

## SEXUAL DIMORPHISM USING HEAD CIRCUMFERENCE

**Running Title - Gender determination using head circumference**

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**ABSTRACT:**

**INTRODUCTION:** Forensic investigation has a difficult task in identifying the gender in an unidentified skull. Though males have a 2% larger size of head compared to females, proper measurements and formulae are needed to identify.

**AIM:** The aim of this study is to determine the gender using head circumference.

**MATERIALS AND METHODS:** One of the methods to determine sexual dimorphism is using head circumference. Using measuring tape, the head circumference was analysed for 70 people ( 35 males and 35 females). The obtained data was tabulated and statistically analysed using SPSS software ( version 23 ).

**RESULT:** The mean value of head circumference in males was  $55.24 \pm 1.87$  cms and in females it was  $54.26 \pm 1.19$  cms. Wilcoxon signed rank test was done and the p value was 0.018 ( $p < 0.05$ ).

**CONCLUSION:** From the current study it was found that head circumference was a reliable source of gender determination.

**KEY WORDS:**

Sexual dimorphism; head circumference; forensic investigations; novel gender determination

**INTRODUCTION:**

Gender determination is very difficult and not easily performed in unidentified skeletons. It is extremely complicated to find gender in situations like explosions, disasters etc.,. Both males and females differ morphologically, physiologically, and have different types of behavior. In fact, differences in physical characters between genders contributes to phenotypic variance in most of animal species (1). Radiography provides accurate dimensions to identify the gender. Many methods like length, height, circumference of the head are used for gender determination. After the effects of brain size, males have a greater volume compared to females. All body sizes range from dimorphism. Males have a 2% larger size of head circumference compared to females. (2).

Compared to non primates, only little sexual dimorphism exists at birth. Though the difference in-between the two genders are for circumferences is quite low, at 13 years of age, sexual dimorphism gradually rises to 17% in adolescence in thoracic circumference.(3,4) Head circumference is a reliable source of gender determination. Some sexual dimorphism is the result of natural selection and in body size it is common but highly different among mammals.(5,6)) Due to the larger head size in males compared to females, few argue that males have more number of neurons (5,6). This study is to provide a comprehensive examination for sexual dimorphism in humans using head circumference. This research provides preliminary steps to examine gender.

Few findings suggest that testosterone and oestrogen have an unclear role in sexual dimorphism, but it will contribute. There are a number of invivo studies on sexual dimorphism. Secretion of growth hormone is one of the important determinants of sexually dimorphic patterns for growth and its factors (7). The extensive knowledge and experience of our research team has been translated into high quality publications (8–15),(16),(17),(18),(19,20),(21),(22),(23–27). Research is needed to determine sexual dimorphism using head circumference. This will fulfill the deficiency of finding the gender of the unidentified skull. The aim of the study is to determine sexual dimorphism using head circumference.

### **MATERIALS AND METHODS:**

The studied sample consisted of 70 people (35 males and 35 females ) and age ranges from 18 - 20 years. Head circumference was also calculated for all 70 people using measuring tape. The head circumference was found by surrounding the measuring tape around the head from glabella to glabella through opisthocranium (Figure 1). For each person, three values were taken and the average was taken for the study The data collected was tabulated and statistically analysed using SPSS software (version 23) and Wilcoxon signed rank test was done



**Figure 1** - Measurement of head circumference using measuring tape

**RESULT:****Table 1- Range, mean and standard deviation of head circumference in males and females**

	N	MINIMUM in cms	MAXIMUM in cms	MEAN in cms	STANDARD DEVIATION
MALE HEAD CIRCUMFERENCE	35	50	58	55.24	1.87
FEMALE HEAD CIRCUMFERENCE	35	52	56	54.26	1.19

\*Wilcoxon signed rank test was done, p value was 0.018 ( $p < 0.05$ )

From Table 1 it is seen that the mean value of head circumference in males was  $55.24 \pm 1.87$  cms and in females it was  $54.26 \pm 1.19$  cms. Wilcoxon signed rank test was done and the p value was 0.018 ( $p < 0.05$ ). So, it is statistically significant, hence sexual dimorphism can be determined using head circumference.

**DISCUSSION:**

Identifying decomposition of human remains is one of the very difficult task in forensic, where sex determination is one of the problem. When all the skeletal bones are present, it is 100% sure that gender can be identified.(28) But during explosions or disasters it is not very easy. Other than head circumference, evaluation of foramen magnum in gender determination is also found by other researchers.(29) (3). There has been no previous documented evaluation of sexual dimorphism of the head circumference within the area under study. Gender determination among the human skull was generally based on differences in size and robustiaty. These differences are unique to each population and thought to be influenced by genetic, environments and socio-economic factors (30). Research was analysed in foetal and infant's head circumference. According to a research done by. The mean of male head circumference of infants is 471 mm whereas in this study, the value is 55.24 cm and the mean of female head circumference in infants was 460 mm whereas in this study, the value is 54.26 cm. Another study by (31) males have a minimum head circumference of 53 cm and females have 51 cm. In this study, the minimum head circumference of male is 50 cm and females are 52 cm. The limitation of this study is less sample size was taken ( 70 students - 35 males and 35 females ). In future, more numbers of males and females could be calculated to analyse the sexual dimorphism using head circumference.

## **CONCLUSION:**

From the present study we found head circumference is a reliable source of gender determination and it is valuable in studying sexual dimorphism in forensic investigations. So sexual dimorphism can be determined using head circumference.

## **AUTHOR CONTRIBUTIONS**

Preethi Raj M : Study Design, Data collection, Data Analysis, manuscript writing.

Yuvaraj Babu K: Study Concept, Data verification, Data Analysis, manuscript drafting and correction.

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## **CONFLICT OF INTEREST**

The authors reported the conflict of interest while performing this study to be nil.

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