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Effect of Body Size, Body Mass Index and Waist-Hip Ratioon Spinal Curvature: A Study of Adult Males in Port Harcourt, Nigeria

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ABSTRACT

This study was conducted using the vertebral column, to determine the Lumbosacral angle (LSA) of non-obese male subjects and evaluate its relationship to selected subject specific variables. After obtaining institutional approval, lateral radiographs of one hundred and forty-two informed healthy male volunteers aged 18-60 were studied using Ferguson's method, and analyzed with respect to age, waist hip ratio (WHR) and body mass index (BMI). Mean (SE) Lumbosacral angle of the sample population was $34.06^0 \pm 0.56^0$, mean body weight was 70.34 ± 1.02Kg, and average BMI was 24. 64 ± 0.38Kgm^{-2}. Angle values were observed to increase with age up to 32years, followed by a sinusoidal increase and decrease pattern thereafter. Significant correlations were observed between LSA and Body weight as well as between LSA and BMI ($p<0.05$). The Lumbosacral angle of males in Port-Harcourt, South South Nigeria is within the range of literature derived measurement values world-wide, but lower than the average reported from previous studies on other Nigerian populations.

Key words: Lumbosacral angle, male, Nigerians, spines, Ferguson's method

INTRODUCTION

The lumbosacral angle is a spine measurement derived from the wedge angle formed when the horizontal base of the angle is parallel to the ground level and the hypotenuse of the angle is formed at the level of the superior border of the sacrum. The plane of the sacrum forms the base from which the lumbar spine takes off in its ascent and by which it achieves its balanced state[1,10,13].

High values of BMI have been reported to be associated with exaggerated lumbar curves and low back pain [13, 23-25, 27, 29]. On the contrary [21, 26], reported there was no significant relationship between BMI and LSA. In a previous study, [27] did a across-sectional evaluation of 44 females 21-45 years, with a mean age of 30years, and reported a significant correlation between BMI and lumbar lordotic angle, lumbosacral angle and lumbar gravity line. In a related study [16], did not find any significant correlation between WHR and lumbar Lordosis.

The vertebral column: Lateral aspect.

Figure 1: Diagram of the vertebral column and main regional curves. (Source: Sandring[1])

In the healthy spine, specific arrangements of the wedge angles result in the regional curves and this enables the spine to provide resilience and enables successive vertebrae bear and transfer weight of magnitude three times that which is attainable for a straight column. [1, 3, 12, 15]It has been suggested that in patients presenting with non-specific back pain, considerable distortion in the size and orientation of lumbosacral angle occurs.[8,11, 20] In the study by [17], as high as 75% cases of pain was observed to be etiologically related to increase in the LSA. Studies have also shown that physical examination of patients presenting with spine problems yield best results when combined with radiographic assessment [3-5, 14, 19, 28]. This study aimed to provide country normal values of the LSA of the spine for healthy male Nigerians, and to find out the influence of age and body indices on these normal values.

MATERIALS AND METHOD

Approval was obtained from the Ethics Review Committee of the Faculty of Basic Medical Sciences, College of Health Sciences, of the University of Port Harcourt. The study sample comprised one hundred and forty – two (142) healthy male volunteers aged 18 – 60 who met the inclusion criteria and voluntarily gave informed consent.

Participants were required to be Nigerians with no medical records of musculoskeletal disease, resident in the South South geopolitical zone, and mentally fit to sign the informed consent form provided. Volunteers were properly and adequately informed about the nature, risks, benefits and confidentiality of the study. Subjects with medical history of X-ray done one month prior to the current study, as well as those with radiographic evidence of scoliosis, kyphosis, degenerative changes such as spondylosis, presence of osteophytes or disc space narrowing were excluded from the study.

The study was conducted in three well designated centers in Port Harcourt (The radiology department of the University of Port Harcourt Teaching Hospital, Image Diagnostics Center, Rumuola Port Harcourt. Ashford and Patrice Clinic LTD, D-line, Port Harcourt), a multiethnic city.

A film plate of 35 x 43 cm was used for the lumbosacral spine, with a minimum subject image distance of 100 cm.

Sample size and Sampling Technique: The convenience sampling method was employed and the participants recruited through phone conversations, direct communication during health talks and conferences as well as by use of posters and radio

Minimum sample size was determined using formula provided by Portney and Watkins[29], Lehana[30] and European Commission.[31]

$n = (A + B)\,2 \times 2 \times (S.D)\,2 / D2$

$= (0.84 + 1.96)2\ x2x\ (7.75)2/52$

$= (0.84+1.96)^2 \times 2 \times 7.752 / 5^2 = 38$

$= (0.84 + 1.96)^2 \times 2 \times 60.0625/25 = 38$

Where;

n = minimum sample size

A = (0.84) probability equivalence of statistical power of 80%, at 0.05 level of significance

B = (1.96) critical value at the level of significance

S. D = (7.75) standard deviation from a previous study.[32]

D = Acceptable difference in mean values of clinical significance = 5º.

The minimum sample size was 38 subjects for each group

A total of 142 subjects were used for the study

Measurement Techniques: The five lumbar vertebrae (L1-L5) were examined and the two end plates (superior and inferior) noted. The first sacral Vertebra (S1) was carefully identified and its end plate (SEP) noted. On a transparent paper, a line (**CD**) was drawn horizontal and parallel to the edge of the table, and a second line (**AB**) drawn through and parallel to the superior end plate (sacral base) of the sacrum, the two lines were extended to their point of intersection, which technically is the fulcrum, at the lumbosacral articulation.

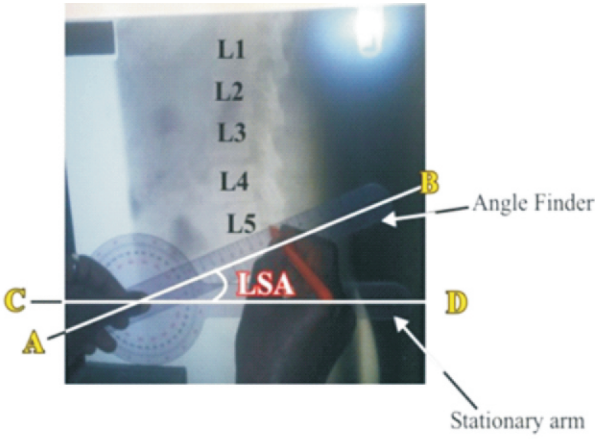

Figure 2: Measurement of LSA)

The fulcrum of the transparent goniometer was positioned to align with that of the joint and the lumbosaral angle is the angle between lines B and D as shown in figure 2 above , being read from the 360

Data were analyzed using SPSS version 17.0 (IBM SPSS). Results were presented as Range, Mean and Standard Error of Mean. Comparison in mean was carried out using Independent sample t-test whereas correlation analysis was done to show relationship.

RESULTS

The results werepresented as Range, Mean and Standard Error of Mean [Table 1]. Comparison in mean was carried out using Independentsample t-test [Table 2] while correlation analysis was done to show relationship [Table 3].

Table1: Distribution of LSA by age groups

Age groups	N	Range	Mean LSA (°)	Standard Error
18-22yrs	31	24 – 45	31.53	1.43
23-27yrs	24	23 – 37	29.86	0.66
28-32yrs	18	22 – 36	30.00	1.36
33-37yrs	20	24 – 27	25.67	0.88
38-42yrs	23	25 – 35	30.38	0.88
>42yrs	26	34 – 38	35.6	0.81
Total	142	22 – 45	30.56	0.5

The mean LSA in this study population is $30.56^0 \pm 0.50^0$.
The highest value of LSA was observed in subjects older than 42 years,whereas the lowest observed mean LSA occurred in age class 23-27years.

Table 2: Independent sample t test, comparing LSA between the different age groups

Age groups		Mean diff.	t-value	p-value	Inference
18-22	23-27	1.67	1.2	0.24	NS
	28-32	1.53	0.69	0.5	NS
	33-37	5.86	1.68	0.11	NS
	38-42	1.14	0.63	0.53	NS
	>42	-4.07	-1.5	0.15	NS
23-27	28-32	-0.14	-0.1	0.92	NS
	33-37	4.19	2.03	0.05	NS
	38-42	-0.53	-0.46	0.65	NS
	>42	-5.74	-3.56	0.00	S
28-32	33-37	4.33	1.75	0.11	NS
	38-42	-0.38	-0.25	0.81	NS
	>42	-5.6	-2.87	0.01	S
33-37	38-42	-4.72	-2.46	0.03	S
	>42	-9.93	-7.88	0.00	S
38-42	>42	-5.22	-3.42	0.00	S

Statistically significant differences were observed among various age groups as shown in the table above ($p<0.05$).

Table 3: Pearson Correlation analysis

Variables		Pearson Correlation		
		R	Sig (2-tailed)	Inference
LSA	Age	0.16	0.06	NS
	Weight	0.37	0.00	S
	WHR	-0.10	0.22	NS
	BMI	0.32	0.00	S

LSA also showed significant correlation with BMI and body weight respectively ($p<0.05$).

DISCUSSION

The purpose of this study was to determine normal reference values of the lumbosacral angles of healthy adult male Nigerians and find out if a significant relationship exists between the size of the angle and specific anthropometric characteristics such as Age, WHR and BMI.

In line with previous reports[1,3, 4], a non-linear relationship was found between LSA and age of subjects. suggesting that among other factors, vertebral column morphology may be influenced by certain others which are unique to individuals.

Peleg [15] via analysis of the sacral orientation angle, and using a method similar to those employed by Bogduk[3], Cailliet[4], Yochum and Rowe[19] reported that LSA first increases with advancing age and then falls around age 21-40 years. Also Kyu-Bok Kang *et al.*[7] analyzed changes of Sagittal Spinopelvic parameters in normal Koreans aged 50years and over;mean sacral slope was 37^0 with a range of $21^0 – 51^0$.

Other investigators[2 3, 4,6, 19, 28] argue that range $25\text{-}57^0$ should be used as normal reference values for Caucasians. However[18], in a more recent study recommended $30\text{-}40^0$ to be used as reference values. Our findings are similar to those of Legaye[9], Monister*et al.*[12] and Maduforo*et al.*[22]The higher LSA values in males as observed by [22], could be as a result of differences in methodology, as subjects were older compared to those of the current study. Similarly, in the study by Okpala[32]the distinction between the lumbosacral angle and lumbar lordosis angle with regards to the measurement technique applied was not made.

In this study, we found a significant correlation with BMI but not with WHR. This is in agreement with previous studies. [23,27,33-35]

CONCLUSION

This study showed that LSA of males in Southern Nigeria increases with advancing age up to the age of 32, followed thereafter by a sinusoidal increase and decrease pattern. We also established that in non-obese males, spinal health can be influenced significantly by BMI and not so by the WHR. These findings will be helpful in the planning and design of interventions aimed at restoring the normal size and shape of the lower spine in patients of different age and body indices

RECOMMENDATIONS:

For the purpose of documentation, management of low back pain, a study of this nature should be done in the other parts of the country.

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