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ABSTRACTS

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Aging processes in chimpanzees (*Pan troglodytes*), one of our closest living relatives, are crucial to contextualize the evolution of human health and longevity. Cardiovascular disease is a major source of mortality in humans, and therefore a key issue for comparative research. Current data indicates that compared to humans, chimpanzees have high blood lipids—an important risk factor for heart disease in humans. However, most work to date on cardiac health in chimpanzees has examined laboratory populations, and lifestyle is an important factor shaping cardiac health in humans. We therefore examined wild-born chimpanzees living in two African sanctuaries, as these populations consume a more naturalistic diet, range in large forested enclosures, and experience species-typical social groups. We measured body weight and blood lipids in these sanctuary-living chimpanzees (N=75) and compared them to data from laboratory-living chimpanzees (N=471, from the Primate Aging Database). We found that semi-free-ranging chimpanzees exhibited lower body weight (linear mixed models account for age and sex: $n=9117$ observations, $X^2=77.11$, $p<0.0001$), total cholesterol ($n=5586$, $X^2=52.81$, $p<0.0001$), and triglycerides ($n=5360$, $X^2=12.11$, $p<0.001$). We further investigated body fat (skinfold thickness) and inflammation (hsCRP and IL-6) in the sanctuary chimpanzees and found these measures to be lower than previously published values from laboratory-living populations. As in human groups characterized by high levels of physical activity, chimpanzees from African sanctuaries maintained healthy cardiovascular profiles across the lifespan. Our findings support the hypothesis that lifestyle can shape health indices in chimpanzees during aging and provide a new evolutionary framework for understanding human cardiovascular health.

This study was funded by the National Institute on Aging of the National Institutes of Health (Award 1R01AG049395-01).

Quantifying the emergence of sexually dimorphic traits using Walker (2008) and evaluating method performance in subadult sex estimation

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At present, little is known regarding the ontogeny of the five traits used in the Walker (2008) method or at what age the method can be reliably applied. The aim of the current study is to evaluate the

performance of Walker (2008) in 301 modern subadults ($f=136$; $m=165$) aged 8 to 21 years using MSCT postmortem scans. Significant differences in trait score frequencies between subadult males and subadult females were first detected by 13 years. With few exceptions, trait score frequencies for subadult males were similar to those observed in adult males by 17 years, suggesting skull "masculinization" is complete by this age. Classification accuracies for all six Walker (2008) equations showed a strong female sex bias in the youngest individuals. As age increased, accuracies changed to favor male classification, which is consistent with validation studies using adults. Recalibration of the equations using the subadult sample improved classification accuracies, however strong sex biases towards female classification in the youngest subadults and towards male classification in the older subadults remained. The results of this research illustrate that sex differences in trait expression are present and trait frequencies comparable to those of adults are reached prior to adulthood. Subsequently, cranial traits commonly used in adult sex estimation could be applied with confidence in forensic and bioarchaeological situations involving subadults of specific ages. This study refutes the claim that distinctive sexually dimorphic features are absent in subadults and demonstrates their potential contribution to, and subsequent improvement of, the subadult biological profile.

This research was funded in part by NIJ grant 2015-DN-BX-K409: Development of Modern Subadult Standards: Improved Age and Sex Estimation in US Forensic Practice.

Climate change and conflict: patterns, processes, prospects

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Concern is growing among policy-makers that the current bout of anthropogenic climate change will increase conflict within and among human societies. For example, the European Commission recently advised that climate change will intensify social and political tensions, leading to more conflict. Similar statements have been issued by the United Nation's Intergovernmental Panel on Climate Change and the US Department of Defense in the last few years. But how well supported is the hypothesis that climate change increases conflict levels? In this paper, we review research on the relationship between climate change and conflict that has been published over the last two decades. We show that the situation is considerably more complex than the aforementioned warnings suggest. To begin with, it appears that key climatic variables can impact conflict levels in opposing ways. For example, there is evidence that increasing temperature

fuels conflict but increasing aridity suppresses conflict. A further complexity is that the impact of climatic variables on conflict is mediated by region such that a given variable can have a significant impact in one region but not in another. Lastly, there is reason to think that even in cases where a particular climatic variable appears to have increased conflict in more than one region, the "linking mechanisms" are not the same. In the final section of the paper, we outline what we think are the implications of these findings for policy and for future research on the topic.

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A geometric morphometric comparison of shape and integration indices in captive and wild *Macaca fascicularis* postcrania

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The effects of captivity, particularly diet in captivity, on the craniofacial structure of primates and other mammals is well documented. However, relatively few studies have examined the effects of captivity on the postcranium. Here, we perform postcranial shape analyses and evaluate indices of integration in samples of wild-caught and captive biomedical *Macaca fascicularis*. Anatomical landmark data were collected on 3D surface scans of the femur, os coxa, tibia, scapula, humerus, and radius. After Procrustes superimposition, standard shape analyses (Principal Components, Canonical Variates and Discriminant Function Analysis) were performed. Integration was quantified using the Integration Coefficient of Variation (ICV), and distributions of ICV values were generated via a resampling protocol. Statistical comparison between ICV distributions for captive and wild individuals were performed using a Mann-Whitney U test with Bonferroni correction.

Apart from the humerus, all skeletal elements present significantly different integration values in wild vs. biomedical samples, pointing to differences in covariance structure between the two groups. In particular, captive individuals tended to be more integrated than wild. Further, all shape analyses showed significant distinctions between captive and wild individuals. While still significant, the least effective morphological distinction was, likewise, with the humerus. Overall, however, these results suggest that captive and wild individuals can indeed present significant differences in morphology and integration, and that caution should be used when constructing samples of

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either or both. Further study is required, however, to assess what systematic effects captivity has on skeletal covariance structure in non-human primates.

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Exploring age related changes in cortical bone in individuals over 50 using radiographs

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Accurate age estimation is an important tool in both reducing the candidate pool for individual identification and for reconstructing the demographic parameters of past populations. In this study, we explored the relationship between the bone volume ratio (MV:BV) using linear measures of medullary cavity breadth and cortical bone thickness at three areas of the femoral shaft as a proxy for age. In addition, we document changes in shaft shape with age using a Generalized Procrustes Analysis (GPA). Digital radiographs of 164 non-pathological left femora from the Texas State University Donated Skeletal Collection (TXSTDSC) were taken and analyzed. The results of this study indicate that the overall MV:BV is moderately correlated with age ($r=0.38$) and that this relationship is stronger in females ($r=0.49$) versus males ($r=0.28$). The GPA revealed that there is site specific bone remodeling with consistent rates of cortical bone loss throughout the aging process with slightly different patterns for males and females. The most significant changes in shape are along the anterior and posterior sides of the bone at midshaft. These results reinforce previous findings that cortical bone thinning is correlated with age and that there are areas of the femur that are more affected by this process than others. The findings of this study have the potential to be applied in both forensic and bioarchaeological settings for individual identification and paleodemographic reconstructions, respectively.

Annular binding in a cranium from Mississippi County, Arkansas: what does this practice tell us about identity?

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Shawnee Village is a Late Prehistoric site with little published archaeological information. A single adult male skull from the site was acquired by Thomas Gilcrease (1890-1962) and was part of his collection when it became the nucleus of the Thomas Gilcrease Institute in Tulsa, Oklahoma. This adult male may have served to illustrate a rare intentional modification of vault shape.

Parallelo-fronto-occipital, annular, and, more recently, pseudocircular binding are not well-differentiated in the literature, and they are difficult to quantify using standard craniometric techniques.

Parasagittal contours of the cranium and the endocast are constructed using a cubic cranio-phor. This skull is remarkably symmetrical in the concave modification of the frontal and the flattened, elevated nuchal region. Suture closure and complexity in this example are not unusual. There is periosteal reaction between the temporal lines, and there are several small destructive lesions in this tissue that suggest trauma or infection. Dental wear is light given the sutural age, reflecting extensive caries and tooth loss. Another unusual feature is a mandibular supernumerary premolar.

Annular binding deformation is unusual in the context of other crania from the Southeast, and it is one of the features that links the Southeast to Mesoamerica. A brief review of this literature is presented.

Socioecological Predictors of Health Profiles in Western Lowland Gorillas

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Socioecological factors are linked to health outcomes, overall health profiles, and disease transmission in primates. Due to their close phylogenetic relatedness to humans, great apes are particularly susceptible to anthropogenic disease infection. Infectious diseases have been documented in wild gorilla populations that have manifested varying patterns of disease prevalence potentially attributable to differences in social groupings and patterns of intergroup contact. We assessed a suite of potential socioecological predictors of health incidences across four groups of western lowland gorilla (*Gorilla gorilla gorilla*) in the northern Republic of Congo. A total 17,951 observational health assessments were conducted during daily follows in the Goulougo and Djeke Triangles from August 2015 to July 2019. While overall presence of disease was relatively low, we detected several respiratory episodes and chronic health issues within the focal population. We observed an average of 9.81 incidences/month (2.6% of total observation days) for respiratory illness and an average of 21.29 incidences/month (5.7% of total observation days) for other incidences associated with declining health profiles across all groups. We suggest there is a correlation between the presence of respiratory illness with other indications

of altered health profiles. Based on the observed dynamics of disease spread, we discuss probable mechanisms of transmission within and between groups. Further, we suggest that identification of the specific predictors and modes of disease transmission can be used to mitigate some specific health risks. Recommendations for best practices and management protocols are presented as they relate to improving health profiles in gorillas.

Arcus Foundation, Cincinnati Zoo, Indianapolis Zoo, Houston Zoo, Columbus Zoological Park, Nouabale-Ndoki Foundation, U.S. Fish and Wildlife Service

Hormonal correlates of biparental care in owl monkeys (*Aotus azarae*)

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This study utilizes a pair-living and sexually monogamous primate, the owl monkey (*Aotus azarae*), as a model to increase our understanding of the role of males and females in societies that are characterized by pair-bonding and biparental care. We quantified variation in hormones across three distinct reproductive periods (mating, gestation, and infant care) to examine physiological mechanisms owl monkeys may have evolved to facilitate high levels of paternal care and mating competition in both sexes. Specifically, we utilized fecal cortisol as a proxy for evaluating energetic demands during reproductive periods, and fecal androgens to evaluate a potential trade-off in investment between mating and parenting effort. We collected ~1150 fecal samples from 26 identified wild adult owl monkeys (13 males, 13 females) in 2011-2015 at the Owl Monkey Project site in Formosa, Argentina. Enzyme immunoassays indicated that females' mean cortisol concentrations during the gestation period (221 ± 51 ng) were double those of the infant care period (98 ± 25 ng), and almost triple those of males' during the gestation period (78 ± 18 ng). Males and females had similar levels in the two other reproductive periods. Males' mean fecal androgen concentrations were similar to, or lower than, females' in all three reproductive periods. The largest difference was during the infant care period when males' levels were a third of those of females (126 ± 68 vs. 403 ± 180 ng; Wilcoxon test: $W=2$, $p=0.005$), tentatively indicating a trade-off between mating and parenting effort in males.

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