

# Estimation of Race and Sex Using Ischiopubic Index and Subpubic Angle in Upper Egypt

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## Abstract

Accurate estimations of race and sex are essential tools in forensic anthropology. The pelvic bones are the most accurate bones from which sex can be determined, where ischiopubic index and subpubic angle are important parameters in these bones. The objective of our study is to determine ischiopubic index and subpubic angle in Egyptian males and females and compare them with other populations. Antero-posterior radiographs of 120 adult males and females (aged from 18 to 70 years) were studied for measurement of the pubic length, the ischial length and subpubic angle. Results: the mean of pubic length, ischial length, ischiopubic index and subpubic angle in Egyptians males were 72.4 mm, 80.6 mm, 86.3 and 102.4° respectively. The mean of pubic length, ischial length, ischiopubic index and subpubic angle in Egyptians females were 83.5 mm, 74.5 mm, 103.5 and 141.2° respectively. The mean of pubic length was significantly increased in females than males in the ( $p < 0.05$ ), while the mean ischial length was significantly higher in males than females ( $p < 0.05$ ), the mean ischiopubic index was significantly higher in females than males ( $p < 0.05$ ), while the mean of subpubic angle in females was significantly higher than males

## Introduction and objective

Our study was done to record the ischiopubic index and subpubic angle of adult Egyptian males & females, then the over all mean was determined and compared to other populations for sexual and racial estimation.

Skeletal characteristics vary among populations, so each population should have specific standards to optimize the accuracy of identification (Iscan, 2005)

The pelvic bones are the most accurate bone from which sex is determined, about 95% of sexing accuracy can be expected if the pelvis is complete (Krogman and Iscan 1986).

The ischiopubic index is the measurement of the distance between the acetabulum and the pubic tubercle of the pelvic bone (pubic length) divided by the distance between the acetabulum and ischial tuberosity of the pelvic bone (ischial length) multiplied by hundred (Rogers and Saunders, 1994).

The sub-pubic angle is one of the most important angles of the pelvic outlet which present below the symphysis pubis as a triangular interval between the inferior rami of the pubic bones. It is also referred to as the pubic arch (Keith and Dalley, 1999).

Gender differentiation in skeletal human remains is an important component of anthropological investigations and should be based on measurements and clarifications on the entire skeleton to be

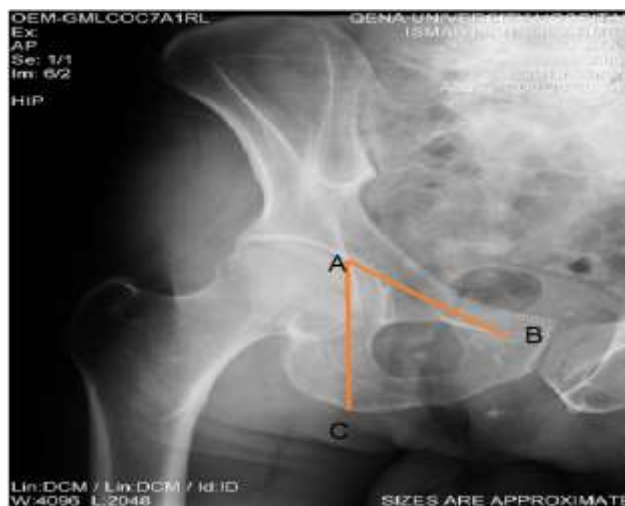
significant. Singh and Potturi (1978) reported that it is almost impossible to determine the sex of an individual from the skeletal remains unless all the bones are available, except in case of the hip bones.

The skeletal remains of infants and children have been excluded from investigations of sex determination as researchers believed that sex determination does not occur until reaching puberty (Rupich 1996), and the indices of sexual dimorphism in the ischiopubic complex do not begin until puberty (Bruzek, 2002).

## Materials and methods

The study was done on 120 anteroposterior pelvic radiographs (60 males and 60 females) in Qena university hospital. The age of the patients ranged from 18- 70 years, the radiographs were chosen with normal pelvic bones, no fractures and good alignment at the inferior margins of the pubic bones at the pubic symphysis. Measurement of pubic length was done from the center of the tri-radiate acetabulum to the pubic tubercle, ischial length from acetabulum to the maximum ischial tuberosity. Measurement of subpubic angle by a protractor where two tangential lines were drawn at the inferior borders of the pubic rami and intersecting at subpubic angle

The results were analyzed with SPSS version 11. Two-sample t tests were used to compare each pair of studies for males and for females separately.



**Figure (1):** Anteroposterior radiograph of pelvis illustrates measurement of pubic length (AB) and ischeal length (AC).



**Figure (2):** Anteroposterior radiograph of pelvis illustrates measurement of the subpubic angle.

## Results

Table 1 represents the range, mean and standard deviation (S.D) of the four measurements (pubic length, ischial length, ischiopubic index and subpubic angle) for male and female subjects in upper Egypt. The mean  $\pm$  S.D values of pubic length in males and females were  $72.4 \pm 8.8$  mm, and  $83.5 \pm 8.5$  mm respectively, while the mean  $\pm$  S.D values of ischial length in males and females were  $80.6 \pm 6.9$  mm and  $74.5 \pm 7.8$  mm respectively. The ischiopubic index mean  $\pm$  S.D value in males was  $86.3 \pm 9.4$ , and in females was  $103.5 \pm 7.9$ , the number of males identified by sex represents 65.4 %, while the number of females identified by sex represents 67.8 %

The subpubic angle mean  $\pm$  S.D values in males and females were  $99.4^\circ \pm 10.6^\circ$  and  $141.2^\circ \pm 12.5^\circ$  respectively. the number of males identified by sex represents 71.3 %, while the number of females identified by sex represents 66.2 %

Table 2 represents the mean  $\pm$  S.D values of ischiopubic index of previously studied populations compared to the present study where all populations show sexual dimorphism

Table 3 shows the mean  $\pm$  S.D values of subpubic angle of previously studied populations (Ugandans, Malawians, Indians, Amerindians Libben and white and black Americans) compared to results of our study

**Table (1): Comparison between male and female Egyptian pubic length, ischial length, ischio-pubic index and subpubic angle**

Parameters	Males (60)	Females (60)	P value
Pubic length			
Range	60 – 81 mm	66 – 87 mm	< 0.05
Mean± S.D	72.4 ± 8.8 mm	83.5 ± 8.5 mm	
Ischial length			
Range	75 – 89 mm	64 – 83 mm	< 0.05
Mean ± S.D	80.6 ± 6.9 mm	74.5 ± 7.8 mm	
Ischio-pubic index			
Range	79 – 93	98 – 110	< 0.05
Mean ± S.D	86.3 ± 9.4	103.5 ± 7.9	
Identified by sex	65.4 %	67.8 %	
Subpubic angle			
Range	86° -127°	99° -163°	< 0.01
Mean ± S.D	99.4° ± 10.6°	141.2° ± 12.5°	
Identified by sex	71.3 %	66.2 %	

$P > 0.05$  = non-significant difference;  $P < 0.05$  = significant difference

**Table (2): Comparison between Ischio-pubic index in different population groups and male and female Egyptian in the present study**

Populations	Males Mean ± S.D	Females Mean ± S.D	P value	Authors
Kalabari people of Nigeria	87.3 ± 6.1	104.1 ± 4.2	< 0.05	Oladipo et al 2012
Ikwerre people of Nigeria	81.1 ± 7.5	101.1 ± 3.7	< 0.05	Oladipo et al 2012
Black Malawians	85.0 ± 15.7	104.6 ± 15.7	< 0.05	Igbigbi & Msamati; 2000
White American	63.7 ± 7.8	88.4 ± 8.5	< 0.05	Tague 1989
Black Americans	65.8 ± 8.7	85.2 ± 8.5	< 0.05	Tague 1989
Portuguese	78.2 ± 6.2	71.3 ± 3.1	< 0.05	Phenice, 1989
South-South Nigerians	81.4 ± 6.4	104.2 ± 11.1	< 0.05	Oladipo et al 2009
France	82.0 ± 7.2	94.5 ± 3.1	< 0.05	Wasbum, 1948

$P > 0.05$  = non-significant difference;  $P < 0.05$  = significant difference

**Table (3): Comparison between subpubic angle in different population groups and male and female Egyptian in the present study**

Population	Males Mean ± S.D	Females Mean ± S.D	P value	Authors	Over all mean angles
Indians	73.8° ± 8.2	98.2° ± 8.4	< 0.001	Tague 1989	80.3°
Malawians	99.2° ± 15.7	129.1° ± 14.6	< 0.001	Msamati et al., 2005	114.2°
Ugandans	93.86° ± 21.12	116.11° ± 17.79	< 0.001	Igbigbi and Igbigbi, 2003	98.2°
White Americans	63.7° ± 7.8	88.4° ± 8.5	< 0.001	Igbigbi and Igbigbi, 2003	76.1°
Black Americans	65.8° ± 8.7	85.2° ± 10.4	< 0.001	Igbigbi and Igbigbi, 2003	75.5°
Libbens	68.8° ± 7.8	95.2° ± 10.8	< 0.001	Tague 1989	80.3°
Amerindians	67.4° ± 8.1	93.1° ± 10.4	< 0.001	Igbigbi and Igbigbi, 2003	80.3°
Egyptian (previous study)	102.3° ± 12.5	143.3° ± 15.8	< 0.001	Abd-El-hameed et al, 2009	122.8°
Egyptian (present study)	99.4° ± 10.6	141.2° ± 12.5	< 0.001	-----	120.3°

$P > 0.05$  = non-significant difference;  $P < 0.05$  = significant difference;  $P < 0.001$  = highly significant

## Discussion

This study has established the presence of sexual dimorphism in ischiopubic index in Egyptians. More females were accurately identified by sex than males (67.8 %, 65.4 %) respectively, while regarding the subpubic angle more males were accurately identified by sex than females (71.3 %, 66.2 %)

This result agreed with previous reports in Nigerians (Oladipo et al 2012), Malawians (Igbigbi &

Msamati; 2000), France (Wasbum, 1968) Portuguese (Phenice, 1989), Amerindians (Tague, 1989), White and Black Americans (Tague, 1989)

Ekanem et al. (2009) conducted a study on the radiographic determination of sex differences in ischio-pubic index of a Nigerian population, and their results revealed that the sex differences of the pubic length, ischial length and ischio-pubic index was found

to be significant. The ischio-pubic index of the females was discovered to be higher than that of males

In this study comparison of the subpubic angles of Egyptians with other populations showed that there was a highly significant racial variability, Egyptians had an overall mean of subpubic angle equal to 120.3° which is higher than that in Malawians (Msamati et al., 2005), Indians and Libbens (Tague 1989), Ugandans, Amerindians, White and black Americans (Igbigbi and Igbigbi, 2003). A previous study by Abd-El-hameed et al. (2009) was done in Assiut University hospital reported that the overall mean of subpubic angle in Egyptians is 122.8° which was a bit higher than the present study.

Though the primary function of the pelvis in males and females is for loco-motion, it is specially adapted for childbirth in females (Ekanem et al., 2009). This may explain the significantly higher sexual differences in ischiopubic index and subpubic angle observed in females in all races when compared with that of males

The presence of racial and sexual, variability of the sub-pubic angle could be explained by presence of genetic, dietary and environmental factors

## Conclusion

The present study has demonstrated the presence of sexual dimorphism in the ischio-pubic index and subpubic angle in Egyptians, and they are of great importance in relation to other populations. We advice that further studies should be done to compare the ischiopubic index and subpubic angle in other Egyptian governorates.

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### الملخص العربي

## تقدير العرق والجنس باستخدام مؤشر طول عظم الفخذ الى طول عظم العانة والزاوية السفلى لعظم العانة في مصر العليا

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المقدمة : يعتبر التقدير الدقيق للعرق والجنس من الأدوات الهامة في الطب الشرعي والبدني. ولقد أثبتت العديد من التحقيقات أن كل مجموعة سكانية تتطلب معاييرها الخاصة بما للتحديد الدقيق للجنس. وتعتبر عظام الحوض هي الأكثر دقة من حيث استخدامها في تحديد الجنس، حيث مؤشر طول عظم الفخذ الى طول عظم العانة وزاوية تحت العانة هي المعالم الهامة في هذه العظام .  
تمت دراسة صور اشعة سينية امامي - خلفي على عظام الحوض لعدد ١٢٠ من المصريين البالغين نصفهم من الذكور و نصفهم من الاناث ( السن من ١٨ الى ٧٠ عاما) لقياس طول عظم العانة ، وطول عظم الفخذ ، و مؤشر النسبة بينهما وكذلك زاوية تحت العانة و تم عمل دراسات احصائية.

النتائج : ظهر من الدراسة ان متوسط قيم طول عظم العانة ، وطول عظم الفخذ، و مؤشر النسبة بينهما وزاوية تحت العانة في الذكور المصريين هو ٧٢,٤ مم ، ٨٠,٦ مم ، ٨٦,٣ ، ١٠٢,٤ درجة على التوالي.  
بينما قيم متوسط طول عظم العانة ، وطول عظم الفخذ ، و مؤشر النسبة بينهما وزاوية تحت العانة في الإناث ٨٣,٥ مم ، ٧٤,٥ مم ، ١٠٣,٥ و ١٤١,٢ درجة على التوالي.  
و كان متوسط طول عظم العانة في الإناث اطول منه في الذكور و له دلالة احصائية، وكان متوسط طول عظم الفخذ في الذكور اطول منه في الإناث و له دلالة احصائية ، وكان متوسط مؤشر طول عظم العانة الى طول عظم الفخذ أكبر في الإناث من الذكور و له دلالة احصائية.

في حين كانت زاوية تحت العانة أوسع بكثير في الإناث من الذكور حيث تراوحت في الإناث من ٩٩ - ١٦٣ درجة و كان متوسطها ١٤١,٢ درجة, بينما تراوحت في الذكور من ٨٦ - ١٢٧ درجة و كان متوسطها ٩٩,٤ درجة

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