ESTIMATING SEX FROM SKULL EMPLOYING WALKER'S NON-METRIC SCORING METHOD

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ABSTRACT

This paper attempts to find out the feasibility of widely used non-metric methods of Walker for sex estimation of crania and mandibles. The sample for this study was taken from the Laboratory of Anthropology Department, Lucknow University and Anatomical Society, KGMU. In all known 20 crania, and 20 mandibles were used for the study. It was noted that the scoring technique was adequately feasible to infer the accurate sex. The technique accurately identified sex of 13 male and 7 female crania, and 15 male and 5 female mandibles.

Keywords: Sex estimation, Walker's Non-Metric Scoring method, Cranium, Mandible

INTRODUCTION

In any forensic investigation, where a deceased body is found, it is important to establish its biological identity. The biological identity, which includes age, sex, stature, and race, occurs due to differences in functionality and adaptations. This paper highlights the widely used non-metric methods. like Walker standards, for sex estimation. The human sexual dimorphism is a very complex dimension attained by anatomical and physiological variation. The paper will help to understand the reason for human sexual dimorphism and the factors that contribute to identifying the sex of an individual. In addition, effort has been made hereto discuss significant aspects to increase accuracy of results. In law enforcement, sex estimation is considered the second most important variable for narrowing the missing person search and matching the human remains. The most widely examined skeletal specimen for this purpose is the skull, which gives 80% to 90% accuracy (Krogman, 1962).

Sex Estimation

Sex estimation is the process of assessing whether skeletal remains are biologically male or female. Biological anthropologists, forensic anthropologists, bioarchaeologists, and paleoanthropologists may be called upon to determine

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sex from skeletal remains. Sex estimation is vital in establishing an accurate biological profile from the human skeleton, as sex influences the analysis of other elements (e.g., stature and age). The terms sex and gender are not to be confused in this context. Gender is a socio-cultural construct, whereas sex is a biological trait. Sex estimation is based on the premise that male and female skeletal morphology differs in size and shape. This difference is referred to as sexual dimorphism. Although humans are less dimorphic than their nonhuman primate relatives, sexual dimorphism in *Homo sapiens* is sufficient to facilitate sex estimation from skeletal morphology.

Walker's Non-Metric Scoring Method for sex estimation

Walker's methods for sex estimation using the skull utilizes five morphological traits of the skull, namely nuchal crest, mastoid process, supra-orbital margin, prominence of glabella, and mental eminence (Figure-1). Each of these features is scored individually and the skull must be held at arm's length position. For assessing the nuchal crest, the skull is viewed laterally; the occipital surface is felt for any surface rugosity. In case of minimal expression, i.e., the surface is smooth with no bony projection, score 1 is given. In case of the massive nuchal crest that defines well-defined hook a score of 5 is given. In order to assess the mastoid process, compare its size with the external auditory meatus and the zygomatic process of the temporal bone. This trait is scored on the basis of the volume of the mastoid process and not length. For minimal expression a score of 1 is used (small mastoid process projects a small distance below the inferior margin of the external auditory meatus) and a massive mastoid process that exceeds the length and width of external auditory meatus must be scored 5. The supraorbital margin is assessed by holding the fingers against the margin of the orbit at the lateral aspect of the supraorbital foramen. The edges of the orbit are felt to determine the thickness. The minimal expression, where the border is felt extremely sharp must be scored 1 and the maximum expression where the border is thick with rounded margin must be scored 5. Next, the prominence of the glabella is viewed laterally for assessment. If the contour of the frontal region is smooth with little or no projection at the midline then the trait is scored; if a massive glabellar prominence is present forming a rounded loaf-shaped projection then the trait must be scored as 5. Lastly, the mental eminence is scored by holding the mandible between the thumb and index finger with thumbs on either side of the mental eminence. A minimal score of 1 has to be given when there is no or little projection and a maximal score of 5 is given when there is a massive mental eminence that occupies most of the anterior portion of the mandible.
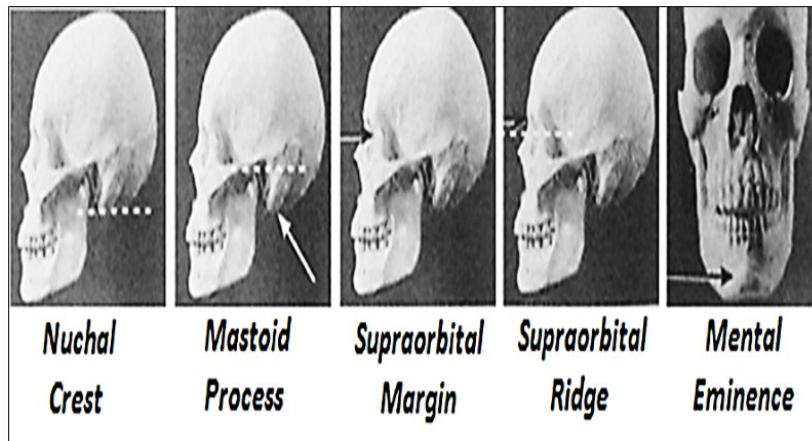
Figure-1: Morphological traits of the cranium used for Walker's method of sex estimation.

Features of Cranium

1. ***Nuchal crest:*** This area, where the muscles from the back of the neck attach to the base of the skull, is smooth and rounded in females but hooked and protruding in males. To observe the nuchal crest, one should view the skull from its lateral profile and feel for the smoothness (1-minimal expression) or ruggedness (5-maximal expression) of the occipital surface, and compare it with the scoring system of that feature (Figure-2).
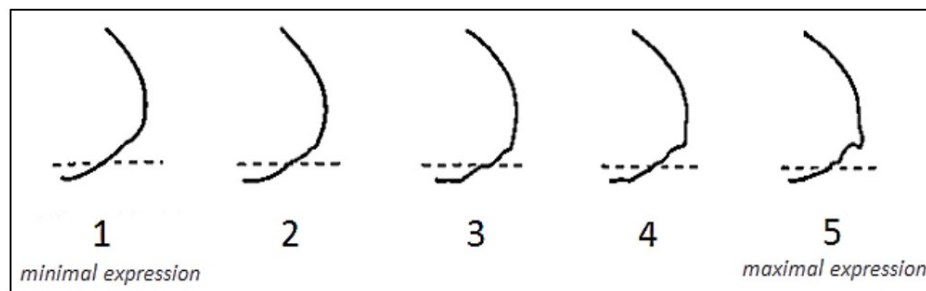

Figure-2: Scoring of nuchal crest of cranium in Walker's method of sex estimation.

2. ***Mastoid Process:*** The mastoid part of the temporal bone is the posterior (back) part of the temporal bone. The mastoid process is located lateral to the styloid process and appears as a conical or pyramidal projection. It is larger in the male than in the female. If the mastoid process descends or projects only a small distance then it should be scored a 1 (minimal expression), where as if it is several times the width and length of the external auditory meatus, then it should be scored as a 5 (maximal expression) (Figure-3).
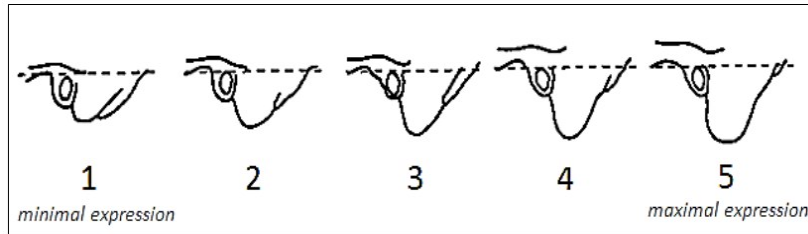
Figure-3: Scoring of mastoid process crest of cranium in Walker's method of sex estimation.

3. ***Supra Orbital Margin:*** The supraorbital margin, forms the upper boundary of the base of the orbit and separates the squama from the orbital portion of the bone. it is blunted in the male and sharp in the female. If the edge feels 'extremely sharp' then it would score a 1, (minimal expression) and if it felt rounded and thick as a pencil it would score a 5 (maximal expression) (Figure-4).
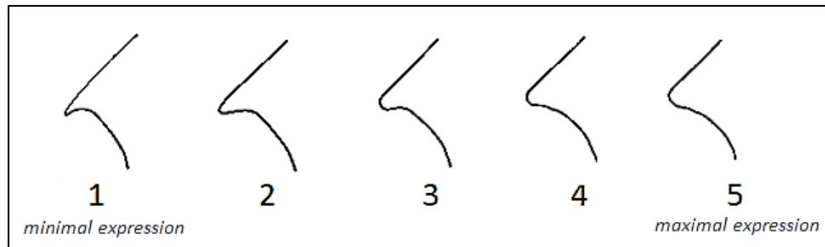

Figure-4: Scoring of supra orbital margin of cranium in Walker's method of sex estimation.

4. ***Supra Orbital Ridge:*** Supraorbital ridge refers to a bony ridge located above the eye socket. The arches are more prominent in men than in women. If the ridge is smooth with little or no projection, then it would have a score of 1, viz., minimal expression, if it is pronounced and forms a rounded 'loaf-shaped' ridge then it would scored as 5, viz., maximal expression (Figure-5).
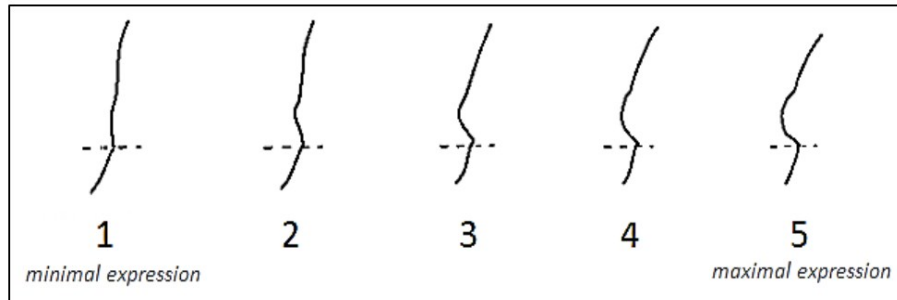

Figure-5: Scoring of supraorbital ridge of cranium in Walker's method of sex estimation.

Features of Mandible

1. ***Mental Eminence:*** To observe the mental eminence, one should view the skull front-facing, and hold the mandible between the thumbs and index fingers, with the thumbs placed either side of the mental eminence. If there is little or no projection of the mental eminence, then it would score a 1, minimal expression, if it is pronounced it would score a 5, maximal expression (Figure-6).
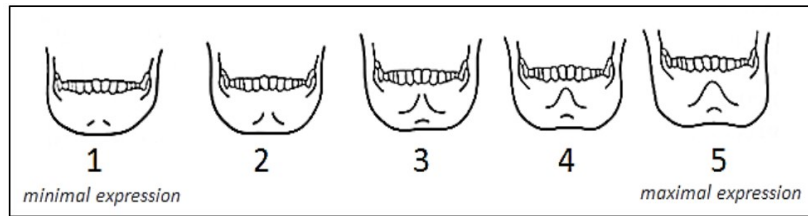

Figure-6: Scoring of mental eminence of mandible in Walker's method of sex estimation.

The non-metric sex estimation of the skull involves analysis of overall shape and relative size of certain cranial and mandibular features. The male skull is more rugged and robust and female skull is smaller in overall size and smoother. Males have more robust muscle attachment sites and cranial features.

RESULTS

Non metric Walker's scoring method was applied on known 20 crania housed in the department of Anthropology and Anatomy Department, KGMU, and the result are presented in Table-1. Most of the probable male and female crania could be identified correctly by using Walker's non metric scoring method.

Table-1: Scores of sampled Crania on the basis of Walkers non-metric Method

S. No.	Cranium No.	Nuchal crest	Mastoid process	Supra orbital margin	Supra orbital ridge	Result
1.	60-B12	4	5	5	**5**	Male
2.	66-A	1	1	1	1	Female
3.	16	5	4	3	4	Male
4.	N-1	4	5	4	4	Male
5.	5.5	1	2	1	1	Female
6.	65-A3	1	1	1	1	Female
7.	ASE-5	2	1	1	1	Female
8.	Z	4	5	5	4	Male
9.	65A-4	2	2	1	2	Female
10.	7A	5	5	5	5	Male
11.	25A	5	3	4	4	Male
12.	12	4	4	4	4	Male
13.	K6B	4	4	5	5	Male
14.	28A	4	5	5	5	Male
15.	6A	4	4	4	5	Male

16.	5A	5	4	5	5	Male
17.	25A	5	3	5	5	Male
18.	24A	2	2	1	1	Female
19.	65A	2	2	2	3	Female
20.	65A	5	4	5	5	Male

Table-1 demonstrates that Walker's method for sex estimation using skull utilizes five morphological traits of the skull including nuchal crest, mastoid process, supra orbital margin, prominence of glabella and mental eminence is helpful in estimation of sex. The score1 stands for female, whereas the score 2 is probable female. Ambiguous sex is scored 3, score 4 for probable male, the score 5 is a definitive male.

20 mandibles of the department of anthropology, Lucknow University and Anatomy department of KGMU were examined, applying Walker's method. It was found that the feasibility of this method is great and determination technique is adequately accurate. As can be seen in Table-2, using Walker's method for sex estimation, 1 stands for definite female and a score of 2 is probable female. Ambiguous sex is scored 3, score 4 for probable male, the score 5 is a definitive male.

Table-2: Distribution of scores among the Mandibles from the department of Lucknow University and Anatomy Department of KGMU.

S. No.	MandibleNo.	Mental Eminence	Result
1	18B	2	Female
2	65MAH	4	Male
3	WR4	4	Male
4	31R	4	Male
5	RK3	4	Male
6	ARK61	2	Female
7	A71	4	Male
8	M2	4	Male
9	RP70	2	Female
10	S29	5	Male
11	SR6	2	Female
12	ARK61	2	Female
13	SR92	4	Male
14	M1	5	Male
15	17A	5	Male
16	31R	5	Male
17	A43	5	Male
18	M3	3	Male
19	A71	4	Male
20	76B	5	Male

CONCLUSIONS

After interpreting all the samples in the present study, it can be concluded that Walker's method of sex estimation is much simpler and easier than other methods. By this method, the sub features of the cranium and the mandible are scored at 5 points. The difference based on these numbers is quite obvious, which makes it very easy to differentiate between a male and a female. Thus, Walker's method presents new dimensions in sex estimation.

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