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A Radiographic Study of Lumbo-Sacral Angle and Its Correlation with Gender & BMI in North Indian Population

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ABSTRACT

Objectives: The lumbo-sacral region is the most important region of the vertebral column in terms of its mobility and weight-bearing function. Measurement of geometrical angles is used to evaluate the stability of this region. There is relative paucity of such data for the North Indian population. We attempted to study the various angles in the lumbo-sacral region in the North Indian population.
Methods: This was a retrospective study in which digital radiographs (lateral view) of the lumbo sacral spine in 500 subjects with low back pain were evaluated. Patients with history of trauma or radiographically detected bony spinal abnormality were excluded. The lumbo-sacral angle (LSA) was measured using the RaDiant Dicom Viewer Software. The demographic parameters were also recorded.
Results: The mean value of lumbo-sacral angle in the whole population was found to be $37.7^0 \pm 8.8^0$. The mean value of lumbo-sacral angle in females was significantly higher than the males. The lumbo-sacral angle is influenced by BMI but no significant result was found.
Conclusion: The mean values of lumbo-sacral angle may form the reference values for the North Indian population. Results of the present study show variability when compared to other similar studies, which further strengthen the fact that normal variation in lumbo-sacral angle differs among different region and races; hence results of the present study may be of use to health care providers for treating different spinal disorders of north Indian population.

Keywords
lumbar angles, lumbo-sacral region, evaluation, spinal disorders

INTRODUCTION

The lumbo-sacral region is the most important region of the vertebral column in terms of its mobility and weight bearing function [1]. The human vertebral column exhibits regional curvatures with the vertebral bones extending cranio-caudally down the sacrum and thus ensures resilience as it enables successive vertebrae bear and transfer weight, up to about three times that of a straight column [2]. The spine is not a rigid body; rather it is a multi-joint with non linear geometry, so this should be considered in biomechanical models of the lumbar spine. The geometrical angles in the lumbo-sacral spine may be used to assess the condition of spine. The geometry of the lumbar spine can be evaluated by imaging techniques like radiography, computed tomography or magnetic resonance imaging [3]. There are various factors which can influence the lumbo-sacral curvature such as age, posture, degenerative changes, stature, trauma or surgery, race and ethnicity [4]. Lumbo-sacral angle (LSA) or Sacro vertebral angle is clinically an important radiographic parameter related to the lordotic curve and is valuable in the management of patients with low back disorders. Its formation is related to evolution of bipedal gait and erect posture [1]. The axial load and anterior shear forces at the lumbo-sacral junction is normally resisted by the spine and it has been found that obesity leads to increase in shearing and compressive forces on the articular facets at lumbo-sacral junction thereby reducing its stability[5]. The lumbar spine in obese individuals becomes hyper lordotic leading to increased

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LSA, which becomes a risk factor for low back pain and poor posture Measurement of LSA is therefore used to evaluate the stability of the lumbo-sacral region.The lumbar spine in obese individuals becomes hyper lordotic leading to increased LSA, which becomes a risk factor for low back pain and poor posture [6]. Measurement of LSA is useful in the designing and development of spinal implants and instrumentation [7].

PATIENTS AND METHODS

This retrospective study was done in the North Indian population (Himachal Pradesh). The data was obtained from the 500 patients who came into the department of Radiology, SLBS GMCH Mandi at Ner Chowk. The patients with complaint of low back pain without radio graphically detected abnormality were considered in the part of this study. The lower age limit was 18 years to ensure that only subjects who had attained spinal maturity to be studied. The upper age limit was set at 45 years to ensure that subjects with osteoporotic changes commonly seen in elderly persons to be excluded. The patients with past fracture and traumatic injury were also excluded from the study.

TECHNIQUE:

The data collection included the age, sex, and occupation of the subject. The X-ray imaging of the lumbo-sacral region in the patients with low back pain was done in lateral position using the Allengers D500 Digital X Ray system in the department of Radiology, SLBS GMCH Mandi at Ner Chowk. The criteria for normality of the radiographs were as follows:

1. Presence of 5 lumbar and 5 sacral vertebrae.
2. Preservation of lumbar lordosis.
3. The intervertebral disc spaces increase in thickness from L1 to L5.
4. No radiographic evidence of congenital abnormality or disease.

The lumbo-sacral angle was measured using the RaDiant DICOM software.

Lumbo-sacral angle (LSA): The angle between the sacral base and the horizontal plane (Figure1). The Lumbo-sacral angle was measured using RaDiant Dicom Viewer Software. The angle was read by two authors with no significant inter- observer error.

- The statistical analysis was done using SPSS Version 20. ANOVA test and student –t test unpaired was used to analyse the data. P-value to ≤ 0.05 was considered as significant value.

RESULTS

The data of 500 subjects who met the eligibility criteria were analyzed. There were 169 males (33.8%) and 331 females (66.2%).the distribution of subjects by gender is shown in table 1.

Table 1: Distribution of Subjects by Gender (N= 500)

Gender	Number	%age
Male	169	33.8
Female	331	66.2

The mean age, BMI and weight in the study population was found to be 38.3, 23.6, 64.4respectively. This is shown in chart1.

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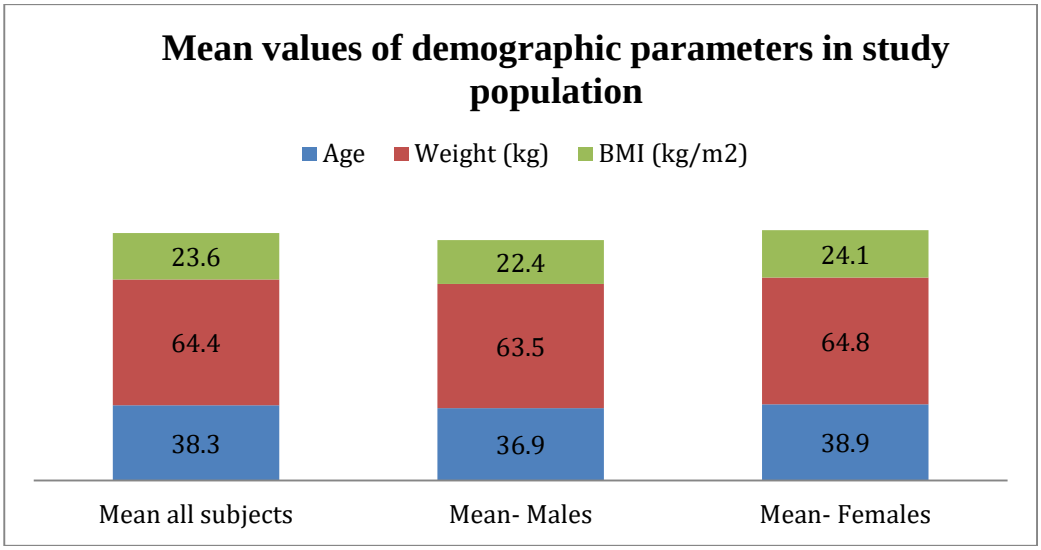

Table 2 summarises the higher significant values in females of mean demographic parameters.

Table 2: Summary of age and demographic characteristics of the subjects

Variables	Mean all subjects	Mean- Males	Mean- Females	P value
Age	38.3	36.9	38.9	**0.001**
BMI ($kg/m^{2)}$	23.6	22.4	24.1	**0.000**
Weight (kg)	64.4	63.5	64.8	**0.026**

Table 3 shows the mean of the lumbo-sacral angle in study population and the comparison of the lumbo-sacral angle between males and females.

Table3: Summary of mean of lumbo-sacral angle in Males and females

Lumbo-sacral angle	Mean value
Total population	37.7
Males	36.6
Females	38.3

The mean LSA was found to be 37.7 in the study population. With a range of 19.2-67.1 However the LSA in females was significantly more than the males.
Table 4 depicts the co-relation of lumbo-sacral angle with BMI. It was found that mean value of lumbo-sacral angle raised with increasing weight of the subjects, however no significant result was obtained.

Table 4: Co- relation of lumbo-sacral angle with BMI

BMI of subjects	Mean of lumbo-sacral angle
Underweight	21.5
Normal	37.4
Over- weight	38.5
Obese	40.4

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DISCUSSION

The mean LSA in our study population was 37.7^0 and thus shows great difference from the other studies [8-13]. In a study of 30 cadaver reported by Von Lackum et al [8],the mean LSA value was found to be 42.5°.A prospective study conducted by Splithoff et al[9] on 100 subjects in the recumbent position recorded 40-44°mean value of lumbo sacral angle. A study reported by Bryan et al [10] in the Caucasian race concluded that lumbo-sacral angle varies between 15° and 25° in erect position. The mean LSA in the present population was significantly higher than the mean LSA reported by Blackburne [11], Kim HJ et al [12] and Chung HS et al [13] which was 32º, 31.7 and 32.4 respectively. The mean LSA reported by Jha et al [14] was 34^0. In the present study, the average LSA in female population was significantly greater than the males. This finding is similar to many other studies [1,10,15-16]. Greater LSA in females could be due to evolutionary changes adapted to assist pregnancy and hormonal changes during reproductive age [16]. The study done by Okpala [16], the average LSA for males was 43.4° and for females was 45.5°. The wide range of difference in lumbo-sacral angle explain the fact that LSA has a racial variation being higher in Caucasians and lower in the Asian population and may be explained by the difference in stature of the different races. The present study led to the finding that BMI had a positive correlation with the LSA in the study population. This is in coherence with the study reported by Onyaemaechi [7], Ridola C et al [17], Braunaugh J et al[18]. It is believed that in overweight and obese subjects, the weight of the trunk displace the base of the sacrum anteriorly, thus leading to increase in lumbo-sacral angle. An increased lumbo-sacral angle has been found suggestive of producing low back pain by increasing the shearing and compressive forces on the articular facets at the lumbo-sacral junction. An increase in lordotic angle proportionally increases the shearing strain or stress in the anterior direction and shifts the centre of gravity anteriorly[5,6].

CONCLUSION

The mean LSA in our study was 37.7^0. In the present study, the average LSA in female population was significantly greater than the males. The lumbo-sacral angle is also influenced by BMI but no significant result was obtained. The evaluation of these angles may be useful in identifying individuals who are at risk of developing low back pain and values be used in the design of spinal instrumentations and implants.

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