Introduction

The Osteological Paradox (Wood et al., 1992) is a central theoretical concept in bioarchaeology in which the authors argue that skeletal samples may be inherently biased due to many factors. One of the main conclusions is that a skeleton with no pathological lesions could be “less healthy” than a skeleton with lesions if the person died before any skeletal changes could manifest. This suggests that those displaying skeletal pathology are more likely to enter the skeletal record than those with none, causing the skeletal record to overestimate the number of unhealthy individuals in the living population.

Most bioarchaeologists agree this paradox poses a significant barrier to assessing health in the past. Some scholars (e.g. Goodman (1993)), however, argue that this paradox can be solved by incorporating data from multiple indicators of pathology to assess health. Collecting data on multiple stress indicators is common practice, but whether it indicates increased mortality is unproven and ignores the complicated interaction between social, biological and environmental stressors and buffering mechanisms.

Research Question

This project proposes to directly investigate the multiple-indicator hypothesis by asking the question:

- Are greater numbers of non-specific indicators of stress a reliable predictor of increased mortality? (i.e.: do individuals with more indicators die earlier?)

Proposed Materials and Methods

This project will use several assemblages of human skeletal remains from the Lower Illinois River Valley housed at the Center for American Archaeology. Data on four of the most commonly collected pathological indicators will be gathered:

- Linear enamel hypoplasia
- Cribra orbitalia
- Porotic hyperostosis
- Tubial periostitis

Data on age and sex data will be collected according to Standards for Data Collection for Human Skeletal Remains (Buikstra and Ubelaker, 1994) and following the Transition Analysis method (Boldsen et al., 2002).

The data will be analyzed using Kaplan-Meier survivorship analysis in SPSS to see if those with more indicators died earlier.

Finally, an ANOVA will be performed to see if the mean ages-at-death differ significantly between individuals with 0, 1, 2, 3 or 4 non-specific stress indicators.

Expected Results

Figure 2 shows a Kaplan-Meier survivorship curve from Budd and Wissler (2016) which, following DoWitte (2014), tested for a relationship between lesion status (absent, active, healed, mixed) and age-at-death. Figure 2 demonstrates that individuals with active lesions were most likely to die at younger ages while those with healed lesions were more likely to die at older ages.

If the multiple indicator hypothesis is correct, I expect to see a Kaplan-Meier survivorship graph in which individuals with greater numbers of nonspecific indicators of stress die at younger ages and those with fewer nonspecific indicators of stress die at much older ages. The ANOVA will demonstrate significant differences in the mean age-at-death among groups with different numbers of nonspecific stress indicators.

According to the Osteological Paradox, the development of pathological lesions does not have such a straightforward relationship with mortality. I hypothesize that the results will show no clear relationship between the number of nonspecific indicators of stress observed and age-at-death, nor will the ANOVA demonstrate significant differences in mean age-at-death among groups with different numbers of nonspecific stress indicators.

Significance

If this research demonstrates that multiple indicators of disease do not serve as a reliable signal for increased morbidity and mortality, the conclusions of hundreds of paleopathology studies come into question. Our understanding of past health and how it has been affected by cultural contact, the transition to agriculture and the effects of structural inequality would need to be reevaluated. It would furthermore underline the need for new methods and theory in paleopathology as well as the need to increase our understanding of heterogeneity in frailty and how differences in genetics and environment contribute to variations in disease experience.

Future Research

This research provides the foundation for future investigations of ancient health and paleopathology. Future steps will include examining the lesion distribution within the sample to elucidate heterogeneity in frailty as well as investigating if certain nonspecific stress indicators, or combination of indicators, is more frequently associated with increased mortality.

I also plan to connect this project to my current research on fluctuating asymmetry. Asymmetry in tooth size and cranial shape is thought to be a sign of developmental stress. I would be interested to explore the relationship between asymmetry, increased mortality and nonspecific indicators of stress.

Works Cited


Figure 1. Map showing location of the Center for American Archaeology.

Figure 2 Kaplan-Meier survivorship curve from Budd and Wissler (2016).

Image credits

http://voices.nationalgeographic.com/files/2015/01/2-Disease.jpg
http://voices.nationalgeographic.com/files/2013/01/2-Disease.jpg
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