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ORIGINAL ARTICLE

Cross-sectional analysis of long bones in a sample of ancient Egyptians

Moushira Erfan Zaki [a,*], Ayman A. Azab [a], Walaa Yousef [a], Eslam Y. Wassal [b], Hala T. El-Bassyouni [c]

[a] *Biological Anthropology Department, Medical Research Division, National Research Centre, Egypt*
[b] *Department of Diagnostic and Interventional Radiology, Kasr Al-Ainy Faculty of Medicine, Cairo University, Egypt*
[c] *Clinical Genetics Department, Human Genetics and Genome Research Division, National Research Centre, Cairo, Egypt*

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KEYWORDS

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Abstract *Background:* As diaphyseal shape is predominantly influenced by mechanical loading history, long bone cross-sections can be used to access activity patterns. The aim of this study was to evaluate long bone cross-sectional properties in a sample of ancient Egyptians from two socioeconomic classes with different habitual activities.
Material and methods: The material of the present study consisted of 174 skeletons, 71 Workers and 103 High Officials. Measurements of cross-sectional properties from CT images were taken for humerus, femur, and tibia. Cross-sectional images were obtained in the transverse plane of each bone, perpendicular to both coronal and sagittal planes.
Results: Cross-sectional thickness and cortical areas of long bones were higher in male Workers than in male High Officials; the differences were significant in anterior thickness of the femur and total cross-sectional areas of both humerus and tibia, and the cortical area of the tibia. Moreover, female Workers had significantly higher values of humeral medullary area and femoral total and cortical areas than High Officials.
Conclusions: Workers had higher level of skeletal robusticity than High Officials which could reflect their higher levels of mobility and physical workload. The study suggests that different activity patterns can significantly affect the bone structure.

1. Introduction

Skeletal robusticity refers to the strength of a skeletal element relative to some mechanically relevant measure of body size, and is generally considered to reflect the magnitude of the mechanical loads that are habitually incurred by that element as the organism interacts with its environment (1).

Mobility behavior in prehistoric populations provides information on numerous aspects of culture and socioeconomic classes. The study of long bone cortical thickness in ancient populations helps in reconstructing their past behavioral patterns, as well as the degree of physical activities

* Corresponding author.
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(2,3). Moreover, cortical bone composition and structure change significantly in response to the mechanical loadings (4,5). Skeletal inter-individual variations are attributed to the interaction of both genetic and environmental factors, although, the evolutionary characteristic of skeletal morphology is mainly genetic (6,7). The genetic factors are the determinants of the variability in bone structure among different species, as well as, at different phases of development.

2. Materials and methods

2.1. Materials

These skeletons were kept in a storeroom at Giza and belong to the Old Kingdom period (2700–2190 B.C.), which is known as the period of pyramid builders (8). They were excavated from the Giza necropolis, and classified into two socioeconomic classes; high officials and workers according to characters, design and contents as well as the writings and drawings on the walls of the tombs (9). The cemeteries around the first pyramid were planned to include the princes on the east side, and the high officials on the western side (10,11). The materials of the present study consisted of 174 adult skeletons of ancient Egyptians, with no gross pathological changes or fractures that may affect the bone's biomechanical properties. They were classified into two groups, according to the socioeconomic status; the High Officials (103 skeletons: 60 male and 43 female) and Workers (71 skeletons: 34 male and 37 female). Determination of the sex of the skeletons was done using the descriptive methods of both pelvis (12) and skull (13,14) when available.

Sexing from the skull was based on some features as mastoid process which it is longer in males than in females and the Glabellas, Supra-orbital ridge, Nuchal crest and Parietal eminence which are more prominent in males than females.

Orbit, Chin of mandible, palate and teeth are larger in males than females, also the size and mass which it is larger and heavier in males than females (Fig. 1).

Sexing from pelvis was based on visual assessments of some features as ventral arc which present in females only, subpubic concavity which convex in males and concave in females, ischiopubic ramus ridge which broad and flat in males and narrow crest like a ridge in females, the preauricular sulcus which deeper and wider in males but shallow or absent in females, acetabula which large and deep in males but small in females and sacrum which long in males and short in females (Fig. 2).

When both pelvis and skull were absent, sexing depended on the long bones. The maximum length and head diameter of humerus and femur and bone length of tibia measured according to the definitions, landmarks and the techniques described by Buikestra and Ubelaker (15).

Age at death was estimated using the metamorphosis of the auricular surface (16), depending on the chronological changes in the auricular surface of the ilium. Age changes of the auricular surface was used to estimate age at death, the present cases aged 50–60 years old, in which auricular surface characterized by dense irregular surface of rugged topography with marked activity in periauricular area and irregularity. The inferior face is lipped at the inferior terminus. Apical changes are marked with increasing irregularity of margins and macroporosity is present and the retroauricular activity is seen (Fig. 3), all of the studied individuals have no macroscopic signs of pathologic changes.

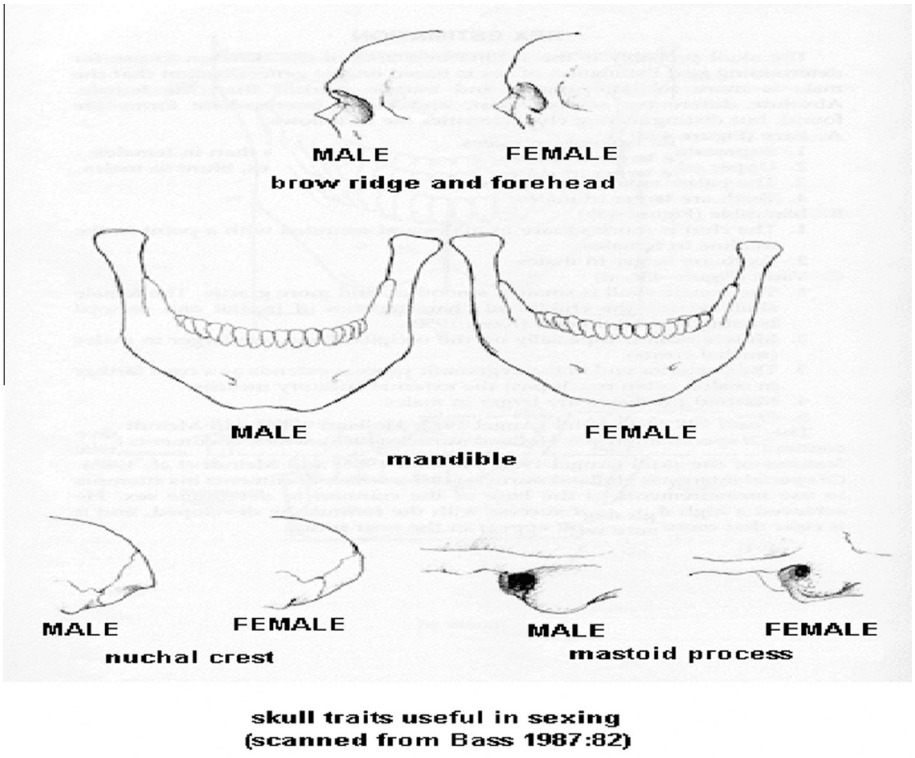

Fig. 1 Diagram shows the difference between male and female skull.