

Stature estimation from femoral bones in an archaeological population from the XVIII century in Lisbon

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Figure 1- Top of the ossuary before excavations (photo obtained during the 2004 excavations provided by Professor João Luís Cardoso).

INTRODUCTION

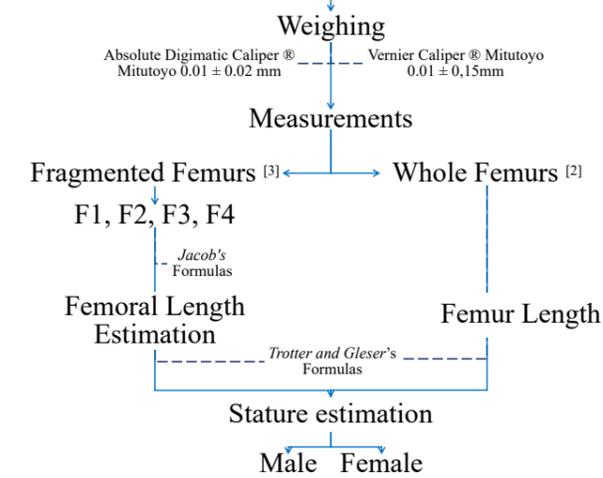
Skeletal remains credited to a catastrophic population concerning the 1755 Lisbon's Earthquake were recovered in archaeological excavations carried out in 2004, in the *Academia das Ciências de Lisboa*. The femur, being the longest bone in the human body, is the most used resource regarding the estimation of the stature of an individual. *Mildred Trotter* and *Goldine C. Gleser* (1952) estimated the stature through the anatomical length of the femur [2]. However, in these types of populations, there is a need to develop a method to estimate stature through fragments of the same bone. *Steele and Mckern* (1970) conducted a study on estimating stature from long bone fragments, where they identified some reference points in american femurs, dividing them into segments. From these segments, they estimated the total length of the femur. From there, it is possible to estimate the stature using the same method as described before, namely through *Trotter and Gleser's* study, although with lower precision [2]. Correlating the maximum length of an individual's femur bone to their stature, in addition to its importance for therapeutic decisions, helps to clarify legal and civil issues, and, in disjointed archaeological populations such as the one under investigation, allows to characterize the demographic profile.

AIMS

Estimate the stature of the catastrophic population using reconstructive identification methods, used in estimation of stature by the femur bone, and identification of the minimum number of individuals (MNI).

MATERIALS AND METHODS

Organization and Cataloging



Figures 2 & 3- Weighing and measuring (Vernier Caliper®, Mitutoyo) a whole femur, in anatomical position



Figure 4 - Measuring the fragment, using Absolute Digimatic Caliper® and Vernier Caliper®, Mitutoyo:

F1^a - From the proximal part of the femur head to the midpoint of the minor trochanter.

F2^b - From the midpoint of the smaller trochanter to the point where the extensions of the medial and lateral supracondylar lines are no longer parallel and differ distally towards the condyle.

F3^a - From the point at which the extensions of the medial and lateral supracondylar lines are no longer parallel and differ distally towards the condyles to the most proximal point of the perimeter of the intercondylar fossa.

F4^a - From the most proximal point of the perimeter of the intercondylar fossa to the most distal point of the medial condyle.

Trotter and Gleser's formulas were used to estimate the stature from the femur length obtained [2].

$$\text{Male}^c \quad 2.58 \times \text{Fem}_m + 54.79 \pm 3.69$$

$$\text{Female}^c \quad 2.47 \times \text{Fem}_m + 56.60 \pm 3.72$$

^c "Fem_m" stands for "Maximum length" of the femur.

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Sponsorship Acknowledgement: Fundação Nacional para a Ciência e a Tecnologia, (FCT) Portugal, in scope of the project UID/MAT/00006/2020.

RESULTS

It was possible to determine a minimum number of individuals (MNI) of 29, correspondent to 8 left whole femurs (of a total number of 14) and 21 left femur bodies (of a 58 total number of femur fragments).

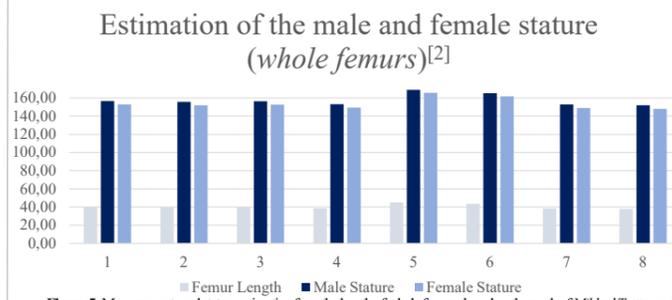


Figure 5: Measurements and stature estimation from the length of whole femurs, based on the work of Mildred Trotter and Goldine C. Gleser (1952)

The values obtained for F1 vary between 6.02 cm and 8.36 cm, for F2 vary between 17.23 cm and 23.22 cm, for F3 vary between 8.48 cm and 11.36 cm, and for F4 vary between 2.71 cm and 3.62 cm [4]. These values were used to estimate the stature (Figure 6). [2]

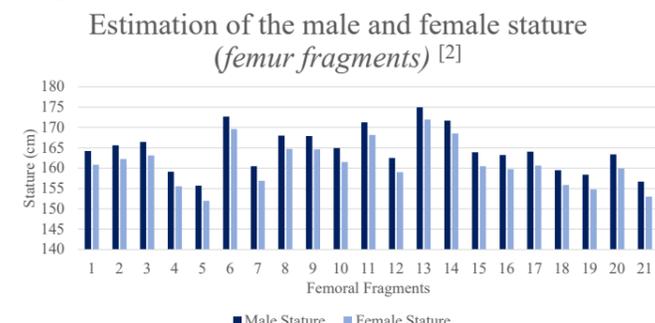


Figure 6: Estimation of the male and female stature, in cm, obtained from the formulas deduced by Mildred Trotter and Goldine C. Gleser (1952) [2], applied to the femur length measurements related to the femur fragments

The results showed that, for the whole femur, the correspondent stature varies between 147.96 cm and 168.82 cm. For the fragments, the obtained estimate vary between 151.96 cm and 174.96 cm.

DISCUSSION

Whole femurs show lower values for total stature comparing to femoral fragments, although both studies were applied to the same population. A possible explanation for this, is that femoral fragments were already previously used to estimate the total length of the femur, which can lead to less accuracy in the obtained results. *Trotter and Gleser* [2] made some adjustments by subtracting 0.06cm to the estimated stature in individuals aged 30 or above, in order to offset the effects of aging in bones. In our study it was not possible to determine the age of the individuals, and so this factor was not accounted for.

		Male			Female		
		Min. (cm)	Max. (cm)	Mean (cm)	Min. (cm)	Max. (cm)	Mean (cm)
Present Investigation Stature	Fragments	155.70	174.96	164.51	151.96	171.94	161.10
	Complete Femurs (fragments + complete)	151.85	168.82	157.57	147.96	165.57	153.89
	Femurs	151.85	174.96	162.60	147.96	171.94	159.11
Manouvrier Stature [5]	Femurs	153.00	171.60	161.83	145.50	171.50	157.54
Mendes-Corrêa Stature [6]	Right Femurs	-	-	165.4	-	-	152.8
	Left Femurs	-	-	164.4	-	-	152.8

Table 1: Results from the estimation of stature of the present investigation compared with Manouvrier's work and Mendes-Corrêa's, discriminated by sex and, regarding Corêa, by side.

The results obtained in this study can be linked to *Manouvrier's* results (1893) [5], even though they are slightly above average. Concerning *Mendes-Corrêa's* study (1932) on a modern population of Portuguese [6], our mean values for the non-discriminative femur length fit between the results obtained by the mentioned author for male and female categories. Regarding the estimation of stature, the mean male stature is slightly lower, and the mean female stature is slightly higher, compared to *Mendes-Corrêa's* results.

		Min. (cm)	Max. (cm)	Mean (cm)	
				Male	Female
Present Investigation Femur Length	Fragments	39.62	47.71	43.32	
	Complete	38	45.13	40.40	
	Femurs	38	47.71	42.52	
Manouvrier Femur Length [5]	Femurs	38.3	47.8	42.54	
Mendes-Corrêa Femur Length [6]	Right Femurs	-	-	43.87	40.10
	Left Femurs	-	-	43.31	39.97

Table 2: Results of femur length, measured or estimated, of the present investigation and its comparison with Manouvrier's and Mendes-Corrêa's studies.

The lower values obtained with complete bones can be easily explained by external factors such as nutrition and during the period of bone growth. Generally, the mean stature obtained, both male and female, is slightly higher compared to the studies mentioned above. It is also possible to highlight that the average male stature is mostly higher than the average female stature.

CONCLUSION

The carried-out investigation has shown that the stature of the catastrophic population concerning the 1755 Earthquake in Lisbon varies between 147.96 cm and 174.96 cm, as well as the reliability of the used methods in estimating the stature and femoral length of individuals, displaying a crucial role in the study, characterization and reconstruction of disjointed populations.