Evaluating Anthropometric Dimensions of the Femur Using Direct and Indirect Methods

Seyed Hassan Eftekhar Vaghefi [1], Leila Elyasi [2*], Saeed Reza Amirian [3], Parviz Raigan [4], Hakimeh Akbari [4], Mina Sheikhshoaiee [4], Arash Borbor [4]

1. Department of Medical Anatomy, Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran.
2. Neuroscience Research Center, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran.
3. Department of Occupational Therapy, Faculty of Rehabilitation Center, Shahid Beheshti University of Medical Science, Tehran, Iran.
4. Department of Medical Anatomy, Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran.

Dr. Leila Elyasi is an assistant professor of Anatomy Department of Medical Anatomy, Golestan University of Medical Sciences, Gorgan, Iran. She teaches anatomy and embryology, and her research fields include neurosciences, Parkinson and Alzaimer disease, and anthropology.

ABSTRACT

Introduction: The human anthropometric characteristics are surveyed in anthropology. Anthropology is used in archeology, rehabilitation and legal medicine. The purpose of this study was to determine femur which has a special place in the science of anthropometry.

Methods: To measure the femur, both direct and indirect methods was used. The direct method of measuring the 113 femur in dissection hall. Samples included persons aged between 20-40 years who were selected randomly. In this descriptive and analytical study, cluster sampling method was used to select the subjects. For anthropometric measurements, metallic and plastic tape, goniometer, caliper were used. Different dimensions of the femur such as anterior-posterior and lateral diameter of the femoral head, anterior-posterior and lateral diameter of the body, the minimum length diameter of the neck, superficial longest and shortest femoral height were measured.

Results: The mean±SD of femoral length was 40.31 CM and 43.3 CM, in females and males respectively, this difference was significant (P<0.05). All dimensions were significantly different between male and female in direct and indirect method.

Conclusion: Usage of anthropometric data in designing a product can reduce human errors and improve public health and qualification of products and efficiency of workplaces. In addition, by using a single bone such as femur, we can determine gender, age or the relationship between bone length and body weight. It is also helpful in forensics, biomedical engineering, ergonomics and surgery.

* Corresponding Author:
Leila Elyasi, PhD
Address: Department of Medical Anatomy, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan. Iran.
Tel: +98 (917) 32420515
E-mail: elyasy_leila@yahoo.com

1. Introduction

Anthropometric data is collected from the dead or alive sample of skeleton. Anthropometric is the study of characteristic of the human body skeleton. Physical characteristics of the human skeleton are under the influence of race, age, sex, type of nutrition [1]. In fact, these factors make the data unusable for other communities of the population. Through measuring length of long bones of the lower organ from the skin or bones separating from the body, we can achieve the indicators in estimating body size and height. We can use these indicators to determine gender, to choose type of environmental conditions and also to design prosthesis [3]. Eftekhar Vaqefi and et al. evaluated 30 dimensions of anthropometric aspect [4]. Meshkdanian and et al.also examined the anthropometric characteristics of upper organ in Iranian and Pakistani adults. These researchers pointed out that when lower organs are cut in incidents such as bombing, war, length index of upper organs can be useful behind lower organs [5].

Also information regarding the index of lower limb prosthesis plays an important role in designing prosthesis. Designing a prosthetic limb with an appropriate length plays an important role in transferring and suffering pressure and facilitating limb movement. The central axis of anthropology is estimating race from skeleton studies in a number of groups that may be the femoral neck, the skull and pelvis is associated with racial differences [6].

The femur is the longest and strongest bone in the body and plays an important role in transmitting body weight. Therefore, this study aims to compare the anatomical femur in both sexes through direct and indirect method in adults of Kerman.

2. Materials & Methods

This study is analytical-descriptive study. The subjects in indirect method ranged between 40-20 years old. Samples were randomly selected. Exclusion criteria were subjects that had a fracture in the femur and pelvis. For the purpose of measuring anatomic aspects of femur bone, 2 indirect and direct methods were used. In the direct method, 113 bones in Kerman dissection part of medical university were used. Of these, 57 samples of woman femur bone and 56 samples of men femur bones were determined through standard method of determining gender with 95 percent accuracy. A measurement protocol to guide the project team colleagues were used.

Anatomical position and body landmark recognition was taught to people of every team as a training program. Measurement was conducted in the summer of 2013 in the city of Kerman. Measurement of bone included: Measuring anterior-posterior diameter of the femoral head, Lateral femoral diameter, least femoral neck, from the highest greater trochanter point to the lowest point of the lower femur, anterior-posterior dimensions of mid shaft. Through indirect measurement method, superficial femoral size of 160 patients (80 females, 80 males) were evaluated. Measured parameters included: height, the apparent size of femur from the greater trochanter to the most prominence of lateral condyle. Age, sex, dominant hand. Plastic meters and metal, protractor were used for measurement.

3. Results

160 person and 113 bones were examined in this study. Table 1 shows the distribution of gender based on femur bone. Table 2 shows information of central index and dispersion of parameters which have been measured in the femur. Table 3 shows parameters which have been measured indirectly. In the direct method, femur length in men is 99.44 and 81.40 in women. Reviewing statics shows meaningful difference between these parameters in both sex. Other parameters which measure anterior-posterior diameter, lateral diameter and neck diameter of femur head in men and women show meaningful difference in these 2 kinds. Table 2 shows superficial length of femur, i.e. the distance of the most protuberant part of grater tronchanter in the direction of upper femur to lower part of external condyle of femur, in indirect method. This is 43.39 in women and is regarded statisti-

Table 1. Distribution of sample.

Gender	Type of measure			
	Direct		Indirect	
Male	49.6	56	50	80
Female	50.4	57	50	80
Total	100	113	100	160

Table 2. Comparison of length, diameter of the anterior-posterior and lateral femoral head, neck diameter, the diameter of the anterior - posterior body femur in direct method.

Index cases	Female		Male	
	SD	Average	SD	Average
Femur length	2.18	40.81	2.44	44.99
Anterior-posterior diameter of the femoral head	0.2	4	0.3	4.6
Lateral diameter of the femoral head	0.25	4.02	0.32	4.57
The diameter of the femoral neck	0.26	2.49	0.34	2.89
Anterior-posterior diameter of the femoral mid shaft	0.21	2.48	0.26	2.85

ANATOMICAL SCIENCES

cally meaningful. Also there is a meaningful difference regarding femoral length in direct and indirect method.

Among the 80 samples, regarding indirect method and without considering gender, 71 people were right handed and 9 people left handed. There is no meaningful difference regarding these parameters between men and women. This study aims to determine the dominant aspect in order to achieve influence of this factor on the size of femur.

4. Discussion

Statistical analysis shows that there is a meaningful difference between the length and height of men. Through presenting mean, it was revealed that average height size in French men is 175.8 and 161.5 in women [7]. It means that regarding height length, there is no significant difference between French and Iranian people. Meaningful difference of femur length in 2 sexes results from high length of height in men comparing with women. Comparing length of right bone in men with height length shows that size of right femur height length is 3.98 CM. This number of women is 3.94. Identification is one of the most important issues in the context of legal medicine. While controlling identity when there is not skull and hip bone, using characteristic of femur can be useful. According to the findings in table 2 and 3 and comparing

with the study of Indian race femur length, it is concluded that femur length in Iranian men and women is longer than Indian race [8]. Femur length in Iranian men and women is longer than Indian race. In a survey conducted in Croatia, the relation between height length and long bones was determined through radiographic images of population.

The results were consistent with our studies [9]. However, it should be noted that factors affecting on the height and length of long bones such as race, nutrition, genetics cannot be attributed to the formulas and tables of other countries. attributing to the foreign sources may leads to the incorrect identification. Also in measuring femur length through direct and indirect method, a meaningful difference was observed and this difference maybe as a result of physical changes in bones after death. Live bone and corpse are different in terms of stiffness and elasticity properties such as tensility and elasticity properties. If the dead bones be kept in a moist environment, they will become similar to the living bones. The size of the femoral head of the hip has a direct relation with the movement size in femur. It is also directly related to the diameter size of articular surface of this bone. Regarding anthropometric, measuring criteria is the head size of diameters of the anterior-posterior femur and lateral femoral head that is 4.60 cm in men and 4 cm in women. However, size of lateral diameter was 4.75 cm in men

Table 3. All central index and dispersion indirect method.

Index cases	Female		Male	
	SD	Average	SD	Average
height	3.8	158.74	6.7	172.53
Length of femur	2.1	40.31	2.34	43.3
Age	6.2	27.3	5.9	28.7

ANATOMICAL SCIENCES

and 4.02 in women. There are significant differences in size between 2 sexes. These diameters are longer in Iranian people compared with Indian race and smaller than Canadian-Egyptian and Sudanese race.

In the study carried out by Mccluskey and et al., athletes with longer limb had high speed. All parameters which were examined in this study show a significant difference between the sexes [11]. Also in reviewing parameters in right and left direction, it is showed that regarding lowest diameter of neck, there is no meaningful difference between right and left direction. In all dimensions, values in men's femur are higher than women which is due to sexual characteristic of men.

So, existence of natural differences among dimensions of body makes it necessary to choose a method in designing products and stations. For the purpose of optimized usage of anthropometric indexes, designs should be in a way that tools, facilities be in the limits of the youngest people and spaces be designed according to the big people. Femur bone is one of the most important bones in recognizing gender, race, sport-culture habits.

This study was carried out for the first time in Iran through 2 direct and indirect methods in order to examine different diameters of femur bone. Comparing with different races show that statistical difference is under the influence of nutrition, genetic, physiologic conditions.

Acknowledgments

References

[1] Chuan TK, Hartono M, Kumar N, Anthropometry of the Singaporean and Indonesian populations. International Journal of Industrial Ergonomics. 2010; 40(6):757-766.

[2] Khadem MM, Islam MA. Development of anthropometric data for Bangladeshi male population. International Journal of Industrial Ergonomics. 2014; 44(3):407-412.

[3] Mehrparvar AH. Static anthropometric dimensions in a population of Iranian high school students considering ethnic differences. Human factors: The Journal of the Human Factors and Ergonomics Society. 2014; 22(4):18-37.

[4] Vaghefi SHE, Elyasi L. Anthropometric survey of worker population in Bandar-Abbas. Thrita Student Journal of Medical Sciences. 2014; 21(3):101-107

[5] Moshkdanian G. Anthropometric characteristics of upper limb in Iranian and Pakistani subjects. Journal of Gorgan University of Medical Sciences. 2014; 16(3): 80-84.

[6] Lin YC, Wang J, Wang M. The comparisons of anthropometric characteristics among four peoples in East Asia. Applied Ergonomics. 2014; 35(2):173-178.

[7] Alunni-Perret V, Staccini P, Quatrehomme G. Sex determination from the distal part of the femur in a French contemporary population. Forensic Science International. 2008; 175(2):113-117.

[8] Goswami A, Ganguli S, Chatterjee B. Anthropometric characteristics of disabled and normal Indian men. Ergonomics. 1987; 30(5):817-823.

[9] Zheng T. Stature estimation of teenagers by limb long bones with computerized radiography. Fa Yi Xue Za Zhi. 2011; 27(3): 178-81.

[10] Kanchan T, Krishan K. Anthropometry of hand in sex determination of dismembered remains-A review of literature. Journal of Forensic and Legal Medicine. 2011; 18(1): 14-17.

[11] McCluskey L. Throwing velocity and jump height in female water polo players: Performance predictors. Journal of Science and Medicine in Sport, 2010; 13(2): 236-240.

[12] Klamklay J. Anthropometry of the southern Thai population. International Journal of Industrial Ergonomic. 2008; 38(1): 111-118.