

Sex estimation in subadults from tibial and femoral metaphyses and epiphyses'width.

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Introduction. The identificative analysis of subadults is complicated especially by the difficulty in sex estimation. Several methods have been based on morphological and morphometric observations of mandible and pelvis. However, they do not allow a sufficient degree of accuracy. Very few studies were carried out on long bones, using diaphyseal length and metaphyseal breadth. The aim of this work is to develop a new method for sex estimation using the difference in width of epiphysis and metaphysis between males and females of the same age.

Material and methods. The study sample comprises of 292 Italian juvenile subjects (124 females and 168 males), all healthy, of known sex and age between 0 and 144 months. Tele-radiogram was provided by the service of Pediatric Radiology of Brescia Hospital and by the Department of Radiology of Varese Hospital. The district analysed is the lower limb, in particular the distal femoral epiphysis and metaphysis, the proximal tibial epiphysis and metaphysis, and the tibial diaphysis. Discriminant function analysis was used to select the optimal combination of variables for sex estimation. The sample was divided into three classes according to age (0-24; 25-86; 87-144) in order to develop the discriminant function equations that separated among the female and the male group.

Results. In each group the most indicative variable has been represented by distal femoral ratio (epiphyses/metaphyses) and proximal tibial ratio (epiphyses/methaphyses). An equation was constructed and a sectioning point was calculated for each group: a score greater or smaller value indicates a different sex; high accuracy was reached in the whole population (74.2% -96%); a low p-value confirmed the difference between sexes in all the subjects ($p < 0.0001$).

Conclusions. This method can offer several advantages both in osteoarchaeological and forensic context, allowing to obtain preliminary identificative results before proceeding, if possible, with the genetic analysis.

Sex estimation in subadults from tibial and femoral metaphyses' and epiphyses' width.

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Introduction. The anthropological analysis of subadults is complicated especially by the difficulty in sex estimation. Several methods have been based on morphological and morphometric observations of mandible and pelvis. However, they do not allow a sufficient degree of accuracy. Very few studies were carried out on long bones, using diaphyseal length and metaphyseal breadth (Stull *et al.* 2017). The aim of this work is to develop a new method for sex estimation using the difference in width of epiphysis and metaphysis between males and females of the same age.

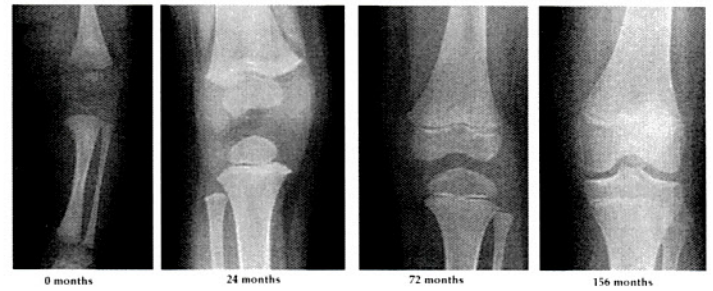


Fig. 1. epiphyses' and metaphyses' growth

Materials and Methods. The study sample comprises of 292 Italian subadult subjects (124 females and 168 males), of age between 0 and 144 months. Tele-radiogram (Fig.2) was provided by the service of Pediatric Radiology of Brescia Hospital and by the Department of Radiology of Varese Hospital.

The district analyzed is the lower limb, in particular:

- the distal femoral epiphysis and metaphysis
- the proximal tibial epiphysis and metaphysis
- the tibial diaphysis.

The ratios between the variables were used in order to decrease the bias given by the radiogram magnification (Fig.3):

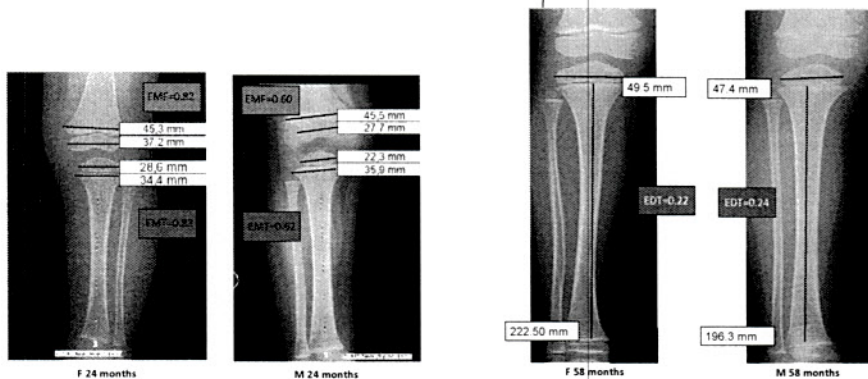


Fig. 3. examples of the different rates between males and females of the same age.

Discriminant function analysis was used to select the optimal combination of variables for sex estimation.

The sample was divided into three classes according to age: 0-24; 25-86; 87-144 (Fig. 4).

Results. For each age class the most significant variables have been found. An equation was constructed and a sectioning point (y) was calculated for each group: a greater or smaller value indicates respectively male and female (Table 1); a low p-value confirmed the difference between sexes in all the subjects (p<0.0001). High accuracy was reached in the whole population under 86 months, in particular in males (95.8-77.8%). Whereas, in the 87-144 group best fit were females (96.4%). In each group the most indicative variable has been represented by EMF.



Fig. 2. example of Tele-radiogram of the lower limb.

EMF: distal femoral epiphysis/distal femoral metaphysis
EMT: proximal tibial epiphysis/proximal tibial metaphysis
EDT: proximal tibial epiphysis/ tibial diaphysis

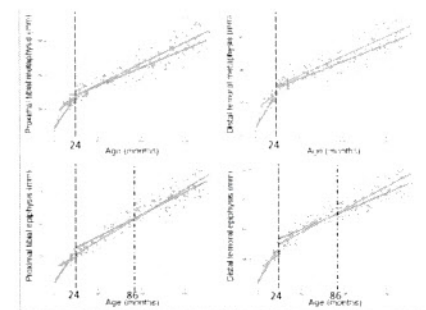


Fig. 4. the different epiphyses' and metaphyses' growth between males (blue lines) and females (pink lines); at 24 months there is the inversion of metaphyses' widths; at 86 months there is the inversion of epiphyses' widths; at 144 months epiphyses and metaphyses could be already fused.

AGE	Variable 1	Variable 2	Coefficient 1	Coefficient 2	Constant	Sectioning point	p value	Accuracy M %	Accuracy F %
0-24	EMT	EMF	25.9	-30.99	3.24	0.4757	<0.0001	95.8	64.3
25-86	EDT	EMF	-45.9	-1.65	10.5	-0.581	<0.0001	77.8	63.5
87-144	EMT	EMF	-15.49	7.79	9.49	0.5517	<0.0001	31.58	96.4

Table 1.

$$y = (\text{variable 1} * \text{coefficient 1}) + (\text{variable 2} * \text{coefficient 2}) + \text{constant}$$

Conclusion: This method can offer several advantages both in osteoarchaeological and forensic context, allowing to obtain preliminary identificative results before proceeding, if possible, with the genetic analysis.