionnaire and a Profile of Mood States. **Results:** No significant differences in salivary sIgA secretion rate were found between sample populations and there was no association with aerobic or anaerobic exercise. No significant differences in salivary sIgA secretion rate were found between athletes and non-athletes or between runners and swimmers, although the difference between runners and non-athletes approached significance. There was no association between sIgA and aerobic or anaerobic exercise. **Conclusion:** It appears that collegiate sport engagement does not affect innate immune function as indexed by salivary sIgA secretion rates. These results suggest that participating in college athletics does not significantly affect immune function.

An inside view: Childhood Stress at the Greek Colony, Himera. *MELISSA CHOWNING, CAREY GARLAND, BRITNEY KYLE, STEFANO VASSALLO and LAURIE J. REITSEMA. University of Northern Colorado.

Background: This study addresses early life stress indicated by internal incremental growth lines of human dental remains from the 7-5th c. BC colony of Himera. Co-occurrence of flexed and supine interment styles at Himera hint at intrapopulation cultural differences in this multi-ethnic colony site. **Methods:** To examine whether these cultural differences are related to differences in health, we test two null hypotheses: that there are no significant differences in prevalence (number of individuals affected) of Wilson bands between supine and flexed burials, and that there are no significant differences in the number of Wilson bands per individual between supine and flexed burials. Canines from 26 adult skeletons were thin-sectioned

and microscopically analyzed for evidence of accentuated internal striae of Retzius (Wilson bands; WB), which are indicative of non-specific childhood stress. **Results:** 82% of supine (n=10) and 94% of flexed (n=16) skeletons exhibited WB (chi-square; p=0.360). The mean number of WB in canines from supine burials is 3.5 and for flexed burials is 6.3 (p=0.097). **Conclusion:** Overall, WB prevalence increases as age at death increases, suggesting individuals who survived childhood stress were more likely to live longer. The lack of statistical significance in WB between burial styles supports our null hypothesis, suggesting childhood stress of these individuals was similar despite differences in how they were buried.

Funding: This research was funded by National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

Be fruitful and multiply: Fertility and tradeoffs in Latter-Day Saints. *AMANDA COOK, *CLAIRE HANSON and NANDA GROW. Utah State University.

Background: In humans, there are evolutionary trade-offs between energy allocated to reproduction and embodied capital (investing in extended development). We see selection toward early and frequent reproduction over embodied capital in the predominantly Latter-Day Saints (LDS) culture of Utah. **Methods:** We hypothesize that encouragement toward reproduction in LDS individuals has trade-offs with embodied capital compared to non-LDS individuals. We collected data through an anonymous online survey (Qualtrics) distributed to a stratified random sample of LDS and non-LDS college students and recent graduates of Utah State University in Logan, UT (n=45) and Texas A&M in College Station, Texas (n=17) . We include questions on marital status, religion, sexual behavior, reproductive goals, and college grades. **Results:** Current results suggest that LDS students are much less likely to be sexually active when unmarried compared to non-LDS students (14% compared to 44%). Non-LDS students in both samples are 65% more likely to have used birth control methods compared to sexually active LDS students. The percentage of participants that wanted children in the future differed according to affiliation with the LDS church $X2(12, N=58)=31.95$, $p<.0001$. Results also indicate that LDS individuals are more likely to express satisfaction with their college grades (63% compared to 25.7%). **Conclusion:** These results suggest differences in embodied capital priorities between LDS and non-LDS students.

Funding: This research is funded by the Anthropology Program in the Department of Sociology, Social Work, and Anthropology at Utah State University. This research was conducted with the approval of Utah State University IRB Exempt protocol #8116.

Biological distance between flexed and supine burials at the ancient Greek city of Himera using dental nonmetric data. *JESSICA CZAPLA, BRITNEY KYLE, STEFANO VASSALO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA. University of Northern Colorado.

Background: We investigate potential differences in genetic relatedness of flexed and supine burials from Himera, a Greek

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colony on Sicily (648-409 BCE), using biodistance analysis of nonmetric dental traits to explore whether locals adopted Greek burial styles, Greek and local customs hybridized, and/or each group maintained distinct burial styles. In other contexts, supine burials have been associated with Greeks, and flexed burials have been interpreted as representing indigenous individuals. Thus, we hypothesize that supine burials will be more closely related to Greeks from Euboea (indirect founders of Himera) and flexed burials will be genetically distinct, possibly representing locals. **Methods:** To test our hypothesis, we recorded presence and absence of 34 dental nonmetric traits using the ASU Dental Anthropology System in 57 individuals from Himera (23 flexed, 34 supine) and 45 from Karystos, Greece. Pseudo-Mahalanobis D2 matrices using different trait combinations were used to estimate biological distance among groups. **Results:** These analyses showed that the individuals buried in flexed and supine positions are genetically similar to one another and distinct from Karystos, suggesting that there were no major genetic differences between the burial types at Himera. **Conclusion:** The only trait that was significantly different between the two burial styles was the interruption groove (i.e., the "Etruscan" lateral incisor), which was significantly more common in the flexed burials (present in 88% of flexed and 59% of supine graves; Fisher's Exact test p=0.0496).

Funding: This research was funded by National Science Foundation Research Experience for Undergraduates award numbers 1560227 and 1560158, the University of Georgia, and the University of Northern Colorado.

A morphometric study of the human ear.
*ARIANA P. DINDIAL, JULIE D. WHITE, DIEGO A. HERNANDEZ and MARK D. SHRIVER. Pennsylvania State University.

Background: Ear prints are as individual as fingerprints and can potentially be a valuable source for identification in forensics investigations. This study examines ear morphology in seven ancestry groups in relation to age, sex, and body mass index (BMI). **Methods:** Using ImageJ, twelve landmarks were placed on the left and right auricles (when possible) of 469 individuals, using a standard 3x5" index card as a scale. The landmarks included: superaurale, subaurale, deepest point of the intertragic notch, Darwin's tubercle, preaurale, most distal point of the tragus, most distal point of the anti-tragus, anterior notch, most anterior point of the inferior crus of the antihelix where it meets the helix, the deepest point of the posterior auricular sulcus, and the most posterior point of the ear lobe. Landmarking was performed by three researchers and the intraclass correlation coefficient (ICC), an index of interrater reliability, was calculated using the icc package in R. A two way model with type as agreement and unit as average was used. In addition, intrarater reliability was assessed after each researcher re-landmarked a random sample of 100 individuals twice more with more than a 24-hour gap in between the replicates (totaling 3x landmark sets for those 100 individuals). Again, ICC was assessed using R, using a two way model with type set as agreement and unit set as single. Nine distances were calculated using the 2D coordinates of the above landmarks and ANOVA were performed to assess the contribution of ancestry, sex, age, and BMI to variance in ear morphology. **Results:** The intraclass

correlation coefficient showed moderately strong agreement between the three raters (average ICC = 0.868, min = 0.797, max = 0.922). Within raters, AD's average ICC values were 0.980, DH's average ICC values were 0.998, and JW's average ICC values were 0.993. Variation in 6 of the 9 landmarks was significantly affected by ancestry, while age was a significant contributor to variation in 8 of the 9 distances, and sex was a significant contributor in 6 of the 9 distances. Ancestry was a significant contributor to distances which correspond to ear width, while age, sex, and BMI had more global effects on ear morphology. **Conclusion:** Variation in ear morphology depends on an individual's ancestry as well as being affected by other factors like age, sex, and BMI. These results could be affected by sampling bias because of unequal sample sizes based on ancestry and sex and because of a skew in the distribution of age and BMI. In future research, statistical analyses should be done to assess whether sampling bias could have affected these results and to retest the findings of this study.

A case study of amputation in Neolithic China. *KAYLA DOMINGUEZ and JACQUELINE T. ENG. Western Michigan University.

Background: This study focuses on a case of upper limb amputation (burial M59.3) from a Neolithic site in Qinghai, China. We discuss the possible causes and the implications of such disability upon the individual, and compare similar cases in the archaeological record. **Methods:** All bones from burial M59.3 were inventoried and examined for any evidence of pathological conditions, but few elements were found in association with the affected right radius and ulna. The location and severity (i.e., healing rate) of the injured areas are recorded. **Results:** The remains are those of an adult, possibly male. The amputation occurred at the midshaft of the right ulna and radius, with osseous fusion between the two at the interosseous crest. Healing is evident in the rounding of the terminal ends of the bones. **Conclusion:** The amputation occurred at midshaft rather than transarticular, suggesting that the procedure was surgical to treat trauma rather than as a form of punishment. The healed nature of the injury and the fact that it was the right arm indicate that the individual was cared for by the community. Similar cases of amputation in the past point to variability in the success of surgeries and the reasons behind it.

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Chenodeoxycholic acid and brown adipose tissue activity in response to cold exposure in Chicagoland area adults. *KAYLIN DONG, *JENNAH THOMPSON-VASQUEZ, STEPHANIE B. LEVY and WILLIAM R. LEONARD. Northwestern University.

Background: Active brown adipose tissue (BAT) has recently been found in some adults who are exposed to cold temperatures; however, potential blood biomarkers of this tissue have yet to be identified. Previous research suggests that, when exposed to cold stress, adults with greater BAT activity exhibit greater energy expenditure, lower levels of LDL cholesterol, and lower BMIs. **Methods:** In this study, 90 residents of the Chicago Metro Area (63 women; 27 men) between 18 and 40 years old were exposed to a 20-minute thermoneutral condition followed by a 40-minute cooling condition.

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BAT thermogenesis was measured using infrared thermal imaging, and energy expenditure was quantified using indirect calorimetry. Anthropometric measurements were measured using standardized protocols and dried blood spots were collected and analyzed for chenodeoxycholic acid (CDCA), a potential blood biomarkers of BAT activity. **Results:** Multiple regression analyses were used to test for a significant relationship between BAT thermogenesis and metabolic rate. Additionally, the relationship between BAT thermogenesis and circulating chenodeoxycholic acid (CDCA) was examined using multiple regression in order to explore whether CDCA may act as a useful biomarker of BAT activity. **Conclusion:** Individuals with greater BAT thermogenesis exhibited significantly greater energy expenditure during the cooling condition. These results indicate that BAT plays a role in adaptive changes in metabolism among adult residents of the Chicago area. Additionally, further research is needed in order to identify potential blood biomarkers of BAT thermogenesis.

Funding: NSF BCS-1455804; Northwestern University

An osteobiography of an institutionalized individual from 19th century Chicago. *SHELBY DOUBEK and ANNE L. GRAUER. Loyola University Chicago.

Background: The 19th century witnessed an expansion of medical colleges and the passing of anatomy laws limiting postmortem anatomical study to bodies of those deemed criminals or unclaimed. Rush Medical College, in Chicago, Illinois, chartered in 1837, likely trained their students on these disenfranchised individuals. **Methods:** This case study explores the accession records of an individual in the Field Museum of Natural History's skeletal collection from Rush Medical College, and along with skeletal analysis investigates how the body reflects structural inequalities in life and death. **Results:** The results of the analysis indicate that individual 1898.132.43855 was an adult male approximately 35-50 years old. Although labeled as having Chinese ancestry, FORDISC evaluation indicates that the individual was more likely of Vietnamese decent. Multiple healed fractures are evident, indicating repeated trauma episodes throughout the individual's life. Poor dental health is accompanied by a number of basic dental restorations. **Conclusion:** Through these analyses, the osteobiography of this individual is contextualized, and the physiological ramifications of social inequality during life (and death) is explored.

Comparisons of length variation of the lower third premolar honing cusp within males and females of the genus *Cercopithecus*. *LUKE D. FANNIN. The Ohio State University.

Background: Dimensions of maxillary canines in anthropoid males and females are known to co-vary with those of the mandibular p3-honing cusp. Several authors have argued that species-level variation in female canine length is attributable to differences in levels of female agonistic behavior. Females in *Cercopithecus* spp. exhibit extensive variation in the length of the upper canine with variation in competitive regime cited as a potential causal factor; few studies have tested whether similar variation is present in the p3. **Methods:** Here I investigate length variation

in the p3 honing cusp within *Cercopithecus* and assess whether levels of variation present in maxillary canines and attributed to competition is similarly represented in the premolars. Lower p3 honing cusp lengths were measured in a sample of females (n=81) and males (n=77) in seven *Cercopithecus* taxa, with lengths averaged for each mandible and scaled to average second molar length. **Results:** Frequency distributions displayed similar standard deviations between male and females for premolar hone cusp length variation, with males having a larger interquartile range as compared to females. One-way ANOVAs showed non-statistically significant differences among male and female species; additionally, paired t-tests showed statistically significant mean differences were present for all species only in comparisons between males and females. **Conclusion:** Results support the conclusion that premolar hone cusp length is a less reliable indicator of competition among female guenons, with low intra-sex variation within species. Additionally, results suggest that the honing complex cannot be classified as strictly modular; rather, it is a flexible system that allows individual changes to its components. Future research will be needed to access the extent of occlusion of the upper canine and the lower third premolar honing cusp in female guenons, in order to gauge whether the canine is being functionally sharpened by the large lower p3 honing cusp (as indicated by wear area on the lower p3 honing cusp) or if larger premolars in these females are just a residual bi-product of selection for smaller female canines.

Funding: Money for travel costs to museum collections of primate crania was awarded to me through The Ohio State University's STEP (Second- Year Transformational Program) undergraduate grant.

A captive ape society: Social structure and dominance hierarchy analyses at Chimpanzee Sanctuary Northwest. *JAKE A. FUNKHOUSER, JESSICA A. MAYHEW and JOHN B. MULCAHY. Central Washington University.

Background: Captive sanctuary settings are a novel arena for investigations of primate social networks and behavioral flexibility. Gaining a greater understanding of captive chimpanzees can be useful in advising management practices and contribute to evolutionary hypotheses of primate sociality through captive-wild comparisons. **Methods:** This study investigated the social structure and dominance hierarchy of seven chimpanzees (*Pan troglodytes*) at Chimpanzee Sanctuary Northwest, WA. We used focal-animal and instantaneous scan sampling to collect 108.5 hours of associative, affiliative, and agonistic data from June to September 2016. Data were analyzed in SOCPROG, UCINET, and R (Perc) to derive dominance hierarchies and network statistics for the chimpanzee group. However, the nature of captivity makes it difficult to separate the chimpanzee and human social networks. For this reason, these same analyses were then conducted including caregiver interactions to explore humans' effect on the chimpanzee network. **Results:** Based on agonistic data, one chimpanzee emerged as most dominant and least connected across all social networks. However, this individual becomes connected to other chimpanzees through the addition of human caregivers. **Conclusion:** The results indicate that (1) human caregivers may occupy more central positions within captive chimpanzee social

structures than previously assumed and (2) conventional methods using single behavioral measures, particularly agonism, to assess dominance hierarchy may be inadequate to wholly depict social systems in captive sanctuary populations.

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Non-specific indicators of stress in a non-adult burial from the community of Homoródszentmárton, Transylvania. *MARGARET FURTNER, *XIE YISHAN and JONATHAN BETHARD. DePauw University, University of South Florida.

Background: Many different physical markers can be identified on the bones of the skull as non-specific indicators of stress during lifetime. Porotic hyperostosis, endocranial lesions, cribra orbitalia, and hyperporosity all have a wide range of etiologies, such as anemia, vitamin deficiency, and diseases such as scurvy—and while some are often found in conjunction to one another, it is possible that these different indicators are the result of distinct processes caused by multiple stressors. **Methods:** We examined burial 22 at the site of Homoródszentmárton in Transylvania—a juvenile aged between one and two years of age with a fairly complete skull. We noted and described instances of stress indicators on each skull bone, recording their location, stage of activity, and level of coalescence of foramina in order to better understand the child's various stressors during life. **Results:** Porotic hyperostosis on the ectocranial surface, as well as endocranial lesions, were quite noticeable on the subject's parietal bones. Both stress indicators were active and unhealed, with slight coalescence of foramina, indicating the stress was ongoing at the time of death. Active cribra orbitalia and hyperporosity were also found along the orbits and on most of the cranial and facial bones. **Conclusion:** The multiple stress indicators found on Burial 22 may be related, but it is possible that certain indicators were caused by separate stressors, or a combination of stressors, such as anemia, nutritional deficiency, traumatic injury, or meningitis. Because all of the stress markers were active, they may be linked to the cause of death. However, without additional historic evidence and further research exploring non-specific stress indicators, it is difficult to claim an exact cause of death.

Bark vs. bite: An assessment of dominance hierarchies using different agonistic behaviors in a Kinda x Grayfooted Chacma (Papio kindae x Papio ursinus griseipes) Hybrid Group in Kafue National Park, Zambia. *KYLEN GARTLAND, CRICKETTE SANZ and MONICA MCDONALD. Washington University in St. Louis.

Background: David's Score has frequently been used to calculate dominance hierarchies in primates. In doing so, researchers have either used displacements or general agonism for their calculations. Displacements, defined as an individual moving within 2 meters of another individual and supplanting that individual within 5 seconds, are only a subset of the total agonism that may be observed in a group. **Methods:** To consider the implications of

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choosing one measurement over the other, we calculated a dominance hierarchy using only displacements and compared it to social rankings based on overall agonism. We collected a total of 158 hours of 10-minute continuous focal follows on 13 adult males in a kinda-chacma baboon hybrid group in Kafue National Park, Zambia. We used instances of male-male (1) displacements (74 instances) and (2) total agonism (109 instances) to calculate David's scores for each male. A Mantel test was then used to determine if there was a significant correlation between the two matrices used in the David's Score analyses. **Results:** Results of the two David's Score analyses revealed that six of the individuals maintained their dominance rank across both calculations. Although there was high degree of consistency between matrices, we found that ranks assigned by displacement versus total agonism differed within middle to low ranking males with most individuals shifting up or down by one rank position. **Conclusion:** We found that while the most dominant individuals remained consistent across analyses, the inconsistency observed in middle to low ranking individuals suggests a degree of fluidity in hierarchical structure. This would also suggest that constructing a linear dominance hierarchy would require interactions between and consideration of multiple measurements of dominance. Future research will be aimed at further examining patterns and context of aggression within this hybrid group.

Variation in tetrapod pisiform ossification. *LIA GAVAZZI, PHILIP RENO and KELSEY KJOSNESS. The Pennsylvania State University.

Background: The mammalian pisiform and calcaneus are the only carpals and tarsals to form a growth plate. Humans have lost the pisiform growth plate, while the calcaneus is expanded and maintains an active growth plate. It is an open question if the presence of these growth plates is a derived mammalian trait or a plesiomorphy shared with other tetrapod lineages. **Methods:** The ossification of the pisiform of alligators, lizards, newts, and mice were compared using a micro-CT and histological analysis. Specimens were scanned on a GE v|tome|x L 300 high-resolution microfocus CT system and subsequently analyzed with Avizo 8.1. Pisiform ossification was visualized in histological sections using safranin O and periodic shiff staining to distinguish cartilage and bone. **Results:** We observe a combination of subperiosteal and oriented subchondral surfaces during pisiform development in non-mammalian tetrapods such as the alligator. This is similar to the patterns observed in the mammalian pisiform during growth plate formation and distinct from carpals that do not form growth plates. **Conclusion:** These observations suggest that complex ossification of the pisiform and calcaneus may have occurred early in tetrapod evolution. These data will be crucial for evaluating the evolutionary and developmental context of ossification of other mammals with derived pisiforms in the family Xenarthra and lorisine primates that are phenotypically similar to humans.

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Comparing post-mortem and osteological measures of primate 2D:4D digit ratios. *ENRIQUE GOMEZ, JOSIE BEAVERS and FRANCES WHITE. University of Oregon.

Background: The ratio of the length of the second to the fourth digit is related to prenatal hormone exposure, specifically testosterone. Prenatal gonadal hormone levels determine the second to fourth digit ratio (2D:4D). A lower 2D:4D ratio indicates higher levels of prenatal androgen exposure, and a higher ratio indicates lower levels. Digit length is typically measured from the proximal crease to the most distal end of the digit in living and post-mortem individuals. However, post-mortem processes such as desiccation or decomposition can affect both landmark identification and accuracy of the measure. Digit length can also be measured on osteological specimens, but there is little information on how these measures compare to post-mortem measures. This study compares different post-mortem measurements with osteological measurements taken on the same specimens. **Methods:** Post-mortem measures were made on fully fleshed and skinned primate hands and compared to measures based on disarticulated and articulated phalangeal bones on a total of 10 hands of eight primate species. We determined whether digit flexion (i.e. flattened palm or curled digits) yielded significantly different 2D:4D ratios. **Results:** Our findings indicate that the 2D:4D measurements obtained in all flattened measurements closely correlated (r= 0.997 - 0.999), but the measurements obtained from the curled and mummified hands were not as closely correlated (r= 0.962 - 0.982). **Conclusion:** These results suggest that 2D:4D measurements on articulated bones are the most closely correlated to the fully fleshed 2D:4D measurement.

Building a methodological and interpretative framework for generating an "isotopic profile" to enhance identification of forensic cases. *DASIA GREEN, *TIMOTHY MARK STEWART, MONET WATSON and RHONDA QUINN. Seton Hall University.

Background: Stable isotopic methodologies have been applied to various tissues of human remains in forensic contexts for the purposes of individuation. The utility of each isotopic system for inferring geographic origins and movement, diet specialty or mixing, and aspects of health depends on several variables encompassing questions of what exactly the isotopic system reveals with respect to specific tissues, what time periods in an individual's life are averaged with isotopic analyses of specific tissues, and what resolution is possible within geographic and cultural landscapes. As with many methodologies, wholesale use of forensic isotopes can lead to oversimplification of data and erroneous interpretation(s). **Methods:** In this study, we review isotopic systems (e.g., δ13C, δ18O, δ15N, 87Sr/86Sr) measured from one or more tissues including bone, dentin, enamel, and hair and commonly applied to forensic contexts in the US. **Results:** We build a series of templates for interpretation drawing from literature, discuss error for each method in data generation and conversion. **Conclusion:** From these templates we propose future research projects to improve resolution for forensic applications. We also examine the potential utility and resolution of each method with respect to the identification of foreign-born individuals.

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A Transylvanian case study in non-specific stress: Marefalva, Sir-11. *MAURA K. GRIFFITH, *JESSICA FILIPELI, ANDRE GONCIAR, NYÁRÁDI ZSOLT and JONATHAN BETHARD. Trinity College, University of South Florida.

Background: The people of medieval Transylvania experienced consistent cultural turmoil as a result of invasion and changes in land ownership from the 11th to 16th centuries. First and foremost, this study brings focus to the Carpathian Basin as a complex region for study in the field of bioarchaeology. The analysis conducted aims to establish a connection between the sociopolitical struggle of individuals in this region, and non-specific indicators of stress. **Methods:** During the 2016 field season, the remains of one individual from Marefalva, Transylvania, Romania were analyzed using Standards (Buikstra et al. 1995). Age and sex were determined using the pubic symphysis, auricular surface, and teeth. The time of linear enamel hypoplasia formation was calculated using regression equations in Goodman and Rose (1990). Factors leading to the presentation of cribra orbitalia were examined using Walker et al. (2009). Stature was determined using Trotter (1970), using a combination of humeral and femoral measurements. **Results:** The results indicate a female between the ages of 16 and 19 at the time of death. Between the ages of 2 and 6, she experienced four interruptions in enamel production, resulting in linear enamel hypoplasia. Significant cribra orbitalia is present and can indicate several pathologies. Neither of these pathologies seem to have affected the stature of the individual, her stature was comparable to populations from the same region (Sládek et al., 2015). **Conclusion:** While the indicators cannot imply any one affliction, in combination, they can be used to make inferences about her environment.

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Investigating the impact of ingested microbes on chimpanzee gut microbiome composition. *MONICA GUARDADO, EMILY DAVENPORT and GEORGE PERRY. The Pennsylvania State University.

Background: The composition of gut microbiomes in animals plays a critical role in digestion and metabolism. Because it is largely influenced by the external environment, especially diet, the microbiome is plastic and capable of adapting to its host's lifestyle. Dietary nutritional components are known to influence gut microbiome composition, but the extent to which ingested microbes are incorporated into the host microbiome has yet to be determined. **Methods:** The microbiomes in fecal samples (n = 23) of wild chimpanzees and the microbiomes of termites (n = 6) from the same region in Tanzania were evaluated. The 16S rRNA V4 region was sequenced to a depth of approximately 10,000 reads per chimpanzee fecal sample and 12,000 reads per termite sample using Illumina's MiSeq platform. . Sequences were then processed and analyzed using QIIME software to compare microbial species profiles between the chimpanzee and termite samples. **Results:** In order to determine if the termite microbiome has been incorporated into the chimpanzee's digestive system, the bacterial taxa that are not common to chimpanzees,

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but common to termites must be identified. The taxa shared between chimpanzee stool samples and termite samples will be compared to a publicly available chimpanzee microbiome database in order to distinguish the termite microbes from chimpanzee microbes. **Conclusion:** A microbiome reflecting the integration of cellulose-digesting microbes from termites would confer a metabolic advantage to the chimpanzee host. The incorporation of cellulose digesting microbes could result in improved energy extraction from its largely plant-based diet.

Copper staining as an indicator of grave inclusions in medieval Transylvanian cemeteries. *ELIZABETH GUNDERSON and *ALEXANDRA MCKENZIE. University of Washington.

Background: Two cemeteries, Bogoz and Telekfalva, located in the modern day Transylvanian region of Romania have turned up multiple remains with green copper staining. This sort of staining on bones is a documented phenomenon that can be used to better understand burial practices. **Methods:** We examined two sets of juveniles remains dated to the 17th century; one recovered from Bogoz and one from Telekfalva. We documented the patterns of staining found on the skulls of these individual. We also utilized records taken on other remains from the sites as well as ethnographic accounts of burial customs from the area. **Results:** We found that both sets of remains had staining indicating that copper was in direct contact with the bone. The staining was concentrated on the temporals, parietals, and frontal bones of both skulls - which is consistent with funerary headbands. The presence of copper close to the skull also appears to have aided in preservation of hair, notably on the temporal bone. **Conclusion:** We found that copper staining in the patterns observed on these remains are characteristic of the funerary headbands used in medieval Transylvania, which provides insight into juvenile funerary practices and artefact assemblages, even if the headband itself is no longer present. Future research could yield a larger sample size that could aid in the certainty of our conclusions.

An evolutionary analysis of gender and reproduction in Latter-Day Saints. *CLAIRE HANSON, *AMANDA COOK and NANDA GROW. Utah State University.

Background: The members of the Latter-Day Saints (LDS) faith are urged to marry young and reproduce frequently. This can be seen in the young average age of first marriage and the average amount of children per household. **Methods:** We used a stratified random sample of LDS and non-LDS college students and recent graduates in Logan, UT (n=64) and College Station, Texas (n=19). These data were collected through an online survey (Qualtrics), consisting of 46 questions about demographics, reproductive behaviors, and life satisfaction. **Results:** Our current results suggest that LDS students and recent graduates are more likely to be married than non-LDS survey respondents; 66% of LDS respondents (n=38) were married, compared to 1% of non-LDS respondents (n=33) and 17% of former LDS respondents (n=12). Of the married respondents, the average age of first marriage was 21 years for females and 25 years for males. Male LDS respondents were less likely to report satisfaction with family life than females, including number of

children (11% of males were dissatisfied or extremely dissatisfied, while 0% of females were). **Conclusion:** We found a positive correlation between affiliation with the LDS faith and age of first marriage and reproduction. We also found differences in age of marriage and family and professional life satisfaction between male and female LDS survey respondents, indicating that females place more importance on earlier reproduction.

Funding: Partial funding from USU Anthropology Department

Defining the relationship between primate seasonal breeding and climate instability. *MARGARITA HERNANDEZ and JAMES PAMPUSH. University of Florida.

Background: Seasonal breeding in mammals is a product of many environmental and social factors. These factors include day and night cycles, caloric intake, food availability, and climate variables. Food intake, which is perhaps the most important factor in breeding for females, is largely dependent on environmental cues. Among these include rainfall, humidity, and temperature. The work conducted for this project is intended to be a case study investigating how rainfall might potentially affect breeding seasons in primates specifically. **Methods:** Information on primate breeding was obtained from The Pictorial Guide to the Living Primates by Noel Rowe. Data was collected for 118 primates. Several species of primates had information about birthing seasons. This was interpreted to mean that, at some point during the year, there must have been a breeding season as well, and therefore were considered seasonal breeders for the study. Their localities were taken from Rowe's book and used to gather climate records regarding maximum and minimum rainfall. The numbers were collected using The World Bank Group: Climate Change Knowledge Portal based on monthly temperature and rainfall averages between 1960 and 1990. If primate localities spanned over a large range, rainfall data was taken from a central area within the entire range. Averages were used to determine ranges of rainfall and the ratio between minimums and maximums respectively. Primate climates were considered unstable if the ratio of the minimum over maximum was 0.1 or below. Analyses were run on BayesTraits under a Bayesian framework using 1000 phylogenies. Independent and dependent runs under 10,000,000 iterations were conducted. Ancestral state reconstructions were run on Mesquite. **Results:** The ancestral state reconstruction for this project slightly favors a seasonally breeding ancestor. The Strepsirrhini clade exhibits seasonal breeding for all of its taxa, and therefore most likely had a seasonal breeding ancestor. This suggests that breeding season, as a behavior, has a genetic component instead of only being influenced by environmental cues. The harmonic means for the independent and dependent runs on BayesTraits were analyzed by inputting them in the likelihood ratio equation: Likelihood ratio = 2(log likelihood (better-fitted model) – log likelihood (worse-fitted model)) The harmonic mean for the dependent model was a better fit for the data, therefore it was used for the first portion of the equation with the independent model used in the second half. The likelihood ratio for both models was 13.354. This number was inputted into a chi-squared distribution along with 4 degrees of freedom. From this a p-value of 0.00967 was

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obtained. These results show a significant correlation between unstable climates and seasonal breeding in primates. **Conclusion:** This study aims to investigate the relationship between primate seasonal breeding and climate instability. From these results, we can conclude that primate seasonal breeding is correlated with unstable climates. However, a genetic mechanism for seasonal breeding cannot be dismissed. Future work will be conducted to provide better rainfall estimates as well as consider other factors that may affect food availability.

Investigating sexual dimorphism in supraorbital ridge development: A two-dimensional geometric morphometric study. *SIERRA T. HIGGINSON and MIRANDA E. KARBAN. Illinois College.

Background: The supraorbital ridge, or brow ridge, is the bony ridge located just above the eye orbits in modern humans. Many studies assume that cranial shape differences, including supraorbital ridge differences, can be used to differentiate between male and female crania. Some other recent studies, however, have been unable to identify significant sexual dimorphism in cranial shape. The purpose of this study is to investigate cranial and frontal bone ontogeny in a longitudinal extant human sample. **Methods:** Lateral cephalograms from 28 Iowa Facial Growth Study subjects (14 males, 14 females) were measured. Subjects were represented at four longitudinal age groups, spanning 5.0 – 17.1 years. Ten landmarks and 7 sliding semi-landmarks were digitized along the midsagittal plane for each cephalogram. Relative Warp Analysis was used to explore variation, both in overall cranial shape, as well as in frontal bone shape, at each age group. Differences between male and female shape were further investigated using Discriminant Function Analysis and Kruskal-Wallis tests. **Results:** Although significant cranial shape differences between males and females were expected at the oldest age group, no significant sexual dimorphism was found at any of the sampled age groups. Similar results were found when analyzing overall cranial shape, as well as when focusing only on frontal bone shape. While some males had visibly robust supraorbital ridges, other males in the sample fell within the female range of variation. **Conclusion:** These results support recent studies which show that significant differences in cranial shape do not exist between males and females. Future research is needed to study the role of allometry and size differences.

Diet and behavior among Bedouin from the Ottoman-period cemetery of Tell el-Hesi using stable carbon and nitrogen isotopes. *BRITTNEY HIGHLAND, *ERIKA DANELLA, LESLEY GREGORICKA and JAIME ULLINGER. University of South Alabama.

Background: There is a lack of work focused on detailing the diets of Ottoman-period Bedouin communities. Skeletons recovered from the Bedouin cemetery of Tell el-Hesi (CE 1400-1800), located in modern day Israel, provided an opportunity to learn more about the past dietary practices of historic Bedouin from the region. **Methods:** Excellent skeletal preservation of the skeletons permitted the analysis of stable carbon and nitrogen isotopes from rib bone collagen for a subsection of adults (n=9) and subadults (n=6). Bone samples were demineralized with a diluted hydrochloric acid, then soaked in sodium hydroxide to remove organic

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containments. Samples were then freeze-dried, and analyzed on an isotope ratio mass spectrophotometer. **Results:** Adult mean ^{13}C values (-17.8±0.8‰) suggest that these communities consumed a mixed C3-C4 diet comparable to those of contemporaneous ovicaprids (-17.5±1.3‰). Relatively depleted subadult ^{13}C values (-15.9±1.5‰) correspondingly indicate that children consumed more C4-based resources – possibly associated with weaning practices involving the use of ^{13}C-enriched camel's milk or a C4-favored childhood diet – although no statistically significant difference between adult and subadult values was noted (Mann-Whitney U: U=33.5; z=-0.71; p=0.24). Adult mean ^{15}N values (9.7±1.1‰) were lower than expected given the predicted reliance of these groups on animal protein, and were just 1.1‰ higher than the faunal mean. Subadult ^{15}N values (10.1±1.3‰) were not significantly different (U=31.5; z=-0.47;p=0.32) from that of adults. **Conclusion:** Carbon isotope values may point to either the passive consumption of at least some C4 resources (via animal primary and/or secondary products) or the active incorporation of C4 domesticates such as millet into human diet. Nitrogen isotope values (indicative of less protein consumption than expected) may fit with ethnohistoric accounts of Bedouin subsistence practices during the Ottoman period, which consisted of both pastoralism and small-scale cultivation or trade for agricultural products. The elevated nitrogen isotope mean of subadults relative to adults is likely reflective of the trophic level effects associated with breastfeeding.

Funding: This research was funded by the University of South Alabama Support and Development Award.

Diachronic perspectives on human diet variation in Greek, Roman, and medieval Albania. *RACHEL N. HORTON, LAURIE J. REITSEMA, BRITNEY KYLE and EDUARD SHEHI. University of Georgia.

Background: Carbon and nitrogen stable isotope analysis of skeletal remains offers information about past human diet, which may be unavailable or incomplete in historical accounts. **Methods:** We assess carbon (δ13C) and nitrogen (δ15N) stable isotope ratios from human bone collagen to interpret paleodiet from two sites in present-day Albania: a rural village neighboring the Greek colony Apollonia (~5th-4th century BC) (n=11) and a more urban settlement, Durres (n=30), occupied since its foundation (7th century BC) to modern day. Four animal bones are used for comparison. We test the null hypotheses that there are no isotopic differences between sites during the Archaic-Hellenistic period, no differences between time periods at Durres, and no differences between sexes in individual sites or periods. **Results:** Mean (±SD) δ13C and δ15N values are -18.7±1.3 and 9.1±1.6 respectively at Durres, -19.4±1.0 and 9.8±1.3 at Apollonia, and -20.9±1.0 and 6.7±1.5 among animals. Nonparametric Kruskal-Wallis tests show no significant sex-based differences at Durres (δ15N, p=0.201; δ13C, p=0.227), no differences between sites (δ15N, p=0.815; δ13C, p=0.212), and no differences between Durres time periods (δ15N, p=0.299; δ13C, p=0.426). **Conclusion:** Diet at both sites comprises terrestrial and marine protein. Two individuals at Durres show isotopic values similar to fauna, suggesting a vegan diet. Apollonian village data show potential intrasite variations, suggesting some individuals may have originated from another region or cultural background.

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Funding: This research was supported by the University of Georgia's Center for Undergraduate Research Opportunities Research Assistantship and the Georgia Museum of Natural History's Joshua Laerm Academic Support Award.

Analysis of capitate proportions of humans and chimpanzees: Implications for hominid hand evolution. *NAOMI JOHNSON and MARISA MARCIAS. Washington University in St. Louis, American Museum of Natural History.

Background: Modern human hands are often considered to be an extremely unique feature to *H. sapiens* because they afford humans the complex ability to manipulate objects – specifically stone tools. Despite the apparent importance of the human manipulation of stone tools, and therefore the human in human history, some research shows that human hand proportions may be a pleomorphic trait. **Methods:** Samples of 157 human and 65 chimpanzee capitates were measured for capitate proportions. In addition, the capitate proportions of AL2881 (*A. afarensis*) and MH2 (*A. sediba*) were analyzed as well. Photographs of the capitates were taken and their proportions were measured using an image processing program (Imagej). The ratio of the total capitate length and the length of the dorsal capitate head was calculated for the samples. Ratio: (capitate length/dorsal articular surface length) **Results:** The chimpanzee and human samples were determined to be significantly different from each other. A t-test between the dorsal capitate ratios of the human and chimpanzee samples yielded a result of 9.20075E-12 indicating a strong significant difference between the samples. Our research found that chimpanzees have a lower dorsal ratio than humans meaning that chimpanzees have a larger articular surface on the capitate head relative to the length of the capitate. However, within the range of the samples there is still a substantial amount of overlap in the dorsal capitate ratio due to variation in the samples. The average ratio for humans was found to be 2.31 while the average ratio for chimpanzees was 1.91. In addition, the ratio for AL2881 was found to be 2.86 and the ratio for MH2 was found to be 2.35. **Conclusion:** AL2881 and MH2 dorsal capitate ratios were firmly in the range of human. This is consistent with other findings that these hominins have hand proportions that are more similar to modern humans than to chimpanzees. Our results may support findings of past research which shows that hand proportions that are similar to modern humans may be an ancestral trait as opposed and that chimpanzees have a more derived hand structure. (Almécija et al. 2015).

Fecal glucocorticoids and aggressive behavior among rhesus macaque females. *MANDY M. JORDAN and JENNIFER DANZY CRAMER. American Public University System.

Background: Rhesus macaque females are subject to physical harassment (i.e., hitting, biting) and non-physical harassment (i.e., displacement) from males as well as from other females. Rhesus macaques engage in more aggression during the mating season, presumably stressing individuals who receive aggression. **Methods:** In this study, we examined the relationship between fecal glucocorticoid (fGC) levels and aggressive behavior in a free-ranging population of female rhesus macaques. We selected 10 females from Group S on Cayo Santiago,

ranging in age from 6 to 21 years. We collected fecal samples to measure fGC levels for each of the ten females and recorded behavioral observations over a three month period during the mating season. **Results:** We predicted that fGC levels would be positively related to rates of physical aggression and to rates of non-physical aggression received by focal females. Our results show the rate of displacements was negatively correlated with lower fGC levels (r=-.58; p=.08). fGC levels were unrelated to rates of physical aggression(r=-.40, p=.25). **Conclusion:** Our results demonstrate a trend opposite from our prediction. Females who received a high rate of displacements had lower fGC levels than females who were rarely displaced. fGC was unrelated to the rate of physical aggression received by females. Additional study is needed to investigate this finding further. One limitation of this study if small sample size. A larger sample size is needed to confirm and examine this relationship more closely. A next step for this project is to examine repeated measures in these females over time to more closely analyze the negative trend between fGC and displacement rate.

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Stress levels in relation to food restriction in captive *Papio ursinus*. *MARY E. KESTER, TODD. R YOKLEY, JILL E. SCOTT and KALEN MEINE. Metropolitan State University of Denver.

Background: Knowledge of situational stress among captive primates is useful for establishing protocols for zoos, sanctuaries, and rehabilitation centers. This project tests the hypothesis that food restriction in captive primates elevates stress as measured by cortisol levels. **Methods:** Cortisol levels were measured in thirteen juvenile chacma baboons (*Papio ursinus*) at Riverside Wildlife Rehabilitation Centre, Letsitele, South Africa, over a period of five days. Subjects were randomly separated into two groups. Group A was separated and "deprived" of food for three hours, while Group B was fed at normal feeding time. Saliva, which has been shown to be the least invasive cortisol collection technique for juvenile primates, was collected by encouraging the baboons to chew on cotton swabs coated with Tang crystals. These procedures were followed for a five-day assay period with separation, feeding, and sampling taking place at the same time every day with initial "base" readings taken on the first day before separation. **Results:** Cortisol levels were measured using an EIA test kit. Differences in cortisol levels were tested using four parameter logistic regression (4PL) and a basic paired t-test. Cortisol levels were significantly elevated ($p = 0.0158$) from control values in the group exposed to feeding restrictions (Group A), while cortisol levels in the control group (Group B) exhibited no significant changes ($p = 0.2139$) over the same assay interval. **Conclusion:** These discrepancies suggest that lack of food is a significant stress inducer for captive *Papio ursinus*, although supplementary stress from separation, overcrowding and ordinal rank could also play a role. Further and more in-depth research needs to be conducted to

understand fluctuations of cortisol based stressed in relation to food deprivation.

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Testing hypotheses for the embryonic origins of primate neocortical expansion. *ANJANA KRISHNAMURTHY, ANDREW C. HALLEY and TERRENCE W. DEACON. University of California, Berkeley.

Background: A central question in primate brain evolution concerns the developmental mechanisms responsible for primate neocortical expansion. Developmental models have proposed that larger neocortices result from larger embryonic neural progenitor pools in either (1) the ventricular zone (VZ; radial unit hypothesis), or (2) the subventricular zone (SVZ; intermediate progenitor hypothesis). **Methods:** We tested these hypotheses using a comparative dataset containing embryos from eight primate (n=34) and eight non-primate mammalian species (n=57). We examined the relative volume of embryonic ventricles – a proposed correlate of the role of the VZ in neocortical expansion. Embryos were reconstructed from microscopic photography of sectioned tissue in museum collections, sorted according to an interspecies staging system (Carnegie Staging), and measures of embryonic brain and ventricle volume were calculated by measuring areas of interest across serial sections along the axis of dissection (Cavalieri method). **Results:** We present evidence that during early neurodevelopment, species with larger adult brains also exhibit larger embryonic ventricles relative to brain volume. Although primates have disproportionately larger neocortices, we found no evidence for a difference between primates and non-primates once adult brain size is accounted for. **Conclusion:** Our findings suggest that while an expansion of progenitors in the VZ plays a role in the regular scaling of brain areas (including larger neocortices in larger brains), neocortical expansion in primates may rely on an increase in progenitors in proliferative regions further from the ventricular wall, such as the SVZ.

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Guess who?: A bio-demographic profile of Northern Kentucky University's human skull collection. *MEGAN MARSHALL, *MICHAYLA LUSTENBERG and MONICA WAKEFIELD. Northern Kentucky University.

Background: In the Laboratory of Anthropology at Northern Kentucky University, there is a small collection of NAGPRA compliant human remains, which include 16 human skulls. We decided to do an osteological profile on the collection to uncover if perhaps, we had a collection with similar ages, sex, and geography ancestry. **Methods:** To estimate age at death we used ectocranial suture closure (Menidl and Lovejoy 1985) and 10 of the 17 cranial suture closures sites proposed by Buikstra and Ubelaker (1994). To diagnose sex of the individuals, we examined six features of the skull - nuchal crest, mastoid process, supraorbital margin, supraorbital ridge, mental eminence and ramus of the mandible, we scaled them from 1-5 with 1 being the minimal expression of the trait and 5 being the maximal expression. When determining

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the geographic ancestry of the skulls in our collection, we primarily focused on the shape of the cranium itself and the height and breadth of the nasal and orbital openings. **Results:** Due to the sample size of our collection, there is no significant statistical evidence, however, we have a majority of middle- aged males with primarily Asian ancestry traits. The collection contains a few outliers being younger, older, female, and of different or mixed ancestry than the majority. **Conclusion:** Although our results did support our hypothesis, more research is required for our data to be significant. Human bone variation could affect the data we have collected and without adequate records of the skulls, it is improbable to determine their geographic ancestry through these preliminary methods for certain. In the future, with more advanced methods and technology a more detailed profile could be ascertained.

Varied arch index as a result of childhood footwear. *ALEXANDRA L.C. MARTIN, STEVEN G. LAUTZENHEISER, ELEN M. FEUERRIEGEL and PATRICIA A. KRAMER. University of Washington.

Background: The modern human foot, with its pronounced longitudinal arch and suite of derived morphologies, evolved in an unshod context on natural substrates. Today, unshod populations are uncommon, and the majority of modern humans walk shod on artificial substrates. The unshod populations that do exist today typically have wider feet than do western populations, but western populations have a more variable longitudinal arch index. **Methods:** Participants (56 women, 19 men, mean age: 24±7.2 years) were asked about their footwear, both in childhood (<18 years) and adulthood (>18 years), to classify those who wore rigid/supportive shoes throughout development and those who were frequently unshod or wore unsupportive shoes. Participant footprints were captured using a RSscan pressure plate in three stances: (i) static double stance; (ii) static single stance; and (iii) dynamic. Arch indices (the ratio of difference between mid-foot and total foot area) were then calculated for each participant and multiple regression with Bonferroni correction used to determine if childhood footwear predicted adult arch index. **Results:** The results indicate that childhood footwear does not predict adult arch index (all p-values > 0.05). **Conclusion:** The implications of these results are that longitudinal arch index variability in western populations is not determined by childhood footwear choice. Further research is required to shed light on this phenomenon.

Hair cortisol measurement and relationships with growth among Amazonian Shuar children. *TIGEST MEQUANINT, GEETA EICK, SAMUEL S. URLACHER, LAWRENCE S. SUGIYAMA and J. JOSH SNODGRASS. University of Oregon.

Background: Cortisol is a widely-used biomarker of chronic stress. Measurement of cortisol from hair allows assessment of cumulative concentrations of cortisol, and therefore stress, over a period of months. The aim of this research was to establish reference levels of hair cortisol in Shuar children and to examine relationships between cortisol and growth parameters. **Methods:** Hair samples, anthropometric dimensions, and immune function data were collected from Shuar participants (3-19 years old) in Amazonian Ecuador in 2012. At least 3 cm of hair was cut

from the posterior vertex of the scalp using surgical scissors (to represent the prior 3 months of cortisol accumulation given human hair growth of ~1 cm/month), was taped to a piece of paper, and was stored in foil pouches at room temperature. Cortisol was extracted from hair samples using a modified version of the method of Meyer et al. (2014) and assayed in duplicate using Salimetrics ELISA kits for free cortisol. **Results:** This project reports modifications to an existing protocol to extract cortisol from human hair (Meyer at al., 2014). Of the 16/82 hair samples assayed to date (10 males, 6 females; all 82 samples will be analyzed in time for the meeting), 9 (56%) had cortisol levels below the limit of detection of the ELISA assay. The mean cortisol concertation for the 7 samples with detectable cortisol concentrations (4 males, 3 females) was 1.93 pg/mg, while the range was 0.13 – 5.19 pg/mg. While the present sample size was too small for statistical analyses, there appeared to be a negative association between height and cortisol level, with the highest measured cortisol level found in the shortest individual among the 16 individuals we evaluated. Furthermore, 6 of the 9 samples with cortisol levels below the limit of detection of the assay were the tallest individuals in the 16 samples we evaluated. **Conclusion:** Hair cortisol levels were high enough to be reliably measured in roughly half of the Shuar children we have evaluated thus far. Cortisol levels in Shuar children were within the range reported by a previous study that measured hair cortisol in 270 Dutch schoolchildren after removal of exogenous cortisol by isopropanol washing [mean, 3.37 pg/mg, range 0.28 – 38.26 pg/mg, Vliegenthart et al., 2016]. Levels, however, were much lower than reported in previous studies that did not wash hair samples before cortisol extraction (e.g. mean level in 42 Dutch children aged 4 years was 27.5 pg/mg – Groeneveld et al., 2013; mean level in 363 Danish children aged 4-7 years was 92 pg/mg, Larsen et al., 2016). These results indicate that washing of hair to remove exogenous cortisol is critical to obtain accurate estimates of physiological cortisol concentrations, and that mean hair cortisol concentrations in Shuar children are generally lower than those reported previously for Western populations. These results are consistent with the generally low levels of salivary cortisol that we have previously measured in the Shuar. We are currently processing and measuring cortisol levels in the remaining 66 hair samples collected during the 2012 field season. These data will allow statistical testing of our hypothesis that growth is negatively related to chronic stress as reflected by elevated hair cortisol levels.

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Tuberculosis and leprosy cross-immunity hypothesis: Considering the potential role of other Mycobacterial species. *HALEIGH MITCHELL, JACOB WHITE, MEGAN DUNCANSON and FABIAN CRESPO. University of Louisville.

Background: Leprosy declined as an infectious disease in Western Europe after the 13th century and one hypothesis suggests cross immunity exists between *Mycobacterium leprae* and *M. tuberculosis*, the pathogen associated with tuberculosis (TB) infection. Recent observations show co-infection between leprosy and tuberculosis is

rare in contemporary populations; with few cases documenting exposure to one Mycobacterium species provides humans some degree of immunity to other species; making harder to accept the proposed hypothesis of full pathogen interaction. However, it was proposed that other mycobacterial species, such as *M. bovis*, played a role and should be taken into consideration when testing the cross-immunity hypothesis. The main objective of our study is to re-visit the cross-immunity hypothesis between *M. tuberculosis* and *M. leprae* studying the expression of key proteins (TNFα and IFNγ) involved in the human immune response against both pathogens when considering the potential role of exposure to other mycobacterial species such as *M. bovis* and *M. smegmatis*. **Methods:** We developed experimental in vitro protocols to improve our understanding of how exposure to one Mycobacterium species (whole lysate or bacterial antigens) can generate a shift in the immune response that could affect the immune response to another species. During our two-day experiment, we exposed human peripheral blood mononuclear cells (PBMCs) from healthy donors to either *M. bovis* or *M. smegmatis* or *M. tuberculosis* on day one; sequentially on day two, we exposed the same cells to *M. leprae* lysate. The expression of TNFα and IFNγ was measured by enzyme-linked immunosorbent assay (ELISA). **Results:** Interestingly, when compare with corresponding controls, our preliminary results showed similar levels of IFNγ expression when PBMCs were exposed to *M. leprae* (day 2) after earlier exposure (day 1) either to *M. bovis* or *M. smegmatis* or *M. tuberculosis*. Moreover, TNFα expression showed the highest level when early exposure to *M. bovis*. **Conclusion:** These in vitro preliminary results suggest that early exposure to other mycobacterial species (such as *M. bovis* or *M. smegmatis*) can prime the cellular immune response, and potentially play a role on leprosy-TB disease interaction. As future direction in this project, we propose new experimental protocols that will include different stimuli and to consider the polarized immune status in leprosy.

A search for significance: spatial analysis of demographic and health markers in Tirup Cemetery. *GRACE MORGAN. George Mason University.

Background: Tirup was a Medieval Danish cemetery that was in use for over 250 years (approximately 1050-1350 AD), and had over 600 burials. This churchyard is a rare find in that it is a fully archaeologically excavated cemetery from a rural community population, and all the skeletal data is available for analysis.The goal of my research is to answer the question: Is there spatial structuring in Tirup cemetery based on age, sex, and health markers? **Methods:** This research is being conducted using SatScanTM to identify statistically significant clustering within the cemetery. Age and Sex are the first demographic features used to find significant clusters. Signs of physiological stress (cribra orbitalia and linear enamel hypoplasia) are used as covariates of the demographic features. SatScanTM gives the coordinates and radius of a significant cluster with-in the cemetery. A graph of the cemetery is made with the cluster (outlined by a circle) drawn over top. The significant clusters are analyzed with-in the context of burial practices of the time. **Results:** This research is ongoing. Our initial analysis shows that there is spatial

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organization in Tirup based on age and sex. Children were clustered in the cemetery close to the church foundations, while adults were more dispersed. There was less differentiation by sex than was expected, with the exception of one significant cluster of males. **Conclusion:** The next step in our research is to combine the demographic data with the stress markers to see if there is significant spatial organization related to health. The expected outcomes of this research will be to find significance in the way Tirup Cemetery was organized, and to identify health and disease patterns.

Funding: This research is supported by a URSP grant through OSCAR at George Mason University.

The effects of cage size in captivity on physical activity levels in *Propithecus coquereli*. *DANIELLE R. ORLANDI, *MARK M. MCGOWAN, ROSHNA E. WUNDERLICH and ANTHONY TONGEN. James Madison University.

Background: The extent to which captive environments allow primates to have physically similar experiences to wild primates is important to primate health, captive primate husbandry, and to experimental research on captive primates. The purpose of this experiment was to assess similarity of locomotor activity and energy expenditure in lemurs in caged enclosures and natural habitat enclosures (NHE's) at the Duke Lemur Center (DLC) to those in the wild. Accelerometry can be used not only to quantify activity but also to identify specific locomotor patterns and as a proxy for energy expenditure during animal movement. **Methods:** Using a custom-designed datalogger attached to the backs of two *Propithecus coquereli* (Pc), we collected three-dimensional acceleration for 4 hours on each of 2 days in 2 settings: 1) Indoor-outdoor cages at the DLC (4 indoor cages 10'H x 7.5'W x 7'L per cage and 4 outdoor cages, 10'H x 7.5-11.5'W x 14'L), and 2) NHE (1.5-14 acres) in the Duke forest. We used continuous focal animal sampling to ground-truth the data. We quantified number of leaps and overall dynamic body acceleration (ODBA) for each period of measurement and compared these data to data of wild *Propithecus verreauxi* at Beza Mahafaly Special Reserve in southwest Madagascar. **Results:** Our preliminary results illustrate considerable variability in leap count and ODBA depending on time of day, age of subject and activity. Our preliminary results cannot reject the hypothesis that *Propithecus* in captive environments exhibit similar locomotor patterns and similar ODBA to *Propithecus* in the wild. **Conclusion:** he preliminary results of this study suggest that lemurs in the captive enclosures studied here display locomotor behaviors and energy expenditure commensurate to those of lemurs in the wild. Nevertheless, there is considerable variability across animals, time of day, and activity that needs to be addressed methodically and with additional data collection. We also demonstrate the effectiveness of accelerometry as a tool for analyzing locomotor behavior and energy expenditure in captive and wild primates.

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The influence of diet on $^{87}Sr/^{86}Sr$ ratio differences in archaeological human enamel measured by TIMS and LA-ICP-MS. *MICHELLE PRIZZI and RHONDA QUINN. Seton Hall University.

Background: Strontium isotopic ($^{87}Sr/^{86}Sr$) methods have been used to infer place of origin and mobility of past human populations across geologic substrates. The promise of precise and accurate stable isotopic data from human tooth enamel by laser ablation (LA)-ICP-MS has been presented for some time to researchers who want to avoid destruction of irreplaceable specimens spanning fossil and forensic contexts. There is debate, however, about the reliability of LA-ICPMS for analyzing human enamel from archaeological and paleontological contexts. **Methods:** Here we test congruency between $^{87}Sr/^{86}Sr$ ratios measured by the traditionally used column chemistry/TIMS and LA-ICP-MS of human enamel from two skeletal samples derived from regions with similar geologic substrates. The Harris Creek samples are from a middle Archaic burial mound in the St. Johns River Valley of Florida. The Mayan samples are from two sites in the Central Lowlands, La Sufricaya and Holmol, and range from Classic to Post-Classic Periods. **Results:** Our results show matching $^{87}Sr/^{86}Sr$ ratios from the Harris Creek samples and significantly offset $^{87}Sr/^{86}Sr$ ratios in the Mayan samples. We do not interpret differential diagenesis or the span of available $^{87}Sr/^{86}Sr$ ratios from geological bedrocks as main influences of these results. Rather the extremely high biogenic Sr concentrations in the Harris Creek samples reduced the effects of interfering isotopes. The Mayan samples in contrast yielded biogenic Sr concentrations that were too low for reliable $^{87}Sr/^{86}Sr$ detection. **Conclusion:** We interpret that the overall pattern is largely the result of Harris Creek inhabitants ingesting different foods than the Mayan individuals.

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Trabecular symmetry in the primate temporomandibular joint. *PATRICIA RAMOS, CLAIRE E. TERHUNE, ADAM D. SYLVESTER and ANDREA B. TAYLOR. University of Arkansas.

Background: The loading environment of the temporomandibular joint (TMJ) varies in relation to feeding behavior, pathological conditions, and between working and balancing sides. Since bony morphology responds to these forces via bone functional adaptation (i.e., Wolff's Law), both external and internal structure of the joint should vary in relation to these factors. **Methods:** We examine microCT scans of 12 sooty mangabey (*Cercocebus atys*, 6 male/6 female) crania, which show varying severity of osteoarthritis. We assess trabecular architecture by using sliding semilandmarks to locate multiple VOIs across the condylar articular surface, and quantify trabecular architecture (e.g., thickness, spacing, anisotropy, and bone volume fraction) in each VOI using BoneJ. **Results:** Results indicate that, although there are differences between left and right sides within an individual, there is no consistent pattern of differences in trabecular properties across the sample. However, individuals with signs of TMJ osteoarthritis show more variability in our measures of trabecular architecture between left and right condyles. **Conclusion:** These results indicate that loading environment may differ between left and

right sides more substantially for pathological individuals than for those unaffected by pathology of the TMJ. These findings have implications for further understanding bone plasticity outside of variation related to feeding behavior.

The evolution of childbirth and the rise of elective cesarean sections. *EMALINE REYES, KAREN ROSENBERG and WENDA TREVATHAN. University of Delaware.

Background: Cesarean sections, or surgical delivery of an infant, are often performed to save the life of the mother, child, or both. However, they are also performed for non-medical reasons and carry risks of their own. The WHO recommends a target rate cesarean section should be 12-15%. Despite this recommendation, many countries (Brazil, Italy, Mexico) report cesarean section rates above 36%. These high rates are often attributed to elective cesarean sections. **Methods:** I examined the literature on this topic to understand the motivation for women requesting cesarean sections. These concerns must be addressed in order to reduce the rates of unnecessary cesarean sections and improve the health of mothers and infants worldwide. **Results:** We found that many women reported fear and anxiety in their decision to seek a cesarean section. These feelings reflect the ancient adaptation to childbirth risks of seeking assistance during delivery, increasing the likelihood of a successful delivery. With the medicalization of birth, women's emotional needs are neglected and behavior that was once adaptive is now the primary motivator for electing cesarean sections. **Conclusion:** Addressing laboring women's fear and anxiety may help to decrease the chances that they would elect a cesarean section. Using simple "low-tech" methods, such as providing women with social and emotional support, we can provide low-risk alternatives to surgical interventions.

Quantifying developmental stress using growth lines in teeth. *JENIFER RICHARDS and HEATHER J.H. EDGAR. The University of New Mexico.

Background: Currently, there is not a good, standard method to measure developmental stress using teeth in a way that allows mass study, instead of tediously measuring 1 or 2 teeth at a time. My mentor and I set out to develop an easier and quicker way to study growth in teeth. **Methods:** After collecting clean, non-modern human teeth, the teeth are then photographed using a white light, 150x microscope. These images are spliced together in Photoshop and the visible perikymata are then measured using the program ImageJ. Using these measurements, it is then possible to track growth cycles and disturbances in said cycles. **Results:** This research has shown that it is possible to measure growth in teeth using simple, easy to reproduce methods that allow for rapid and mass study of samples. This method does not work on modern teeth, however, due to modern hygiene methods that smooth over the perikymata and effectively eliminate the growth lines from the surface of the tooth. **Conclusion:** In conclusion, this method of study is far more productive than previous methods for studying perikymata in teeth. The ideal magnification sits around 100x, with a range up to 150x depending on how visible the actual perikymata are on the tooth. This method of study will be further developed to improve consistency.

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Age estimation using cranial suture closure methods on a modern population. *NATALIE RIVELLO. Youngstown State University.

Background: The use of cranial suture closures as a method of age estimation in forensic anthropology began as early as the 16th century. Although this method has been utilized for hundreds of years, recent tests have shown that ectocranial sutures are not as accurate as once believed. **Methods:** Data was collected on a modern sample from North East Ohio during autopsy of both males and females, ranging in age from early twenties to fifty-five and older. A combined method of several researchers, including Meindel and Lovejoy and Todd and Lyon, were used to rank the sutures on a scale from 0-3 and then enter them into a composite scoring chart to obtain an estimated age range. **Results:** With the data collected thus far, this research proposal has been yielding negative results, consistent with Khndare, Bhise, Shinde (2015), and Kumar (2012). The suture closures have been erratic and inconsistent, showing that ectocranial suture closures are not an accurate method to estimate the age of modern individuals in North East Ohio. **Conclusion:** In conclusion, this research is consistent with findings of studies stating that ectocranial sutures should not be used as a method of age estimation.

Are metacarpals a handy indicators of sex? The applicability of metacarpal metrics in sex determination. *KASHIQUE A.S. ROBINSON, TRACY K. BETSINGER, JAMIE M. ULLINGER and DANIELLA R. TARQUINIO. SUNY Oneonta.

Background: Metacarpal metrics have been shown to be a useful alternative for sex determination when the pelvis and skull are not available. However, the accuracy of these methods has not been fully researched or tested. **Methods:** A sample of 804 metacarpals from 169 individuals of known sex, from 19th century St. Bride's Church, London, were measured. A maximum of six measurements were taken from each metacarpal using digital sliding calipers and a mini osteometric board. Regression equations from two previous studies (Case and Ross, Khanpetch et al.) were assessed for their accuracy in correctly determining sex. **Results:** The Case-Ross equation could be applied to 26 individuals; results provided a maximum accuracy rate of 83% for males and 74% for females. These results were similar to the 80% overall accuracy Case and Ross found in their study. The sex of 67 burials could be predicted using the Khanpetch equation, resulting in a maximum accuracy rate of 48% for males and 0% for females. These results are very different from the results Khanpetch and colleagues found in their study; they found a maximum accuracy rate of 89.8%. **Conclusion:** This study found greater accuracy of metcarpals in predicting sex for males than females; however, the regression equations may not be equally applicable to all samples. Whenever possible, an equation developed from a sample that is similar to the unknown sample should be used. Future research includes assessing the accuracy of additional regression equations. Additionally, a regression equation will be developed based on the samples used in this study.

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Assessing cytosine methylation of LINE1 and NR3C1 across multiple human tissues: Implications for paleoepigenetics. *SANA SABOOWALA, RICK SMITH and DEBORAH BOLNICK. University of Texas at Austin.

Background: Paleoepigenetics is an emerging area of ancient DNA research that reconstructs chemical modifications to DNA obtained from ancient or extinct organisms. Like most ancient DNA work, paleoepigenetics research is often limited to the analysis of teeth and bone, which are more often preserved in the archaeological record than soft tissues. Because patterns of DNA methylation can differ between tissues, it is important to assess how methylation in archaeologically available tissues like bone compares to tissues that are more widely studied in living humans, such as buccal cells or blood. The objective of this study is to assess the relationship between methylation patterns in teeth, buccal cells, blood, and hair for two loci of interest: LINE1 and NR3C1. **Methods:** DNA was extracted from molars, buccal cells, blood, and hair obtained from two individuals. DNA extracts were bisulfite converted using three protocols (Qiagen Epi-Tect Fast, Zymo Gold, and Zymo Lightning) and DNA yield was evaluated. Methylation patterns were determined for 4 CpGs in human LINE1 elements and 5 CpGs in the promoter region of NR3C1 using PCR amplification and pyrosequencing. Methylation patterns were compared between tissues using linear regression analysis. **Results:** We found that methylation patterns in LINE1 and NR3C1 are strongly correlated ($R>0.9$) between teeth, buccal cells, blood, and hair. **Conclusion:** LINE1 and NR3C1 methylation patterns are tissue-independent, suggesting that patterns obtained from archaeologically available tissues (teeth and sometimes hair) are likely to reflect methylation patterns in tissues that have been more widely studied in living humans (buccal cells, blood, and hair).

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Engaging in combat: Interpersonal violence in the ancient Greek colony, Himera. *CAITLIN B. SAWYER, BRITNEY KYLE, NORMA LONOCE, STEFANO VASSALLO, PIER F. FABBRI and LAURIE J. REITSEMA. University of Central Florida, University of Northern Colorado.

Background: We investigate skeletal trauma among individuals in mass graves killed at the Greek colony of Himera during two ancient battles (480 BCE and 409 BCE). **Methods:** Sex and age distributions were compared between the two battles, with more variation expected in the later battle. Type, severity, and timing of trauma were recorded based on The Global History of Health Data Collection Codebook. **Results:** All skeletons from both battles were identified as male. Young individuals were more numerous in the first battle, and greater variation in age was observed in the second battle, but these differences were not statistically significant (Kolmogorov-Smirnov $p>0.05$). Interestingly, no trauma was observed in the 409 BCE battle. **Conclusion:** More antemortem and perimortem trauma in the first battle suggests that the trained Greek soldiers and mercenaries in the first battle sustained more physical trauma during the battle and in

previous battles than the potential civilians who died in the second battle. Further analysis of soldier and civilian burials is needed to understand the extent of trauma within both populations.

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Premature and trauma-induced sutural fusion in a protohistoric cranium. *PINA SIMONE, *CORTNEY CONNOR, REBECCA JABBOUR and GARY RICHARDS. University of California Berkeley, University of Pacific.

Background: This study examines a cranium from protohistoric California with shape changes driven by premature lambdoidal-sagittal fusion and trauma-induced partial coronal suture fusion. Among premature sutural fusions, lambdoidal-sagittal fusions are particularly rare. We assess cranial shape and blood flow patterns, their impact on brain development, and possible neurocognitive impacts. **Methods:** This individual (male, ≈25-30 y) derives from California site CA-Lak-203 (≥1500 CE). Normal crania from prehistoric California (n=10) and modern crania with lambdoidal-sagittal and multisutural fusions (n=5) were employed for comparisons. Individuals were CT scanned (0.3-mm isotropic voxels). Bone surfaces were visualized and the endocranial surface reconstructed with Amira. **Results:** Given the extent of deformation, the lambdoidal and sagittal sutures were obliterated during early postnatal development. A trauma-induced depression on the coronal suture is associated with remodeled fractures. The trauma resulted in a partial coronal suture fusion during late infancy-early childhood. Remaining sutures are patent. Craniofacial shape differs from that in premature lambdoidal-sagittal or multisutural fusions. Partial coronal suture fusion contributes to a large supraglabellar depression, a convex midface, anterolaterally placed zygomatics, and an anteroinferior elongation of the face. Increased intracranial pressure and restricted venous outflow, with shunting to emissary veins, likely induced neurological damage during growth, resulting in mild-to-severe neurophysiological defects. Further, a shallow posterior cranial fossa suggests a Chiari I malformation, which could lead to central sleep apnea and syringomyelia. **Conclusion:** Difficulties faced by families caring for individuals with such extreme morphologies and neurophysiological deficits must have been magnified in prehistoric-protohistoric contexts and may relate to their rarity in the archaeological record.

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The small but healthy hypothesis: Evidence of skeletal stress and adaptation in Himera, Sicily. *TESSA J SMITH, BRITNEY KYLE and LAURIE J. REITSEMA. University of Northern Colorado.

Background: This research will look at the "small but healthy" hypothesis in Himera, Sicily. Generally, skeletons with more markers of physiological stress (paleopathology) and shorter stature (stunted individuals) are interpreted as being less "healthy." However, some argue that

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being shorter does not automatically imply poor health. **Methods:** This study will test the "small but healthy" hypothesis by analyzing a sample size of 14 individuals from Himera, Sicily (six females and eight males) that were measured for height and also observed for various pathologies including cribra orbitalia, porotic hyperostosis, periostitis, and linear enamel hypoplasia. **Results:** All individuals, regardless of whether they were tall or short, showed evidence of at least one skeletal pathology. No clear differences were observed in skeletal pathology between tall and short individuals. We did not observe any statistically significant differences in level of skeletal pathology between tall and short individuals. **Conclusion:** The "small but healthy" hypothesis encourages researchers to look at short stature as a potential adaptation to environmental stressors. Shorter stature could mean that the individual would need less fuel to survive and the "small but healthy" hypothesis suggests that in areas with limited resources, an individual might be shorter to allow for a better chance of survival. Although this appears to support the small but healthy hypothesis, a larger sample size is needed to truly test this hypothesis.

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Sex differences in enamel hypoplasia and dental caries in the Tepe Hissar skeletal sample in periods of extreme stress. *ANISSA SPEAKMAN. University of Delaware.

Background: Health status is, in part, a reflection of social status. In many societies females display greater prevalence of caries than males, suggesting poorer dental health. However, no clear pattern has been established for sex differences in linear enamel hypoplasia (LEH) an independent indicator of stress. I explore sex differences in LEH and dental caries at the prehistoric Tepe Hissar site (north-eastern Central Iranian Plateau). I examine sex differences in stress and the different life experiences of men and women through time. **Methods:** 75 individuals from Tepe Hissar were macroscopically analyzed for LEH, carious lesions, and abscesses, and dental measurements were taken (crown height, bucco-lingual length and mesio-distal length) following the standards for Buikstra and Ubelaker (1994). **Results:** 41.5% of females (N=41) displayed at least one carious lesion, while the percentage of males (N = 33) was 39.4% (not statistically significant according to a two-population proportion test). 65.9% of the females had at least one LEH, while the percentage of males was 33.3% (statistically significant). Males and females had similar average ages for LEH development on canines and molars. **Conclusion:** These data illustrate more LEH in females, indicating that males may have been favored, even during periods of stress. This conclusion is corroborated by higher rates of tooth loss and osteoporosis in females. This finding helps us to understand the relationship between stress indicators, sex, and societal status.

Assembling a winning army: Strontium isotope analysis of local and non-local soldiers from the ancient Greek battles of Himera (480 BCE, 409 BCE). *JULIANNE R. STAMER, KATHERINE L. REINBERGER, BRITNEY KYLE, PIER FRANCESCO

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FABBRI, STEFANO VASSALLO and LAURIE J. REITSEMA. The Ohio State University, University of Georgia.

Background: Herodotus writes of two ancient battles fought at the Greek colony of Himera in Sicily between Greek and Carthaginian forces. He tells us that the Battle of 480 BCE was won by the Greeks who assembled a coalition of allied and mercenary soldiers from other regions; however, the Greeks lost just 71 years later because they had little time to prepare and relied on citizen soldiers to defend the city. **Methods:** We analyze strontium isotope ratios of human tooth enamel from 29 individuals recovered from mass graves associated with the two battles, to distinguish "local" soldiers from "non-locals" and compare them across battle contexts. We compare human values to those of four faunal enamel specimens (pig, sheep, and dog) and three shells representing baseline 87Sr/86Sr values for Himera. Non-local humans are designated as those whose 87Sr/86Sr ratios are outside one standard deviation of the mean of the faunal baseline. **Results:** Results show more non-local soldiers in the 480 BCE mass graves (n=17; 81%) than in the 409 BCE mass graves (n=1; 14%), supporting historical accounts. **Conclusion:** We find that during the Battle of 480 BCE soldiers from mainland Greece, elsewhere on Sicily, and possibly other Mediterranean regions, bolstered the army and contributed to a Greek victory. In addition we can see that the Greeks, lacking support from other Greek cities and allies, lost the Battle of 409 BCE.

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Dental morphology and human evolution: An analysis of the *Homo naledi* dentition.
*TYLER CHRISTIAN THOMPSON, LUCAS DELEZENE and MATTHEW SKINNER. University of Arkansas.

Background: First described in 2015, the skeletal remains in the Dinaledi chamber of Rising Star cave represent one of the largest single hominin assemblages ever discovered in Africa, and have been assigned to a novel species: *Homo naledi*. The morphology of the mandibular first premolar (P3) was used as evidence for its species designation, however shape quantification was excluded, leaving a gap of objective data supporting the taxonomic diagnosis. **Methods:** Well preserved P3 crowns representing early Homo (n=9), African H. erectus (n=9), A. afarensis (n=6), *A. africanus* (n=12), *P. robustus* (n=14), *P. aethiopicus/boisei* (n=5) , unassigned Hominin (n=3), and *H. naledi* (n=4) were compared using a combination of traditional morphometrics and 2D geometric morphometrics. Data were collected from occlusal photographs and screenshots of micro-CT scans. Absolute occlusal area, as well as relative protoconid, metaconid, and talonid areas were compared. In addition, four homologous points (protoconid and metaconid apices and both mesial and distal foveae) and forty sliding semilandmarks placed on the crown perimeter were used to record crown shape variation. Crown size and relative crown areas were compared using randomization tests and P3 shape variation was analyzed using a generalized procrustes analysis. **Results:** The relative talonid area of the *H. naledi* P3 is significantly larger than that of *H. ergaster* ($p<0.05$) but is

not statistically different from that of any other hominin groups; however, measurements of absolute occlusal area reveal that the *H. naledi* P3 is significantly smaller than that of all other hominins in this study. *H. naledi* premolars are uniform in shape and plot near each other and away from other taxa in the procrustes analysis. **Conclusion:** The P3 crown shape of *Homo naledi* is morphologically distinct from other hominins, combining small crown size with a relatively broad talonid.

Funding: This research was funded by a $2,750 grant awarded by the Arkansas Department of Higher Education through the Student Undergraduate Research Fellowship (SURF) program.

Investigating the genetic basis for hominoid taillessness. *SAMANTHA TICKEY, HANNA WEGENER and HOLLY DUNSWORTH. University of Rhode Island.

Background: How did hominoid tail loss occur? Our goals are to test phylogenetic and adaptive hypotheses for tail length variation among macaques, and use those insights to reconstruct the evolution of hominoid taillessness. Further, we aim to ultimately uncover which candidate genes or pathways may be responsible for catarrhine tail loss and what other traits may be affected by these developmental and genetic pathways. **Methods:** We looked to published catarrhine vertebral counts and phylogenies in the literature. We also collected data from 94 *Macaca* and *Papio* individuals in the collections at the American Museum of Natural History. Based on known mechanisms of tail formation in embryos, we identified the genes that might be responsible for the interruption of tail development. We took these candidates to the annotated whole genomes of catarrhine primates and used a comparative approach across 10 taxa. **Results:** Regarding the skeletal data, there appears to be a pattern where tail length variation is determined by factors of 3-4 caudal vertebrae, suggesting a segmental basis for the genetic factors involved. Our preliminary genomic analyses indicate that comparing candidate genes is valuable but is only a first step because cis-regulatory elements associated with these genes are likely to be significantly involved in taillessness. **Conclusion:** Investigating the developmental and genetic bases of tail variation among *Macaca* holds great promise for reconstructing the evolutionary history of hominoid taillessness and its consequences. Future studies continuing to probe whole genomes and the expansion of available primate genomes will make this possible.

Funding: University of Rhode Island, College of Arts and Sciences

Examining the osteological paradox: Frailty in mass graves versus the general population at the Greek colony of Himera. *JANELLE TYLER, BRITNEY KYLE, APRIL SMITH, STEFANO VASSALO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA. The Ohio State University, University of Northern Colorado.

Background: My project is looking at the skeletal stress markers of two populations of Himera, a general population (648-409 BCE), and a population of individuals who died in the 480 and 409 BCE battles of Himera. Being that the general population died of natural causes while the mass grave population died from trauma due to war, the research examines if one population had higher

amounts of frailty than the other, and if these findings will support or reject the osteological paradox. **Methods:** 173 individuals, (mass grave n=64; general population n=109) were examined macroscopically for four skeletal stress indicators, cribra orbitalia, porotic hyperostosis, linear enamel hypoplasia, and periostitis. If any lesions were observed, it was marked down on a numbered scale that related to the severity of such lesion. Once all the data was sorted chi-square analysis were preformed to see if any results were statistically significant. **Results:** The results showed that individuals from the general population overall were more frail than those from the mass grave population. The general population had statistically more linear enamel hypoplasia ($p<0.001$) and periostitis ($p=0.01$) than the mass grave individuals, while no statistically significant difference was seen in cribra orbitalia and porotic hyperostosis. **Conclusion:** This research supports the hypothesis that stressful experiences during life lead to greater frailty and risk of mortality. Those who died of natural causes (general population) had higher amounts of frailty than those who died of trauma due to war (mass grave population). These findings counteract what is thought of in the osteological paradox, which states that individuals with higher amounts of skeletal stress markers might experience lower rates of frailty, because the high prevalence of stress markers show that the individual was able to survive what disease or stressful event plagued them, instead of perishing before any sign of stress could be seen on the skeleton. These results indicate that the two populations might have had similar access to nutrients, but might have differed in their exposure to certain infectious environments.

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Limb joint degenerative joint disease prevalence in German populations from the Little Ice Age (AD 1300-1850). *ELEANOR WADDLE, *KENDRA WEINRICH and LESLIE LEA WILLIAMS. Beloit College.

Background: The Little Ice Age (LIA) was characterized by changing environmental stresses, impacting populations across northern Europe. . To understand the effect of these stresses on human activity patterns, we investigated differences in prevalence of Degenerative Joint Disease (DJD) in limb joints between pre-peak LIA (AD 800-1500) and peak LIA (AD 1500-1850). **Methods:** Global History of Health (GHHP) Standards were used to score DJD in individuals with at least one observable bone in a joint system. We then calculated DJD prevalence in upper and lower limbs, prevalence of moderate/severe DJD (GHHP categories 3-4), and age specific prevalence for adults. **Results:** DJD prevalence in both the upper limb (pre-peak LIA: 87.5% (28/32); peak LIA: 72.4% (63/87) likelihood ratio, $p > 0.05$) and lower limb (pre-peak LIA: 93.3% (28/30); Peak LIA: 78.4% (76/97); likelihood ratio, $p = 0.049$) decreased between pre-peak and peak LIA. Though not statistically significant, this pattern was reversed for moderate to severe DJD of the upper and lower limbs. When examining prevalence by age, moderate to severe DJD increases from the pre-peak LIA to the peak LIA across all age categories in

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both the upper (Pre-peak LIA: 0.0% (0/32); Peak LIA: 2.3% (2/87); likelihood ratio, $p > 0.05$) and lower limbs (Pre-peak LIA: 3.3% (1/30); Peak LIA: 7.2% (7/97); likelihood ratio, $p > 0.05$). **Conclusion:** These results highlight the complex relationships between environmental factors, activity patterns, and DJD prevalence in the Little Ice Age. While there are no plans for future research, there is potential for further study of these concepts.

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Prevalence of degenerative joint disease and Schmorl's nodes in Little Ice Age German populations. *KENDRA WEINRICH, *ELEANOR WADDLE and LESLIE LEA WILLIAMS. Beloit College.

Background: Skeletal markers of vertebral osteoarthritis, including osteophytosis, eburnation, and joint surface porosity, are commonly used to reconstruct population activity patterns. **Methods:** The cervical, thoracic, and lumbar vertebrae of three medieval and post-medieval German populations were analyzed to determine the prevalence and severity of degenerative joint disease (DJD) and Schmorl's nodes during the apex of the Little Ice Age (AD 1500-1850). We assess whether activity patterns intensified during this phase of climate related resource scarcity, hypothesizing that the prevalence of degenerative joint disease and Schmorl's nodes will increase in comparison to earlier periods (AD 800-1500). Vertebral bodies were scored according to Global History of Health Project Standards; Schmorl's nodes were quantified by individual. **Results:** Thirty-four individuals from the pre-peak LIA and 90 individuals from the peak LIA had vertebrae present for analysis. The prevalence of vertebral DJD decreases from the pre-peak LIA (50%) to the peak LIA (44.4%). This pattern is maintained through all adult age categories: younger adult (pre-peak LIA: 36.4% (4/11); peak LIA 33.3% (5/15)), middle adult (pre-peak LIA 81.8%, (9/11); peak LIA 59.1% (13/22)), and older adult (pre-peak LIA 75% (3/4); peak LIA 75% (12/16)). None of these differences were statistically significant. Schmorl's node prevalence (pre-peak LIA: 36.4% (12/33), peak LIA: 41.1% (37/90)) increased between the two time periods, though these differences also were not statistically significant. **Conclusion:** Therefore, our data do not support our hypothesis and suggest a more intricate relationship between activity patterns and the resource stresses of the LIA than previously thought.

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Analysis of growth disruptions in two burial populations in the Greek colony of Himera. *ABDUL H. ZAHID, BRITNEY KYLE, NORMA LONOCE, APRIL SMITH, STEFANO VASSALLO, PIER FRANCESCO FABBRI and LAURIE J. REITSEMA. University of California, Berkeley, University of Northern Colorado.

Background: This study examines growth disruption between individuals buried in two different styles, flexed and supine, at the Greek colony of Himera (Sicily, Italy, 648-409 BCE). Individuals buried in different styles

may have had different cultural affiliations, and thus may vary in their lived experiences, including stress and health. **Methods:** At Himera, flexed burials are theorized to represent local Sicilians, and supine burials are theorized to represent non-local Greeks. However, since this is unconfirmed, we test the null hypothesis that flexed and supine graves will show equal prevalence of growth disruption, as evidenced by linear enamel hypoplasia (LEH) and stunted growth at Himera, to determine if skeletal stress varies in groups with different cultural affiliations. LEH was scored following standards outlined in The Global Health Project Data Collection Codebook. Average stature was calculated using multiple stature regression formulae. Individuals were scored for the presence of growth disruption, as well as the severity of observed growth disruptions. **Results:** Analysis of growth disruptions in flexed and supine burials showed no significant differences between the two groups ($X2= 1.37$, $p= 0.24$). Males and females in both groups also displayed nearly identical prevalence of LEH ($X2 = 0.04$, $p= 0.84$). **Conclusion:** These findings support the null hypothesis, and tentatively suggest that Himerans and non-local Greeks had similar life experiences, regardless of their preferred burial style. Alternatively, cultural buffering and/or catch-up growth could explain similar prevalence of growth disruption despite different levels of stress experienced during life. Future research can provide more insight into inter- and intra-population differences in observed growth disruptions, and provide greater insight into differences in lived experiences.

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