# SEX IDENTIFICATION USING STERNAL MEASUREMENTS BY MULTI-SLICE COMPUTED TOMOGRAPHY IN A SAMPLE OF THE EGYPTIAN POPULATION

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## ABSTRACT

**Background:** Sex determination from bone fragment measurements is a critical aspect of forensic medicine. **Objectives**: This study aimed to identify sex from sternal measurements using multi-slice computed tomography among a sample of the Egyptian population. **Methods**: This cross-sectional study included 180 adult Egyptians (95 males, 85 females) who were recruited for chest examinations for various medical reasons. Three-dimensional thin multi-slice computed tomography covering the sternum was used. The sagittal images declared the manubrial length (ML), the sternal body length (BL), the combined manubrial and sternal body length (CL), and the total sternal length (TSL). The coronal images declared the manubrial width (MW), the sternal body width at the first sternebra (CS1W), and the sternal body width at the third sternebra (CS3W). The sternal index (SI) was calculated. The data were analyzed by calculating the area under the curve (AUC) and receiver operating characteristics (ROC) parameters. Binary logistic regression analysis was utilized to predict the male sex. **Results**: Male sternal measurements including ML, BL, CS1W, CS3W, TSL, MW, CL, the combined ML + MW, CS3W + BL, and CS1W + CS3W were statistically higher than the female except SI was higher in females than males (p<0.001). The ML, MW, BL, SI, as well as, ML + MW and CS3W + BL, had excellent areas under the curves. At cut-off levels >8.89 of BL, < 49.83 of SI, > 5.635 of MW, and > 11.675 of CS3W + BL**,** the accuracy levels of male sex identification were more than 90 %. **Conclusions**: Using multidetector computed tomography, the MW, BL, and SI measurements were highly significant for sex determination. The CS3W + BL is a valuable option for sex identification when only the sternum can be assessed. This study will establish a database for forensic anthropology for the sex identification of skeletal remains in Egypt.

**Keywords:** sex identification; sternum; multidetector-computed tomography; radiology

## INTRODUCTION

Forensic medicine is witnessing an increasing necessity to evaluate sex identification, particularly in medico-legal contexts. In instances where numerous judicial rulings are contingent upon sex identifications and where accurate gender identification is frequently essential in civil courts, the need for forensic medicine to address this issue is clear **(Franklin et al., 2015**). Furthermore, terrorist bombings can result in a significant loss of life. In such instances, the speed of the identification process has become a crucial factor. In the context of mass burial investigations, the analysis of individual preserved bone fragments within disintegrated bones can facilitate the process of identifying victims in a catastrophe **(Amores-Ampuero & Alemán, 2016**) **(Ellingham et al., 2017**)

The current recommended approach for identifying the sex of living individuals in forensic cases involves a combination of physical examination, X-ray inspection of the hip bone, and a radiographic or computer tomographic survey of the hip **(Schmeling et al., 2016**). Post-mortem examinations of skeletal remains, in conjunction with radiographs of living individuals, provide invaluable databank for the differentiation of sex **(Spradley & Jantz, 2011; Singh & Pathak, 2013; Verna et al., 2013; Wang et al., 2016**).

The sternum is a robust bone, and its ability to maintain its integrity is of paramount importance in terms of bone structure **(Robinson & Bidmos, 2009; Verna et al., 2013; Chandrakanth et al., 2014**). The majority of research on sternal length for determining sex has been conducted through cadaver dissections. The Forensic Anthropology Data Bank has announced a 59% recovery rate for skeletal remains **(Bongiovanni & Spradley, 2012**). Prior research has incorporated radiological sternal lengths as a means of determining sex in several populations, Jordanians **(Kalbouneh et al., 2021**), Indian **(Singh & Pathak, 2013**), Australian **(Franklin, Flavel, et al., 2012**), Egyptian **(Darwish et al., 2017**).

The applications of computed tomography (CT) in forensic age and sex identification have been documented. It is anticipated that forthcoming advancements will enhance the reliability of this forensic method for identifying sex **(Focardi et al., 2014**). When compared to standard radiography, it offers numerous advantages, particularly the lack of superimposition effects from other anatomical structures **(Christensen et al., 2018**). Nevertheless, it has been demonstrated that varying slice thicknesses significantly impact the precision of forensic evaluations of the sternum's developmental stage. It is currently recommended that a slice thickness of no more than 1 mm be used to ensure the most precise estimation **(Wittschieber et al., 2014**). The effective application of radiological measurements in forensic medicine necessitates the availability of validated data from a diverse range of ethnic populations worldwide **(Robinson & Bidmos, 2009; Verna et al., 2013**).

The Egyptian population is considered ethnically diverse due to the significant influx of refugees from surrounding countries. Due to the lack of traditional storage facilities for skeletal remains in Egypt, alternative means of identification must be used. The lack of osteometric data available to determine the sex of unidentified skeletal remains in Egypt represents a significant challenge. Thus, this study aimed to identify the sex from the sternal measurements using multi-slice computed tomography in a sample of the Egyptian population.

## SUBJECTS AND METHODS

### Ethical considerations

The ethical committee of the Faculty of Medicine at Tanta University in Egypt approved this study. The assigned identification code was 35814/9/22. Following a comprehensive description of the study's objectives and methodology, each participant or guardian provided written informed consent. To ensure the confidentiality of patient identities, we implemented measures to restrict investigators' access to the data.

### Design, Setting, and duration

This cross-section study evaluated healthy adult individuals as routine evaluation at the radiodiagnosis and medical imaging radiology department, Tanta University Hospital, between October 2022 and October 2023.

### Participants

The study included male and female volunteers over the age of 16 years who were referred to the radiology department for radiological investigations using a CT chest. We excluded patients with a history of sternum fracture, chronic disease, or treatment with steroids, chemotherapy, or immunosuppressive drugs, as these conditions could potentially affect bone formation.

### Computed tomography techniques and Measurements:

The imaging technique involved a high-resolution, thin-slice CT scan. This scan can focus only on the sternum region or be part of a previously ordered chest scan.

A 320-slice multidetector CT (Toshiba one aquilion) was used at radiodiagnosis and medical imaging, radiology department, Tanta University Hospital; the patient lies in the supine position, thorax cantered within the gantry and both arms elevated, the scan direction done craniocaudally extended from the lung apices to the chest bottom.

Imaging was performed with a slice thickness of 1 mm, a tube voltage of 120 kV and a tube current of 120 mAs. The images were processed after transfer to the workstation (Vitrea Fx Toshiba one aquilion), and in some cases, commercial software (RadiAnt DICOM viewer) was used. Three-dimensional (3D) reconstructed images were evaluated using volume rendering techniques. The sternum was examined in the bone window with maxim intensity projections (MIP) 8-10 mm, overlapping 50%. The photographs of each case were stored in a separate file with an unidentified case number. Each case file contained a pair of coronal and sagittal photographs. Two observers independently recorded measurements on both sides in centimeters (cm), and an average was calculated.

The following measurements were taken for this study (Figures 1 and 2):

- Manubrium length (ML) was measured from the jugular notch to the midpoint of the manubriosternal joint, along the sagittal plane **(Ekizoglu et al., 2014**) **(Franklin, Flavel, et al., 2012**).
- Body length (BL) was measured from the sternal angle to the sagittal midpoint of the xiphisternal joint (sagittal plane) **(Franklin, Flavel, et al., 2012**) **(Ekizoglu et al., 2014**).
- Combined length of manubrium and sternal body (CL) was measured from incisura jugularis to xiphisternal joint (sagittal plane)**(Franklin, Flavel, et al., 2012**) **(Ramadan et al., 2010**).
- Total sternal length (TSL) (including xiphoid process) was measured from incisura jugularis to distal point of xiphoid process (coronal plane) **(Yonguc et al., 2015**) **(Koşar et al., 2022**).
- Manubrium width (MW) was measured between the first incisura costalis on either side (coronal plane) **(Franklin, Flavel, et al., 2012**) **(Ramadan et al., 2010**).
- Sternebra 1 width (CS1W) was measured between the left and the right depressions between the articulation notches for the 2nd and 3rd costal cartilages **(Franklin, Flavel, et al., 2012**).
- Sternebra 3 width (CS3W) was measured between the left and right depressions between the articulation notches for the 4th and 5th costal cartilages **(Franklin, Flavel, et al., 2012**) **(Ekizoglu et al., 2014**).
- Sternal index (SI) was calculated as (ML/BL) x 100 **(Ekizoglu et al., 2014**).

## SAMPLE SIZE

The sample size was calculated using OpenEpi software. According to Kosar et al., the average monthly number of patients referred for CT at the radiology department of Tanta University Hospitals was 2500 **(Koşar et al., 2022**). CS3W's accuracy was 85.7%. Therefore, at a confidence interval of 95%, the estimated sample size was 176 participants. To account for potential dropouts, the sample size was increased to 180.

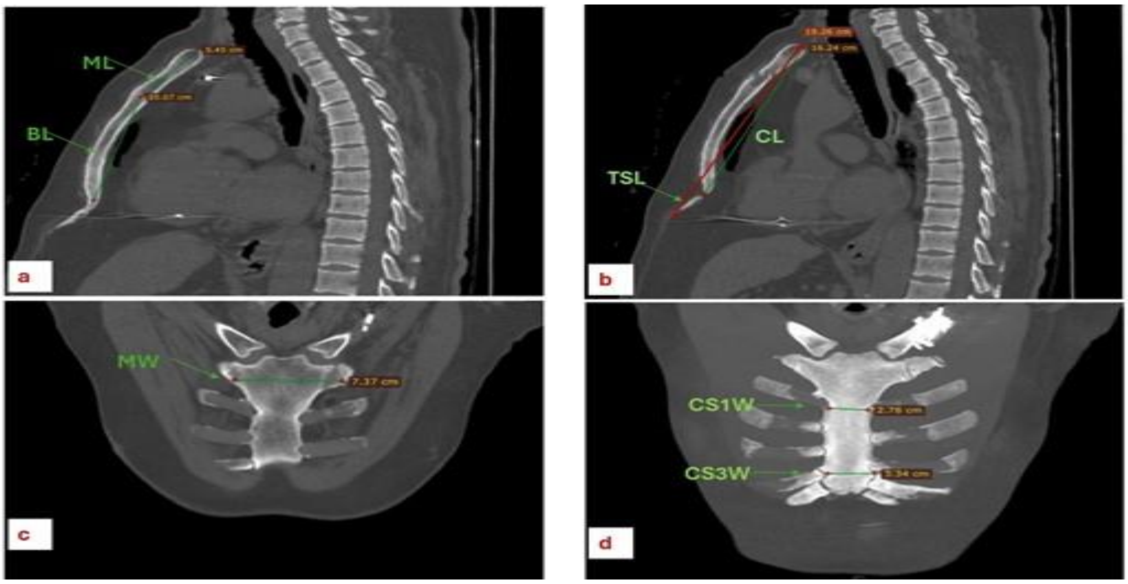


**Figure 1. Sagittal and coronal CT images of the sternum of a male patient.** (a) ML: Manubrium length; BL: Sternal body length, (b) CL: Combined length of manubrium and sternal body; TSL: Total sternal length, (c) MW: Manubrium width, (d) CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra.

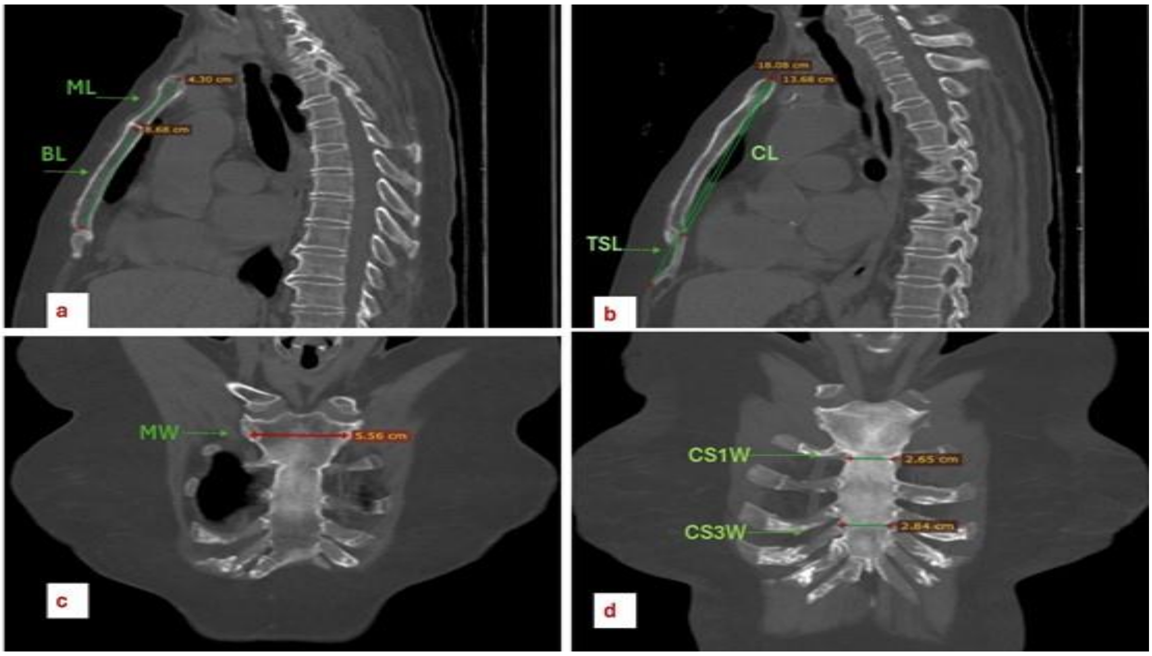


**Figure 2. Sagittal and coronal CT images of the sternum of a female patient**. (a) ML: Manubrium length; BL: Sternal body length, (b) CL: Combined length of manubrium and sternal body; TSL: Total sternal length, (c) MW: Manubrium width, (d) CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra.

## STATISTICAL ANALYSIS

The collected data were analyzed using the statistical computer package SPSS for Windows, version 25 (IBM Corp., Armonk, N.Y., USA). The Shapiro-Wilk test was performed to evaluate the distribution of numerical data for normality. Data were expressed as mean, standard deviation (SD), range, and the independent t-test (t) was used. The receiver operating characteristics (ROC) curve was used to calculate each score's appropriate cut-off value, sensitivity, specificity, and positive and negative predictive values (PPV and NPV). The area under the curve (AUC) was divided into different categories based on the following ranges: 0.9-1 = excellent; 0.8-0.9 = acceptable; 0.7-0.8 = fair; and 0.6-0.7 = poor. Binary logistic regression analysis was done for the prediction of the male sex (Y=

dependent variable). A p-value of less than 0.05 was chosen as the threshold for determining the significance of the statistical test results.

## RESULTS

This study recruited 180 participants. They were divided into a male group (95 males, 52.78 %) and a female group (85 females, 47.22 %). The mean age of females was 44.45 ± 18.60 years, and that of males was 43.13 ± 19.91 years. All measurements from the sternum, including ML, BL, CS1W, CS3W, TSL, MW, and CL, were statistically higher in males than females (p < 0.001). Meanwhile, the mean SI was statistically higher in females than in males (52.5 ± 1.68 vs 47.3 ± 2.23, p < 0.001). The combined sternal measurements, including ML + MW, CS3W + BL, and CS1W + CS3W, were statistically higher in males than females (p < 0.001, Table 1).

**Table 1:** Age and sternal measurements (n=180)

| | | Male (n=95) | Female (n=85) | Test of sig. t | P |
|---|---|---|---|---|---|
| **Age** | Mean ± SD | 43.13 ± 19.91 | 44.45 ± 18.60 | | 0. 6475 |
| | Range | 16.0 – 80.0 | 16.0 – 70.0 | 0.458 | |
| **ML (cm)** | Mean ± SD | 4.8 ± 0.49 | 4.0 ± 0.35 | | <0.001* |
| | Range | 3.0 – 5.75 | 3.2 – 4.8 | 11.502 | |
| **BL (cm)** | Mean ± SD | 10.2 ± 0.87 | 7.7 ± 0.74 | | <0.001* |
| | Range | 7.2 – 12.01 | 6.01 – 9.4 | 19.832 | |
| **SI** | Mean ± SD | 47.3 ± 2.23 | 52.5 ± 1.68 | | <0.001* |
| | Range | 37.5 – 53.55 | 43.82 – 56.41 | 17.072 | |
| **CS1W (cm)** | Mean ± SD | 2.7 ± 0.21 | 2.5 ± 0.18 | | <0.001* |
| | Range | 2.0 – 3.01 | 2.1 – 2.85 | 8.565 | |
| **CS3W (cm)** | Mean ± SD | 3.0 ± 0.30 | 2.7 ± 0.22 | | <0.001* |
| | Range | 2.1 – 3.61 | 2.21 – 3.1 | 8.838 | |
| **TSL (cm)** | Mean ± SD | 19.7 ± 2.48 | 16.9 ± 1.56 | | <0.001* |
| | Range | 16.45 – 25.2 | 13.0 – 19.8 | 9.303 | |
| **MW (cm)** | Mean ± SD | 6.4 ± 0.40 | 5.3 ± 0.16 | | <0.001* |
| | Range | 5.67 – 7.37 | 5.0 – 5.93 | 24.777 | |
| **CL (cm)** | Mean ± SD | 15.7 ± 1.54 | 13.2 ± 1.95 | | <0.001* |
| | Range | 12.29 – 19.7 | 10.2 – 17.2 | 8.923 | |
| **ML + MW (cm)** | Mean ± SD | 11.2 ± 0.67 | 9.4 ± 0.37 | 23.471 | <0.001* |
| | Range | 9.2 – 12.89 | 8.53 – 10.12 | | |
| **CS3W + BL (cm)** | Mean ± SD | 13.2 ± 1.04 | 10.4 ± 0.85 | | <0.001* |
| | Range | 9.3 – 15.44 | 8.41 – 12.11 | 19.165 | |
| **CS1W + CS3W (cm)** | Mean ± SD | 5.7 ± 0.44 | 5.2 ± 0.38 | 9.391 | <0.001* |
| | Range | 4.1 – 6.58 | 4.33 – 5.9 | | |

SD: standard deviation; t: Independent t test; n: number; ML: Manubrium length; BL: Sternal body length; CL: Combined length of manubrium and sternal body; TSL: Total sternal length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra; SI: Sternal index; *p ≤ 0.05 (Statistically significant).

Table 2 and Figs. 3, 4, and 5 show the ROC analysis for the optimal values in sex prediction. The MW, BL, and SI, as well as the combined CS3W and BL, had optimal sensitivity, specificity, and accuracy > 90% for sex prediction. The AUC of ML, MW, BL, and SI, as well as the combined measures of ML + MW and CS3W + BL, were in excellent ranges (0.9 - 1). At cut-off values > 8.89 for BL, < 49.83 for SI, > 5.635 for MW, and > 11.68 for CS3W + BL, the accuracy of sex determination was 93.9%, 97.2%, 99.4%, and 94.4%, respectively.

Binary logistic regression analysis was utilized to predict the male sex. The predicted equations models for the male sex were clarified in Table 3.

Table 4 shows the mean values of sternal measurements by multi-slice CT in different populations, including Egyptian, Turkish, Spanish, Australian, and Japanese.

**Table 2.** Receiver operating characteristics (ROC) curve for sternal measures in diagnosis of male sex

| | AUC | P value | 95% C.I | Cut off | Sensitivity | Specificity | PPV | NPV | Accuracy |
|---|---|---|---|---|---|---|---|---|---|
| **ML** | 0.915 | $<0.001^*$ | 0.868 – 0.963 | >4.495 | 89.5 | 88.0 | 91.3 | 85.7 | 88.9 |
| **BL** | 0.971 | $<0.001^*$ | 0.948 – 0.994 | >8.89 | 93.3 | 94.7 | 96.1 | 91.0 | 93.9 |
| **SI** | 0.974 | $<0.001^*$ | 0.945 – 1.00 | <49.83 | 98.7 | 96.2 | 94.9 | 99.0 | 97.2 |
| **CS1W** | 0.836 | $<0.001^*$ | 0.777 – 0.895 | >2.59 | 81.0 | 73.3 | 81.0 | 73.3 | 77.8 |
| **CS3W** | 0.828 | $<0.001^*$ | 0.768 – 0.887 | >2.815 | 79.0 | 70.7 | 79.0 | 70.7 | 75.6 |
| **TSL** | 0.831 | $<0.001^*$ | 0.773 – 0.889 | >17.95 | 72.4 | 70.7 | 77.6 | 64.6 | 71.7 |
| **MW** | 0.999 | $<0.001^*$ | 0.996 – 1.00 | >5.635 | 100.0 | 98.7 | 99.1 | 100.0 | 99.4 |
| **CL** | 0.833 | $<0.001^*$ | 0.768 – 0.897 | >14.51 | 79.0 | 78.7 | 83.8 | 72.8 | 78.9 |
| **ML + MW** | 0.980 | $<0.001^*$ | 0.96 – 0.999 | >9.69 | 96.2 | 80.0 | 87.1 | 93.8 | 89.4 |
| **CS3W + BL** | 0.965 | $<0.001^*$ | 0.936 – 0.993 | >11.675 | 94.3 | 94.7 | 96.1 | 92.2 | 94.4 |
| **CS1W + CS3W** | 0.865 | $<0.001^*$ | 0.811 – 0.919 | >5.495 | 81.0 | 78.7 | 84.2 | 74.7 | 80.0 |

ML: Manubrium length; BL: Sternal body length; CL: Combined length of manubrium and sternal body; TSL: Total sternal length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra; SI: Sternal index; AUC: Area Under a Curve; p-value: Probability value; CI: Confidence Intervals; NPV: Negative predictive value; PPV: Positive predictive value; *: Statistically significant at $p \leq 0.05$.

**Table 3:** Binary logistic regression for predictors of male sex identification (y dependent variable)

| | Equation | Wald | Sig. | OR | 95% C.I. for OR Lower | 95% C.I. for OR Upper |
|---|---|---|---|---|---|---|
| **ML** | y = 0.08 + 0.56 * x | 48.681 | <0.001* | 35.739 | 13.087 | 97.598 |
| **BL** | y = 0.01 + 0.28 * x | 47.000 | <0.001* | 14.862 | 6.871 | 32.149 |
| **SI** | y = 8.47 - 0.12 * x | 42.449 | <0.001* | 0.227 | 0.146 | 0.355 |
| **CS1W** | y = -0.41 + 1.14 * x | 39.722 | <0.001* | 420.950 | 64.290 | 2756.245 |
| **CS3W** | y = 0.17 + 0.84 * x | 35.400 | <0.001* | 182.862 | 32.880 | 1016.974 |
| **TSL** | y = 0.63 + 0.11 * x | 34.395 | <0.001* | 2.480 | 1.831 | 3.359 |
| **MW** | y = -1.44 + 0.68 * x | 11.945 | 0.001* | 30855235.4 | 1746.52 | 545110294311.2 |
| **CL** | y = 0.61 + 0.13 * x | 42.592 | <0.001* | 2.144 | 1.705 | 2.696 |
| **ML + MW** | y = -1.5 + 0.39 * x | 31.818 | <0.001* | 157.463 | 27.148 | 913.311 |
| **CS3W + BL** | y = -0.32 + 0.24 * x | 48.651 | <0.001* | 9.171 | 4.920 | 17.094 |
| **CS1W + CS3W** | y = -0.49 + 0.56 * x | 41.297 | <0.001* | 26.595 | 9.778 | 72.334 |

ML: Manubrium length; BL: Sternal body length; CL: Combined length of manubrium and sternal body; TSL: Total sternal length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra; SI: Sternal index; OR: Odds Ratio; CI: confidence interval; y: dependant variable (prediction of male); x: independent variable; *: Statistically significant at $p \leq 0.05$.

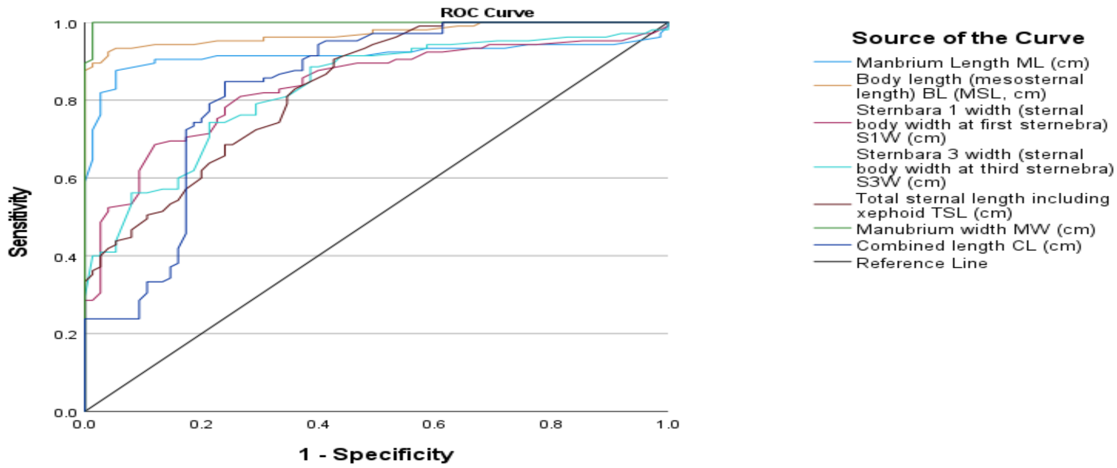


**Figure 3. Receiver operating characteristics (ROC) curve analysis of sternal measurements;** ML: Manubrium length; BL: Sternal body length; CL: Combined length of manubrium and sternal body; TSL: Total sternal length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra.

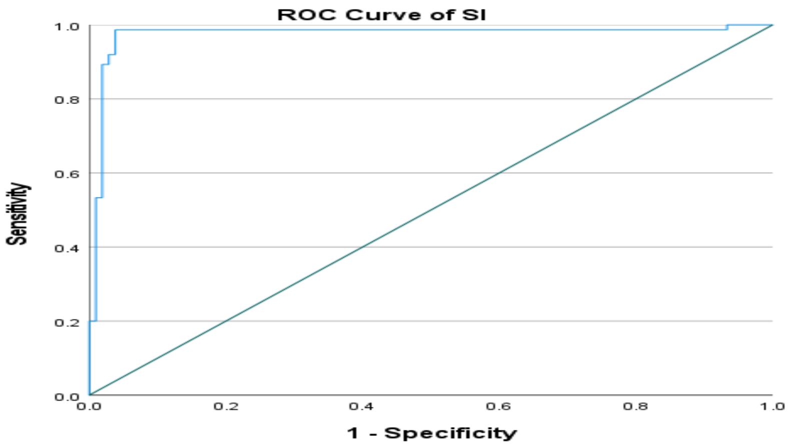


**Figure 4. Receiver operating characteristics (ROC) curve analysis of the sternal index.**

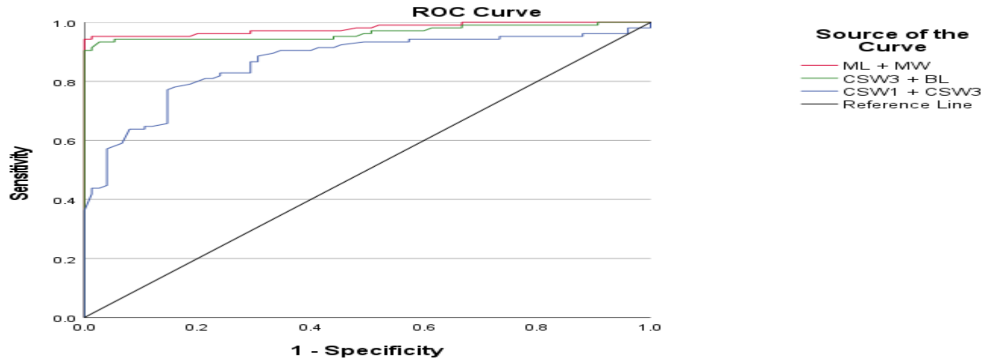


**Figure 5. Receiver operating characteristics (ROC) curve analysis of the combined ML + MW, CSW3 + BL, and CSW1 + CSWM.** ML: Manubrium length; BL: Sternal body length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra**.**

**Table 4.** Population-specific mean sternal measurements (by centimetres) through Multi-Slice Computer Tomography scan.

| | **ML** | | **BL** | | **SI** | | **CS1W** | | **CS3W** | | **MW** | | **CL** | | **TSL** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** | **M** | **F** |
| **The Current Study** | 4.8 | 4.01 | 10.2 | 7.7 | 47.3 | 52.5 | 2.7 | 2.5 | 3 | 2.7 | 6.4 | 5.3 | 15.7 | 13.2 | 19.7 | 16.9 |
| **Egyptian (Darwish et al., 2017)** | 4.64 | 3.76 | 10.30 | 8.67 | | | 2.87 | 2.51 | 3.51 | 2.93 | 6.44 | 5.49 | | | | |
| **Egyptian (Elsayed et al., 2022)** | 5.17 | 4.62 | 9.93 | 8.9 | | | 2.51 | 2.22 | 2.92 | 2.6 | | | | | | |
| **Egyptian (Sweilum et al., 2017)** | 4.7 | 4.23 | 9.83 | 7.69 | 47.8 | 55.1 | 2.64 | 2.33 | 3.36 | 2.69 | 6.64 | 5.43 | 14.53 | 11.93 | | |
| **Egyptian (Ali et al., 2021)** | 5.03 | 4.76 | 9.63 | 8.23 | 52.52 | 58.97 | 2.78 | 2.30 | 3.27 | 2.81 | | | | | | |
| **Jordanian (Kalbouneh et al., 2021)** | 4.97 | 4.71 | 10.14 | 8.45 | 49.3 | 56.4 | 2.85 | 2.49 | 3.47 | 3.04 | 6.44 | 5.48 | 15.12 | 13.16 | | |
| **Saudi Arabian (Ahmed et al., 2017)** | 4.78 | 4.33 | 9.75 | 8.16 | 49.39 | 53.56 | 2.49 | 2.18 | 3.03 | 2.67 | 5.30 | 4.72 | 14.53 | 12.49 | | |
| **Turkish (Koşar et al., 2022)** | 5.371 | 4.90 | 10.36 | 8.41 | 52.54 | 59.25 | 2.86 | 2.50 | 3.36 | 2.92 | 5.93 | 5.14 | 15.65 | 13.20 | 19.87 | 16.41 |
| **Turkish (Ekizoglu et al., 2014)** | 5.25 | 4.82 | 10.49 | 8.91 | 50.7 | 54.7 | 2.88 | 2.50 | 3.41 | 3.02 | | | | | | |
| **Turkish (Ramadan et al., 2010)** | 5.39 | 5.03 | 10.07 | 8.51 | 54.1 | 59.8 | 2.87 | 2.52 | 3.49 | 3.07 | 6.1 | 5.4 | 15.46 | 13.54 | | |
| **Western Australian (Franklin, Flavel, et al., 2012)** | 4.90 | 4.53 | 10.29 | 8.49 | 48.02 | 54.32 | 2.72 | 2.34 | 3.32 | 2.91 | 5.72 | 5.02 | 15.20 | 13.02 | | |
| **Spaniards (Macaluso & Lucena, 2014)** | 5.185 | 4.59 | 10.63 | 8.78 | 49.22 | 52.8 | 2.83 | 2.47 | 3.54 | 3.02 | 5.98 | 5.18 | 15.81 | 13.36 | | |
| **Japanese (Torimitsu et al., 2015)** | 5.02 | 4.70 | 10.11 | 8.63 | 50.21 | 54.97 | 2.92 | 2.49 | 3.30 | 2.72 | 5.86 | 5.07 | 15.13 | 13.32 | | |

M: male; F: female; ML: Manubrium length; BL: Sternal body length; CL: Combined length of manubrium and sternal body; TSL: Total sternal length; MW: Manubrium width; CS1W: Sternal body width at first sternebra; CS3W: Sternal body width at third sternebra; SI: Sternal index.

## DISCUSSION

The fundamental anthropological approaches for determining the sex of skeletal remains involve the analysis of different bones using direct measurements or radiological techniques. The primary challenges in collecting bones of high integrity include trauma, putrefaction, and disappearance due to numerous causes (**Ellingham et al., 2017**). In such cases, evidence obtained from a solitary bone may hold significance in determining the sex of an individual (**Byers, 2002**) (**Sutherland & Suchey, 1991**). Hence, this study aimed to identify the sex from the sternal measurements using multi-slice computed tomography in an Egyptian population.

Our main findings were that male sternal measurements, including ML, BL, CS1W, CS3W, TSL, MW, and CL, as well as the combined ML + MW, CS3W + BL, and CS1W + CS3W, were statistically higher than those of females. Meanwhile, SI was statistically higher in females compared to males. Based on the ROC curve analysis, the MW, BL, and SI, as well as the combined CS3W and BL, had the highest AUC and accuracy > 90%. Using the multi-slice CT scans, the sternal measurements differed between the populations.

It is important to examine the efficacy of sternum measurements for sex identification. Skeletal remains can sometimes be subjected to direct measurement studies, although this is not always feasible. There is a lot of research because radiographic methods are becoming increasingly important in clinical diagnosis (**Hunnargi et al., 2008**) (**Krogman & Iscan, 1986**).

From a technical point of view, CT and MRI offer high resolution and allow the acquisition of three-dimensional images. For morphometric research, these features can provide a great deal of detail. According to the Royal College of Radiologists, radiological images increased by 26.5% in 2012 compared to 2004/2005. They recorded an 86% increase in CT utilization. Between 2006 and 2020, CT chest studies increased by more than 500% (**Bruls & Kwee, 2020**).

In the current study, the sex morphology we examined reaches maturity around 16 years of age. Starting the sample at this age allowed us to capture the full range of variation in the adult sternal shape, which was necessary for developing reliable sex estimation methods (**Rogers, 2009**). Furthermore, the mean age was comparable between males and females, allowing for a more accurate comparison. Similarly, Darwish et al. (**2017**) recruited an equal number of female and male participants in a 1:1 ratio. This is consistent with Wadhawan et al. (**2009**), where cases were also evenly distributed across both genders.

While the basic construction of the sternum is similar in men and women, early research indicates that the male sternum tends to be longer, narrower (especially in the lower two-thirds), thicker, and much stronger than the female sternum (**Torwalt & Hoppa, 2005**) (**Selthofer et al., 2006**) (**Mahajan et al., 2009**) (**Paterson, 1904**) (**Stewart & McCormick, 1983**). The sternum's metric characteristics showed significant sex differences. These can be attributed to differences in body size between males and females, the effects of different selection pressures on the shoulder-thoracic region, and the influence of different hormonal factors that regulate sternal growth in each sex.

In this study population, the sternal measurements were statistically higher in males than females. Similarly, previous research on the Egyptian population (**Darwish et al., 2017**) (**Elsayed et al., 2022**) (**Sweilum et al., 2017**) and different populations (**Emeka et al., 2010**) (**Ekizoglu et al., 2014**) (**Mall et al., 1991**) (**Franklin, Cardini, et al., 2012**) have observed notable distinctions between male and female sternal morphometrics. Evaluating similarities and assessing the similarities and differences in morphometric analysis data from previous research is critical to establishing the trustworthiness of measurement methods.

Sex-specific regression algorithms have been developed to estimate the biological sex of an individual accurately. However, accurately determining the sex of bones and fragments can be challenging, even for experts in the field (**Chandrakanth et al., 2014**). It can lead to misunderstandings, especially when bones and body parts lack consistent sexual dimorphic characteristics. Under these circumstances, it is advisable to use regression methods to improve the accuracy of sex estimation. However, it is important to note that there is variability among studies. Therefore, it is important to tailor each formula to a specific demographic and update it periodically.

Studies focusing on specific populations have demonstrated that the mean sternum measurements of individuals in South Africa **(Macaluso, 2010**) and India **(Hunnargi et al., 2008**) **(Mukhopadhyay, 2010**) **(Singh et al., 2012**) **(Menezes et al., 2009**) are comparatively smaller than those of individuals in the United States **(Spradley & Jantz, 2011**) **(Bongiovanni & Spradley, 2012**), Canada **(Spradley & Jantz, 2011**), and Europe **(Marinho et al., 2012**) **(Torwalt & Hoppa, 2005**) **(Teige, 1983**). However, it is important to note that ethnic variations within country populations may also influence the outcomes. Previous studies comparing populations in North and West India revealed higher sternal measurements for females in North India and higher sternal measurements for males in West India. Therefore, population differences can be determined using sternal measurements **(Hunnargi et al., 2008**) **(Mukhopadhyay, 2010**) **(Singh et al., 2012**) **(Menezes et al., 2009**).

In the Egyptian population, Darwish et al., **(2017**) conducted a study using a sample of 60 adults from Alexandria University Hospitals, located in northern Egypt. The researchers found that multi-slice CT scanning provides a significant advantage in examining skeletal remains and highly degraded individuals. The sternal measurements, sternal area, and the width of the fourth rib proved to be the most accurate. In addition, Torwalt and Hoppa **(2005**) and Ramadan et al. **(2010**) found that the combination of sternal area and fourth rib provided the most accurate results for sex determination.

Elsayed et al., **(2022**) conducted a study on 100 adult participants selected from Sohag University Hospitals, located in the south of Egypt. Elsayed and his colleagues reported that the BL and CL were the best-discriminating variables between genders, with an overall accuracy of 100% in both females and males.

Sweilum et al. **(2017**) conducted a study on 261 CTs of adult Egyptians (159 males, 102 females) from Menoufia governorate, located in the middle of the Nile Delta region. They indicated that a CT scan of the sternum and fourth rib is a quick and simple technique that can be used to determine the sex of an Egyptian population with high reliability for sex determination. Furthermore, ROC analysis showed that although BL alone had higher sensitivity and specificity values for sex determination (83% and 70.6%, respectively), TSL had higher sensitivity and specificity (88.6% and 84.3%).

In a subsequent study on Egypt, Ali et al. **(2021**) examined 165 multidetector CT scans. The sex estimate assessed five sternal measurements, namely ML, BL, CS1W, CS3W, and SI. The researchers concluded that all of the sternal measurements examined were relevant for assessing sexual differences in the sternum. The binary logistic regression formula is a reliable statistical method for predicting the sex of individuals in the Egyptian population. Consequently, utilizing the aforementioned sternal measurements for sex estimation in the Egyptian population is a highly encouraging method.

The integration of data from studies conducted in various locations throughout Egypt with a substantial number of cases is expected to facilitate the establishment of an Egyptian forensic anthropological database. This, in turn, is expected to make significant contributions to forensic medicine and forensic anthropology.

The MW, BL, and SI in our study population had excellent AUC and accuracy for predicting sex based on ROC curve analysis. Although there may be variations in BL measures between different groups based on sex, numerous studies have consistently demonstrated accuracies ranging from 70% to 85% with good levels of reliability. The BL demonstrated the highest levels of sensitivity and specificity, with values of 75.9% and 87.6%, respectively, using a cut-off value of 98.7. In a Spanish population, Macaluso et al. **(2014**) 89.7% of the samples had sex discrimination accuracy when the measures of MW, BL, CSWS1, and CSWS3 were analyzed stepwise. In the literature, the reliabilities of BL were found to be higher than those of ML, CS1W, and CS3W, **(Bongiovanni & Spradley, 2012**) **(Franklin, Cardini, et al., 2012; Ekizoglu et al., 2014**). In the Gujarat population, Changani et al. (**2014**) found that BL was not a reliable indicator of sex, as most of the male and female samples overlapped.

The SI is calculated by dividing ML by BL and multiplying the result by 100. Hyrtl's law states that the SI is less than 50 in males and greater than 50 in females. In the Turkish population, Koşar et al. (**2022**) found the accuracy rate of SI was 66.1% for predicting females and 66.4% for males. The cut-off value determined in the ROC analysis was 52.69. Meanwhile, Ramadan et al., (**2010**) reported that the cut-off value determined by ROC analysis was 54.5. The study found that females had an accuracy rate of 72% and males had an accuracy rate of 60% in predicting sex.

A study conducted on the sternum bones of both black and white American populations found that the average scores showed a high degree of similarity between both sexes (**Bongiovanni & Spradley, 2012**). Conversely, in other populations, mean scores have been shown to vary, particularly in females. The study variation has been attributed to several causes, including genetic, environmental, and socioeconomic influences. Physical activity affects the amount and length of growth, hormone levels, and muscle mass (**Krogman & Iscan, 1986**) (**Scheuer, 2002**). Therefore, it is expected that developing algorithms tailored to individual populations would be more advantageous than using universal formulas to estimate sex. Nevertheless, numerous studies have demonstrated that the SI is an unreliable metric due to the substantial overlap across sexes and the resulting strong bias towards a particular sex (**Bongiovanni & Spradley, 2012**) (**Ekizoglu et al., 2014; Ahmed et al., 2017**).

The measurement of CL varies between populations, with accuracy rates ranging from 74.4% to 85.1% (**Franklin, Flavel, et al., 2012**) (**Macaluso & Lucena, 2014**) (**Chandrakanth et al., 2014**). In the Spanish population, Macaluso and Lucena (**Macaluso & Lucena, 2014**) showed an 81% predictive success rate for sex determination using CL. In the Gujarat population, Changani et al. (**2014**) found that the most accurate measurement for determining sex from the sternum was the CL. In Turkish population, Koşar et al. (**2022**) and Ekizoğlu et al. (**2014**) found a high prediction of sex from the sternum by using the CL value, while Yonguç et al. (**2015**) reported that CL was the highest predictor for sex after BL.

Zhang et al. (**2016**) found a 76.1% success rate of the MW measurement in predicting the sex of individuals. The BL had a prediction success rate of 78.4%. The CL accurately predicted the sex of 82.4%. In the central Delhi population, Gupta et al. (**2014**) found that the ML was the most reliable measurement for sex determination.

In case it is not possible to collect the whole sternum, it is imperative to use models based on the available parts of the sternum. For example, Koşar et al. (**2022**) found that the ML + MW model can be used when only the manubrium is available, and the CS3W + BL model can be used when only the sternal body is available. This approach provides reliable results for researchers conducting sex determination. Macaluso and Lucena (**2014**) revealed an accuracy rate of 89.7% for BL + CS1W and 87.1% for ML + MW. Bongiovonni and Spradley found that the ML, BL, and CS1W models had an accuracy rate of 82.75%. When all parameters were utilized together, the accuracy rate increased to 84.12% (**Bongiovanni & Spradley, 2012**).

**Limitation**: This cross-sectional study was conducted on a small number of participants from a single Egyptian governorate.

## CONCLUSION

Multidetector computed tomography is a useful method to determine sex using sternal measurements. For accurate sex determination, MW, BL and SI measurements were highly significant. The CS3W + BL is a valuable option for sex determination in cases where only the sternum can be assessed. Furthermore, this study establishes a forensic anthropological database for sex determination of skeletal remains in Egypt.

**Recommendation:** Further studies, including different Egyptian governorates, are needed to establish an Egyptian forensic anthropological databank.

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**List of abbreviations**

The sagittal images declared the manubrial length (ML), The sternal body length (BL),

The combined manubrial and sternal body length (CL), The total sternal length (TSL), The coronal images declared the manubrial width (MW), The sternal body width at the first sternebra (CS1W), The sternal body width at the third sternebra (CS3W), The sternal index (SI).

## REFERENCES:


**Ahmed, A. A., Alshammari, F. O., Alrafiaah, A. S., Almohaisani, A. A., Al-Mohrej, O. A., & Alkubaidan, F. O. (2017):** Estimation of sex in a contemporary Saudi population based on sternal measurements using multidetector computed tomography. *HOMO,* 68(6), 411-421.

**Ali, M. I. M., Mosallam, W., Mostafa, E. M. A., Aly, S. M., & Ali, N. M. (2021):** Sternum as an indicator for sex and age estimation using multidetector computed tomography in an Egyptian population. *Forensic Imaging,* 26, 200457.

**Amores-Ampuero, A., & Alemán, I. (2016):** Comparison of cranial sex determination by discriminant analysis and logistic regression. *Anthropol Anz,* 73(3), 207-214.

**Bongiovanni, R., & Spradley, M. K. (2012):** Estimating sex of the human skeleton based on metrics of the sternum. *Forensic Sci Int,* 219(1-3), 290.e291-297.

**Bruls, R. J. M., & Kwee, R. M. (2020):** Workload for radiologists during on-call hours: dramatic increase in the past 15 years. *Insights into Imaging,* 11(1), 121.

**Byers, S. N. (2002)**: *Introduction to forensic anthropology : a textbook*. Boston: Allyn and Bacon.

**Chandrakanth, H. V., Kanchan, T., & Krishan, K. (2014):** Osteometric analysis for sexing of modern sternum - an autopsy study from South India. *Leg Med (Tokyo),* 16(6), 350-356.

**Changani, M., Chudasama, J., Talsaniya, D., Vadgama, J., Thummar, B., & Singel, T. (2014):** Determination of sex from the width and the area of human sternum & manubrium in Gujarat population. *Journal of Research in Medical and Dental Science,* 2, 13.

**Christensen, A. M., Smith, M. A., Gleiber, D. S., Cunningham, D. L., & Wescott, D. J. J. F. A. (2018):** The Use of X-ray Computed Tomography Technologies in Forensic Anthropology. *Forensic Anthropology,,* 1(2), 124-141.

**Darwish, R. T., Abdel-Aziz, M. H., El Nekiedy, A. M., & Sobh, Z. K. (2017):** Sex determination from chest measurements in a sample of Egyptian adults using Multislice Computed Tomography. *J Forensic Leg Med,* 52, 154-158.

**Ekizoglu, O., Hocaoglu, E., Inci, E., Bilgili, M. G., Solmaz, D., Erdil, I., & Can, I. O. (2014):** Sex estimation from sternal measurements using multidetector computed tomography. *Medicine (Baltimore),* 93(27), e240.

**Ellingham, S., Cordner, S., & Tidball-Binz, M. (2017):** Revised practical guidance for first responders managing the dead after disasters. *International Review of the Red Cross,* 98, 1-23.

**Elsayed, r. m., Soliman, s. a., Said, A. m., & Allam, S. A. (2022):** Determination of Gender from Sternal Measurements Using Computed Tomography Imaging in a Sample of Sohag Governorate Population. . *J Zagazig Journal of Forensic Medicine,* 20(2), 90-110.

**Emeka, O., Gwunireama, I., Orish, C., Ordu, K., & Ebowe, I. (2010):** A study of sexual dimorphism of the human sternum in the southern Nigerian population. *J. Appl. Biosci.,* 26, 1636-1639.

**Focardi, M., Pinchi, V., De Luca, F., & Norelli, G. A. (2014):** Age estimation for forensic purposes in Italy: ethical issues. *Int J Legal Med,* 128(3), 515-522.

**Franklin, D., Cardini, A., Flavel, A., & Kuliukas, A. (2012):** The application of traditional and geometric morphometric analyses for forensic quantification of sexual dimorphism: preliminary investigations in a Western Australian population. *Int J Legal Med,* 126(4), 549-558.

**Franklin, D., Flavel, A., Kuliukas, A., Cardini, A., Marks, M. K., Oxnard, C., & O'Higgins, P. (2012):** Estimation of sex from sternal measurements in a Western Australian population. *Forensic Sci Int,* 217(1-3), 230.e231-235.

**Franklin, D., Flavel, A., Noble, J., Swift, L., & Karkhanis, S. (2015):** Forensic age estimation in living individuals: methodological considerations in the context of medico-legal practice. *Res Rep Forensic Med Sci,* 5, 53-66.

**Gupta, M. C., Kumar, G. P., & Khana, S. K. (2014):** Determination of Sex from sternal bone in Central Delhi Population. *Journal of Indian Academy of Forensic Medicine*, 36(3), 234-237.

**Hunnargi, S. A., Menezes, R. G., Kanchan, T., Lobo, S. W., Binu, V. S., Uysal, S., . . . Garg, R. K. (2008):** Sexual dimorphism of the human sternum in a Maharashtrian population of India: a morphometric analysis. *Leg Med (Tokyo),* 10(1), 6-10.

**Kalbouneh, H., Mubarak, N., Daradkeh, S., Ashour, O., Alkhatib, A. M., Suboh, L., . . . Alsalem, M. (2021):** Estimation of sex based on metrics of the sternum in a contemporary Jordanian population: A computed tomographic study. *Medicine (Baltimore),* 100(49), e28169.

**Koşar, M. İ., Uğuz Gençer, C., Tetiker, H., Yeniçeri, İ. Ö., & Çullu, N. (2022):** Sex and stature estimation based on multidetector computed tomography imaging measurements of the sternum in Turkish population. *Forensic Imaging,* 28, 200495.

**Krogman, W., & Iscan, M. (1986)**. *The Human Skeleton in Forensic Medicine*. In.

**Macaluso, P. J., Jr. (2010):** The efficacy of sternal measurements for sex estimation in South African blacks. *Forensic Sci Int,* 202(1-3), 111.e111-117.

**Macaluso, P. J., & Lucena, J. (2014):** Estimation of sex from sternal dimensions derived from chest plate radiographs in contemporary Spaniards. *Int J Legal Med,* 128(2), 389-395.

**Mahajan, Pal Singh Batra, A., & Khurana. (2009):** Sex determination of human sterna in North Indians. *Punjab Academy of Forensic Medicine & Toxicology,* 9, 12-15.

**Mall, G., Sprinzl, G., & Koebke, J. (1991):** [Clinical morphology of the sternum]. *Biomed Tech (Berl),* 36(11), 288-289. doi:10.1515/bmte.1991.36.11.288

**Marinho, L., Almeida, D., Santos, A., & Cardoso, H. F. (2012):** Is the length of the sternum reliable for estimating adult stature? A pilot study using fresh sterna and a test of two methods using dry sterna. *Forensic Sci Int,* 220(1-3), 292.e291-294.

**Menezes, R. G., Kanchan, T., Kumar, G. P., Rao, P. P., Lobo, S. W., Uysal, S., . . . Shettigar, S. (2009):** Stature estimation from the length of the sternum in South Indian males: a preliminary study. *J Forensic Leg Med,* 16(8), 441-443.

**Mukhopadhyay, P. (2010):** Determination of sex from adult sternum by discriminant function analysis on autopsy sample of indian bengali population: A new approach. *J Indian Acad Forensic Med,* 32(4).

**Paterson, A. M. (1904)**: *The human sternum*. Liverpool: Williams & Norgate.

**Ramadan, S. U., Türkmen, N., Dolgun, N. A., Gökharman, D., Menezes, R. G., Kacar, M., & Koşar, U. (2010):** Sex determination from measurements of the sternum and fourth rib using multislice computed tomography of the chest. *Forensic Sci Int,* 197(1-3), 120.e121-125.

**Robinson, M. S., & Bidmos, M. A. (2009):** The skull and humerus in the determination of sex: reliability of discriminant function equations. *Forensic Sci Int,* 186(1-3), 86.e81-85.

**Rogers, T. L. (2009):** Sex determination of adolescent skeletons using the distal humerus. *Am J Phys Anthropol,* 140(1), 143-148.

**Scheuer, L. (2002):** Application of osteology to forensic medicine. *Clin Anat,* 15(4), 297-312.

**Schmeling, A., Dettmeyer, R., Rudolf, E., Vieth, V., & Geserick, G. J. D. Ä. I. (2016):** Forensic age estimation: methods, certainty, and the law. *Deutsches Ärzteblatt International,*, 113(4), 44.

**Selthofer, R., Nikolić, V., Mrcela, T., Radić, R., Leksan, I., Rudez, I., & Selthofer, K. (2006):** Morphometric analysis of the sternum. *Coll Antropol,* 30(1), 43-47.

**Singh, J., & Pathak, R. K. (2013):** Sex and age related non-metric variation of the human sternum in a Northwest Indian postmortem sample: a pilot study. *Forensic Sci Int,* 228(1-3), 181.e181-112.

**Singh, J., Pathak, R. K., & Singh, D. (2012):** Morphometric sex determination from various sternal widths of Northwest Indian sternums collected from autopsy cadavers: A comparison of sexing methods. *Egyptian Journal of Forensic Sciences,* 2(1), 18-28.

**Spradley, M. K., & Jantz, R. L. (2011):** Sex estimation in forensic anthropology: skull versus postcranial elements. *J Forensic Sci,* 56(2), 289-296.

**Stewart, J. H., & McCormick, W. F. (1983):** The gender predictive value of sternal length. *Am J Forensic Med Pathol,* 4(3), 217-220.

**Sutherland, L. D., & Suchey, J. M. (1991):** Use of the ventral arc in pubic sex determination. *J Forensic Sci,* 36(2), 501-511.

**Sweilum, O. A. H., Galal, H. K. A., & Habib, R. M. (2017):** Determination of sex from the sternum and fourth rib measurements (a cross-sectional study (using thoracic computed tomography (CT) images. *J The Egyptian Journal of Forensic Sciences,* 17(2), 27-38.

**Teige, K. (1983):** [Morphometric studies of x-rays of the sternum]. *Z Rechtsmed,* 90(3), 199-204.

**Torimitsu, S., Makino, Y., Saitoh, H., Sakuma, A., Ishii, N., Inokuchi, G., . . . Iwase, H. (2015):** Estimation of sex in Japanese cadavers based on sternal measurements using multidetector computed tomography. *Leg Med (Tokyo),* 17(4), 226-231.

**Torwalt, C. R., & Hoppa, R. D. (2005):** A test of sex determination from measurements of chest radiographs. *J Forensic Sci,* 50(4), 785-790.

**Verna, E., Piercecchi-Marti, M. D., Chaumoitre, K., Bartoli, C., Leonetti, G., & Adalian, P. (2013):** Discrete traits of the sternum and ribs: a useful contribution to identification in forensic anthropology and medicine. *J Forensic Sci,* 58(3), 571-577.

**Wadhawan, M., Murari, A., & Naik, S. (2009):** Correlation between age and degree of fusion, between sternal joints. *J Indian J Forensic Med Pathol,* 2, 83-87.

**Wang, Y., Cao, L., Bai, Z., Reed, M. P., Rupp, J. D., Hoff, C. N., & Hu, J. (2016):** A parametric ribcage geometry model accounting for variations among the adult population. *J Biomech,* 49(13), 2791-2798.

**Wittschieber, D., Schulz, R., Vieth, V., Kuppers, M., Bajanowski, T., Ramsthaler, F., . . . Schmeling, A. (2014):** Influence of the examiner's qualification and sources of error during stage determination of the medial clavicular epiphysis by means of computed tomography. *Int J Legal Med,* 128(1), 183-191.

**Yonguc, G. N., Kurtulus, A., Bayazit, O., Adiguzel, E., Unal, I., Demir, S., & Acar, K. (2015):** Estimation of stature and sex from sternal lengths: an autopsy study. *Anatomical Science International,* 90(2), 89-96.

**Zhang, K., Cui, J. H., Luo, Y. Z., Fan, F., Yang, M., Li, X. H., . . . Deng, Z. H. (2016):** Estimation of stature and sex from scapular measurements by three-dimensional volume-rendering technique using in Chinese. *Leg Med (Tokyo),* 21, 58-63.

# تحديد الجنس من خلال عظم القص
# في عينة من المصريين باستخدام الأشعة المقطعية متعددة الشرائح

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**المقدمة:** يعد تحديد الجنس من قياسات شظايا العظام جانبًا مهمًا في الطب الشرعي. **الهدف من الدراسة:** تهدف هذه الدراسة إلى تحديد جنس الأفراد من قياسات عظمة القص باستخدام التصوير المقطعي المحوسب متعدد الشرائح ضمن عينة من السكان المصريين. **طريقة البحث:** تضمنت هذه الدراسة المقطعية عدد ١٨٠ مصريًا بالغًا (٨٥ من الإناث و٩٥ من الذكور) والذين خضعوا لفحص الصدر لأسباب طبية مختلفة. تم استخدام التصوير المقطعي المحوسب ثلاثي الأبعاد متعدد الشرائح الرفيعة الذي يغطي عظمة القص. حددت الصور طول الحدبة (ML) وطول جسم عظمة القص (BL) والطول المشترك للحدبة وجسم عظمة القص (CL) والطول الكلي لعظمة القص .(TSL) وأظهرت الصور الإكليلية عرض الحدبة (MW) وعرض جسم عظمة القص في الفقرة القصية الأولى (CS1W) وعرض جسم عظمة القص في الفقرة القصية الثالثة (CS3W) وتم حساب مؤشر عظمة القص (SI) تم تحليل البيانات عن طريق حساب المساحة تحت المنحنى (AUC) ومنحني (ROC). وتم استخدام تحليل الانحدار اللوجستي الثنائي للتنبؤ بالجنس الذكري. **النتائج:** كانت قياسات عظمة القص للذكور بما في ذلك (ML) و (BL) و (CS1W) و (CS3W) و (TSL) و (MW) و (CL) ومجموع كلا من ( ML + MW) و(CS3W + BL) و( CS1W + CS3W ) أعلى إحصائيًا من الإناث باستثناء (SI) الذي كان أعلى لدى الإناث من الذكور وذي دلالة احصائية. وكانت لكل من(ML ) و (MW) و (BL) و (SI) بالإضافة إلى (ML + MW) و(CS3W +BL) مساحات ممتازة تحت المنحنيات عند استخدام منحني (ROC) .ووجد عندما يكون مستوي قياس (BL) أكبر من ٨٫٨٩ و قياس مؤشر (SI) أقل من ٤٩٫٨٣ وقياس (MW) أكبر من 5.635 و مجموع قياس كلا من (CS3W+ BL) أكبر من 11.675 فيمكن تحديد جنس الذكور بنسبة أكثر من ٩٠٪. **الإستنتاجات:** تعد قياسات (MW) و (BL) و (SI) عوامل مهمة لتحديد الجنس باستخدام التصوير المقطعي المحوسب متعدد المقاطع. ويعد مجموع كلا من (CS3W + BL) خيارًا قيمًا لتحديد الجنس عندما لا يمكن تقييم سوى عظمة القص. ستنشئ هذه الدراسة قاعدة بيانات للطب الشرعي تفيد في تحديد جنس بقايا العظام الهيكلية في مصر.