Early Onset Osteoporosis in Early Bronze Age Burials from Bab edh-Dhra, Jordan

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INTRODUCTION

Bab edh-Dhra is an important Early Bronze Age site located near the Dead Sea in the southeastern Oner region of Jordan. Three field seasons of excavation at the site between 1977 and 1981 resulted in the discovery of 579 total secondary burials from the EB 1a period (3300-3200 BCE). In this paper we will examine the high prevalence of early onset osteoporosis in the population, as was determined by obtaining the mass of the bones and confirming that data with radiographs which displayed the degree of bone loss in a particular specimen.

The sample size is limited to 36 individuals, the number of burials present at the Smithsonian Museum of Natural History for which complete skeletal elements remain of at least one of the long bones, the L3 vertebrae, or the sacrum. In healthy individuals, the trabeculae in these bones is dense, and can provide us rare insight into the degree of bone loss in an ancient population, allowing us to assess and understand the relative health of individuals at that time of their death and better comprehend the prevalence and patterns of osteoporosis in modern populations.

Osteoporosis is defined as a reduction in bone mass that exceeds 20% of the average bone mass for a given age and sex category (Ortner, 2000). Increased bone porosity and fragility are generally linked to age, but severe bone density loss can also occur in younger populations that are malnourished or starving. It is clear that some of the young women in the sample bore signs of bone loss sufficient to show that malnutrition likely lead to both morbidity and mortality in the population and played a role in the health of the Bab edh-Dhra people. It has been noted in a review of studies on bone mass in other historical populations (Agarwal and Grynpas, 1996), that generally female bone density loss begins to occur at an earlier age in ancestral populations than in modern day ones. This is likely due to the fact that females were required to build their skeletons than was necessary for their skeleton to maintain a balance between bone resorption and formation.

Materials & Methods

The skeletal elements present for each burial were assessed to determine sex and estimates of age. For each individual bone, the data was determined as a control for the measurements of bone weight. The skeletal elements present for each burial were assessed to determine sex and estimates of age. In order to confirm the data obtained from weighing the bones, radiographs of the femora (Figure 1) and vertebra (Figure 2) were taken for each individual. These radiographs were compared to those of contemporary osteoporotic individuals and to normal bones in the sample in order to assess the relative degree of bone loss. The amount of cortical bone loss in a radiograph of postcranial bone was measured as 25-30%, which is why cortical bone thickness relative to overall thickness of the midshaft of the femur was measured using calipers.

RESULTS

Figure 3 shows the association between weight and for the EB 1A females. Eight females in the study were clear outliers, lying well below the regression line. Radiographic analysis of those same eight femora showed there to be significant trabecular bone loss and, in most cases, at least a mild degree of cortical bone loss. Weight and age comparisons of the femur, third lumbar vertebra shows similar results, in which the clear outliers remained, for the most part, the same few females.

The average age of these eight females was about 30 years old, much younger than the age expected of someone typically suffering osteoporosis. A CT scan comparing cross sections of two different EB 1A females (Figure 4) showed the degree of bone loss and increased marrow space in an osteoporotic 25-35 year old.

CONCLUSIONS

Previous study of the paleopathology of the Bab edh-Dhra remains resulted in the conclusion that there was clear evidence of malnutrition (Ortner et al., 2008). The prevalence of metabolic disorders observed in this study in combination with the high occurrence of pre-menopausal osteoporosis in the female population makes it very likely that malnutrition was a problem in the EB 1A period. Data on modern third world populations (UN-SCN Report, 2004) shows a strong correlation between malnutrition and bone density loss. Malnutrition is also a significant factor in the health of the Early Bronze Age inhabitants of Bab edh-Dhra, leaving many of the females severely undernourished. These affected individuals remain the biological markers of bone resorption, which occurred at a rate much more rapid than in healthy populations. This imbalance between bone formation and bone destruction resulted in a high prevalence of young women with osteoporosis.

REFERENCES


Ortner, Donald J. et al. (2008). The Paleopathology of the EBIA and EB IB People. The Early Bronze Age Tombs and Burials of Bab edh-Dhra, Jordan, Altamira Press, Plymouth, UK.


ACKNOWLEDGMENTS

I would like to thank Dr. Ortner for advising me over the course of the summer and imparting on me invaluable knowledge necessary to navigating this research project and any osteological research I do in the future. I would also like to give a huge thank you to Dr. Cristian Samper and the Smithsonian Museum of Natural History for funding the NHRE program, and Virginia Power, Elizabeth Cottrill, and Gene Hunt for coordinating the program. Dr Frohlich also helped a great deal with using the statistical software and interpreting the results yielded in the experiment.