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# Metrical and Non Metrical Methods in Sexing of Crania-Review

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**Abstract**

Anthropology is the science of man, the science devoted to the comparative study of man as a cultural and physical being. The most common and critical problem faced by anatomist, forensic science experts and anthropologists is to identify the deceased person from the bones. Sexing of the skull is predominantly done by using metrical and non metrical parameters in different populations. This will help in medicolegal cases.

**Keywords:** Sex, Crania, metrical, anthropology

## Introduction

Anthropology is the science of man, the science devoted to the comparative study of man as a cultural and physical being. [1]Anthropometric study of the bones is important to convey the information regarding the race to which they belong. Apart from this the data can lead to more important conclusions and everyday sought for opinions in the medico legal cases regarding the determination of age, sex, stature etc. The attainment of accuracy in anthropometry requires a good deal of practice. [2]

The most common and critical problem faced by anatomist, forensic science experts and anthropologists is to identify the deceased person from the bones. The record of organic evolution is largely written by the hard parts of the body. The bones of the body are last to perish after the death next to enamel of the teeth. Hence a skeleton remains has been used for sexing of the individual. Almost all the bones of human skeleton show some degree of sexual dimorphism.[3] Sex can be determined from examination of the pelvic bones, skull, first cervical vertebra, mandible, clavicle, sternum, and various long bones. Sex determination from the skeletal remains forms an important component in the identification procedure. But sometimes it becomes a difficult task for the forensic anthropologists to identify the sex from skeletal remains especially in the absence of pelvis.The accuracy of the determination depends mainly on the kinds of bones available and their condition.

## Discussion

The importance of craniometry in the description and analysis of the remains of fossil of man and of other primates is obvious. [4]To opinion on the sex of the individual, skull is one of the commonest parts of the skeleton. In the pre-pubertal age group although adult skulls show a few non-metrical and metrical

differences, there is a paedomorphic tendancy in the human skull of either sex.[5] Absolute sexual differences seldom exist.[6] Further, hormones, nutritional status, cultural difference, race, geographical regions and environmental factors affect these variations. Skull shapes may also vary within population and even among the closely related. [7]

Traditionally, the skull was the single most studied bone in physical anthropology and human evolution based on cranial remains.[8] Equally, traditionally the sexing of the skull has been done on the osteological basis. So that descriptive skeletal features have ruled other than dimensions. In a sexing of skull, the initial impression often is a deciding factor i.e. a large skull is generally male, a small skull female.[9] Sexing of the skull is predominantly done using non metrical parameters, but they are best appropriate only in relative terms.[7]

Metrical studies may provide certain advantages because it is more objective way of attaining data with the use of osteometric techniques, determination of sex from the skulls relied very much on statistical analysis.[10] The known metrical parameters fail to show clear differences between the sexes hence the need was felt to establish more effective new parameters.[7] The cranium probably ranks foremost as the classical, most studied and informative subject of examination in physical anthropology.[11]

Cranial measurements offer the simplest and fairly accurate way of judging the similarity or differences when comparing the skulls of different racial groups.[12]

Hardlika stated that 80% accuracy can be done by using the adult skull alone, but if mandible were present he predicted 90%. The most interesting and important part of the skeleton was naturally the cranium and this has received the most attention from the beginning of the anthropology. The preoccupation of anthropologists with the skull had been done particularly since the repeated discoveries of the remains of early man. [13]

Stewart TD (1936) proposed more than one classification of the cephalic index. [14] In 1936 Howell introduced a useful standard of variability for an anthropometric measurement known as “mean sigma”. This standard was related to any particular measurements that simplify the mean of the standard deviations, calculated without weighing, from all the available series of fifty or more cases. [15] In 1940 , the average height index below 83 which indicated a relatively low skull. Stewart suggested that the distribution of low headedness in North America might be due to the late arrival of these people on the continent. [16]

Stewart felt that in the adult skeleton, the adult pelvis or one adult hip bone could sex correctly 90-95% of cases and for the adult skull alone it is about 80%. Stewart TD understood the medicolegal aspects of the skeleton in 1948.[17] The problem of deciding whether a given skull was male or female presented itself under two aspects. First in case of isolated skull not related to any known group and second a number of skulls belonging to a known group. [18]

Taylor (1956) in his book of medical jurisprudence have stated that the accuracy of sexing various bones is as follows Skull and femur- 97.35%,Coccyx + sacrum-97.18%,Pelvis95%,Skull alone - 91.38%, Femur 39.84%, Atlas 31.18% From these findings one can determine sex of unknown identity with above 90% accuracy from the skull, sacrum and pelvis.[23] Giles E et al (1962) used two pairs of discriminant function formulas for males and for females. The skulls placed into white, American and Negro categories by means of eight cranial measurements[19]

The sexing depends upon the reorganization of their morphological features of those series like size, heaviness, shape, muscular and ligamentous markings etc. This non metrical visual impression about the bone morphology for determination of sex involves a subjective element and entirely depends on ability and experience of examiner [20] Bennett KA (1965) studied the relationship between the length of the basi-occiput and the presence of wormian bones in 116 Negro, 113 White and 50 Southweastern American Indian adult male crania. Among all three races, there was a statistically significant difference between those who possesses wormian bones and those who do not. Bennett suggested that wormian bones were not under direct genetic control, but instead represented secondary sutural characteristics which were brought about by stress. [21] Kajanoja P(1966) determined the sex of 232 finnish crania of known sex by using multivariate discriminant function analysis. The eight measurements taken were maximum width, maximum diameter bizygomatic, glabello-occipital length, basion-bregma height, basion-prosthion, basion-nasion, prosthion-nasion height and nasal breadth. [22]

Berry AC (1975) studied the incidence and sexual difference of 30 non-metrical variants. He concluded that the variants showed statistically significant sexual heterogeneity. [23] An x-ray cephalometric study was performed in a male and a female group of Danish dental students. .[24]

The purpose of the study of Carpenter JL (1976) was to compare the metrical variables with the non metric traits in relation with the age, sex and race. The metric variables were found to be significant sex race discriminators, whereas the non metric variables were found to be were non significant. The non metrical parameters were found to be better age discriminators than metric variables. It was concluded that non metrical traits by themselves have very little discriminatory value and should be used instead to supplementother osteological measurements and observations. [25]The purpose of the study of Ossenberg NS (1977 indicated that the battery of non metric variants was useful for the study of extinct North American populations.[26] In opinion of Krogman (1982) the accuracy of sexing of bony material is as follows Entire skeleton 100%,Skull and pelvis - 98%,Pelvis alone- 95%, Skull alone - 90%Long bones alone-80%,Long bones + pelvis- 98% .[27] The cranial base could be used to determine the sex of fragmentary or deformed skulls studied by . [28]

The study of Iscan Y (1995) evaluated sexual dimorphism in modern Japanese cranial dimensions.[29] The aim of the study of Brasili P et al (2000) were to supply further knowledge about variations in nonmetric cranial traits in relation to sex, age and laterality and to evaluate biological distance between samples from recent populations. .[30]

Shav JV (2004) stated that cephalic index was an important parameter for deciding the race and sex of an unknown individual. Cephalic index was worked on the 500 medical students from Gujarat using head length and breadth. This study proved that tendency towards brachycephalisation means evidence of continuous growth of brain more in lateral direction. [31]

Uytterschaut H. T. (2006) compared the sex-discriminatory power of five discriminant functions based on different ordination and selection procedures ( e.g. professional knowledge, stepwise discriminant analysis, literature etc.) of the cranial variables. He concluded that a certain combination and weighing of a few sex dimorphism variables can give a good discrimination between male and female individuals,

independent of the racial group to which this function is applied.[32]

The Chimmalgi et al (2007) used four metrical parameters for sexing of skull in Western India. Among the combinations of the parameters, that of bizygomatic diameter and combined area of carotid canal openings gave the best results with 100% accuracy ad was able to identify the sex of 5% of male and 60% of female skulls. [6] The purpose of the study of Kimmerle EH (2008) et al was to examine the effect of size and sex on craniofacial shape among American populations. [33]The aim of the study of Kranioti E. F. (2008) was to develop a sex determination technique using osteometric data from skeletal remains of a contemporary Cretan cemetery population. The bizygomatic breadth was the most discriminatory single dimension can provide an accuracy rate of 82% on an average. [34] Nooranipour M. and Farahani R M (2008) estimated brain weight and cerebral index in 772 normal 18-22 year old Iranian people of different socioeconomic groups, using linear dimensions of the head. They concluded that the neurocranial volume and weight of male was higher than female.[35]

Walker PL (2008) tested the accuracy of sex determinations based on visual assessments on 304 skulls of known age and sex from people of European American, African American and English ancestry. For this assessment, traits used were the mental eminence, orbital margin, glabellar area, nuchal area and mastoid process. All five cranial traits correctly classified 88% of the modern skulls with negligible sex bias of 0.1%. [36] Gapert R. (2009) et al stated that the basal region of the occipital bone is covered by a large volume of soft tissue and relatively well protected in anatomical position. Hence the classification of sex using the occipital bone may prove useful in cases of significantly disrupted remains.[37]Chovalopoulou (2013)studied the sexual dimorphism in the palate and base of the adult crania using three dimensional geometric morphometric methods.[38]The findings of the study of K. Godde (2018) who focused on estimating sex by visual assessment of human cranial morphology supported the hypothesis that the method does not estimate the sex of crania from all populations in the same manner, indicating that populations display differing patterns of sexual dimorphism[39]

**Conclusion**

The present review article concluded the importance of craniometry and non metrical characters which are really useful to identify age, sex and race. Which will be having importance in medicolegal use and for the anthropologists.

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