CORRELATION BETWEEN LUMBO SACRAL ANGLE AND PROPRIOCEPTION IN SUBJECTS WITH CHRONIC LOW BACK PAIN

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ABSTRACT

Background: Chronic low back pain is a significant issue that is only becoming worse, partly as a result of the ageing and expanding global population. It affects people of all ages and is typically linked to sedentary jobs, tobacco use, obesity, and low socioeconomic status. According to Andersons et al., the point prevalence of LBA in adults is estimated to be 30%, with the yearly incidence at 15%. **Objective:** To determine the correlation between lumbosacral angle and proprioception in subjects with chronic low back pain. **Methods:** A total of 175 subjects have been recruited for the study out of which 120 subjects with CLBA who met the selection criteria were included in the study. The subjects who reported having chronic low back pain without any radio-graphically visible abnormalities were taken into consideration; the VAS score and chronicity were also gathered to gauge the severity of the pain. Lumbosacral angle and Proprioception were recorded. **Results:** For males and females, the correlation between LSA and VAS has an r-value of -0.131 and 0.144. It was discovered that there was no correlation between the two (p>0.05).In men, the association between VAS and sickness duration has an r-value of 0.122, while in women, it has an r-value of -0.134. Both are discovered to be not significant (p>0.05). **Conclusion:** There is a positive correlation between joint proprioception impairment and chronicity in CLBP patients. This correlation was found to be more pronounced in females than in males in (JPE) lumbar flexion movement and significant in both males and females in (JPE) lumbar extension movement.

Keywords: Chronic Low back Pain; Lumbosacral angle; Proprioception & x - ray

INTRODUCTION

Worldwide, chronic low back pain is a significant issue that is only becoming worse, partly as a result of the ageing and expanding global population. It affects people of all ages and is typically linked to sedentary jobs, tobacco use, obesity, and low socioeconomic position [1].

It is described as a localized pain that may or may not radiate to the legs that is felt between the 12th rib and the inferior gluteal folds. Degeneration of the spine and discs, the use of trunk stabilisers, jobs requiring frequent heavy lifting, the use of machinery and operating motor vehicles, excessive mechanical stress on the intervertebral disc, smoking and tobacco use, as well as patient psychological factors, are some of the common causes of back pain[1].

60% to 80% of persons will have low back pain (LBA) at some point in their lives. According to Andersons et al., the point prevalence of LBA in adults is estimated to be 30%, with the yearly incidence at 15%. According to Papageorgiou et al., at least 50% of people would have gone through an episode of LBP. According to certain research, LBP is one of the most frequent reasons people visit their doctors, and both men and women are equally afflicted by LBA. According to the literature, 30 percent of teenagers worldwide have at least one episode of LBP. Numerous researches have revealed that LBP is a relatively prevalent issue among adolescents, peaking in prevalence around the third decade of life [2].

Chronic low back pain affects a large portion of the population. Its prevalence rises with age up to 65 and is thought to be detrimental to the healing of chronic low back pain. In India, the prevalence of persistent low back pain ranges from 6.2% (in the general population) to 92%. (in construction workers) [2]. 97% of cases of chronic back pain involve spinal tissues such bone, ligaments, discs, joints, nerves, and meninges. In the absence of growing neurologic impairments and other underlying, non- mechanical causes, acute back pain may be treated conservatively with a focus on preserving function and activity levels 3.

The length of the symptoms can be categorised as acute (less than 4 weeks), sub-acute (4–12 weeks), or chronic (more than 12 weeks). There are numerous causes of lower back discomfort. The majority of instances are thought to result from a sprain or strain in the back's muscles and soft tissues. Others may experience sacroiliac joint dysfunction, or pain in the area where the spinal column joins to the pelvic. Physical causes may include osteoarthritis, rheumatoid arthritis, spinal disc herniation or degeneration, osteoporosis-related vertebral fractures, infection, or malignancy in rare cases. The great majority of the time, no notable or

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significant cause is ever found. The need for further testing is not necessary if the pain goes away after a few weeks [3]. When it comes to movement and weight bearing, the lumbo-sacral area of the spinal column is the most crucial. Regional curvatures in the vertebral column of humans, which stretch cranio-caudally down to the sacrum, promote resilience by allowing succeeding vertebrae to bear and transfer weight up to nearly three times as much as a straight column. The fact that the spine is a multi-joint with nonlinear geometry rather than a rigid structure should be taken into account in lumbar spine biomechanical models [4]. Obesity has been observed to increase shearing and compressive stresses on the articular facets at the lumbo-sacral junction, diminishing its stability. The spine generally resists the axial load and anterior shear forces at the lumbo-sacral junction. Obesity causes the lumbar spine to become hyperlordotic, which increases LSA and raises the risk of chronic low back pain and bad posture.

In order to assess the stability of the lumbo-sacral area, LSA measurements are performed. Obesity causes the lumbar spine to become hyperlordotic, which increases LSA and raises the risk of chronic low back pain and bad posture. The development of spinal implants and instrumentation benefits from LSA measurement [5]. Proprioceptive function is widely acknowledged as being essential for balance, posture, and motor control. Joint position sense and the sensation of limb movement make up the majority of proprioception, which is defined as the perception of the position and movement of different body parts in space. One aspect of "joint position sense" (JPS) is the awareness of how the members or segments are positioned in relation to one another. On the other hand, "kinesthesia" is described as the perception of motion to identify the various body parts and to assess their movement (velocity and direction). Anesthesia is the term for the static part [6].

Proprioceptive changes brought on by illnesses, trauma, surgery, accidents, or normal ageing may make specialised therapy necessary in order to address balance deficits and prevent injuries. Proprioception has been demonstrated to be more crucial for maintaining balance in the older population than vision, and a decline in proprioception increases the chance of falling [6]. According to a recent systematic review and meta-analysis on lumbar proprioception in LBP, patients do indeed exhibit limitations in lumbar proprioception when compared to people who do not experience pain for active joint repositioning sense (JRS) and detection threshold of passive motion while seated. This was done using a force plate to analyse postural sway on stable and unstable support surfaces. It's interesting to note that a greater ankle-steered proprioceptive weighting has been linked in a prospective research to a higher incidence of moderate LBP in young people. The need for more longitudinal research in this field is highlighted by the opposite finding, which indicates that there is no correlation between proprioceptive impairments and the onset of LBP, which was also observed in a study including approximately 300 participants [7].

Due to muscle fatigue, nociceptors being activated, or traumatic tissue damage, proprioceptive information may be diminished or altered, which will affect motor control. The sympathetic nervous system, which directly innervates muscle spindles and regulates their discharge, becomes more activated as a result of persistent nociception. Therefore, it is plausible that (physical or emotional) stress related to the activation of the sympathetic nervous system could inhibit the information flow from muscle spindles, resulting in a decline in the proprioceptive information flow across the spinocortical axis. This could be a mechanism causing the reported trunk proprioception issues in LBP patients [8-10].

Numerous researches have examined the relationship between changes in proprioception and the lumbosacral angle as a result of chronic low back pain. There is, however, a paucity of research on how proprioception and lumbosacral angle interact to each other in patients with chronic low back pain. Therefore, it is necessary to link changes in the lumbosacral angle with proprioception in people who have persistent low back pain.

Objectives of the study: To determine the correlation between lumbosacral angle and proprioception in subjects with chronic low back pain.
Source of Data: ESI Hospital, Rajajinagar, Bangalore. Padmashree Physiotherapy Clinic, Nagarbhavi circle, Bang alore. Padmashree Diagnostics, Vijayanagar, Bangalore

METHODOLOGY

Population: Chronic low back pain subjects.

Sample design: Convenience Sampling.

Samplesize:120Subjects.

Type of study: Correlational Study.

Duration of study: 6months.

Inclusion Criteria: Subjects' willing nesstocomply with the study protocol. age:22-55years. Gender: Both gender. Subjects with chronic low backache (chronic:3months or m ore).

Exclusion Criteria: Subjects with history of spinal surgery in lumbosacral region, subjects with history of spinal fractures. Subjects with neurological conditions effecting proprioception. Subjects with history of alcohol abuse. Materials required: iPhone, I handy application, laptop, waist belt/ Strap, pen/pencil, documentation folder

A total of 175 subjects have been recruited for the study out of which 120 subjects with CLBA who met the selection criteria were included in the study. All participants have provided their written informed consent.

The subjects who reported having chronic low back pain without any radio-graphically visible abnormalities were taken into consideration. Age, gender, and BMI were among the demographic information gathered. For all subjects, the VAS score and chronicity were also gathered to gauge the severity of the pain.

Measurement of lumbosacral angle:

The subjects with chronic low back pain underwent lateral X-ray imaging of the lumbo-sacral region.

The radiographs had to meet the following criteria to be considered normal.

- The existence of 5 sacral and 5 lumbar vertebrae.
- Maintenance of lumbar lordosis.
- From L1 to L5, the intervertebral disc spaces get thicker.
- There is no congenital disease or abnormality visible on radiographs.

The lumbo-sacral angle was measured using two different techniques.

The conventional approach (scale-pencil method): The LSA was calculated by putting each radiograph on a viewing screen with adequate lighting. The LSA is formed between a line spanning the superior edge of S1 plane and a horizontal line. Using a transparent ruler that is 30 cm long, draw lines for the measurement of the angle using the proper landmarks. A protractor was used to measure the angle in degrees.

Using a digital method and the Radiant Dicom Image Viewer programme: The software programme Radiant Dicom X ray imported the digital X-ray. After the import of the picture. From the top bar, we chose "measurement and tools." After seeing one drop-box, we chose the "angle" option. A horizontal line was used to measure the angle created by drawing a line through the superior margin of S1's plane. The angle that was captured was recorded [11-24].

Measurement of Proprioception: The iPhone® (Apple Inc., Cupertino, CA, USA) was used as a measuring device with a level application (iHandy level) for the proprioception tests.

The iPhone® includes the iHandy® level application. It was a free programme with a visual display that resembled a digital inclinometer in terms of the size of the numbers. The application measured angle using the phone's built-in accelerometer and digital display. Degrees (°) was used as the measurement unit [25].

Measurements were made while standing: Standing with their feet externally rotated (about 20 degrees) from the progression line and their heels spaced 3 cm apart; they were instructed to focus at a fixed location at eye level. The iPhone® was positioned upright immediately above the iliac crest, at a location in the middle of the anterior superior and posterior inferior posterio superior iliac spine that is belt-fixed. The inclinometer was set to its starting position at 0°, meaning that its inclination will be 0°. The individual was passively guided by the assessor to a 30° flexion during the 0° to 30° range of motion. This position has to be remembered by the subject for 10 seconds. Then, the subject was brought actively back to its starting position. The position had to be actively recreated three more times by the subject. The three attempts' average value was recorded. The same steps were taken to extend the lumbar spine. There were five minutes in between each attempt. There were no visual or auditory cues present during the evaluations. Every evaluation was documented and recorded [25,26].

RESULT

Table-1: Range, mean and SD of background variables of subjects with chronic low back pain

Variable	Male (50, 41.7%)		Female (70, 58.3%)		Unpaired t- test
	Range	Mean± SD	Range	Mean± SD	
Age in years	22-55	36.9±8.5	20-55	37.83±7.6	t=0.652 p>0.05
Height (cm)	157-187	168.4±7.8	150-165	156.8±4.1	t=10.591 p<0.05*
Weight (Kg)	49-86	66.28±8.6	38-94	61.1±11.1	t=2.632 p<0.05*
BMI	17.3-48	27.55±8.3	16.25-45	27.5±7.0	t=0.41, p>0.05

*Significant (p<0.05)

Table 2: Range, mean & SD of outcome measures of subjects with chronic low back pain over gender

Variable	Male		Female		Mann-Whitney U test/ Unpaired t-test
	Range	Mean±SD	Range	Mean±SD	
VAS	1-8	4.9±1.8	2-8	4.9±1.4	z=0.41 p>0.05
LSA	22.0-59.0	35.6±9.5	21.0-57.0	37.3±8.9	t=0.627, p>0.05
JPE (Flexion)	0.26-4.54	1.9±1	0.26-5.21	2±1.1	t=0.37 p>0.05
JPE (Extension)	0.42-4.65	2.4±1.1	0.33-4.68	2±1	t=0.978, p>0.05
Duration of illness	1-10	5.1±2.4	2-24	5.9±3.5	t=1.325, p>0.05

Note: VAS- visual analogue scale, LSA- lumbosacral angle, JPE- joint position error, Not significant (p>0.05)

Table 3.Correlation between LSA with VAS, joint proprioception (flexion, extension) of subjects with chronic low back pain.

Correlation	LSA			
	Male		Female	
	r	p-value	r	p-value
VAS	-0.131NS	p>0.05	-0.144NS	p>0.05
JPE(flexion)	-0.072NS	p>0.05	0.224NS	p>0.05
JPE (extension)	-0.233NS	p>0.05	-0.141NS	p>0.05

For males and females, the correlation between LSA and VAS has an r-value of -0.131 and 0.144. It was discovered that there was no correlation between the two (p>0.05).

The r -value for the relationship between LSA and joint proprioception, or JPE flexion, is -0.072 for men and

0.224 for women. LSA and VAS were found to have no significant correlation (p>0.05).

The r-value for the relationship between LSA and joint proprioception, or JPE extension, is -0.233 for men and 0.141 for women. LSA and proprioception were not found to be significantly correlated (p>0.05).

Table 4: Correlation between duration of illness with-VAS, Joint proprioception and LSA of subjects with chronic low back pain

Corre-lation	Duration of illness (months)			
	Male		Female	
	r	p-value	r	p-value
VAS	0.112NS	p>0.05	-0.134NS	>0.05
JPE (flexion)	0.097NS	p>0.05	0.407S	<0.05
JPE (extension)	0.530S	p<0.05	0.484S	<0.05
LSA	-0.055NS	p>0.05	0.012NS	>0.05

Note: VAS- visual analogue scale, JPE- joint position sense, LSA- Lumbo-sacral angle, S-significant(p<0.05), NS- Not significant (p>0.05)

In men, the association between VAS and sickness duration has an r-value of 0.122, while in women, it has an r-value of -0.134. Both are discovered to be not significant (p>0.05).

Males' joint proprioception, or JPE (flexion), and sickness duration had an r-value of 0.097, which is not statistically significant(p>0.05). Females have a significant (p< 0.05) value of 0.407, which is shown to be the case.

In both males and females, the r-value of the correlation between the length of the illness and joint proprioception, or JPE (extension), is 0.530 and 0.484, respectively. Both values are significant (p< 0.05).

DISCUSSION

The purpose of the study is to examine the relationship between joint proprioception (JPE) and lumbar sacral angle (LSA) in individuals with chronic low back pain (CBLP). Age, height, weight, and BMI—the baseline variables—were discovered to be homogenous across genders. According to the study's findings, there are more female participants (58.3%) than male participants (41.7%). According to a study by Mukherjee et al. (2021), women are more likely than males to develop low back pain due to ergonomic and occupational factors that are strongly associated with LBA [11].

The study by Dr. Okpala Francis Osita (2014), which found no significant differences in LSA with gender and between different age groups, is supported by the fact that the mean values of the LSA between males and females in CLBP (35.629.45 and 37.278.88, respectively) are homogenous, i.e., there is no significant difference in the mean values of males or females [12-15].

The typical curvature of the lumber spine provides some resilience as well as some defence against compressive stresses on the lumbar spine. However, alterations frequently take place, particularly in middle age, possibly as a result of ongoing spinal muscular deterioration, age-related wear and tear effects, abnormal postural alignment, etc. According to Kuofi (1992), using the curvature of the lumbar spine to measure lumbosacral stability is a practical approach. Lumber lordosis can be measured using a variety of tools, including inclinometers, flexible rulers, software methods, spinal mice, and others that have been developed over time to measure different angles. However, in terms of radiographic measurements,

Ferguson's method for computing LSA is widely regarded as one of the most straightforward and precise methods currently available in the field of lumber lordosis [11].

The superior edge of S1 and the horizontal line on a lumbar radiograph form an angle, known as the lumbosacral spine angle (LSA). Reduced lumbar lordosis is more associated with acute LBP, according to Agichani.S. (2017), because para-spinal muscle spasm occurs concurrently. This supports the research's conclusions as well [11].

As measured by KP Gill et al. (1998) using the joint position error in lumbar flexion and extension method, the mean value of joint proprioception is homogenous for males (1.900.99/2.411.08) and females (2.020.98/ 2.040.98). It is hypothesized that lumbar proprioception impairment will affect movement accuracy and control, timing of motor commands, spinal posture, and muscle activity, which will undermine spinal stability and worsen spinal loading [27-29].

Other outcome variables, such as VAS (4.941.83 for men and 4.901.41 for women) and sickness duration (5.122.41 for men and 5.863.50 for women), are also homogeneous. Three out of the 120 subjects who participated in the study had chronicity that lasted under three months.

There is no statistically significant relationship between VAS and lumbosacral angle in either males or females (r=-0.131, p>0.05). The results of a study by Güldal Funda Nakipoglu et al. (2008) showed that there was no statistically significant difference for lumbar stability between the radiological values for the shape of the SIA, LSA, SHA, and total and segmental lordosis as noted on screening x-ray techniques [30].

The lack of a correlation between LSA and joint proprioception in subjects with CLBP, as determined by joint position error in flexion and extension, is supported by a study by Tong et al. (2016), which compared proprioceptive functioning in patients with chronic LBP and in participants who did not have the condition and was unable to identify a consistent pattern [31].

According to a 2009 study by Madhuri A. and Wilson SE, the amount of the reposition sense error rose with torso flexion in the middle range of lumbar angles and sharply dropped at the extremes, especially at high torso flexion angles. Extreme lumbar angles lead to a reduction in the magnitude of error, which suggests that limit-sensing components, possibly in ligamentous tissues or facet joints, may be crucial for position sense and stability control in these extreme curvatures. Even though these curvatures have less inaccuracy, which suggests better control, this control may still be required due to the increased loading of the spine's passive structures and possibly higher risk of injury [24].

It is also done to correlate the length of the illness with other outcome measures like VAS Joint proprioception and LSA. The lack of significance in the correlation between illness duration and VAS in males and females, r= 0.112 (p>0.05) and r= -0.134 (p>0.05), indicates that neither the intensity of the pain nor its duration are correlated.

Both males and females had a correlation of -0.055 between the length of the illness and the LSA. There is no link between LSA and the length of sickness in participants with CLBP, as indicated by the non-significant value of 0.012 (p>0.05).

Joint position error flexion is correlated positively with illness duration in female subjects, while it is negatively correlated with illness duration in male subjects (r=0.097, p>0.05), according to research on the relationship between joint proprioception and illness duration. The significant (p0.05) connection between JPE extension and disease duration in males and females, r= 0.530 and r= 0.484, supports the conclusion that there is a positive relationship between these two variables across all participants.

Overall, it can be said that in people with CLBP, joint proprioception and illness duration are positively correlated. This finding is supported by Andrea Radebold et al., who report that patients with CLBP had slower trunk muscle response times and poorer postural control of the lumbar spine than healthy control volunteers. They conclude that the correlation between these two phenomena points to a common underlying pathology in the lumbar spine. (31)

Another study by Tong MH et al. (2016) who conducted a systemic review on the relationship between lumbar proprioception and low back pain came to the conclusion that there may be a connection between prolonged sitting, slumped postures, and the escalation of LBP. This connection is likely due to muscle inactivity, which results in the transmission of forces to passive spinal structures, stressing soft tissue. A lack of neutral spine due to lumbar proprioception impairment during sitting may promote a position with poor muscle mechanical advantage. Additionally, weakened proprioception may lessen sensitivity to postural difficulties and prolong.

This incorrect placement Also mentioned in the article was the fact that thixotropic muscle spindle adaptations, or the stiffening of muscle spindles through the formation of cross-bridges when they are held in static positions, impair proprioceptive signaling, which can cause LBP either by increasing muscle engagement and strain or by increasing stresses on passive structures. Therefore, thixo tropy in LBP patients may be the cause of lumbar proprioception deficits seen in JPE tests [31].

The results in males were different in flexion and extension movements, which is supported by a study by Descarreaux M et al. Thixotropy may also explain why patients with LBP may perform well in proprioception tests with lots of practice trials, as these movements would detach cross bridges and return muscle spindles to ideal lengths, re enabling optimal position and movement sensing (2005) [31].

CONCLUSION

According to the study's findings, among people with persistent low back pain, there is little to no link between the lumbosacral angle and proprioception. In subjects with CLBP, there is no statistically significant correlation between Lumbosacral angle and VAS, chronicity and VAS, or chronicity and Lumbosacral angle. There is a positive correlation between joint proprioception impairment and chronicity in CLBP patients. This correlation was found to be more pronounced in females than in males in (JPE) lumbar flexion movement and significant in both males and females in (JPE) lumbar extension movement.

Limitations:

When using the iPhone software iHandy to calculate joint proprioception, individuals were instructed to hold the final position for 5 to 10 seconds. This caused them to modify their stance and posture, which in turn affected their trunk position and maybe caused some calculation errors.

Recommendations: As a follow-up investigation, a prospective study using one of the more probable accessible and reasonably priced non-radiographic methods of lumbar lordosis measurement is advised. The clinical method can be utilised for monitoring and follow-up, significantly lowering the patient's cost of care, if the more trustworthy radiographic technique is employed for the first examination.

In particular, prospective studies in older populations, subgroup testing, and the creation of more accurate proprioception tests call for more investigation.

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