INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

PREVALENCE OF LOWER CROSS SYNDROME AND ITS ASSOCIATION WITH BMI AMONG NURSES: A CROSS-SECTIONAL STUDY

Original Research

Imran Ali[1], Haroon Khan[2], Bilal Rahman[3], Ayesha Nadir[4], Hafiz Yaseen Khan[5], Mudassir Ahmad[6]
[1]PT, Academic coordinator and Lecturer, Health sciences department, Cusit Peshawar Pakistan.
[2]Physical therapist, Ibadat international university Islamabad Pakistan.
[3]Physical therapist, Peshawar, Pakistan.
[4]Physical therapist, Ibadat international university Islamabad Pakistan.
[5]PT, Lecturer, Health sciences department, Cusit Peshawar Pakistan.
[6]Physical therapist at PIMS, Peshawar, Pakistan.
Corresponding Author: Hafiz Yaseen Khan, PT, Lecturer, Health sciences department, Cusit Peshawar Pakistan, dryaseenkhan11@gmail.com
Acknowledgement: The authors sincerely thank the staff and administration of Lady Reading Hospital, Peshawar, for their support and cooperation throughout the study.

Conflict of Interest: None

Grant Support & Financial Support: None

ABSTRACT

Background: Lower Cross Syndrome (LCS) is a common postural dysfunction caused by muscular imbalances, including tight hip flexors and lower back muscles, and weakened abdominal and gluteal muscles. It is often associated with sedentary lifestyles, poor ergonomics, and increased body mass index (BMI). Healthcare workers, particularly nurses, are at elevated risk due to prolonged standing, awkward postures, and physical demands. Identifying the prevalence and associated factors of LCS in this population is essential for early prevention and management.

Objective: To determine the prevalence of Lower Cross Syndrome and its association with Body Mass Index among registered nurses working at a tertiary care hospital.

Methods: This descriptive cross-sectional study was conducted at Lady Reading Hospital, Peshawar, involving 292 registered nurses selected through non-probability convenient sampling. Inclusion criteria were nurses aged 25–45 years with at least one year of professional experience. Individuals with recent trauma, surgery, chronic illness, disabilities, or pregnancy were excluded. Assessment tools included the REEDCO Postural Scale, BMI calculator, Modified Thomas Test for hip flexor tightness, and Manual Muscle Testing (MMT) for abdominal strength. Statistical analysis was performed using chi-square tests to assess associations.

Results: Among the 292 participants, the prevalence of LCS was 24.31% based on the Modified Thomas Test and REEDCO scale. According to MMT, 35.6% of participants were classified in grade 2 and grade 3 muscle strength. A higher prevalence was observed in the 41–45 age group. Statistically significant associations were found between BMI and the Thomas test ($p = 0.011$), REEDCO scale ($p = 0.005$), and MMT ($p = 0.03$), indicating increased LCS risk with rising BMI.

Conclusion: LCS is prevalent among nurses, with strong associations to increased BMI and age. Preventive strategies, including ergonomic training and physical activity, are vital to reduce musculoskeletal risks in this high-risk group.

Keywords: Abdominal Muscles, Body Mass Index, Lower Back Pain, Muscle Weakness, Nurses, Postural Imbalance, Risk Factors.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Lower Crossed Syndrome (LCS) is a prevalent musculoskeletal imbalance characterized by an "S"-shaped curvature of the lower spine resulting from hypertonicity of the hip flexors and lumbar erector spinae muscles, paired with the weakening of the abdominal and gluteus maximus muscles—a condition also referred to as pelvic crossed syndrome or distal crossed syndrome (1). This neuromuscular dysfunction disrupts the biomechanical equilibrium of the pelvis and lower spine, contributing to joint dysfunctions particularly at the L4-L5, L5-S1 vertebral segments, sacroiliac joints, and hip articulations (2,3). The resulting stress concentration on these structures can lead to chronic lower back pain, impaired posture, and a decline in functional capacity, thereby affecting quality of life (4,5). Muscle imbalances involved in LCS not only compromise postural alignment but also predispose individuals to a range of pain syndromes and movement inefficiencies. Particularly concerning is the growing evidence of LCS and its variant presentations in diverse populations (6). For instance, a study explored the prevalence of crossed pelvic syndrome in women with primary dysmenorrhea. Among the 305 participants assessed using validated tools such as the Thomas test, modified Schober test, and manual muscle testing, 28.5% were found to have pelvic crossed syndrome. The majority of these women also reported moderate to severe dysmenorrhea, with 67% engaging in less than one hour of physical activity daily, highlighting the syndrome's tangible impact on functional activity levels (7).

Similarly, researchers examined the incidence of LCS in school-aged children (11–15 years), revealing that 21% of 369 children exhibited clinical features of LCS, while 32% were at risk. Manual muscle testing and flexibility assessments indicated a gender difference, with 22% of boys and 18% of girls affected. These findings underscore the importance of early detection and preventive strategies, especially considering the sedentary habits and prolonged sitting common in children of this age group (8-10). Despite increasing recognition of LCS in both pediatric and adult populations, there remains a need for broader awareness and proactive intervention strategies to mitigate its long-term consequences. The evidence suggests that this neuromuscular syndrome, if left unaddressed, can significantly impair physical function across different life stages. Therefore, the present study aims to further investigate the prevalence and functional implications of Lower Crossed Syndrome, with a particular focus on its association with physical activity limitations and postural dysfunction, thereby contributing to more effective preventive and rehabilitative frameworks.

METHODS

The study employed a descriptive cross-sectional design and was conducted at Lady Reading Hospital, Peshawar, Pakistan. A total of 292 participants were recruited using non-probability convenient sampling, with the target population comprising registered nurses. Eligibility was determined based on defined inclusion and exclusion criteria. Participants included both male and female nurses aged between 25 and 45 years who had a minimum of one year of continuous clinical experience. Individuals were excluded if they had a history of recent trauma or surgery, suffered from chronic illnesses or physical disabilities, or were pregnant at the time of data collection, in order to minimize potential confounding variables that could affect posture or musculoskeletal function (3,4). All participants provided informed written consent after being briefed about the study's objectives, procedures, and their rights to voluntarily withdraw without any consequences. Ethical approval was obtained from the Research Committee of the City University of Science and Information Technology (CUSIT) as well as the Institutional Research and Ethics Committee of Lady Reading Hospital, Peshawar. Data collection was carried out using standardized and validated assessment tools to evaluate posture and musculoskeletal imbalances associated with Lower Crossed Syndrome. Postural assessment was performed using the REEDCO Posture Scale, which is designed to systematically score postural alignment (11). Body Mass Index (BMI) was calculated to assess body composition and rule out weight-related postural deviations. Hip flexor tightness, a key indicator of LCS, was assessed using the Modified Thomas Test, while abdominal muscle weakness was evaluated through manual muscle testing performed by trained assessors following standardized protocols.

RESULTS

A total of 292 registered nurses participated in the study, with a mean age of 31.79 years (SD ±5.41). The largest proportion of participants (53.43%) fell within the 25–29 age range. The gender distribution included 239 females (81.8%) and 53 males (18.2%). According to BMI categorization, 37 participants (12.7%) were underweight, 201 (68.8%) were of normal weight, 43 (14.7%) were

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

overweight, and 11 (3.8%) were obese. Postural assessments using the REEDCO scale revealed that 31 participants (10.6%) had poor posture, 235 (80.5%) had fair to moderate posture, and 26 (8.9%) had good posture. The prevalence of Lower Crossed Syndrome (LCS), determined using the Modified Thomas Test, was found to be 24.31%, with 71 participants testing positive and 221 testing negative. Among those with poor posture, 30 out of 31 individuals had LCS, while among those with fair to moderate posture, 41 out of 235 exhibited signs of the syndrome.

Manual muscle testing (MMT) of abdominal strength indicated that no participants were in grade 0 or grade 1. A total of 28 participants (9.6%) were classified as grade 2, 77 (26.4%) as grade 3, 154 (52.7%) as grade 4, and 33 (11.3%) as grade 5. Based on the proportion of participants in grades 2 and 3, the prevalence of muscle weakness associated with LCS was calculated at 35.6%. Gender-wise analysis showed that 24.5% (13 out of 53) of male nurses and 24.2% (58 out of 239) of female nurses were diagnosed with LCS. Age-wise, the prevalence increased with age; the highest frequency of positive cases was observed in the 41–45 age group, where 13 out of 22 participants were LCS positive. The majority of negative cases were observed in younger age groups, particularly 26–30 and 31–35 years. Statistical analysis using the chi-square test demonstrated a significant association between BMI and the presence of LCS as identified by the Thomas Test ($p = 0.011$), abdominal weakness per MMT ($p = 0.03$), and postural deficits per REEDCO scale scores ($p = 0.005$), suggesting a potential link between higher BMI and musculoskeletal imbalances leading to LCS.

Table 1: Shows Age, Gender, And BMI Of Participants.

Demographic Data						
Age	Gender		BMI			
31.79±5.414	Male (53)	Female (239)	Underweight (37)	Normal-weight (201)	Over-weight (43)	Obese (11)

Table 2: Shows the Prevalence of LCS According to The Thomas Test

	Frequency	**Percent**
Poor	31	10.6
Fair/ Moderate	235	80.5
Good	26	8.9
Total	292	100

Table 3: Shows the Prevalence of LCS According to The MMT Scale and Also Abdominal Muscles Strength

	Frequency	**Percent**
Negative	221	75.7
Positive	71	24.3
Total	292	100.0

Table 4: Shows the Prevalence of LCS According to The REEDCO Postural Scale and Also Its Frequencies and Percentages According to Their Categories.

Grading	**Frequency**	**Percent**
Grade 0	0	0
Grade 1	0	0
Grade 2	28	9.6
Grade 3	77	26.4
Grade 4	154	52.7
Grade 5	33	11.3
Total	292	100

Table 5: Shows the Prevalence of LCS In Male and Female Nurses According to The Thomas Test

20-25	**3**	**0**	**3**
26-30	127	26	153
31-35	56	19	75
36-40	24	8	32
41-45	9	13	22
46-50	2	3	5
51-55	0	2	2
Total	221	71	292

Table 6: Shows How Common Is LCS Among Different Age Groups.

Gender	Negative	Positive	Total
Male	40	13	53
Female	181	58	239
Total	221	71	292

Table 7: Shows the Association Between LCS (THOMAS TEST, MMT Scale, and REEDCO SCALE) and BMI.

LCS	BMI	p-value
THOMAS TEST		0.001
MMT Scale		0.003
REEDCO SCALE		0.005

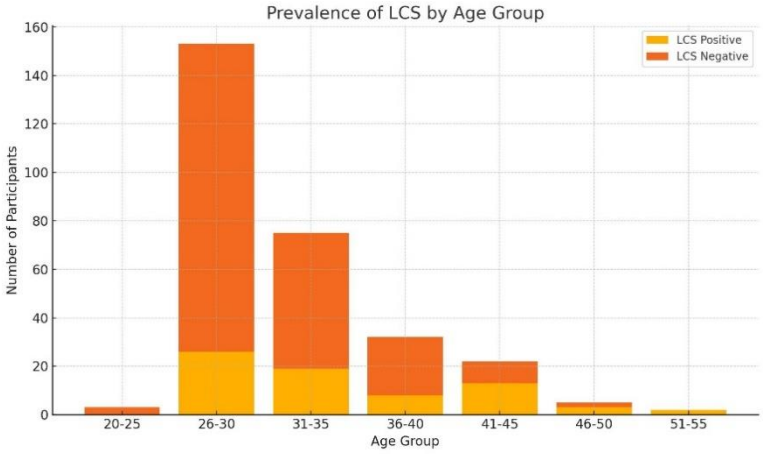

Figure 1 Prevalence if LCS by Age Group

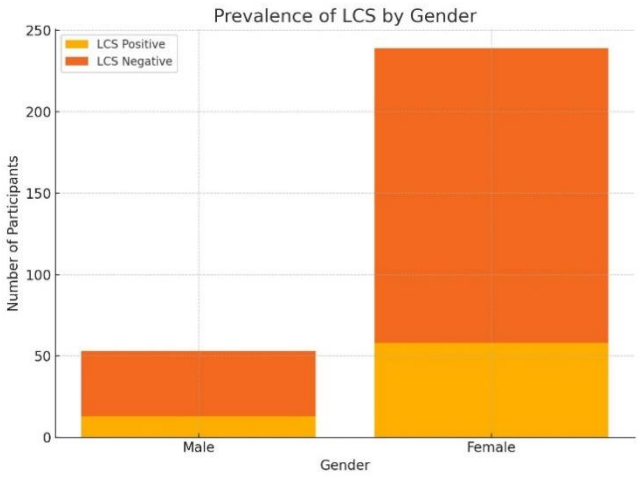

Figure 2 Prevalence of LCS by Gender

DISCUSSION

The findings of the present study, which revealed a 24.31% prevalence of Lower Cross Syndrome (LCS) among nurses, align closely with previously reported data from various populations, suggesting that LCS is a widespread musculoskeletal condition driven by muscle imbalances and postural deficits. Notably, the association between LCS and increased BMI was statistically significant in this cohort, reinforcing the understanding that excessive body weight may contribute to or exacerbate postural and muscular dysfunctions (12). This is consistent with earlier research where a significant relationship between BMI and LCS was established using similar statistical

approaches, further supporting the biomechanical rationale that increased body mass imposes additional strain on postural muscles, leading to compensatory patterns and eventual dysfunction (13,14). Previous studies conducted on asymptomatic individuals have also emphasized the role of prolonged sitting and poor posture as primary contributors to LCS. These studies utilized comparable evaluation tools, including the REEDCO posture scale, Thomas test, and manual muscle testing, and confirmed that muscle tightness—especially of the iliopsoas—and abdominal weakness are key features of the syndrome (14,15). However, those findings were derived from the general population and did not focus on a specific professional group, which limits direct comparability. The current study adds value by focusing specifically on the nursing profession, a population particularly vulnerable to musculoskeletal issues due to prolonged standing, repetitive tasks, and irregular shifts, making the results more relevant for occupational health planning (16,17).

Another study highlighted gender-related differences in LCS prevalence, reporting higher rates in females, particularly due to increased muscle tension and postural adaptations. In contrast, the present study revealed nearly equal LCS prevalence among male and female nurses—24.5% and 24.2%, respectively—suggesting that occupational demands may override gender-specific physiological differences in this context (18). This discrepancy in findings highlights the importance of population-specific research, as occupational roles and physical demands can influence musculoskeletal health differently than generalized lifestyle factors. Supporting evidence from athletic populations such as professional jockeys also aligns with the present findings, confirming that muscular imbalances, particularly in the hip flexors and trunk extensors, play a crucial role in the development of LCS (19,20). However, such populations differ significantly in physical demands and conditioning levels, limiting direct applicability to healthcare professionals. Nonetheless, the shared conclusion that poor posture during activity contributes to LCS reinforces the core pathophysiological mechanism common across studies (21).

The strength of the current study lies in its structured use of multiple validated assessment tools—REEDCO scale, Modified Thomas test, and MMT—offering a comprehensive musculoskeletal profile of participants. The relatively large sample size and focus on a specific, high-risk professional group also enhance the study's relevance. Moreover, the statistically significant associations with BMI add a novel dimension that was overlooked in some earlier works. However, limitations must be acknowledged. The use of non-probability convenience sampling limits generalizability. Potential confounding variables such as physical activity levels, footwear, work shifts, and pre-existing ergonomic interventions were not controlled or assessed. Additionally, the cross-sectional nature of the study restricts causal interpretations. Future research should aim to incorporate longitudinal designs to establish causality and examine the progression of LCS over time. Studies could also benefit from integrating electromyographic or imaging assessments to validate muscular involvement more objectively. Expanding the scope to include lifestyle variables such as physical activity, ergonomics, and psychosocial stressors could further refine risk stratification and inform preventive strategies. In summary, this study underscores the substantial prevalence of Lower Cross Syndrome among nurses and confirms its significant association with BMI and postural impairments. The results call for targeted preventive interventions in clinical settings, including postural training, ergonomic corrections, and weight management programs, to mitigate long-term musculoskeletal complications in the healthcare workforce.

CONCLUSION

The study concludes that Lower Cross Syndrome is a prevalent musculoskeletal issue among nurses, affecting both genders almost equally. A clear association was found between poor posture, muscle weakness, and increased body mass index, indicating that individuals with higher BMI are more likely to develop LCS. As age advances, the risk also appears to rise, particularly in middle-aged professionals. These findings highlight the need for early screening and preventive strategies in occupational settings, especially in physically demanding professions like nursing, to reduce the risk of postural dysfunctions and promote long-term musculoskeletal health.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

AUTHOR CONTRIBUTION

Author	Contribution
Imran Ali	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Haroon Khan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Bilal Rahman	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ayesha Nadir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hafiz Yaseen Khan*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Mudassir Ahmad	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

REFERENCES

1. Paillard T. Acute and chronic neuromuscular electrical stimulation and postural balance: a review. Eur J Appl Physiol. 2020;120(7):1475-88.
2. Rezaei A, Bhat SG, Cheng CH, Pignolo RJ, Lu L, Kaufman KR. Age-related changes in gait, balance, and strength parameters: A cross-sectional study. PLoS One. 2024;19(10):e0310764.
3. Kuan YC, Huang LK, Wang YH, Hu CJ, Tseng IJ, Chen HC, et al. Balance and gait performance in older adults with early-stage cognitive impairment. Eur J Phys Rehabil Med. 2021;57(4):560-7.
4. Collings TJ, Lima YL, Dutaillis B, Bourne MN. Concurrent validity and test-retest reliability of VALD ForceDecks' strength, balance, and movement assessment tests. J Sci Med Sport. 2024;27(8):572-80.
5. Moezy A, Masoudi S, Nazari A, Abasi A. A controlled randomized trial with a 12-week follow-up investigating the effects of medium-frequency neuromuscular electrical stimulation on pain, VMO thickness, and functionality in patients with knee osteoarthritis. BMC Musculoskelet Disord. 2024;25(1):158.
6. Azab AR, Mahmoud WS, Basha MA, Hassan SM, Morgan EN, Elsayed AE, et al. Distinct effects of trampoline-based stretch-shortening cycle exercises on muscle strength and postural control in children with Down syndrome: a randomized controlled study. Eur Rev Med Pharmacol Sci. 2022;26(6):1952-62.
7. Dupuis F, Ginis KAM, MacKay C, Best KL, Blanchette V, Cherif A, et al. Do Exercise Programs Improve Fitness, Mobility, and Functional Capacity in Adults With Lower Limb Amputation? A Systematic Review on the Type and Minimal Dose Needed. Arch Phys Med Rehabil. 2024;105(6):1194-211.
8. Mahmoud WS, Radwan NL, Ibrahim MM, Hasan S, Alamri AM, Ibrahim AR. Effect of blood flow restriction as a stand-alone treatment on muscle strength, dynamic balance, and physical function in female patients with chronic ankle instability. Medicine (Baltimore). 2023;102(44):e35765.
9. Ren Y, Lin C, Zhou Q, Yingyuan Z, Wang G, Lu A. Effectiveness of virtual reality games in improving physical function, balance and reducing falls in balance-impaired older adults: A systematic review and meta-analysis. Arch Gerontol Geriatr. 2023;108:104924.
10. Sadeghi H, Jehu DA, Daneshjoo A, Shakoor E, Razeghi M, Amani A, et al. Effects of 8 Weeks of Balance Training, Virtual Reality Training, and Combined Exercise on Lower Limb Muscle Strength, Balance, and Functional Mobility Among Older Men: A Randomized Controlled Trial. Sports Health. 2021;13(6):606-12.
11. Nadeem I, Butt SK, Mubeen I, Razzaq A. Effects of core muscles strengthening exercises with routine physical therapy on trunk balance in stroke patients: A randomized controlled trial. J Pak Med Assoc. 2024;74(5):848-51.

12. Park C, Son H, Yeo B. The effects of lower extremity cross-training on gait and balance in stroke patients: a double-blinded randomized controlled trial. Eur J Phys Rehabil Med. 2021;57(1):4-12.
13. Adıguzel H, Elbasan B. Effects of modified pilates on trunk, postural control, gait and balance in children with cerebral palsy: a single-blinded randomized controlled study. Acta Neurol Belg. 2022;122(4):903-14.
14. Chiu HL, Yeh TT, Lo YT, Liang PJ, Lee SC. The effects of the Otago Exercise Programme on actual and perceived balance in older adults: A meta-analysis. PLoS One. 2021;16(8):e0255780.
15. Geng Q, Zhai H, Wang L, Wei H, Hou S. The efficacy of different interventions in the treatment of sarcopenia in middle-aged and elderly people: A network meta-analysis. Medicine (Baltimore). 2023;102(27):e34254.
16. Hernández-Belmonte A, Martínez-Cava A, Buendía-Romero Á, Franco-López F, Pallarés JG. Free-Weight and Machine-Based Training Are Equally Effective on Strength and Hypertrophy: Challenging a Traditional Myth. Med Sci Sports Exerc. 2023;55(12):2316-27.
17. Zhou J, Liu B, Xu JF, Wang FB, Ye H, Duan JP, et al. Home-based strength and balance exercises for fall prevention among older individuals of advanced age: a randomized controlled single-blind study. Ann Med. 2025;57(1):2459818.
18. Yeum WJ, Lee MY, Lee BH. The Influence of Hip-Strengthening Program on Patients with Chronic Ankle Instability. Medicina (Kaunas). 2024;60(8).
19. Mahishale A, Bhattarai A. Prevalence of Pelvic Crossed Syndrome in Females with Primary Dysmenorrhea and its Impact on Physical Activity: An Observational Study. Indian Journal of Physical Therapy and Research. 2023;5(1):60-5.
20. Sahu P, Phansopkar P. Screening for lower cross syndrome in asymptomatic individuals. J Med Pharm Allied Sci. 2021;10(6):3894-8.
21. Khan HY, Khan SH, Gillani A, Gillani A, Yousaf M, Qandeel HS, Daud M. Knowledge, Attitudes and Beliefs of Clinical Physiotherapists Towards Chronic Back Pain. National Journal of Life and Health Sciences. 2024 Mar 30;3(1):20-4.

