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Assessment of Superior and Inferior End plates In Normal lumbar Vertebrae from L1 to L5, Using Computed Tomography in Sudanese Population

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Abstract: ***The purpose of this study was to standardize the normal values as reference for Cobb angle of lumbar vertebral in normal Sudanese subjects using Computerized Tomography (CT).This study was done at Al-Zytouna specialized hospital and Royal Care hospital. This is a descriptive study, the samples of 200 patients in different ages and different genders and used Cobb method in measurement. The lateral scouts for lumbar spine were obtained. Traumatic cases, any disease of the vertebral column, spinal canal, para vertebral muscles diseases cases were excluded. Toshiba CT scanner was used. The exposure factors were KVp120, MA10-50. End plates angle from L1 to L5 was measured using Cobb method for both genders and the data were correlated to their ages, weight, height and body mass index (BMI). . The mean Cobb angles of lumbar vertebrae in males were found to be (4.77^0), (4.80^0), (4.64^0), (4.99^0), (7.16^0), and in females (5.420^0), (5.34^0), (5.28^0) (5.66^0), (8.05^0) for L1, L2, L3, L4 and L5 respectively. There were significant differences in the Cobb angle of lumbar spine between both genders at p value 0.05. The mean BMI in males was (24.53 kg/m2), and in females was (25.79 kg/m2), where was a linear relationship between Cobb angle of the lumbar vertebral and BMI There is significant differences in Cobb angle of lumbar spine between the two genders at p value 0.05. The study concluded that the mean Cobb angle of lumbar vertebral differs significantly from males and females Sudanese.***

Keywords: Cobb Angle, end Plates, lumber, CT

1. 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]

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]

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 narrowing of the spinal canal, also called 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 MSCT technique for whole-body evaluation. [4]

The currently, the accepted measure for clinical assessment of spinal curve is the Cobb angle. The Cobb 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 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 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 angle is used on sagittal plane radiographs to assess thoracic kyphosis and lumbar lordosis. [5]

The traumatic cases, any disease of the vertebral column, spinal canal, para vertebral muscles diseases cases were excluded. This paper answers the question of what is a normal value for vertebral endplate from L1 to L5 in normal Sudanese population.

2. Material and Methods

This study was done at Al-Zytouna specialized hospital and royal care hospital, the samples of 200 patients in different ages and genders and was used Cobb method in measurement.

The lateral scouts for lumbar spine were obtained. Traumatic cases, any disease of the vertebral column, spinal canal, Para vertebral muscles diseases cases were excluded. Toshiba CT scanner was used. The exposure factors were KVp120, MA10-50. End plates angle from L1 to L5 were measured using Cobb method for both genders and the data were correlated to their ages, weight, height and BMI. The ages and BMI for males were classified to different groups; the measurements were presented in as mean values for L1 to L5 Cobb angle endplate for each group, also for females all the measurements were done for to each group. The data were analyzed using SPSS program.

3. Results

The following tables and figures presented the results

Table 1: Shows results for both gender including age classes, mean and standard deviation of lumbar Cobb angles

Age classes	Gender	L1 Mean± SD	L2 Mean± SD	L3 Mean± SD	L4 Mean± SD	L5 Mean± SD
21-30	Male	5.47±1.5	5.17±1.4	5.06±1.4	5.50±1.7	8.12±2.3
	Female	5.37±1.1	5.4±1.0	5.17±0.9	5.52±0.9	7.4+±2.1
31-40	Male	4.59±1.2	4.86±1.1	4.90±1.3	5.21±1.9	7.04±2.6
	Female	5.36±1.0	5.33±0.8	5.23±0.8	5.56±1.1	7.77±2.3
41-50	Male	4.98±1.7	4.91±1.4	4.67±1.4	5.47±2.4	7.51±3
	Female	5.30±1.0	5.22±0.9	5.25±0.8	5.82±1.4	9.05±4.2
51-60	Male	4.33±0.9	4.34±1.1	3.99±1.0	4.04±1.1	6.34±2.7
	Female	5.57±1.0	5.31±0.8	5.30±0.9	5.85±1.2	8.20±3.0
61-70	Male	4.83±1.7	4.80±1.5	4.95±1.5	5.03±1.8	7.47±2.7
	Female	5.64±0.9	5.49±0.9	5.54±0.9	5.65±1.1	7.50±2.9
71-80	Male	4.25±0.8	4.68±0.6	3.82±0.6	4.13±1	5.86±2.8
	Female	5.20±1.0	5.43±0.5	5.13±0.9	5.46±1.2	8.53±2

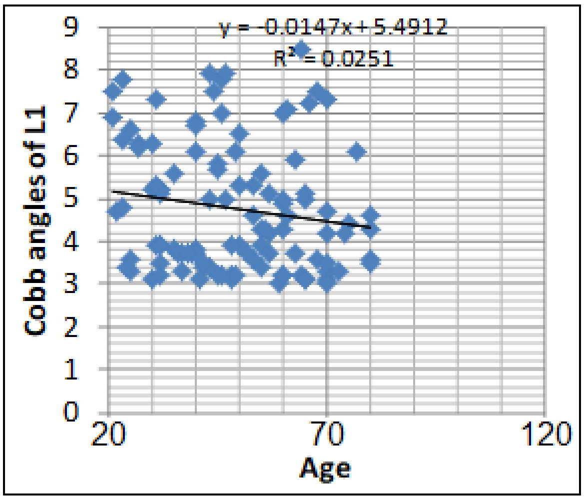

Figure (1-1): Scatter plot diagram shows the linear relationship between Cobb's angle of L1 and Age group for male

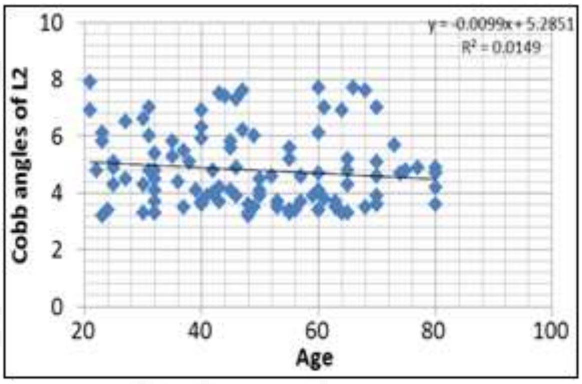

Figure (1-2): Scatter plot diagram shows the linear relationship between Cobb's angle of L2 and Age group for male

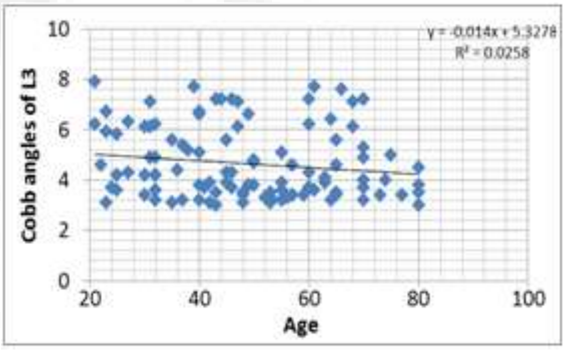

Figure (1-3): Scatter plot diagram shows the linear relationship between Cobb's angle of L3 and Age group for male

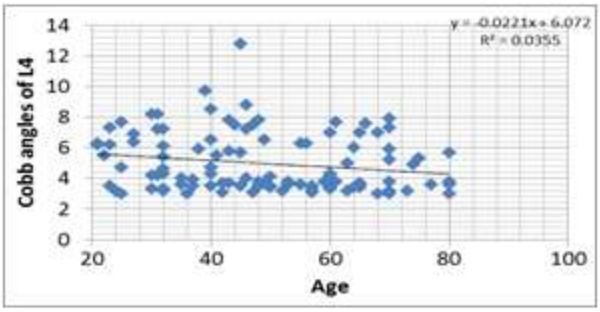

Figure (1-4): Scatter plot diagram shows the linear relationship between Cobb's angle of L4 and Age group for male.

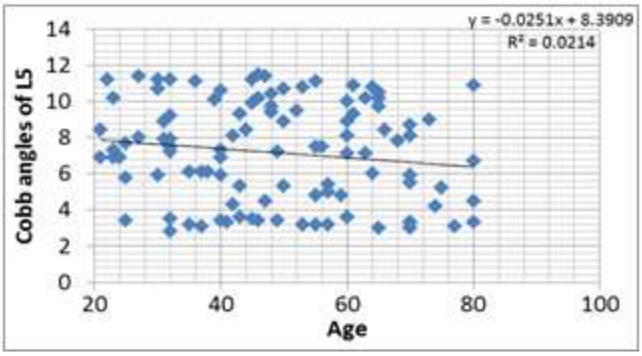

Figure (1-5): Scatter plot diagram shows the linear relationship between Cobb's angle of L5 and Age group for male

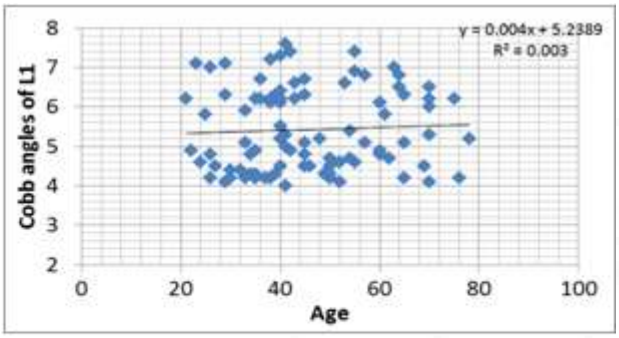

Figure (1-6): Scatter plot diagram shows the linear relationship between Cobb's angle of L1 and Age group for Female

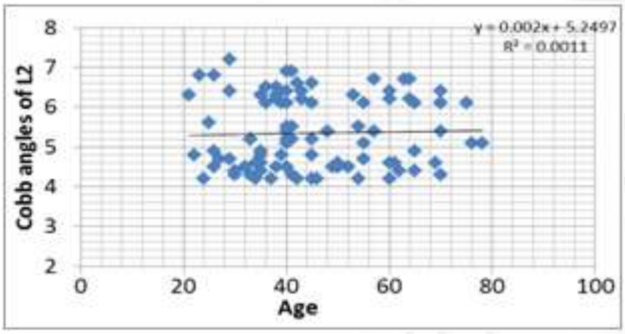

Figure (1- 7): Scatter plot diagram shows the linear relationship between Cobb's angle of L2 and Age group for Female

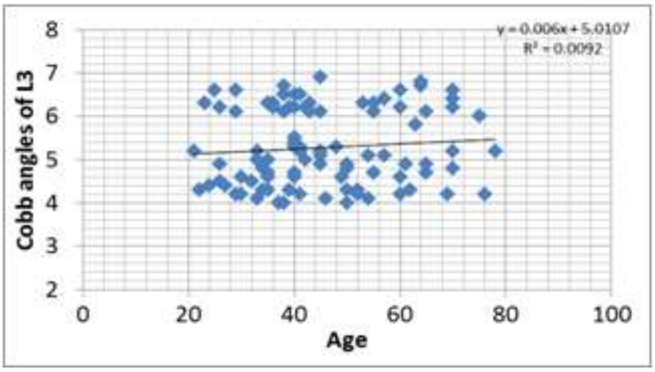

Figure (1-8): Scatter plot diagram shows the linear relationship between Cobb's angle of L3 and Age group for Female

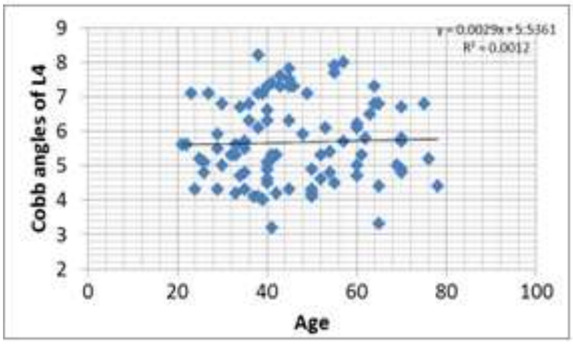

Figure (1-9): Scatter plot diagram shows the linear relationship between Cobb's angle of L4 and Age group for Female

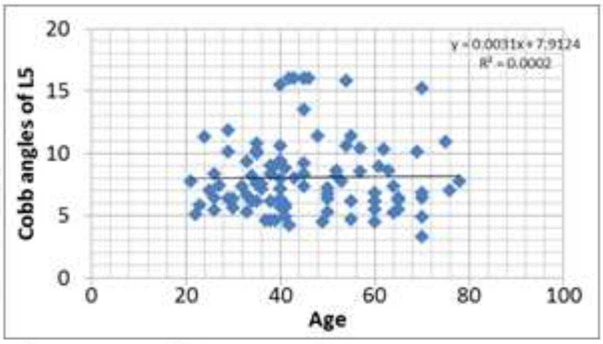

Figure (1-10): Scatter plot diagram shows the linear relationship between Cobb's angle of L5 and Age group for Female

Table 2: shows results for both gender including body mass index classes, mean and standard deviation of lumbar Cobb angles

BMI classes kg/m2	Gender	L1 Mean± SD	L2 Mean± SD	L3 Mean± SD	L4 Mean± SD	L5 Mean± SD
18.5-24.9	Male	4.69±1.1	4.78±1.2	4.49±1.3	4.73±1.6	6.82±2.7
	Female	5.43±1.0	5.33±0.9	5.30±0.9	5.74±1.1	7.77±2.6
25-29.9	Male	4.87±1.6	4.82±1.4	4.85±1.5	5.34±2.2	7.63±2.7
	Female	5.34±0.9	5.29±0.8	5.21±0.8	5.53±1.1	8.30±3.3
30-39.9	Male	0±0	0±0	0±0	0±0	0±0
	Female	6.25±1.4	6.02±1.0	5.97±0.7	6.50±1.2	7.80±0.8

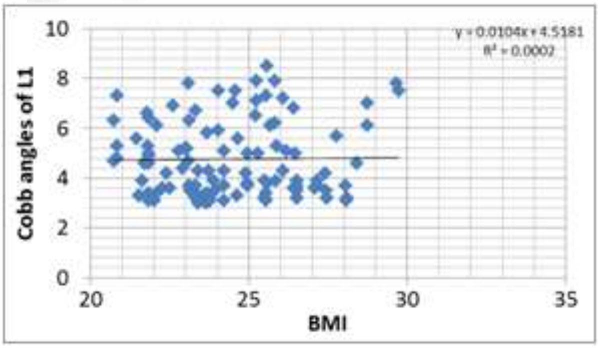

Figure (2-1): Scatter plot diagram shows the linear relationship between Cobb's angles of L1and BMI group for male

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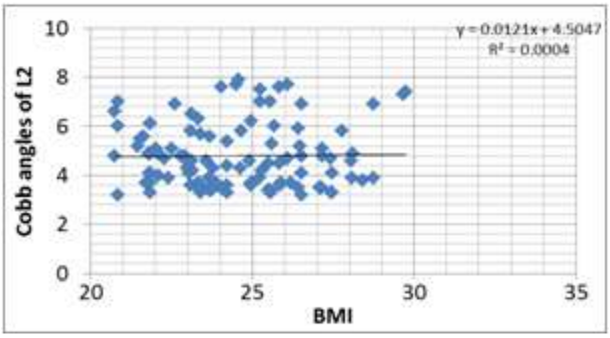

Figure (2-2): Scatter plot diagram shows the linear relationship between Cobb's angles of L2and BMI group for male

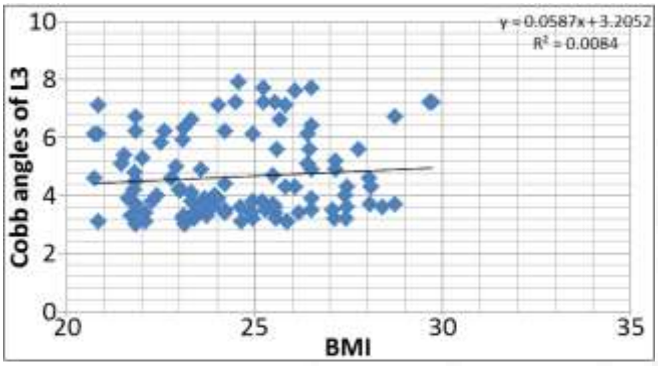

Figure (2-3): Scatter plot diagram shows the linear relationship between Cobb's angles of L3and BMI group for male.

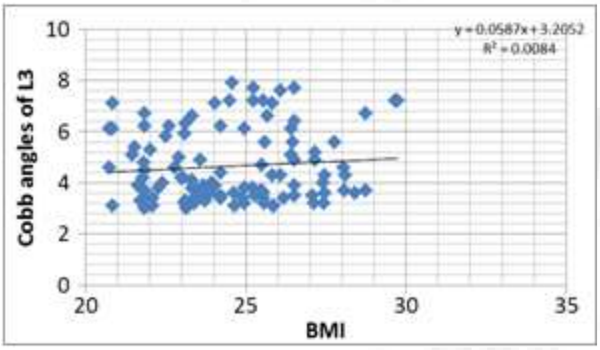

Figure (2-4): Scatter plot diagram shows the linear relationship between Cobb's angles of L4and BMI group for male.

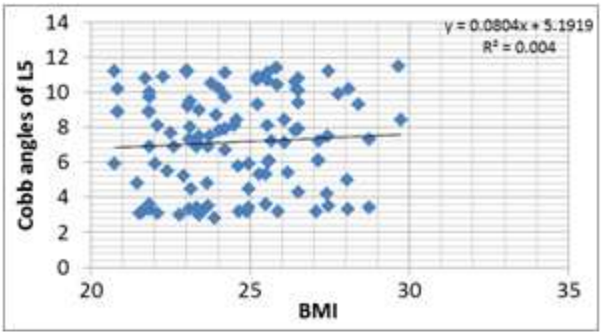

Figure (2-5): Scatter plot diagram shows the linear relationship between Cobb's angles of L5and BMI group for male.

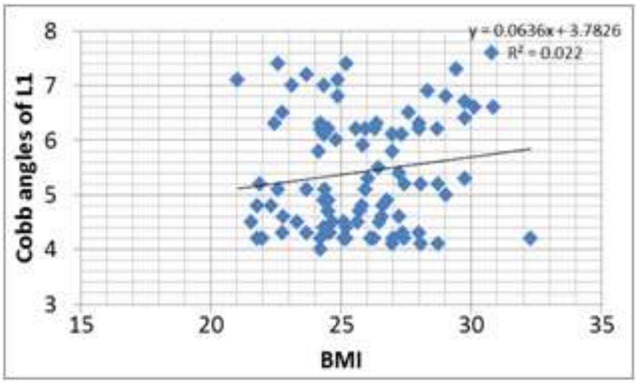

Figure (2-6): Scatter plot diagram shows the linear relationship between Cobb's angles of L1and BMI group for Female

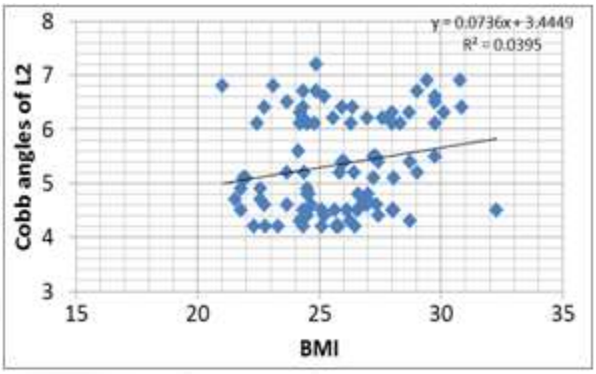

Figure (2-7): Scatter plot diagram shows the linear relationship between Cobb's angles of L2and BMI group for Female

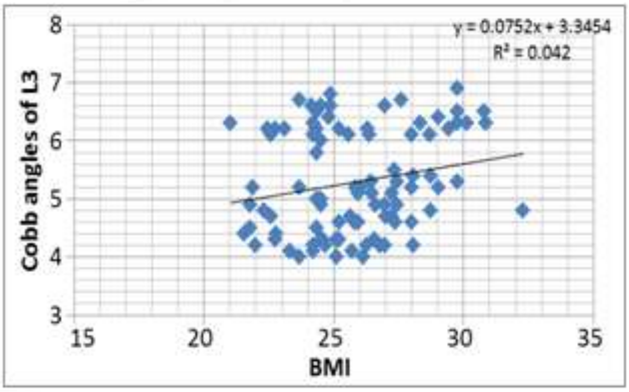

Figure (2-8): Scatter plot diagram shows the linear relationship between Cobb's angle of L3 and BMI group for Female

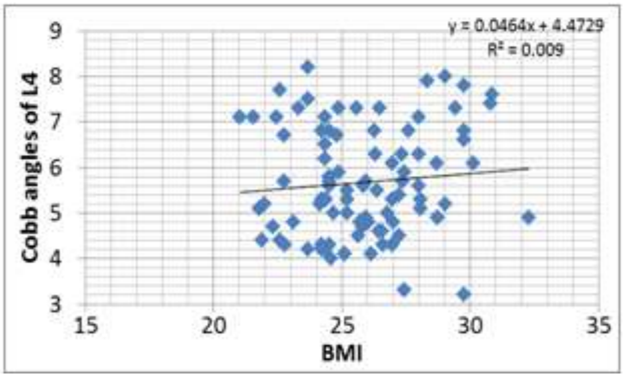

Figure (2-9): Scatter plot diagram shows the linear relationship between Cobb's angle of L4 and BMI group for Female

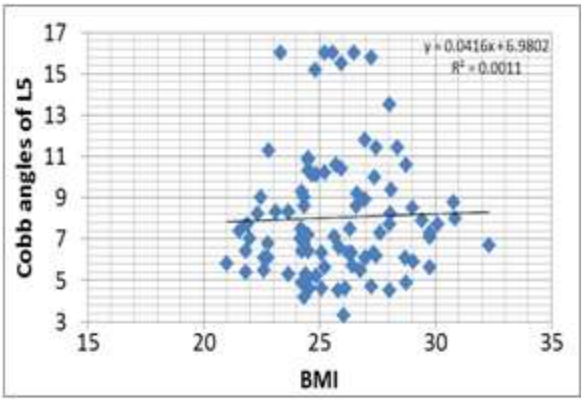

Figure (2-10): Scatter plot diagram shows the linear relationship between Cobb's angle of the L5 and BMI group for Female

Table 3: Shows results for both gender including mean and standard deviation of lumbar Cobb angles, body weight classes

	Gender	N	Mean± SD	Seg (2tail)
L1 Cobb angle	Male	107	4.77±1.4	0.01*
	Female	93	5.42±1.0	
L2 Cobb angle	Male	107	4.80±1.3	0.01*
	Female	93	5.34±0.8	
L3 Cobb angle	Male	107	4.64±1.4	0.000*
	Female	93	5.28±0.8	
L4 Cobb angle	Male	107	4.99±1.8	0.03*
	Female	93	5.66±1.1	
L5 Cobb angle	Male	107	7.16±2.7	0.03*
	Female	93	8.05±3.0	
	Female	93	22.85±2.0	
BMI	Male	107	24.53±2.1	.000*
	Female	93	25.79±2.4	

4. Discussion

The purpose of this study was to standardize the normal values as reference for Cobb angle of lumbar vertebral in normal Sudanese subjects using Computerized Tomography (CT).

200 lateral scouts CT scan were obtained from (107males, 93 females).their ages were ranged from (21to80) years old. Toshiba CT scan machine was used with KV120- MA10 -50. The Cobb angles were measured from L1 to L5for both gender and correlated to their ages. The ages for both gender were classified to different groups, the measurements were presented in (table 1) as mean values for lumbar vertebral Cobb angles.

The mean Cobb angles of lumbar vertebrae in males were found to be (4.77^0), (4.80^0), (4.64^0), (4.99^0), (7.16^0), and in females (5.420^0), (5.34^0), (5.28^0) (5.66^0), (8.05^0) for L1, L2, L3, L4 and L5 respectively. The Cobb angle related to their ages was found to be decreased by increasing age; the justification for these , the results is that imbalance of trunk muscle due to weakness of abdominal muscles can decrease in lumbar Cobb angle. [6] The female lumbar spine is morphologically suited to increased lumbar Cobb angle [7] and the lumbar lordosisn increase due to increase in weight. [8]

The presented figure (1-1): correlate between the age and the Lumbar vertebral Cobb angle. There were linear relationships, as the age increased the angle was decreased. BMI for both gender were classified to different groups, the measurements were presented in (table 2) as mean values for lumbar vertebral Cobb angles. The mean BMI in males was (24.53 kg/m2), and in females was (25.79 kg/m2). There is a significant difference in Cobb angle of lumbar spine between the both genders at p value 0.05.

The presented figures (4-5-1, 4-5-2): correlate between BMI and the Lumbar vertebral Cobb angle and where was a linear relationship between Cobb angle of the lumbar vertebral and BMI.

The linear relationship between Cobb 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 vertebral [10] and which increased the Cobb angle of the lumbar vertebral. This agrees with the findings of previous studies.

5. Conclusion

The purpose of this study was to standardize the normal values as reference for Cobb angle of lumbar vertebral in normal Sudanese subjects using Computerized Tomography (CT).

The mean Cobb angles of lumbar vertebrae in males were found to be (4.77^0), (4.80^0), (4.64^0), (4.99^0), (7.16^0), and in females (5.42^0), (5.34^0), (5.28^0) (5.66^0), (8.05^0) for L1, L2, L3, L4 and L5 respectively. There is a significant difference in Cobb angle of lumbar spine between both genders at p value 0.05.

The mean BMI in males was (24.53 kg/m2), and in females was (25.79 kg/m2).

The mean Cobb angle end plate of the lumbar vertebrae differs significantly from males and females' Sudanese subjects.

6. Recommendations

Further studies should measure the Cobb angle and dimensions of the lumbar vertebrae in sagittal plane. Used of other variables such as patient length and relation to Cobb angle of the lumbar vertebrae.

7. Acknowledgements

I wish to thank my supervisor Dr. Caroline Edward Ayad

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