

Femoral head diameters in Nigerians

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Summary

The transverse (TD) and vertical (VD) diameters of the head of the femur in 256 adult Nigerians in Ile-Ife were measured on the X-ray films of the hips of these subjects. There was no significant difference between the diameters of the left and right femoral heads ($P > 0.05$), but the diameters in the males were significantly larger than in the females ($P < 0.001$). The VD and TD reported by Singh *et al.* [1] in Calabar men, and TD for women were significantly larger than those reported here in Ile-Ife ($P < 0.05$), suggesting the existence of regional variation of the head of the femur in Nigerians. The VD and TD reported for Nigerians were larger than those reported for Caucasians, Indians, and Chinese, supporting racial and geographical variation of the head of the femur. Application of identification point differentiated the sex of most of the bones and might be useful in sex discrimination of the femur.

Résumé

Les diamètres transversal (DT), et vertical (DV) de la tête du fémur chez 256 adultes nigériens à Ile-Ife ont été mesurés sur la radiographie de la hanche de ces individus. Il n'y avait pas de grande différence entre les diamètres des têtes fémorales de la gauche et ceux de la droite ($P > 0.05$). Les diamètres de la tête chez les hommes étaient sensiblement plus grands que ceux des femmes ($P < 0.001$). Les DV et DT chez les hommes et les femmes de Calabar étaient, selon la communication de Singh *et al.* [1] sensiblement plus grands que ceux obtenus à Ile-Ife ($P < 0.05$), indiquant ainsi l'existence d'une variation régionale dans les diamètres de la tête du fémur chez les Nigériens. Les DV et DT rapportés pour les Nigériens étaient plus grands que ceux qui ont

été rapportés pour les Caucasiens, les Indiens et les Chinois, indiquant une variation raciale et géographique des diamètres de la tête du fémur. L'emploi de point d'identification a distingué le sexe d'un bon pourcentage d'os et serait utile à la discrimination sexuelle du fémur.

Introduction

The diameters of the head of the femur are useful in the diagnosis and treatment of the fractured neck of the femur [1]. The dimensions are even more important in the discrimination of the sex of the femur. Dwight [2] stated that it is very evident that the difference between the bones of the arm and the thigh in the matter of length are much less important sexually than those of the diameters of the heads. Other authors [3-5] have also emphasized the importance of head dimensions of the femur in sexual dimorphism and this is particularly useful in forensic medicine. The dimensions of the head of the femur have been found to show racial differences [7-10]. Even regional differences have been reported in Indians [5,11] and in the English [3,4]. It would therefore appear appropriate that the findings of Singh *et al.* [1] in South-east Nigeria be compared with work in South-west Nigeria.

The present work investigates the femur head diameters of people in Ile-Ife, South-west Nigeria, and compares the results with the findings of a similar work in Calabar, South-east Nigeria.

Materials and methods

Plain antero-posterior radiographs of the right and left femora of 256 patients who attended the Obafemi Awolowo University Teaching

Hospitals Complex, Ile-Ife, Nigeria between 1983 and 1987 for suspected injury to the pelvis were used. X-ray films of patients with pathological conditions affecting the head of the femur were excluded from the study. The radiographs were taken from an anode-film distance of 92 cm and in this position the patient's big toes were touching at their medial sides. The patients comprised 138 males and 118 females. The ages of the patients ranged from 25 to 50 years. The measurements of the head of the femur were taken directly on the X-ray film, using ruler and vernier callipers. The measurements were made as described below:

- (i) transverse (medial to lateral) diameter (TD): from a point in the region of the fovea centralis to a point at the junction of the head and the neck; and
- (ii) vertical diameter (VD): from the topmost point to the lowest point on the head of the femur in a vertical direction.

The values of VD and TD obtained here were recorded for the right and left femora in each sex. Minimal and maximal values obtained for each variable were calculated. Identification and demarking points were also calculated for use in sexual discrimination. The identification point (IP) is the point beyond which only the value for one sex is obtainable. No overlap in

the values exists at or beyond the IP. The demarking point (DP) was also utilized here. DP makes the discrimination of sex more accurate [12] and if DP is defined as mean \pm 3 s.d. it would be applicable to 99.75% of bones obtainable in the particular region [5]. The statistical significance of any differences in the value of the two sexes was assessed by means of Student's *t*-test.

Results

The data concerning the two diameters measured are depicted in Table 1. Although in the males TD is slightly greater than VD the reverse is the case in the females. There was no significant difference between the two sides in each sex ($P > 0.05$). Each of the two diameters is significantly greater in the males compared to the females ($P < 0.001$). A comparison of the result in the present work and that of Singh *et al.* [1] is shown in Table 2. In the males in the present work, both VD and TD are significantly greater than the corresponding values reported for females ($P < 0.05$). Similarly, TD is significantly greater in Calabar men compared to men in Ile-Ife ($P < 0.001$). However, no significant difference was observed in the values of VD in the females in the two reports ($P > 0.05$). On the left, an upper IP of 56 mm VD

Table 1. The difference between the male and female values of VD and TD for right and left heads of femur

	Right		Left	
	VD (mm)	TD (mm)	VD (mm)	TD (mm)
Male				
<i>n</i>	138	138	138	138
Range	41.0–58.0	42.0–64.0	45.0–58.0	42.5–61.0
Mean	50.3	50.7	50.4	50.8
s.d.	3.7	4.3	3.6	4.1
s.e.	0.65	0.51	0.63	0.49
Female				
<i>n</i>	118	118	118	118
Range	41.5–55.0	38.0–54.0	42.0–56.0	40.0–54.0
Mean	47.3	45.6	47.5	45.5
s.d.	3.0	3.0	3.3	3.2
s.e.	0.59	0.39	0.65	0.41
<i>P</i> -value	<0.001	<0.001	<0.001	<0.001

Table 2. Student's *t*-test for the significance of the difference in mean VD and TD reported in Nigerians by the present author in Ile-Ife and by Singh *et al.* [1] in Calabar

Male		Female	
Right		Right	
Left		Left	
VD (mm)	TD (mm)	VD (mm)	TD (mm)
<hr/>			
Present author	Present author	Present author	Present author
<i>n</i>	138	138	138
Range	41.0-58.0	42.0-64.0	45.0-58.0
Mean	50.30	50.70	47.50
s.d.	3.70	4.30	3.30
Singh <i>et al.</i> [1]	Singh <i>et al.</i> [1]	Singh <i>et al.</i> [1]	Singh <i>et al.</i> [1]
<i>n</i>	100	100	100
Range	45.7-59.6	48.0-61.4	40.0-59.0
Mean	51.78	54.04	46.51
s.d.	3.19	3.21	3.19
<i>P</i> -value	<0.05	<0.001	<0.001

and 54 mm TD classified 9% and 29%, respectively, of male bones while a lower IP of 45 mm VD and 42.5 mm TD classified 12% and 15%, respectively, of female bones. On the right, an upper IP of 55 mm VD and 55.4 mm TD classified 12% and 20%, respectively, of male bones, while in the female a lower IP of 42 mm VD classified 12% of bones. None of the female right bones was identified by an IP of TD. A DP of 57.4 mm VD and 55 mm TD classified a total of 12% and 26%, respectively, of male bones, while a DP of 39.2 mm VD and 38.5 mm TD did not classify any of the female bones. In the male and in the female Nigerians, the mean VDs reported by Singh *et al.* [1] (52.02 mm male, 45.8 mm female) and by the present author (50 mm male, 45 mm female) are greater than the corresponding values reported by Dwight [2] (49.68 mm male, 43.48 mm female), Holtby [8] (48 mm male, 41.75

mm female) and Lofgren [10] (48 mm male, 44 mm female) in Caucasians, Thieme [7] (47.17 mm male, 41.52 mm female) in American Negroes, and Singh and Singh [5] (44.2 mm male, 39.8 mm female) in North Indians (Table 3). The TDs reported for Nigerians are also greater than the corresponding TDs reported by Hashimoto [9] (46.8 mm male, 46.8 mm female) in Chinese people and by Singh and Singh [5] (38.83 mm male, 35.8 mm female) in Indians. The IPs of VD for the males are remarkably higher than those for the females in all the countries and races compared. These IP values are higher in Nigerians than in the countries and races compared (Table 4).

Discussion

The report in the present work that VD and TD are significantly higher in the male than in the

Table 3 Mean VD for head of femur in males and females of different countries/ races

Author/year	Country/race	Mean VD (mm)	
		Male	Female
Dwight, 1905	U.K. (Caucasians)	49.68	43.84
Holtby, 1918	U.K. (Caucasians)	48.80	41.75
Lofgren, 1956	Finland (Caucasians)	48.00	44.00
Thieme, 1957	U.S.A. (Negroes)	47.17	41.52
Singh and Singh, 1972	North Indians	44.20	39.80
Singh <i>et al.</i> , 1986	South-east Nigerians	52.02	46.80
Present author, 1988	South-west Nigerians	50.35	46.50

Table 4. Mean identification points (IP) of vertical diameter for different countries/ races

Author/year	Country/race	Mean IP (mm)	
		Male	Female
Parson, 1924	U.K. (Caucasians)	48.00	44.00
Holtby, 1918	U.K. (Caucasians)	46.00	43.00
Pearsons, 1919	U.K. (Caucasians)	45.50	41.50
Singh and Singh, 1972	North Indians	45.00	36.00
Singh <i>et al.</i> 1986	South-east Nigerians	52.00	45.00
Present author, 1988	South-west Nigerians	50.00	45.00

female (Table 1) supports the earlier observations in different countries by different authors [1,3,11] that femoral heads are larger in males than females. The values of VD and TD obtained for males and TD for females in Calabar, Nigeria were significantly ($P < 0.001$) higher than values obtained in Ile-Ife in the present work, suggesting that femoral heads of people from Calabar, South-east Nigeria, are larger than those of people in Ile-Ife, South-west Nigeria, and supporting regional variation of femur heads as reported earlier in other countries [3-5,11]. The variation in Nigeria may be related to the varying stature of people from the two regions or to some other undetermined genetic factors. VDs for Nigerians were higher than for the English [2,8,10] and Indians [5], and TDs for Nigerians were higher than TDs reported for the English and the Chinese [9]. These reported values suggest larger femoral head diameters for Nigerians compared to the other countries, and Negroes compared to Caucasians and Mongoloids. The variation might be related to undetermined genetic factors between Nigerians and those of other races.

IPs reported for males were higher than for female Nigerians (Table 3), suggesting the usefulness of IPs in sexual differentiation of the femur. IPs for Nigerians were also higher than for the other countries and races compared indicating it could also be used in racial differentiation. DPs were found to distinguish only very small percentages of bones and so have limited value in sex discrimination.

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References

1. Singh SP, Ekandem GJ, Ani EO. Identification of sex from the head of the femur — demarking points for Calabar, Cross River State. *West Afr J Anat* 1986;1:16-23.
2. Dwight T. The size of the articular surfaces of the long bones as characteristic of sex, an anthropological study. *Am J Anat* 1905;4:19-31.
3. Parsons FG. The character of English thigh bone. The difficulty of sexing. *J Anat* 1914;49:335-61.
4. Pearson KA. Study of the long bones of the English skeleton. Part I — the femur. *Draper's Co Res Mem Biom Service* 1919;19:63-113.
5. Singh SP, Singh S. The sexing of adult femora — demarking points for Varanasi Zone. *Ind Med Gazette* 1972;11:45-9.
6. Krogman WM. *Skeleton in forensic medicine*. Chicago: Trac Inst Med 1946;16:154-67.
7. Thieme FP. Sex in Negro skeleton. *J Forensic Med* 1957;4:72-81.
8. Holtby JRD. Some indices and measurement of the modern femur. *J Anat* 1918;52:363-82.
9. Hashimoto M. Ethnologic studies on Chinese. *J Orient Med* 1938;19:32-4.
10. Lofgren L. Some anthropometric anatomical measurements of the femur of Finns from the view points of surgery. *Acta Chir Scand* 1956;110:477-84.
11. Javadekar BSA. Study of the measurement of the head of the femur with special reference to sex. A preliminary report. *J Anat Soc Ind* 1961;10:25-7.
12. Jit I, Singh S. The sexing of the adult clavicles. *Ind J Med Res* 1966;54:551-71.

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