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ORIGINAL ARTICLE **OPEN ACCESS**

To Establish a Correlation between Lumbar Proprioception, Lumbar ROM with Change in Lumbar Lordosis Angle In Workers In Steel Industries

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ABSTRACT
The aim of this study is to signify a correlation between lumbar proprioception with ROM & lumbar lordosis angle in workers in steel industries. In total, 50 subjects excluding history of acute low back pain interfering their ADLs were taken for measurement of lumbar lordosis. Then, all four ranges including lumbar flexion, extension, side bending to left and right side were taken. And after 5 minutes, lumbar proprioception in standing and sitting were taken in 5 minutes of interval. According to spearmen test, the p value was >0.05, statistically suggests that there is no correlation between lumbar proprioception with ROM & lumbar lordosis angle.This study concludes that there is almost no effect of lumbar proprioception, lumbar ROM with change in lumbar lordosis.
KEY WORDS: *Lumbar Lordosis, proprioception, non-specific low back pain*

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INTRODUCTION

One of the factors is work-related musculoskeletal disorders that make them one of the most prevalent and significant occupational health issues among working people, having a significant negative impact on quality of life and reducing potential production on all fronts.(1)A general awareness of the related bodily parts while at rest or in motion is referred to as proprioception, which is defined as internal sensations. Proprioception is a term used to describe physical sensations that help people become aware of how their body parts are positioned in relation to one another both while moving and while at rest. It is well acknowledged that precise movement and posture control require proprioceptive input from muscles, joints, and other sensors.(2), (3)

Sanes et al. 1985 found that patients who lack proprioceptive or disruptive input find it difficult to adapt their motions in the face of unexpected loads and to maintain a constant joint angle in the absence of vision. (4)Testing of Joint position sense is done by position matching accuracy replication, which disclose about the calibration of the mechanism of proprioception. And in contrast with repetitive repositioning error might indicate a problem with the precision sense. Proprioceptive sensations must be intact to control movement. The structures of ligaments, facet joints, intervertebral discs, and erector spinae muscles provide information about the proprioceptive sensation of the spine. Many muscle spindles are concentrated in the deep paraspinal rotator.(5)According to recent studies done in between 2000-2022 stated that lumbar joint position sense are affected by increased age, fatigue, pain and incorrect mechanism of lifting. There is a huge importance of proprioception which play crucial role in normal joint movement pattern. (6)For standing posture and four-point kneeling, patients with chronic LBP have lower proprioception in the spine. Defects in reaction time, postural control, and postural stability have been observed in such patients, possibly as a result of impaired proprioception. The significance of examining lumbar range of motion is in determining impairment and mobility restrictions that cause discomfort.(7)Proprioception position and movement, joint position sense (active/passive), kinaesthesia, force sense (effort/tension/heaviness), and perception of velocity change are all components of the somatosensory system (SCV). (11)

Sagittal curvatures are one of the specific parameters which impact mechanical consequences during comprehensive loading with weight, sagittal calibration regulates postural stacking & the load distribution of intervertebral disc in normal healthy adults without back pain or abnormal spinal pathology. (12)Loss of proprioception has been found to cause significant system errors in many joint movements, possibly due to poor engine planning. Measurement of lumbar range of motion in spinal pathology and LBA is recommended as a familiar and pertinent method for regulating the range of function of the spine and assessing the potential of rehabilitation protocols and their response to treatment. Researchers have devised a number of techniques for determining the lumbar range of motion. There's a chance that the methods used to assess intervertebral mobility aren't accurate. Tape measure, ruler, spinal mouse, goniometry, phone inclinometer, inclinometer, distance from fingertip to floor, spinal motion analyser, and radiography are some of the methods and tools used to quantify ROM. As stated by guide to physical therapist's practise, to select appropriate physical therapy interventions, the process of assessing range of motion and joint integrity is essential. In addition, assessment of movement disorders can assist clinical therapists in determining progress, diagnosis, and functional activities of daily living. (13),(14)

Each of measuring methods has its own disadvantages. Amongst them is X-ray which is high cost & X-ray exposure for patients. Availability of X-ray in clinical set-ups, mobile assessments and assessment during physiotherapy camps, awareness drives is not feasible either. (13)Smartphones can be a more practical and convenient alternative to inclinometry in terms of accessibility. Recent studies by Morege (2013) found high intra rater and inter rater reliability with intra class correlation coefficients (ICC) ≥0.81 for bubble inclinometry and ≥0.80 for iPhone®. Lumbar flexion, lumbar extension, and lateral flexion to the right and left were all measured. Providing basic evidence and a mild suggestion that a smart phone application can be more clinically useful than inclinometry for measuring lumbar spine/spinal mobility than inclinometry.Assessment of body condition is one of the important components of physiotherapy examination. Postural assessment is necessary to determine the body's ability to adapt to gravity and structural abnormalities. Correct postural impairment assessment will aid clinical practitioners in identifying the status of musculoskeletal balance, which safeguards the body from deformities and accidents. (13)The clinical examination of lumbar was lordosis done with various instruments like flexible curve radiography or inclinometry. In majority of cases, inclinometry is used as lightweight & inexpensive instrument. But most of clinical therapist does not possess them. Therefore Paul A Salamn found good interrater reliability of (ICC) 0.90 & intrarater reliability of 0.85. Provide a preliminary index to compare gravity-based bubble inclinometers and traditional inclinometers to measure standing lumbar lordosis when using I phone application.

Lumbar spine consists of 5 vertebrae named from L1-L5. And very complex anatomical design of the lumbar spine is remarkable combination of strength, loading capabilities, mobility. These joints have multiple elements like bony vertebrae, linked by joint capsule, flexible yet strong ligaments, tendons, large muscle groups & highly susceptible nerves with complicated innervations & vascular supply. Excessive or minimal lumbar curvature may develop to be a deformity and lead to abnormal postures and pain in long term. And previous researches proved that with aging the lumbar lordosis gets reduced. Measurement of range of motion in any plane depicts the ability of movement and limited range of motion shows inability to the normal movement or inconvenience with the ADLs too. This study will check if there is statistical correlation between lumbar proprioception with lumbar lordosis and lumbar ROM.

STATEMENT OF THE PROBLEM

- Lack of proprioception leads to rise of falls, pain and imbalance problems.
- Bad proprioception leads to relative alteration in biomechanics of any joint,especially of weight bearing joints majorly the spine.
- Studies have shown reduction in proprioception due to aging, fatigue, (pain acute and chronic both).
- Decreased lumbar proprioception might be co related with decreased or increased lumbar lordosis.

AIM OF THE STUDY

- To establish a correlation between lumbar proprioception with Lumbar ROM.
- To rule out the correlation between lumbar lordosis and lumbar ROM.
- To find correlation between lumbar lordosis and lumbar proprioception.

HYPOTHESIS

Alternative hypothesis: There is a significant correlation between lumbar proprioception with ROM & lumbar lordosis angle in workers in steel industries.

Null hypothesis: There is no significant correlation proprioception, lumbar ROM with change in the lumbar lordosis angle in daily wage workers in steel forging companies.

MATERIAL AND METHODS

STUDY DESIGN-A co- relation study

STUDY SETTING-Steel and Iron Industry, Faridabad

SAMPLE SIZE- Calculated using G-power, total of 46 was derived.

ETHICAL APPROVAL– Ethical approval was obtained from ethical committee at Faculty of Allied Health Sciences in accordance to ethical principles for medical research involving human (WMA declaration of HELSINIKI) having reference number MRIIRS/FAHS/PT/2022-23/M-08 dated 4 February, 2022.

SAMPLING METHOD-Convenience sampling

SOURCE OF SAMPLING- Participants were recruited from Iron and Steel Mundi, Nehru Ground, Faridabad for the study.

SELECTION OF CRITERIA

Inclusion criteria

- No current/acute history of LBA.
- Able to understand the commands in Hindi /English.
- Only male candidates.
- No current spinal deformity on assessment.
- Age – 23-44
- Heavy weight lifting while working at least from 3-6 months.

Exclusion criteria

- History of acute head injury
- Subject with any mental disorder.
- Acute history of LBA.
- Subject with any current injury that include spine, pelvis & lower extremities.
- Subject with any psychological disorder.
- Any Neurological deficit.
- Hospitalization or admittance into a care facility for 3 or more days within a month.

INSTRUMENTS

- Blindfold
- Mobile phone application for Inclinometer
- Chair
- Weighing Machine
- Measuring tape
- Marker

VARIABLES

1. Lumbar ROM (flexion, extension, side flexion right and left).
2. Lumbar lordosis.
3. Lumbar proprioception.

MEASUREMENT OF LUMBAR PROPRIOCEPTION

Inclinometer application of phone was used to compute the lumbar proprioception in standing and sitting by repeating three repetitions of 30° lumbar flexion in which 1st trial was done as free trial then 2 more trials were done and mean was taken.

- Standing inaccuracy was assessed by placing the arms against the body, turning the legs out of sight (about 30 degrees) and looking at a specified site at level of the eye, excluding the heels.
- The seated location was taken on a chair without using back rest and arms resting on thighs, feet were kept apart and hands were placed on thigh.
- The phone was placed vertically over the crest of the iliac bone, fixed by a strap.
- Inclinometer set on 0 ◦ as starting locus.
- The range of motion was 0 to 30 ◦ .
- The therapist then passively bent the subject 30°.
- The subject must hold the position for 10 seconds.
- The subject returns to its original state.
- The subject must then play the active mode three times.
- The first review is an introductory practice test.
- "Test" and "Retest" were used as second and third experiment.
- These assessments were made in an environment with no visual or audible indicators.

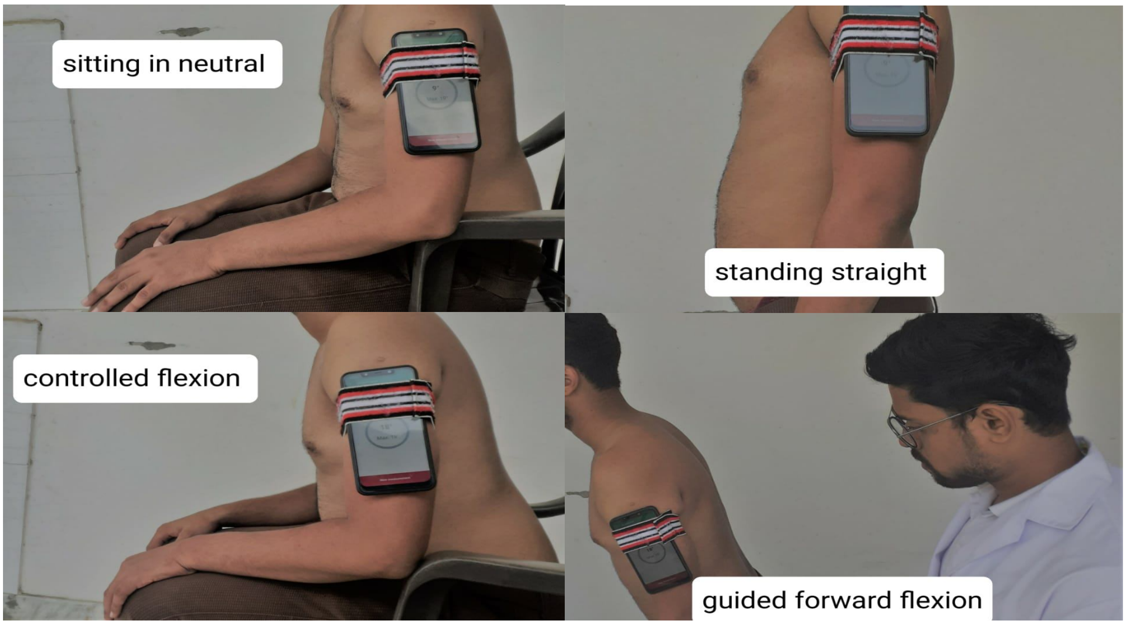


Fig 1.1 Measurement of lumbar proprioception, in sitting (left), in standing (right)

LUMBAR RANGE OF MOTION

- Lumbosacral flexion (total lumbar flexion) AROM was obtained from a candidate who was standing with his feet shoulder width apart and his arm unbending by his side. The phone was placed on the charging side at the T12-L1 level and the reading was compared with the mark indicated by the indicator. Then the subject was instructed to lean forward and touch the floor with his hands without breaking the knee extension. After the movement halted, measurements were obtained and the procedure was repeated, but the phone's position was now altered to S1-S2. T12-S1-S1-S2 = lumbar lordosis angle was removed from the measurements. Thoracolumbar pelvic-extension prior to initiating the action, the subject stood with their hands on their low back and an inclinometer was positioned at S1-S2 and zeroed. During the measurement of the knee angle, the subjects were requested to lean back at most.

THORACOLUMBAR LATERAL FLEXION AROM

- The participant was measured with feet shoulder-width aside and arms outward on either side. Before starting the movement, the phone's clinometer was canceled and then adjusted to T9-T12. Participants were instructed to lower their arms as much as possible with their feet, keeping their torso and head ahead and both feet on the floor. When the movement came to a halt or the participant was unable to continue without jeopardizing his or her safety.(27)

Fig 1.2 Measuring total lumbar flexion

Fig 1.3 Thoracolumbar pelvic extension **Fig 1.4**Thoracolumbar lateral flexion AROM

MEASUREMENT OF LORDOSIS IN STANDING POSTURE

Subjects were requested to stand in a restful position with their arms on both sides while carefully marking the T12 and S1 spinal processes with markers. For L4-L5, the iliac crest was used as the reference point. In the L4-5 arrangement, the spinous processes are palpated from S1 and palpated on the 12th rib T12. These marks were used to place the phone. Lumbar lordosis was measured by placing the instruments at the indicators T12-L1 and S1-S2, and their angles were documented and totaled. (23)

Statistical analysis was performed with the help of SPSS V.25

Before doing parametric tests, assumptions of normality were evaluated using a Shapiro-Will. Test.

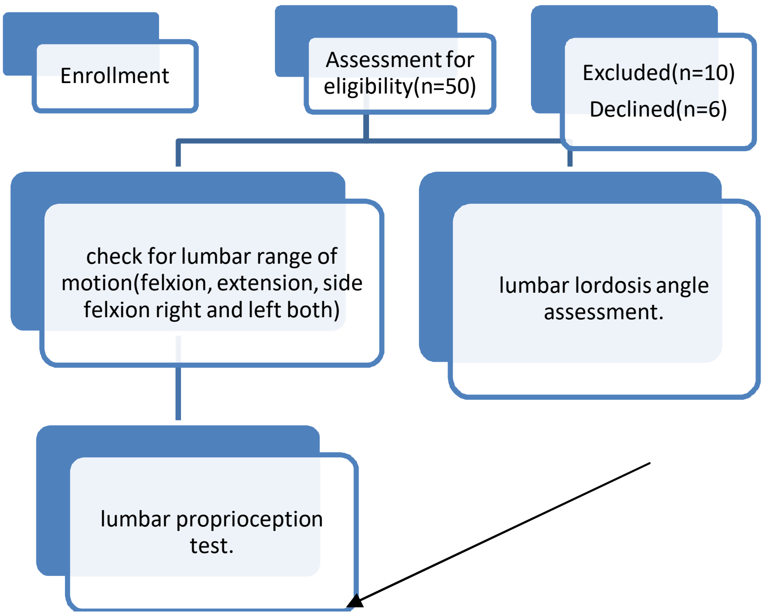
The data distribution for all variables at all levels were tested at p-value >0.05.

The significance level was set at p <0.05 and the confidence interval was 95%. The Shapiro-Wilk test was performed for all outcome measures, and the results showed that the p-value is greater than 0.05.

This means that the data is not normally distributed, so a non-parametric test was used.

The Spearman's rank correlation coefficient test suggested that p value>0.05 which suggest that there was no co-relation seen between lumbar proprioception with lumbar ROM and no correlation was found between lumbar lordosis and lumbar proprioception, neither any correlation was found between lumbar ROM & lumbar lordosis.

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$



The study was conducted on labours [n=50]

RESULTS

TABLE 1: The anthropometric characteristics of labours

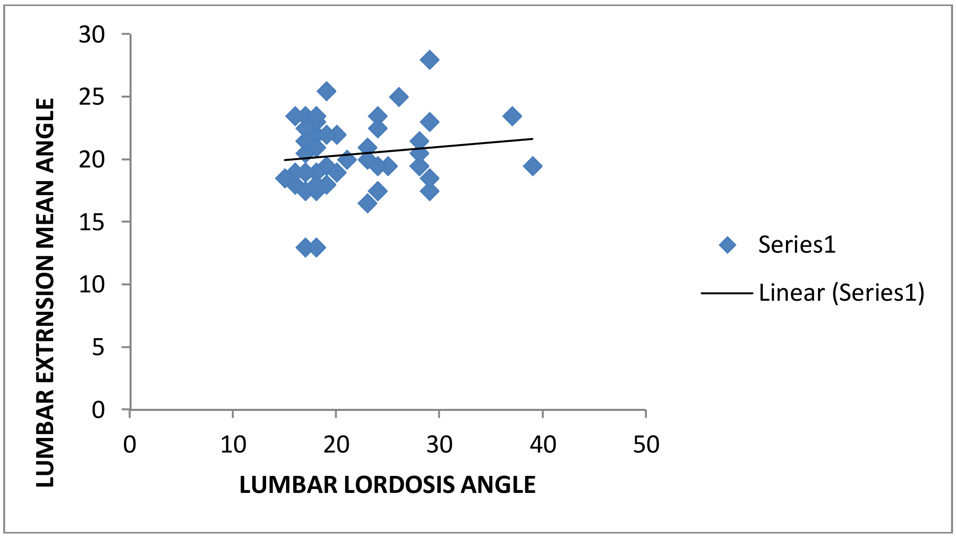
ANTHROPOMETRIC DATA	(mean±sd)	Standard deviation
AGE(years)	34.38	7.66
WEIGHT(kg)	60.46	8.07
HEIGHT(M)	1.69	0.05
BMI	21.00	2.51

In the table, study according to spearman correlation analysis. Spearman correlation used to calculate the correlation between lumbar proprioception, lumbar ROM with change of lumbar lordosis. Spearman correlation revealed that there is no correlation showing between lumbar proprioception, lumbar ROM with change of lumbar lordosis in steel industry labours.

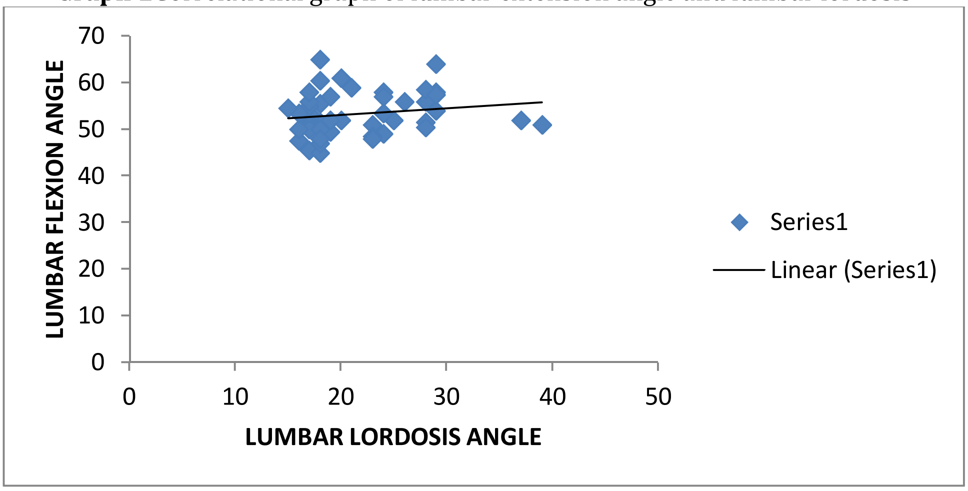
Table2: Spearman correlation used to calculate the correlation between lumbar proprioception, lumbar ROM with change of lumbar lordosis

Correlations

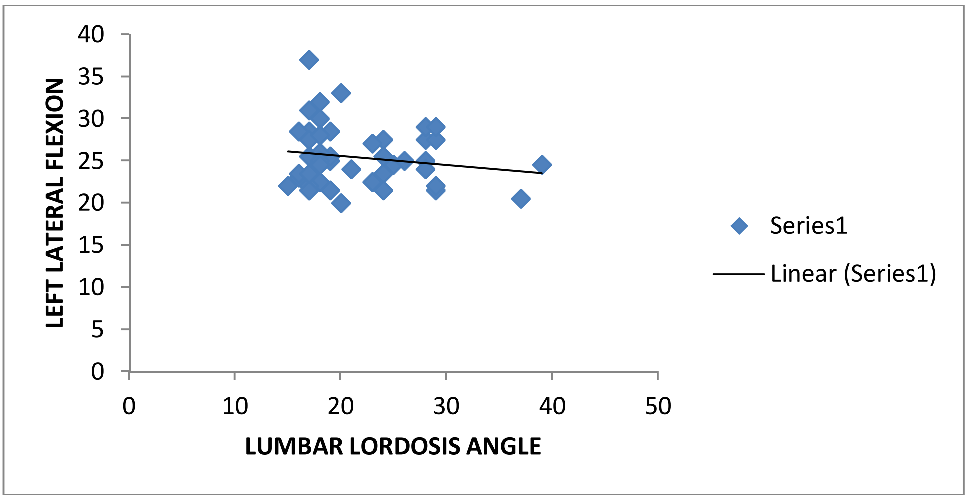
			LUMBAR REPOSITION ERROR/SITTING(30°) MEAN	LUMBAR REPOSITION ERROR/STANDING(30°) MEAN	LUMBAR LORDOSIS (IN°)	THORACOLUMBAR PELVIC EXTENSION MEAN ANGLE (in °)	ISOLATED LUMBAR FELXION MEAN (in °)	LEFT LATERAL FLEXION MEAN	RIGHT LATERAL FLEXION MEAN
Spearman's rho	LUMBAR REPOSITION ERROR/SITTING(30°) MEAN	Correlation Coefficient	1.000	.010	-.088	.274	.139	.052	.145
		Sig. (2-tailed)	.	.944	.546	.055	.337	.720	.313
		N	50	50	50	50	50	50	50
	LUMBAR REPOSITION ERROR/STANDING(30°) MEAN	Correlation Coefficient	.010	1.000	.155	-.005	.036	-.052	-.072
		Sig. (2-tailed)	.944	.	.282	.973	.804	.722	.620
		N	50	50	50	50	50	50	50
	LUMBAR LORDOSIS(IN°)	Correlation Coefficient	-.088	.155	1.000	.165	.236	-.092	-.084
		Sig. (2-tailed)	.546	.282	.	.252	.098	.524	.562
		N	50	50	50	50	50	50	50
	THORACOLUMBAR PELVIC EXTENSION MEAN ANGLE (in °)	Correlation Coefficient	.274	-.005	.165	1.000	.132	-.173	-.126
		Sig. (2-tailed)	.055	.973	.252	.	.362	.230	.383
		N	50	50	50	50	50	50	50
	ISOLATED LUMBAR FELXION MEAN (in °)	Correlation Coefficient	.139	.036	.236	.132	1.000	.074	-.003
		Sig. (2-tailed)	.337	.804	.098	.362	.	.609	.981
		N	50	50	50	50	50	50	50
	LEFT LATERAL FLEXION MEAN	Correlation Coefficient	.052	-.052	-.092	-.173	.074	1.000	.146
		Sig. (2-tailed)	.720	.722	.524	.230	.609	.	.313
		N	50	50	50	50	50	50	50
	RIGHT LATERAL FLEXION MEAN	Correlation Coefficient	.145	-.072	-.084	-.126	-.003	.146	1.000
		Sig. (2-tailed)	.313	.620	.562	.383	.981	.313	.
		N	50	50	50	50	50	50	50



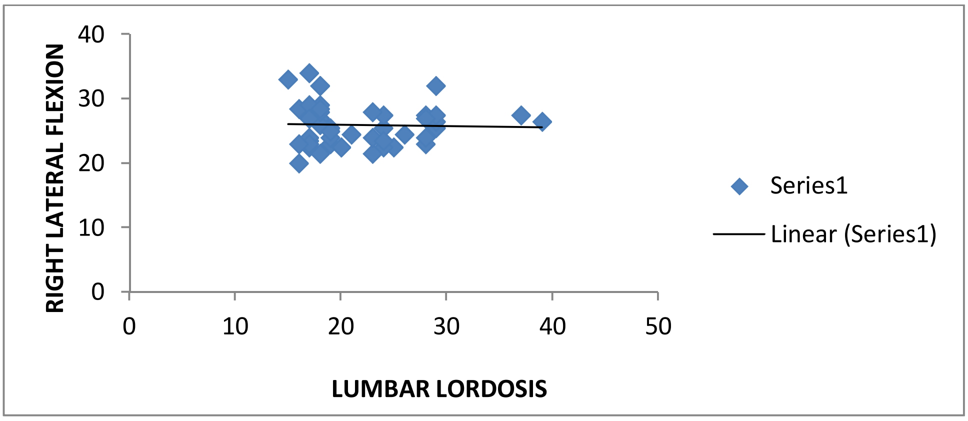
Graph 1 Correlational graph of lumbar extension angle and lumbar lordosis



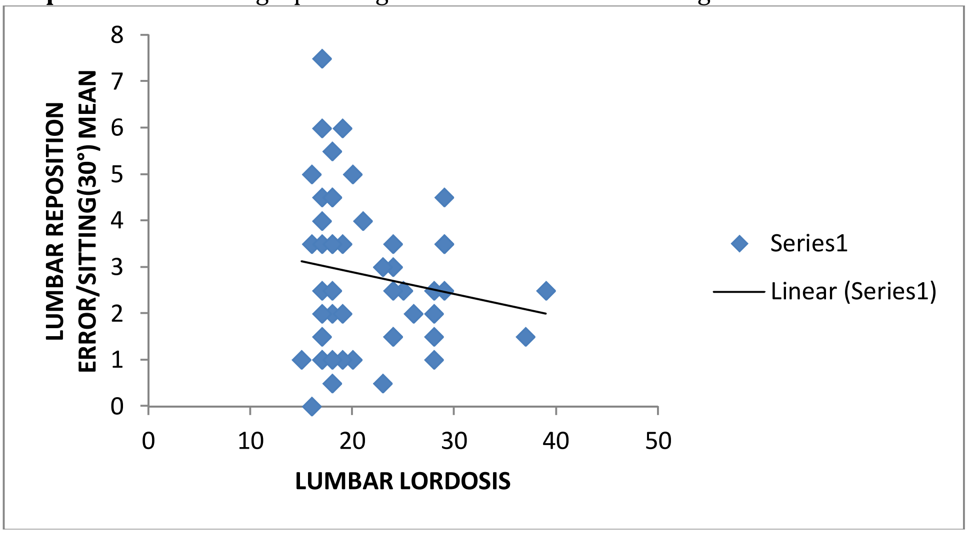
Graph 2: Correlational graph of lumbar flexion angle and lumbar lordosis



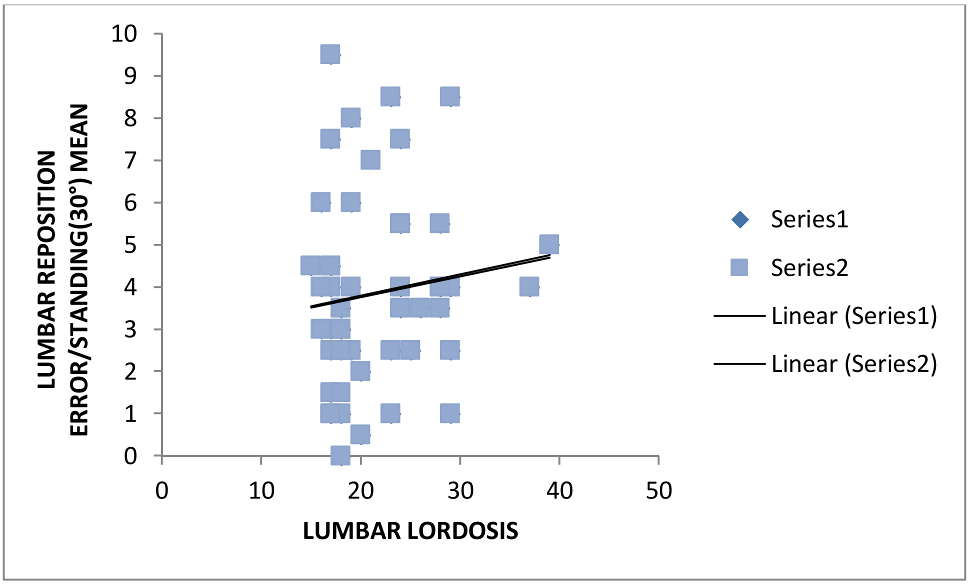
Graph 3 Correlational graph of left lateral lumbar flexion angle and lumbar lordosis



Graph 4 Correlational graph of right lateral lumbar flexion angle and lumbar lordosis



Graph 5 Correlational graph of lumbar reposition error/sitting (30°) mean and lumbar lordosis



Graph 6 Correlational graph of lumbar reposition error/standing (30°) mean and lumbar lordosis

DISCUSSION

This study was conducted in order to find out to establish a correlation between lumbar proprioception with ROM & lumbar lordosis angle in workers in steel industries. The lumbar proprioception was measured by asking the subject to mimic the position in standing and sitting which was memorized by the patients according to the command and procedure taught. Lumbar lordosis was measured by taking the inclination from T12-L1 to S1-S2 and adding it. Lumbar exercises like flexion, extension, side flexion right and left was measured by positioning the phone on positions guided. There was no significant correlation ruled out.

Sabina M. Pinto et al in 2020 conducted a study to rule out differences between youth and adulthood with and without chronic low back pain, where the author found a significant difference in statistical error between young and middle-aged adults. CLBP, error-corrected values are not correlated in all groups.

Martin Descarreaux *et al* 2005 published an article where he tried to rule out Adaptation of precision and motion specifications in people with back pain and health checks. After comparing the control group and CLBP group for reposition errors where the group with CLBP performed with as equal accuracy for joint reposition error. Even low back pain patients did almost equal to the healthy control group.

V.L. Murrie *et al* 2003 was unable to found any significant variation in his study of patients of lumbar lordosis with and without Low Back Pain with lordosis. With age data didn't demonstrate any significant difference between any magnitude of lordosis with or without back pain. Men with back pain showed slightly lower lumbar lordosis but that was also weakly significant.

Peter B. O'Sullivan et al in 2004 investigated the association between posture and back muscle endurance in industrial workers with flexion-related low back pain. Assessment of standing and lifting showed no significant differences between groups. These preliminary findings suggest that flexed spinal postures have a weak link in their relationship.

Malin Asell *et al*., 2006 investigated that hip movement errors were higher in patients with chronic low back pain in contrast with asymptomatic patients. There were no differences in movement errors between CLBP patients, their subgroups, and controls. Only small associations were found between adjustment delusion and self-disclosed functional impairment, self-efficacy, and pain.

Tim Michel et al., 2008 investigated topical difference in lumbar spine health and the impact of back pain. They excluded that variations in angles of lumbar spine or range of motion were related to LBP. There were regional disparities in lumbar posture and mobility. In sitting, the mean lower lumbar posture did not correspond with the upper lumbar posture.

Win Damkaerts *et al* 2006 conducted a study on variations in sitting position associated with unspecified chronic low back disorders when there are sub classed patients. The study found no significant difference between the control group and NS-CLBP patients (chilled) during normal sitting.

CONCLUSION

This study concluded that there is no link between lumbar ROM and changes in lumbar lordosis angle in steel industry workers.

LIMITATION

1. Sample size was small.
2. Vast age group.
3. More precise instrument or diagnosis measures like MRI films or modern devices could have been used.
4. Weight lifted by the participants on daily basis was not uniform.
5. Posture alignment while lifting was not assessed.

FUTURE SCOPE

1. Large sample size
2. More modern devices and diagnostic film or video assessment could be used.
3. Small age variation and age group could be taken.
4. Specificity of weight lifted

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest. The research received no specific grant from any funding agency in the public, community, or non-for profit sectors.

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