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Norms of Sudanese lumbar Cobb's angle: A computed tomography based study

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Abstract: *The purpose of this descriptive study was to standardize the normal values of lumbar vertebral Cobb's angle for Sudanese subjects using Computerized Tomography (CT).This study was obtained at Al-Zytouna specialized hospital and Royal Care hospital. A sample of 200 Sudanese patients with different ages and genders were included. Cobb's method was used in the evaluation of superior and inferior lumbar vertebra end plates.*
The lateral scouts for lumbar spine were obtained. Traumatic cases and any disease of the vertebral column, spinal canal, para vertebral muscles were excluded. Toshiba CT scanner was used. The exposure factors were 120 KVp, 10-50 MA. End plates angle from L1 to L5 were measured using Cobb's method for both genders and the data were correlated to their ages, and body mass index (BMI). The mean Cobb's angle of lumbar vertebral in males was (30.59^0) and in females was (35.65^0).There is significant differences in Cobb's angle of lumbar spine between the two genders at p=0.000. The mean BMI in males was (24.53) and in females was (25.79),There is a linear relationship between Cobb's angle of the lumbar vertebral and BMI .
The study concluded that the mean Cobb's angle of lumbar vertebral differs significantly between genders in Sudanese.

Keywords - *Cobb's Angle, end Plates, lumber, CT.*

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I. Introduction

The vertebral column is called the spine, back bone, or spinal column, makes up about two-fifths of the total height and is composed of a series of bones called vertebrae. The vertebral column, the sternum, and the ribs form the skeleton of the trunk of the body. The vertebral column consists of bone and connective tissue. [1]The spinal cord that it surrounds and protects consists of nervous and connective tissues. At about 71 cm (28 in.) in an average adult male and about 61 cm (24 in.) in an average adult female, the vertebral column functions as a strong, flexible rod with elements that can move forward, backward, and sideways, and rotate. In addition to enclosing and protecting the spinal cord, it supports the head and serves as a point of attachment for the ribs, pelvic girdle, and muscles of the back and upper limbs. The total number of vertebrae during early development is 33.As a child grows several vertebrae in the sacral and coccygeal regions fuse. As a result, the adult vertebral column typically contains 26 vertebrae. These are distributed as follows: seven cervical vertebrae in the neck region, twelve thoracic vertebrae posterior to the thoracic cavity, five lumbar vertebrae supporting the lower back, one sacrum consisting of five fused sacral vertebrae and one coccyx usually consisting of four fused coccygeal vertebrae. The cervical, thoracic, and lumbar vertebrae are movable, but the sacrum and coccyx are not.[1]

The vertebral endplate is a thin layer of dense, sub chondral bone adjacent to the intervertebral disc, which tends to be thinnest in the central region and thickest towards the periphery. [2]

CT is an imaging method in which a cross-sectional image of the structures in a body plane is reconstructed by a computer program from the x-ray absorption of beams projected through the body in the image plane. [4] Spine CT are commonly requested for a herniated disc or spinal stenosis, but the most frequent use of spinal CT is to get a better look at spinal column damage in patients who have been injured. [2] CT is accepted as the imaging modality of choice in most skeletal diseases when structural or spatial information of the affected bones and articulations is needed. A special advantage of CT is its capability of a fast whole body examination that offers diagnostic information about all organ systems. When using the CT technique for whole-body evaluation. [4] The currently, the accepted measure for clinical assessment of spinal curve is the *Cobb's* angle. The *Cobb's* angle is measured on plane radiographs by drawing a line through the superior endplate of the superior end vertebra of spinal curve, and another line through the inferior endplate of the inferior-most vertebra of the same spinal curve, and then measuring the angle between these lines. Clinically, many *Cobb's* measurements are still performed manually using pencil and ruler on hardcopy X-ray films, but PACs systems (computer networks) are increasingly used which allow manual *Cobb's* measurements to be performed digitally by clinicians on the computer screen. As well as being used to assess scoliosis in the coronal plane, the *Cobb's* angle is used on sagittal plane radiographs to assess thoracic kyphosis and lumbar lordosis. [5]

Evaluation of bone morphology is important; the shape changes associated with normal aging are still under debate. There is no consensus on whether a mild wedging of the vertebral body is the result of a continuous remodeling with the advancing age or due to fractures. To be able to diagnose morphological changes, the normal should be well known.[3]. This paper answers the question of what is a normal value for vertebral endplate *Cobb's angles* from L1 to L5 in normal Sudanese population.

II. Material and methods

This study was done at Al-Zytouna specialized hospital and Royal Care Hospital A sample of 200 patients with different ages and genders were included . *Cobb's* method was used for measuring the superior and inferior end plates angle.The lateral scouts for lumbar spine were obtained. Traumatic cases, any disease of the vertebral column, spinal canal, Para vertebral muscles were excluded. Toshiba CT scanner was used. The exposure factors were 120 KVp, 10-50 MA. End plates angle from L1 to L5 were measured using *Cobb's* method for both genders and the data were correlated to their ages, weight, height and BMI. The ages and BMI for both males and females were classified into different groups; the measurements were presented in as mean values for L1 to L5 *Cobb's* angle endplate for each group, . The data were analyzed using SPSS program.

III. Results

Table 1: The lumbar *Cobb's* angle classified according to the age class for Sudanese males

Age classes	*Cobb's angle Mean± SD*
21-30	32.33±9.7
31-40	29.35±9.2
41-50	30.32±7.8
51-60	31.85±11.8
61-70	28.66±9.9
71-80	30.12±4.9

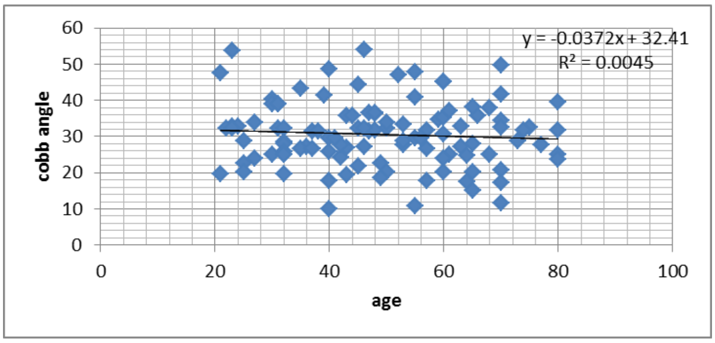

Figure1: Scatter plot diagram shows the linear relationship between Cobb's angle of the Lumber spine and age group for Male.

Table 2: The lumbar *Cobb's* angle classified according to the age class for Sudanese females

Age classes	*Cobb's angle Mean± SD*
21-30	30.56±9.2
31-40	31.58±8.4
41-50	39.24±11.2
51-60	37.82±8.4
61-70	39.02±10.8
71-80	39.96±4.0

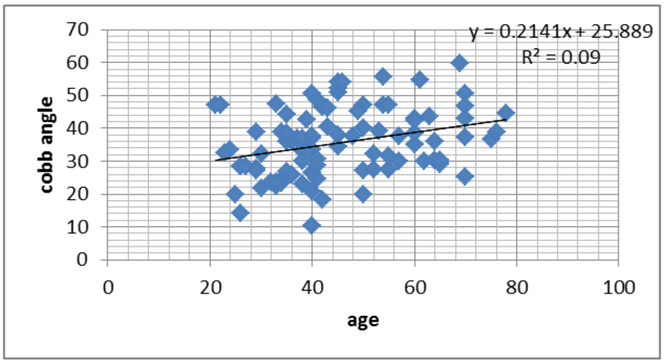

Figure2: Scatter plot diagram shows the linear relationship between Cobb's angle of the Lumber spine and Age group for Female.

Table 3: The classification of BMI measured for males (under weight, normal weight, over weight and obese) presented as mean and standard deviation of lumbar *Cobb's* angle

Classes of BMI		**BMI/Female Mean± SD**	***Cobb's* angle/Female Mean± SD**
Underweight	less or 18.5	-	-
Normal	18.5 -24.9	23.59±1.1	35.35±10.3
Overweight	25 -29.9	27.15±1.3	35.64±10.1
Obese	30 - 39.9	31.01±0.9	38.82±8.8

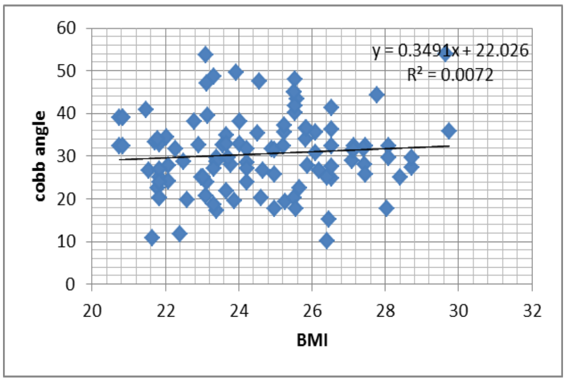

Figure3: *Scatter plot diagram shows the linear relationship between Cobb's angle of the Lumber spine and BMI group for Male*

Table 4. The classification of BMI measured for females (under weight, normal weight, over weight and obese) presented as mean and standard deviation of lumbar *Cobb's* angle

Classes of BMI		***BMI /Males Mean± SD***	***Cobb's angle/Males Mean± SD***
Underweight	less or 18.5	-	-
Normal	18.5 -24.9	23.01±1.2	29.82±8.8
Overweight	25 -29.9	26.67±1.2	31.70±9.0
Obese	30 - 39.9	-	-

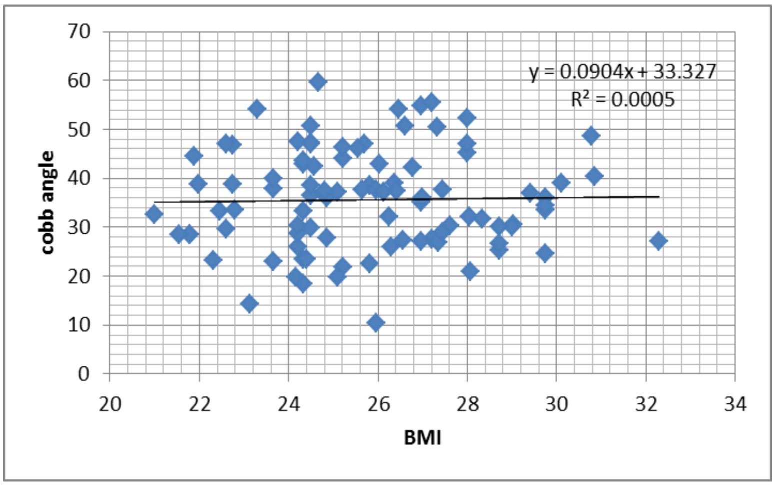

Figure 4: *Scatter plot diagram shows the linear relationship between Cobb's angle of the Lumber spine and BMI group for Female.*

Table 5.*shows Total sample results including age classes, mean and standard deviation, P-Value of lumbar spine Cobb's angle*

Gender	N	***Cobb's* angle**		**Sig***
		Mean	SD	**0.000**
Male	107	30.59	8.9	
Female	93	35.65	10.1	

Table 6: *Total sample results including BMI, mean and standard deviation, P-Value of lumbar spine Cobb's angle*

	N	Mean	STDV	Sig*
BMI Male	107	24.53	2.1	**0.000**
Cobb's Male	107	30.59	8.9	
BMI Female	93	25.79	2.4	**0.000**
Cobb's Female	93	35.65	10.1	

IV. Discussion

This study was conducted to establish a reference for *Cobb's* angle measured for superior and inferior end plate in normal lumbar vertebrae, using CT scan in Sudanese population.200 lateral CT scan scouts were obtained from (107males, 93 females). Their ages were ranged between (21 -80) years old. Toshiba CT scan machine was used with KV120- MA10 -50.The *Cobb's* angles were measured from L1 to L5for both genders and were correlated to their ages. The ages for both gender were classified to different groups, the measurements were presented in (table 1, 2) as mean values for lumbar vertebral *Cobb's* angles.

The mean *Cobb's* angle of lumbar vertebral in male was (30.59^0) and in female was (35.65^0).There was differences in *Cobb's* angle of lumbar spine between males and females. The *Cobb's* angle related to their ages was found to be decreased by increasing age; the justification for these results is that imbalance of trunk muscle due to weakness of abdominal muscles can decrease in lumbar *Cobb's* angle. [6] For the female lumbar spine is morphologically suited to increase lumbar *Cobb's* angle [8] due to the increasing of weight. [11]

Figure (1) showed the correlation between the age and the lumbar vertebral *Cobb's* angle. There is negative relationships, as the age increased the angle was decreased but for females in figure (2): it increases. By applying the following equation the female *Cobb's* angle can be estimated:

Female Cobb's angle = 0.2141X age + 25.88 ***Equation: 1***

This relationship is for all Sudanese females within this age group. The wedging in the females is constant before menopause, postmenopausal women.

BMI for both genders were classified to different groups, the measurements were presented in (table 3, 4) as mean values for lumbar vertebral *Cobb's* angles. The mean BMI in males was (24.53) and in females was (25.79). The mean *Cobb's* angle of lumbar vertebral in male was (30.590) and in female was (35.650) There is significant differences in *Cobb's* angle of lumbar spine between the two genders at p=0.000.

Figures (3, 4) showed the correlation between BMI and the Lumbar vertebral *Cobb's* angle and there was a linear relationship between *Cobb's* angle of the lumbar vertebral and BMI. By applying the following equations the *Cobb's* angle can be estimated:

Male Cobb angle= 0.3491xBMI + 22.026 Equation: 2
Female Cobb angle= 0.904xBMI + 33.327 Equation: 3

The linear relationship between *Cobb's* angle of the lumbar vertebral and BMI due to increased mechanical loading of the lumbar spine [9], the anterior shifting of the center of mass, resulting in increased flexion of the lumbar vertebra [10] this might increase the *Cobb's* angle of the lumbar vertebral.[7]This agrees with the findings of previous studies. [7][9]

V. Conclusion

The study concluded that the mean *Cobb's* angle end plate differs significantly between the males and females Sudanese subjects and it has relation with age and body mass index .the values differ from what was mentioned previously.

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