JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

DOI: https://doi.org/10.61919/m3dkfx44

Original Article

Association of Quadratus Lumborum Muscle Tightness with Low Back Pain due to Prolonged Sitting among Young Adults: A Cross-Sectional Study

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"Cite this Article" **Received**: 19 March 2026; **Accepted**: 22 June 2026; **Published**: 10 July 2026

Author Contributions: Concept: AT, HZ, DA; Design: SS, MNF, FA; Data Collection: SS, MNF, FA; Analysis: SS, MNF, FA; Drafting: SS, MNF, FA... **Ethical Approval**: University of Management and Technology, Sialkot, Pakistan. **Informed Consent**: Written informed consent was obtained from all participants; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: NA

ABSTRACT

Background: Low back pain is increasingly reported among young adults, particularly in those exposed to prolonged sitting and sedentary academic routines. Quadratus lumborum muscle tightness may contribute to altered lumbar mechanics, pain, and functional limitation, but its association with sitting-related low back pain in young adults remains insufficiently documented. Objective: To assess the association between quadratus lumborum muscle tightness, pain intensity, and functional disability among young adults with low back pain and prolonged sitting exposure. Methods: This cross-sectional observational study included 94 participants aged 18–25 years recruited through non-probability purposive sampling from two campuses of the University of Management and Technology, Sialkot, Pakistan. Eligible participants had low back pain and reported sitting for more than six hours per day. Quadratus lumborum tightness was assessed clinically using seated side-bending, hip hike, and deep palpation procedures. Pain intensity and disability were assessed using the Numeric Pain Rating Scale and Oswestry Disability Index, respectively. Data were analyzed using Shapiro–Wilk testing, chi-square analysis, Mann–Whitney U testing, and Spearman correlation. Results: Quadratus lumborum tightness was present in 67 participants (71.3%). Participants with tightness showed higher pain and disability categories than those without tightness. Quadratus lumborum tightness was significantly associated with ODI category, $\chi^2(3) = 10.567$, $p = 0.014$, and NPRS category, $\chi^2(3) = 29.073$, $p < 0.001$. Spearman analysis showed positive correlations between quadratus lumborum tightness and ODI category ($r = 0.328$, $p = 0.001$) and NPRS category ($r = 0.537$, $p < 0.001$). Conclusion: Quadratus lumborum muscle tightness was common and significantly associated with higher pain and disability categories among young adults with low back pain and prolonged sitting exposure. Keywords: Disability, Low back pain, Muscle tightness, Numeric Pain Rating Scale, Oswestry Disability Index, Quadratus lumborum

INTRODUCTION

Low back pain is one of the most common musculoskeletal disorders and remains a major contributor to pain, functional limitation, reduced productivity, and healthcare utilization across different age groups. Although low back pain is often considered more prevalent in older or occupationally exposed populations, its occurrence among young adults has become increasingly important because of prolonged sitting, reduced physical activity, poor postural habits, and extensive use of digital devices during academic and daily activities. Non-specific low back pain is particularly relevant in this population because symptoms often occur without a clearly identifiable structural pathology, yet may still interfere with mobility, concentration, academic participation, and quality of life (1).

Lumbar stability depends on the coordinated activity of deep and superficial trunk muscles, including the multifidus, erector spinae, psoas major, latissimus dorsi, and quadratus lumborum. These muscles contribute to spinal alignment, load transfer, postural control, and functional movement of the trunk and pelvis. Dysfunction or imbalance within this system may alter lumbar biomechanics and contribute to pain-related movement limitation. Among these muscles, the quadratus lumborum has specific clinical relevance because of its anatomical attachments to the iliac crest, iliolumbar ligament, twelfth rib, and transverse processes of the lumbar vertebrae, allowing it to assist in lateral flexion, lumbar stabilization, pelvic control, and postural support (2).

The quadratus lumborum may become tight, hyperactive, tender, or mechanically restricted in individuals exposed to prolonged static sitting. Sustained sitting can increase lumbar loading, encourage slumped posture, reduce movement variability, and contribute to muscle stiffness and altered neuromuscular control. These biomechanical and postural changes may increase mechanical stress on the lumbar spine and surrounding soft tissues. Previous research has reported associations between sedentary behavior, prolonged sitting, poor sitting posture, and low back pain, suggesting that sitting-related musculoskeletal symptoms may be influenced by both duration and posture rather than sitting exposure alone (3,4).

Young adults who spend extended hours sitting for study, screen use, or academic activities may be vulnerable to early musculoskeletal dysfunction. Evidence from student and young adult populations indicates that sitting duration, postural behavior, reduced physical activity, and trunk muscle imbalance can be associated with low back pain, discomfort during sitting, and impaired physical health indicators (5,6). Prolonged sitting has also been shown to increase low back pain symptoms and lumbar repositioning error, particularly among individuals with chronic or sedentary-related low back pain, supporting the clinical importance of assessing sitting-related lumbar dysfunction in young populations (7).

Although low back pain has multifactorial causes, muscle tightness is an important modifiable clinical factor. Tightness or reduced flexibility of muscles around the lumbar spine and pelvis may influence pelvic alignment, lumbar mobility, pain perception, and functional disability. Studies on non-specific low back pain have shown that muscle tightness, pelvic imbalance, and altered trunk or hip mechanics may be associated with disability and pain intensity (8,9). Therapeutic approaches targeting the quadratus lumborum, including stretching, myofascial release, muscle energy techniques, and stabilization-based exercises, have also shown potential benefits for pain and functional outcomes in patients with non-specific low back pain (10).

Despite the growing literature on sedentary behavior and low back pain, fewer studies have specifically examined the association between quadratus lumborum tightness and low back pain-related disability in young adults with prolonged sitting. Much of the available evidence addresses general posture, lumbar kinematics, core endurance, or broader muscle dysfunction, while the quadratus lumborum is often discussed as one component of lumbar dysfunction rather than evaluated as a specific clinical factor. This creates a practical knowledge gap for physiotherapists because quadratus lumborum tightness is commonly assessed clinically, but its association with pain intensity and disability among young adults who sit for prolonged periods remains insufficiently documented.

Therefore, this study aimed to assess the association between quadratus lumborum muscle tightness, pain intensity, and functional disability among young adults with low back pain associated with prolonged sitting. The study also compared pain and disability levels between participants with and without quadratus lumborum muscle tightness. It was hypothesized that quadratus lumborum muscle tightness would be significantly associated with higher pain intensity and greater functional disability among young adults with low back pain.

MATERIA AND METHODS

This study was conducted as a cross-sectional observational study to assess the association between quadratus lumborum muscle tightness, pain intensity, and functional disability among young adults with low back pain and prolonged sitting exposure. A cross-sectional design was selected because the objective was to examine the relationship between clinical muscle tightness status and pain/disability outcomes at a single point in time, without assigning an intervention or establishing temporal causality. The study was conducted at the University of Management and Technology, City Campus and Iqbal Campus, Sialkot, Pakistan, over a six-month period from November to April after approval of the synopsis and institutional permission from the study setting.

Participants were selected using a non-probability purposive sampling technique. Eligible participants were young adults aged 18–25 years, of either sex, who reported low back pain and prolonged sitting of more than six hours per day. Participants were excluded if they had systemic disease such as rheumatoid arthritis or infection, recent trauma, fracture, or surgery involving the spine, pelvis, or lower limbs, known spinal pathology such as disc herniation or scoliosis, or participation in regular physiotherapy or exercise programs specifically aimed at core or back strengthening within the previous three months. These criteria were used to reduce the influence of specific spinal disease, systemic pathology, recent injury, and recent therapeutic conditioning on pain, disability, and quadratus lumborum muscle tightness.

The sample size was calculated using OpenEpi on the basis of an expected low back pain prevalence of 57.8%, a 95% confidence level, and a 10% margin of error, yielding a required sample of 94 participants. Participants who met the eligibility criteria were approached at the study settings, informed about the purpose and procedures of the study, and enrolled after written informed consent. Participation was voluntary, and participants were informed that they could withdraw at any stage without penalty. Confidentiality of participant information was maintained throughout data collection and analysis.

Data were collected using a structured questionnaire and standardized clinical outcome measures. Demographic data included age, sex, weight, height, and body mass index. The primary exposure variable was quadratus lumborum muscle tightness, assessed clinically using seated side-bending, hip hike, and deep palpation procedures. Quadratus lumborum tightness was classified as present when clinical assessment indicated restriction, tightness, tenderness, or hyperactivity consistent with quadratus lumborum involvement during the applied tests. The outcome variables were pain intensity and functional disability. Pain intensity was assessed using the Numeric Pain Rating Scale, where participants rated pain from 0 to 10, with higher scores indicating greater pain intensity. Functional disability related to low back pain was assessed using the Oswestry Disability Index, which evaluates limitations in daily activities associated with low back pain and categorizes disability severity according to the total score (11).

The seated side-bending test was used to assess lateral trunk movement restriction and possible quadratus lumborum tightness by observing limitation or asymmetry during side bending. The hip hike test was used to evaluate quadratus lumborum activity and tightness during pelvic elevation while the participant stood with one limb supported and the opposite side allowed to move. Deep palpation was performed to identify tenderness, spasm, or trigger-point-like sensitivity in the quadratus lumborum region. These clinical procedures were used collectively to support classification of participants into quadratus lumborum tight and non-tight groups.

Data were entered and analyzed using IBM SPSS version 26. Continuous variables, including age, weight, height, and body mass index, were summarized using mean and standard deviation. Categorical variables, including sex, quadratus lumborum tightness status, pain category, and disability category, were summarized using frequency and percentage. The Shapiro–Wilk test was used to assess the distribution of ODI and NPRS data within quadratus lumborum tightness groups. Because the outcome

data were not normally distributed, non-parametric statistical tests were applied. Associations between quadratus lumborum tightness and categorical pain or disability levels were assessed using the chi-square test. Differences in pain and disability scores between participants with and without quadratus lumborum tightness were assessed using the Mann–Whitney U test. Correlations among quadratus lumborum tightness, pain intensity, and functional disability were assessed using Spearman's rank correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

To reduce avoidable bias, eligibility criteria were applied before data collection, participants with known spinal pathology or recent musculoskeletal trauma were excluded, and standardized outcome measures were used for pain and disability assessment. Potential confounding from sex, body mass index, physical activity level, posture, and daily sitting pattern was considered during interpretation because these variables may influence low back pain and muscle tightness. Ethical principles were followed throughout the study. Written informed consent was obtained from all participants, confidentiality was maintained, and participant responses were used only for academic and research purposes.

RESULTS

A total of 94 young adults with low back pain and prolonged sitting exposure were included in the analysis. The study sample comprised 35 males and 59 females. Quadratus lumborum muscle tightness was present in 67 participants and absent in 27 participants. The mean age of participants was 22.31 ± 2.21 years, mean weight was 57.23 ± 8.74 kg, mean height was 163.83 ± 11.32 cm, and mean body mass index was 21.83 ± 2.11 kg/m².

Table 1. Demographic and Anthropometric Characteristics of Participants

Variable	N	Minimum	Maximum	Mean ± SD
Age, years	94	18	25	22.31 ± 2.21
Weight, kg	94	42	75	57.23 ± 8.74
Height, cm	94	145	186	163.83 ± 11.32
BMI, kg/m²	94	17	28	21.83 ± 2.11

The participants were young adults within a narrow age range of 18–25 years, with a mean age of 22.31 ± 2.21 years. The mean BMI was 21.83 ± 2.11 kg/m², indicating that the overall sample was within the normal BMI range.

Table 2. Distribution of Sex and Quadratus Lumborum Muscle Tightness

Variable	Category	n (%)
Sex	Male	35 (37.2)
Sex	Female	59 (62.8)
Quadratus lumborum tightness	Not tight	27 (28.7)
Quadratus lumborum tightness	Tight	67 (71.3)

Females represented 62.8% of the study sample, while males represented 37.2%. Quadratus lumborum tightness was observed in 67 of 94 participants, indicating that approximately seven out of ten participants demonstrated clinical tightness.

The Shapiro–Wilk test was used to assess normality of ODI and NPRS category scores within the quadratus lumborum tightness groups. Both ODI and NPRS showed non-normal distributions in tight and non-tight groups.

Table 3. Shapiro–Wilk Normality Test for ODI and NPRS by Quadratus Lumborum Tightness

Variable	QL Tightness	Statistic	df	p-value
ODI category score	Tight	0.845	67	<0.001
ODI category score	Not tight	0.658	27	<0.001
NPRS category score	Tight	0.774	67	<0.001
NPRS category score	Not tight	0.718	27	<0.001

Both outcome variables had p-values below 0.05 in each tightness group, supporting the use of non-parametric statistical procedures for between-group comparison and correlation analysis.

Table 4. Oswestry Disability Index Categories According to Quadratus Lumborum Muscle Tightness

QL Tightness	Minimal Disability, n (%)	Moderate Disability, n (%)	Severe Disability, n (%)	Crippled, n (%)	Total
Not tight	18 (66.7)	7 (25.9)	2 (7.4)	0 (0.0)	27
Tight	21 (31.3)	29 (43.3)	14 (20.9)	3 (4.5)	67
Total	39 (41.5)	36 (38.3)	16 (17.0)	3 (3.2)	94

Participants with quadratus lumborum tightness showed a greater concentration in higher disability categories. In the non-tight group, 66.7% had minimal disability, whereas only 31.3% of the tight group had minimal disability. Moderate disability was present in 43.3% of the tight group compared with 25.9% of the non-tight group, while severe disability was present in 20.9% of the tight group compared with 7.4% of the non-tight group.

Table 5. Chi-Square Association Between Quadratus Lumborum Tightness and ODI Category

Outcome	χ^2	df	p-value
ODI category	10.567	3	0.014

Pearson chi-square analysis showed a statistically significant association between quadratus lumborum tightness and ODI disability category, $\chi^2(3) = 10.567$, $p = 0.014$. This indicates that disability category distribution differed between participants with and without quadratus lumborum tightness.

Table 6. Numeric Pain Rating Scale Categories According to Quadratus Lumborum Muscle Tightness

QL Tightness	No Pain, n (%)	Mild Pain, n (%)	Moderate Pain, n (%)	Severe Pain, n (%)	Total
Not tight	1 (3.7)	16 (59.3)	10 (37.0)	0 (0.0)	27
Tight	0 (0.0)	8 (11.9)	39 (58.2)	20 (29.9)	67
Total	1 (1.1)	24 (25.5)	49 (52.1)	20 (21.3)	94

Pain severity was higher among participants with quadratus lumborum tightness. In the non-tight group, mild pain was the most frequent category at 59.3%, and no participant reported severe pain. In contrast, 58.2% of the tight group reported moderate pain and 29.9% reported severe pain.

Table 7. Chi-Square Association Between Quadratus Lumborum Tightness and NPRS Category

Outcome	χ^2	df	p-value
NPRS category	29.073	3	<0.001

Pearson chi-square analysis showed a statistically significant association between quadratus lumborum tightness and NPRS pain category, $\chi^2(3) = 29.073$, $p < 0.001$. The distribution pattern indicates that participants with quadratus lumborum tightness were more frequently represented in moderate and severe pain categories.

Table 8. Mann–Whitney U Test Comparing ODI and NPRS Category Scores by Quadratus Lumborum Tightness

Variable	QL Tightness	N	Mean Rank	U	z	p-value
ODI category score	Not tight	27	34.43	551.500	-3.167	0.002
ODI category score	Tight	67	52.77			
NPRS category score	Not tight	27	26.56	717.000	-5.180	<0.001
NPRS category score	Tight	67	55.94			

The Mann–Whitney U test showed significantly higher ODI category ranks in participants with quadratus lumborum tightness compared with those without tightness. NPRS category ranks were also higher in the tight group, indicating greater pain severity among participants with quadratus lumborum tightness. Because the available data were reported as categories rather than raw ODI percentages and raw NPRS scores, these findings should be interpreted as differences in ranked disability and pain categories. Spearman correlation analysis demonstrated a positive correlation between NPRS and ODI category scores, $r = 0.640$, $p < 0.001$, indicating that higher pain categories were associated with higher disability categories. Quadratus lumborum tightness was positively correlated with ODI category score, $r = 0.328$, $p = 0.001$, and NPRS category score, $r = 0.537$, $p < 0.001$. The association was stronger for pain category than for disability category. Overall, the results showed that quadratus lumborum muscle tightness was common among young adults with low back pain and prolonged sitting exposure. Participants with quadratus lumborum tightness had higher pain and disability categories than those

without tightness. Significant chi-square associations, higher Mann–Whitney mean ranks, and positive Spearman correlations consistently supported an association between quadratus lumborum tightness, pain intensity, and functional disability.

Table 9. Spearman Correlation Between ODI, NPRS, and Quadratus Lumborum Tightness

Variables	ODI Category Score	NPRS Category Score	QL Tightness
ODI category score, r	1.000	0.640	0.328
ODI category score, p-value	—	<0.001	0.001
NPRS category score, r	0.640	1.000	0.537
NPRS category score, p-value	<0.001	—	<0.001
QL tightness, r	0.328	0.537	1.000
QL tightness, p-value	0.001	<0.001	—

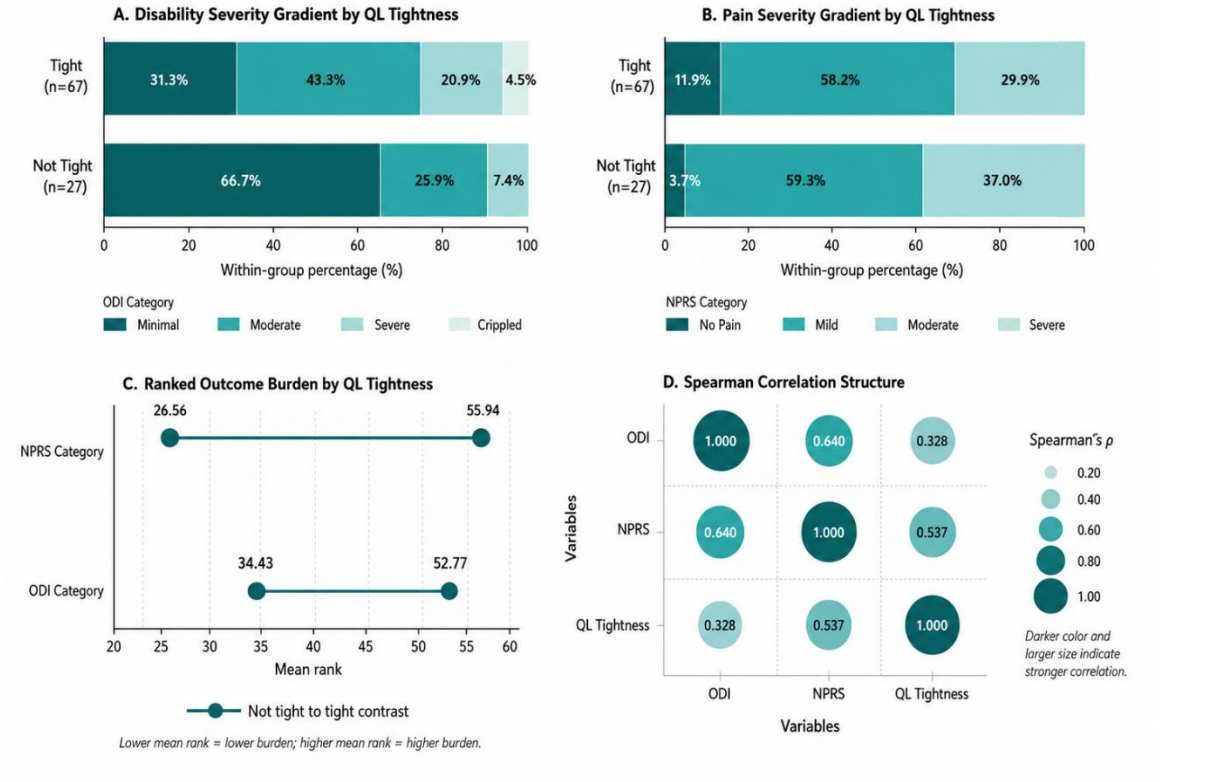

Figure 1 The panelled figure demonstrates a clear clinical gradient between quadratus lumborum tightness, pain severity, and disability among 94 young adults with low back pain and prolonged sitting. In the non-tight group, 66.7% of participants had minimal disability and 59.3% reported mild pain, whereas the tight group showed a shift toward greater burden, with 43.3% reporting moderate disability, 20.9% severe disability, 58.2% moderate pain, and 29.9% severe pain. Ranked outcome burden was consistently higher in participants with quadratus lumborum tightness, with mean ranks increasing from 34.43 to 52.77 for ODI category and from 26.56 to 55.94 for NPRS category. The correlation structure further supports this pattern, showing positive associations between quadratus lumborum tightness and pain category (r = 0.537), quadratus lumborum tightness and disability category (r = 0.328), and pain and disability categories (r = 0.640), indicating that greater pain severity clustered with greater functional limitation in this sample.

DISCUSSION

The present study examined the association between quadratus lumborum muscle tightness, pain intensity, and functional disability among young adults with low back pain and prolonged sitting exposure. The findings showed that quadratus lumborum tightness was common in this sample, with 67 of 94 participants classified as having tightness. Participants with quadratus lumborum tightness had higher pain and disability category distributions than those without tightness. The association was supported by significant chi-square findings for ODI and NPRS categories, higher Mann–Whitney mean ranks for pain and disability in the tight group, and positive Spearman correlations between quadratus lumborum tightness, pain category, and disability category. These findings suggest that quadratus lumborum tightness may be an important clinical feature to assess in young adults presenting with

sitting-related low back pain, although the cross-sectional design does not allow inference of causality or temporal direction.

The high frequency of quadratus lumborum tightness observed in this study may be clinically relevant in the context of prolonged sitting. Sustained sitting can reduce movement variability, increase static loading on the lumbar spine, and promote postural patterns that may increase demand on trunk stabilizing muscles. Previous evidence has associated sedentary behavior, prolonged sitting, and poor sitting posture with low back pain in adults and young populations, supporting the view that sitting-related musculoskeletal symptoms are multifactorial and influenced by both duration and posture (12,13). The current findings are consistent with this broader evidence, as the study population consisted of young adults who reported low back pain and prolonged sitting exposure. However, because sitting duration and posture were not measured in detail beyond eligibility criteria, the role of specific sitting behaviors could not be independently quantified.

Quadratus lumborum tightness was associated with greater functional disability. In the non-tight group, 66.7% of participants had minimal disability, whereas only 31.3% of the tight group fell in this category. Conversely, moderate disability was more frequent in the tight group than the non-tight group, and severe disability was also more frequent among participants with quadratus lumborum tightness. This distribution supports the clinical relevance of quadratus lumborum assessment in patients with low back pain because the muscle contributes to lumbar stabilization, lateral flexion, pelvic control, and load transfer. Restriction or tenderness in this muscle may coexist with altered movement strategies, reduced tolerance for sustained posture, and activity limitation. Similar findings have been reported in studies linking lumbar muscle dysfunction, pelvic imbalance, and muscle tightness with disability in non-specific low back pain populations (14,15).

Pain severity also differed according to quadratus lumborum tightness status. In the non-tight group, mild pain was the most frequent category, and no participant reported severe pain. In contrast, most participants in the tight group reported moderate pain, and nearly one-third reported severe pain. This pattern indicates that quadratus lumborum tightness clustered more strongly with pain severity than with disability severity. The correlation analysis supported this observation, as quadratus lumborum tightness showed a stronger positive correlation with NPRS category than with ODI category. This may suggest that pain is a more immediate clinical correlate of quadratus lumborum tightness, while disability may be influenced by additional factors such as coping behavior, physical activity, ergonomic exposure, fear of movement, academic workload, and general conditioning.

The positive correlation between NPRS and ODI category scores indicates that higher pain categories were associated with higher disability categories. This finding is clinically expected because pain can limit sitting tolerance, walking, lifting, studying, sleeping, and participation in daily activities. Previous studies on non-specific low back pain have also reported associations between pain intensity, disability, and functional capacity (16). Nevertheless, pain and disability should not be interpreted as identical constructs. Some individuals with pain may retain function, while others with similar pain intensity may report greater disability because of psychosocial, behavioral, or environmental factors. Therefore, both pain intensity and functional disability should be assessed separately when evaluating young adults with low back pain.

The findings also have practical implications for physiotherapy assessment. Quadratus lumborum tightness is commonly evaluated through clinical examination, but its reporting in research is often less standardized than pain or disability outcomes. The present study used seated side-bending, hip hike, and deep palpation procedures to classify quadratus lumborum tightness. These tests are clinically relevant, but future work should improve reproducibility by defining a more explicit diagnostic algorithm, such as the number of positive tests required, side-specific criteria, examiner training, and inter-rater reliability. Without such standardization, classification bias may influence group allocation and affect the strength of observed associations.

From a rehabilitation perspective, the results support the inclusion of quadratus lumborum assessment in young adults with sitting-related low back pain. Treatment may include education regarding sitting posture and movement breaks, stretching of the quadratus lumborum and surrounding lateral trunk structures, myofascial release or trigger point techniques when clinically indicated, and progressive stabilization exercises targeting trunk and pelvic control. Previous intervention studies and reviews suggest that stretching, myofascial release, muscle energy techniques, core stabilization, and active-break strategies may improve pain and disability in non-specific low back pain populations (17–20). However, the present study did not test an intervention, so treatment recommendations should be viewed as clinically reasonable implications rather than direct evidence from this dataset.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design prevents conclusions about whether quadratus lumborum tightness preceded pain and disability or developed as a response to them. Second, participants were selected through non-probability purposive sampling from university settings, which limits generalizability to broader young adult populations. Third, prolonged sitting was used as an eligibility criterion but was not quantified in detailed domains such as academic sitting, screen time, transport sitting, total sedentary time, posture quality, or frequency of movement breaks. Fourth, potential confounders such as physical activity level, sex, BMI, psychological stress, sleep quality, ergonomic exposure, and daily workload were not adjusted in multivariable analysis. Fifth, quadratus lumborum tightness was assessed clinically, but examiner reliability and a fully prespecified diagnostic rule were not reported. Finally, ODI and NPRS were analyzed as categories, which limits interpretation of raw pain and disability magnitude and reduces sensitivity compared with continuous scale reporting.

Despite these limitations, the study contributes useful preliminary evidence regarding the clinical association between quadratus lumborum tightness and low back pain burden in young adults with prolonged sitting exposure. The consistency of findings across categorical distribution, mean-rank comparison, and correlation analysis strengthens the internal interpretation that participants with quadratus lumborum tightness had greater pain and disability burden than those without tightness. Future studies should use larger samples, probability-based or multi-center recruitment, standardized quadratus lumborum diagnostic criteria, raw ODI and NPRS scoring, and adjusted regression models to clarify the independent contribution of quadratus lumborum tightness after accounting for sitting behavior, physical activity, BMI, sex, and psychosocial factors.

CONCLUSION

This cross-sectional study found that quadratus lumborum muscle tightness was common among young adults with low back pain and prolonged sitting exposure and was significantly associated with higher pain and functional disability categories. Participants with quadratus lumborum tightness showed a greater proportion of moderate-to-severe pain and disability than those without tightness, and correlation analysis demonstrated positive associations between quadratus lumborum tightness, NPRS category, and ODI category. These findings support the clinical value of assessing quadratus lumborum tightness during physiotherapy evaluation of young adults with sitting-related low back pain. However, because of the cross-sectional design, non-probability sampling, and absence of adjusted analysis, the findings should be interpreted as associative rather than causal. Future research should use standardized quadratus lumborum assessment criteria, raw outcome scores, larger samples, and multivariable models to determine whether quadratus lumborum tightness independently predicts pain and disability in this population.

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