WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
Coden USA: WJPRAP Impact Factor 8.453
Volume 15, Issue 1, 904-917. Research Article ISSN 2277–7105

PREVALACE OF LOWER CROSS SYNDROME IN SCHOOL TEACHERS: A CROSS-SECTIONAL STUDY

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Article Received on 06 Dec. 2025,
Article Revised on 26 Dec. 2025,
Article Published on 01 Jan. 2026,
https://doi.org/10.5281/zenodo.18094909

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How to cite this Article: Syed Ashna Aalam[1]*, Pooja Rathod[2] (2026). PREVALACE OF LOWER CROSS SYNDROME IN SCHOOL TEACHERS: A CROSS-SECTIONAL STUDY. "World Journal of Pharmaceutical Research, 15(1), 904–917.

ABSTRACT

Background: In contemporary times, work is intrinsically associated with capitalist relationship, in which workers need continuous update on their job skills and a constantly demanded to keep being successful in their position. In educational context, teachers belong to risk group for the development of MSDs, since poor working condition in school leads to reduced quality of life among the professionals. They are also exposed to long hours standing during teaching and prolonged sedentary position, which leads to poor posture and low back pain. **Methods:** Total 154 school teachers aged between 35 to 50 years participated and were screened for to the total kinetic chain neuromuscular efficiency, integrated functional strength, flexibility and also a degree of muscle fatigue, using Overhead Squat Test. The Numerical Pain Rating Scale (NPRS) for pain assessment, and length of bilateral Iliopsoas muscle: was measured by Modified Thomas test and using Universal Goniometer. Length of spinal extensor muscle: was checked by non-elastic measuring tape. Abdominal muscle strength and Gluteus maximus muscle strength was measured by using MMT, according to the grades. **Results:** The study results showed a high occurrence of LCS among the teacher population and demonstrated a statistically significant link between the syndrome and increased pain levels, iliopsoas tightness, and weakness in the abdominal and gluteus maximus muscles. **Conclusion:** The observed clinical findings emphasize the importance of early screening and primary prevention strategies. Identifying this postural imbalance, which often precedes chronic lower back pain, allows for targeted, cost-effective corrective

measures such as stretching the tight muscles and strengthening the weak ones in order to minimize the musculoskeletal risk among teachers.

KEYWORDS: School teachers, Lower cross syndrome, Overhead squat test, Erector spinae muscle, Iliopsoas muscle, Gluteus maximus muscle, Abdominal muscle.

INTRODUCTION

The Lower Crossed Syndrome (LCS) is defined as "S" shaped posture of the lower back characterized by tight hip flexors and lower back muscles paired with weak abdominal muscle and gluteus maximus muscle, also referred as distal or pelvic crossed syndrome.[1]

In LCS, tightness of the thoraco-lumbar extensors on the dorsal side crosses with tightness of the iliopsoas and rectus femoris. Weakness of the deep abdominal muscles ventrally crosses with weakness of the gluteus maximus and medius. This pattern of imbalance creates joint dysfunction, particularly at the L4-L5 and L5-S1 segments, SI joint and hip joint.[1]

Specific postural changes seen in LCS include anterior pelvic tilt, increased lumbar lordosis, lateral lumbar shift, lateral leg rotation and knee hyperextension.[1] If the lordosis is deep and short, then imbalance is predominantly in the pelvic muscles.[1]

People in the age group of late teens to 40 years are highly active in daily life and are exposed to various stresses. Unlike in the elderly, the age-related changes are minimal in this age group.[1]

Burton A.K in the year of 1996 shown that the prevalence of developing low back pain in young adolescents is similar to that of adults.4 G T Jones et al in his study shows that lifetime prevalence as high as 70–80% by 20 years of age.[1]

In addition, several studies have calculated new onset rates of around 20% over a 1–2year period. Birger et al concluded that 85% of low back pain has an origin due to muscle imbalance commonly due to long term postural faults called lower crossed syndrome.[1]

According to the International Labour Organization (ILO), activities and environments with particular risk factors for MSDs include those with rapid or repetitive motion, forceful exertion, concentration of excessive mechanical force, awkward or non-neutral posture, and vibrations.[3]

Teachers are prone to various types of physical and psychological health issues caused by work-related factors. One of the most common physical health complaints in the teaching profession is musculoskeletal disorders (MSDs).[3] The National Institute for Occupational Safety and Health (NIOSH) defines MSDs as a group of conditions that involve the nerves, tendons, muscles and supporting structures of the body.[3]

Teachers are exposed to these risk factors, for example when writing on the blackboard with the arms extended, and other awkward postures like bending and stooping when teaching and assisting student with learning difficulty.3 They are also ex-posed to long hours standing during teaching and pro-longed sedentary position when planning lessons and doing paperwork, in particular when recording student output.[3]

Therefore, This research has been done to assess lower cross syndrome in school teachers.

MATERIALS AND METHODOLOGY

This was a cross-sectional study in **Bandra East** Mumbai Maharashtra India with a duration of 18 months. A total of 154 individuals who were school teachers between the age 35 to 50 years participated in this study. A written consent form was taken from all the participants and the purpose of the study along with instructions were explained prior to participants in the study.

Inclusion criteria- Teachers who are willing to participate, Female and Male both included, long standing individuals (1/2 hr). Teachers with at least one year of service in the age group of 35 to 50 yrs.

Exclusion criteria- Subjects with any history of back surgery, trauma to back or lower extremity, diagnosed cases of rheumatoid arthritis or osteoarthritis of the spine or hips, neurological disease, any history of cardiovascular diseases such as hypertension, stroke, or other cardiac disorder.

Ethical clearance was obtained from the institutional ethical committee prior to the commencement of the study.

The demographic data was recorded as per data record sheet. The participants were first screened according to the inclusion criteria. NRPS scale will be used to identify the severity of pain.

Overhead squat test: This is a good test because it tests the total kinetic chain neuromuscular efficiency, integrated functional strength, flexibility and also a degree of muscle fatige A way to assess the lower cross syndrome is a global assessment. This test was done by having the patient stand shoulder width apart and hold hands overhead with arm fully extended. Then the therapist ask the patient to slowly squat down to a comfortable position, as the therapist walks around the patient looking at the anterior, lateral, posterior views of the knees, feet, lumbar lordosis, chin elevation, arms movement.

Length of bilateral Iliopsoas muscle: was measured by Modified Thomas test and using Universal Goniometer. The subject was instructed to lie in supine with half of the thigh out of the couch while the therapist standing by the tested table. Lumbar spine was checked for excessive lordosis. The subjects was instructed and demonstrated to pull (flex) and hold the non tested hip in flexed position, bringing the knee close to the chest to flatten out the lumbar spine and to stabilize the pelvis. The therapist measured the length of opposite side iliopsoas with a universal goniometer by keeping the fulcrum over greater trochanter, movable arm kept parallel to the lateral boarder of femoral shaft and stationary arm parallel to the tested table. The test was done on both sides. The iliopsoas was considered tight if hip extension angle is less than 15°.

Length of spinal extensor muscle: was checked by non-elastic measuring tape. The participants was instructed to stand erect with the cervical, thoracic, and lumbar spine in 0° of lateral flexion and rotation. Spinous process of C7 and S1 vertebrae was marked by a skin marking pencil and distance between two processes was measured by a tape measure. The pelvis were stabilized by keeping the therapist hand over PSIS to prevent anterior tilt of the pelvis. Instruction was given to the subjects to bend forward gradually while keeping the arm relaxed maintaining equal load on both feet. The motion was stopped when resistance to additional flexion was experienced by the subject and the therapist feels the pelvis start to tip anteriorly. Then the distance between the two spinous processes was again measured. The difference between the first and second measurement indicates the amount of thoracic and lumber flexion. The length of muscle were considered normal when it is equal to 10 cm.

Abdominal muscle strength: was measured by positioning the subjects in supine lying with both hip and knee flexed and hands clasped behind the head (For Grade-V) arms crossed over the chest (for Grade-IV) and with arms outstretched in full extension above the plane of body (For Grade-III). Therapist stands at side of the table at level of subject’s chest to ascertain scapular clearance from table during test. Then the subjects was instructed to flex the trunk through full range of motion. A trunk curl up will be emphasized until scapula clears the table. Instruction were given as "Tuck your chin and bring your head, shoulders and arms off the table, as in a sit up.

Gluteus maximus muscle: Subject was asked to lie in prone position with knee flexed to 90 degree, and the therapist stands on the tested side at the level of pelvis. Pelvis was stabilized by applying downward pressure at the low back by one hand of the therapist. The subjects was instructed to extend the hip maintaining the knee flexion at 90°.Resistance was applied (mild resistance for Grade-IV and maximum for Grade-V) by the therapist manually against the lower part on the posterior thigh in the direction of hip flexion so that the subject could complete the full range of hip extension. Then the strength of gluteus maximus were graded according to MRC grading.

RESULT

The data collected from 154 individuals was entered using MS EXCEL 2010 and statistical analysis was done using SPSS23.0v.

To assess the presence of Lower Cross Syndrome (LCS) using Overhead Squat Test

The Overhead Squat Test (OHST) is a functional assessment used to identify muscle imbalances, postural deviations, and movement dysfunctions in the lower body and core. It evaluates the coordinated action of the hips, knees, ankles, and trunk during a dynamic squatting motion. The test helps detect compensatory patterns associated with conditions like Lower Cross Syndrome, making it a valuable tool in both clinical and occupational settings.

We have outcomes of Overhead Squat Test in binary form (Positive/Negative) so essentially,

- Positive = Lower Cross Syndrome Present
- Negative = Lower Cross Syndrome Absent

Prevalence of LCS among school teachers

Over Head Squat Test	
Positive	72
Negative	82
Total Participants	154

$$\text{Prevalence of LCS (\%)} = \frac{\textit{Number of positive OHST}}{\textit{Total Participants}} \times 100$$

$$\text{Prevalence of LCS (\%)} = \frac{72 \times 100}{154}$$

Prevalence of LCS (%) = 46.75

❖ CONCLUSION

Out of 154 school teachers studied, 72 (about 47%) showed a positive result on the Overhead Squat Test, which means they may have postural problems related to Lower Cross Syndrome. This shows that almost half of the teachers could have muscle imbalances or weak core and hip muscles. Identifying these issues early can help in doing exercises or corrections to prevent pain and improve posture.

➢ One Sample Proportion Test

A one-sample proportion test is a statistical method used to determine whether the proportion of a certain characteristic in a single sample differs significantly from a hypothesized population proportion.

Hypothesis

We have to test the hypothesis as,

Null Hypothesis: H_0 = There is no significant prevalence of Lower Cross Syndrome in school teachers.

v/s

Alternative (Research) Hypothesis: H_1 = There is significant prevalence of Lower Cross Syndrome in school teachers.

➢ SPSS Output

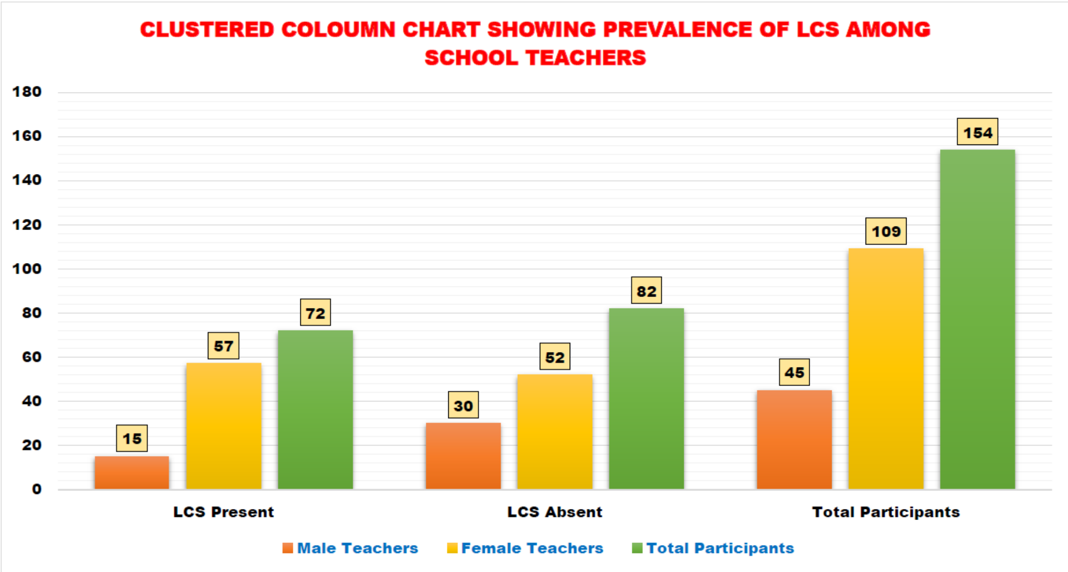
Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
OHST_Result	Group 1	0	82	.53	.50	.468
	Group 2	1	72	.47		
	Total		154	1.00		

Here we can see that p-value provided by SPSS is **.468** which is greater than 0.05 (i.e. $p > 0.05$) therefore we have significant evidence to reject the alternative hypothesis. This indicates that "**There is no significant prevalence of Lower Cross Syndrome in school teachers.**"

In other words, the statistical test showed that this proportion is not significantly different from what was expected (p = 0.468). This means that, in this group, **the occurrence of LCS is roughly as expected and not unusually high or low.**

➢ **Clustered Column Chart**



❖ CONCLUSION

The chart shows that 72 out of 154 teachers had Lower Crossed Syndrome, with more female teachers affected; it may be due to the reason that they represented a larger portion of the sample. Overall, the distribution indicates that LCS is present in a notable number of teachers, highlighting the need for posture-related awareness and preventive measures.

To assess pain using NRS

➢ **Normality**

In statistics, normality tests are used to determine if a data set is well-modelled by a normal distribution.

Problem: To investigate whether numerical rating scale (NRS) score is normally distributed or not.

Hypothesis: We have to test the hypothesis as,

Null Hypothesis: H0 = Set of data comes from a normal distribution OR NRS Score follows normal distribution.

v/s

Alternative (Research) Hypothesis: H1 = Set of data do not come from a normal distribution OR NRS Score do not follow normal distribution.

- **SPSS Output**

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
NRS Score	154	100.0%	0	0.0%	154	100.0%

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
NRS Score	.190	154	.000	.862	154	.000

a. Lilliefors Significance Correction

The above table shows the results of Kolmogorov-Smirnov and Shapiro-Wilk tests of normality (tests statistic, degrees of freedom, p-value). Since we have greater than 50 observations (N = 154 > 50), we will interpret the Kolmogorov-Smirnov test results.

Here we can see that p-value provided by SPSS is **.000** which is less than 0.05 (i.e. $p < 0.05$) therefore we have significant evidence to reject the null hypothesis. This indicates that "**Set of data do not come from a normal distribution OR NRS Score do not follow normal distribution.**"

❖CONCLUSION

Since our set of data do not come from a normal distribution OR NRS Score do not follow normal distribution we cannot go for parametric test such as independent t-test therefore we will go for **"Mann-Whitney U Test"** which is non-parametric alternative to independent t-test.

- **Mann-Whitney U Test**

The Mann-Whitney U test, also known as the Wilcoxon rank-sum test, is a non-parametric statistical test used to compare the distributions of two independent groups. It assesses whether one group tends to have larger values than the other, without assuming a normal distribution of the data. It's often used as an alternative to the independent samples t-test when data is not normally distributed.

Hypothesis

We have to test the hypothesis as,

Null Hypothesis: H0 = There is no significant difference in pain (NRS) scores between teachers with Lower Cross Syndrome and those without Lower Cross Syndrome.

v/s

Alternative (Research) Hypothesis: H1 = **There is a significant difference in pain (NRS) scores between teachers with Lower Cross Syndrome and those without Lower Cross Syndrome.**

➢ **SPSS Output**

Ranks

	LCS	N	Mean Rank	Sum of Ranks
NRS Score	0	82	55.46	4548.00
	1	72	102.60	7387.00
	Total	154		

Here LCS, **0 = No LCS**

1 = LCS Present

Test Statistics[a]

	NRS Score
Mann-Whitney U	1145.000
Wilcoxon W	4548.000
Z	-6.678
Asymp. Sig. (2-tailed)	.000

a) Grouping Variable: LCS

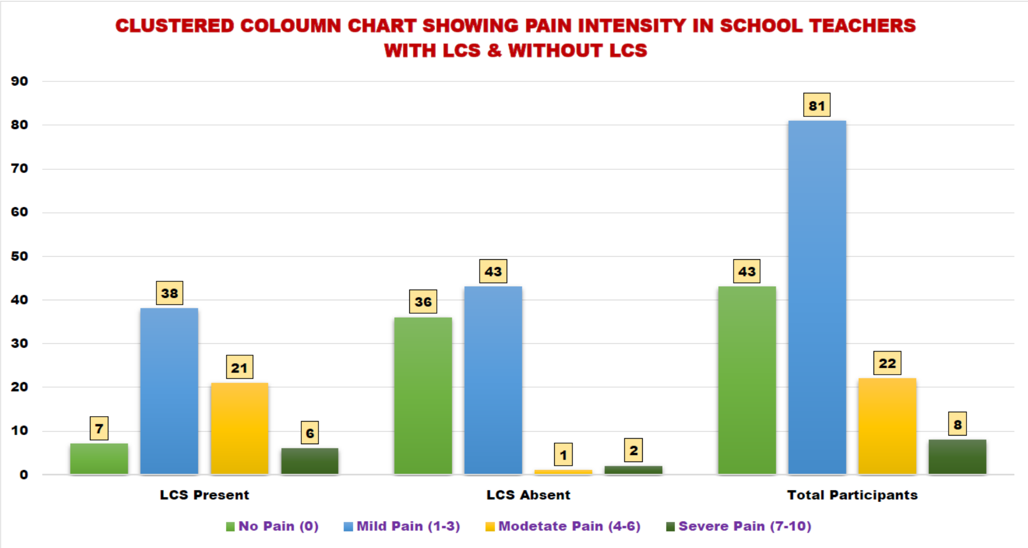
Here we can see that p-value provided by SPSS is **.000** which is less than 0.05 (i.e. $p < 0.05$) therefore we have significant evidence to reject the null hypothesis. This indicates that "**There is a significant difference in pain (NRS) scores between teachers with Lower Cross Syndrome and those without Lower Cross Syndrome.**"

From the Ranks table, we can see that Mean Rank for group of teachers with no LCS is **55.46** & for the group of teachers having LCS is **102.60.** Mean rank tells you how the values are distributed and **lower the mean rank = lower the pain**.

Here, mean rank for the group of teachers with no LCS < mean rank for the group of teachers having LCS (i.e., 55.46 < 102.60) therefore we can conclude that **Teachers with Lower**

Cross Syndrome reported significantly higher pain scores compared to those without Lower Cross Syndrome.

➢ Clustered Column Chart



❖ CONCLUSION

The chart shows pain intensity distribution among school teachers with and without Lower Cross Syndrome (LCS). Teachers with LCS most commonly reported mild pain (38 participants), followed by moderate pain and no pain. In contrast, those without LCS mostly reported no pain (36 participants) or mild pain (43 participants). Overall, teachers with LCS experience higher levels of pain compared to those without LCS.

To check for tightness using Goniometer of the lower body muscles

We know that,

• Angle < 15° ⟶ limited hip extension ⟶ tight iliopsoas

• Angle ≥ 15° ⟶ considered normal or not tight

From the collected data we have,

School Teachers	Right Side		Left Side	
	Tightness	Normal Muscle	Tightness	Normal Muscle
LCS Present	67	5	64	8
LCS Absent	23	59	23	59

❖ CONCLUSION

The table shows the distribution of iliopsoas muscle tightness among teachers with and without Lower Cross Syndrome (LCS). On the right side, 67 teachers with LCS exhibited muscle tightness compared to only 23 teachers without LCS. Similarly, on the left side, 64 teachers with LCS had tightness, whereas 23 without LCS showed tightness. In contrast, most teachers without LCS had normal muscle length on both sides (59 on each side). This indicates that **iliopsoas tightness is much more common in teachers with LCS. These findings suggest a strong association between iliopsoas muscle tightness and the presence of LCS.**

To check for weakness using MMT of the lower body muscles

We know that,

- **Angle ≤ 3 → weakness**
- **Angle > 3 → considered normal**

From the collected data we have,

School Teachers	Abdominal Muscle		Gluteus Maximus Muscle	
	Weakness	Normal Muscle	Weakness	Normal Muscle
LCS Present	65	7	61	11
LCS Absent	10	72	14	68

❖ CONCLUSION

The table shows a clear difference in muscle weakness between teachers with and without Lower Cross Syndrome (LCS). Among those with LCS, 65 teachers showed abdominal muscle weakness compared to only 10 in the non-LCS group. A similar pattern appears in the gluteus maximus muscle, where 61 teachers with LCS demonstrated weakness versus 14 without LCS. In contrast, the majority of teachers without LCS had normal abdominal (72) and gluteus maximus strength (68). Overall, **muscle weakness is much more common in individuals with LCS, indicating a strong association between reduced lower body muscle strength and the presence of Lower Cross Syndrome.**

DISCUSSION

This cross-sectional study investigated the prevalence of Lower Cross Syndrome (LCS) in school teachers and examined its association with pain, muscle tightness, and muscle weakness.

This study was motivated by the high prevalence of musculoskeletal disorders among school teachers, due to prolonged posture when writing on the blackboard with the arms extended, and other awkward postures like bending and stooping when teaching and assisting student with learning difficulty. They are also ex-posed to long hours standing during teaching and pro-longed sedentary position when planning lessons and doing paperwork, in particular when recording students output.

The research followed a methodology that included the Overhead Squat Test (OHST) for diagnosis, the Numerical Pain Rating Scale (NPRS) for pain assessment, and goniometry/Manual Muscle Testing (MMT) for evaluating specific muscle groups. Lower Cross Syndrome (LCS) Prevalence and Postural Risk. The study found a prevalence of 46.75% of LCS among the 154 school teachers, meaning nearly half of the participants showed a positive result on the Overhead Squat Test.

Although the one-sample proportion test indicated that this prevalence was not significantly different from a hypothesized population proportion (p=0.468), the raw number of affected teachers (72 out of 154) is substantial. This highlights a notable occupational health concern, as prolonged postural faults, like those from extended sitting for paperwork or standing while teaching, are known risk factors for developing LBP and LCS.

Gender Distribution: The analysis also noted that more female teachers were affected by LCS, though this may be attributed to them constituting a larger portion of the sample. Other literature cited in the review also suggests that females may be more prone to developing LCS than males.

Association with Pain (NPRS): The research established a significant association between the presence of LCS and higher pain scores. Statistical Findings: The NRS scores were found not to follow a normal distribution, leading to the use of the non-parametric Mann-Whitney U Test to compare pain scores between groups.

Conclusion: With a p-value of .000, the null hypothesis was rejected, confirming a significant difference in pain scores. The mean rank for teachers with LCS was higher (102.60) compared to those without LCS (55.46), indicating that the LCS group reported significantly higher pain scores.

CONCLUSION

The study successfully identified a high occurrence of LCS (46.75%) among the teacher population and demonstrated a statistically significant link between the syndrome and increased pain levels, iliopsoas tightness, and weakness in the abdominal and gluteus maximus muscles.

This research meets the need for studies on LCS prevalence in school teachers, who are recognized to be at risk for musculoskeletal disorders due to occupational factors like prolonged standing and awkward postures.

The results emphasize the importance of early screening and primary prevention strategies. Identifying this postural imbalance, which often precedes chronic lower back pain, allows for targeted, cost-effective corrective measures such as stretching the tight muscles and strengthening the weak ones.

ACKNOWLEDGEMENT

I would express my sincere gratitude to those people without whose support and concern this project would not have been possible. I would like to acknowledge and thank all the participants who willingly participated in this study.

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