



ASSOCIATION BETWEEN TIGHTNESS OF HAMSTRING, QUADRICEPS AND ILIOPSOAS MUSCLES ON PAIN, LOW BACK PAIN RELATED DISABILITY AND AGILITY AMONG MEDICAL STUDENTS

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Abstract: Muscular tightness leads to restricted range of motion and is caused by decreased ability of muscles to deform. Poor posture, prolonged sitting, lack of physical activity, and muscle imbalance are major contributing factors to muscle tightness and associated musculoskeletal problems. The research was conducted for six months in 2024 at Pakistan Institute of Rehabilitation and Medical Sciences (PIRMS), Karachi. The study population included medical students aged 19-25 years. Data collection involved Numeric Pain Rating Scale, Roland Morris Disability Questionnaire, and Hexagonal Agility Test. Chi-square test was used to analyze associations between variables. A total of 114 medical students were included. Percentage of female was high as compared to male. Moderate and severe pain was reported by majority with moderate disability most common. Agility was mostly intact. Gender showed significant association with pain and disability, while age, marital status, field of education, and level of education showed no significant association. These findings highlight that muscle tightness is associated with pain, disability, and reduced functional ability among medical students. Regular stretching, physical activity, and posture correction are important for reducing pain and improving quality of life.

Key words: Muscle Tightness, Hamstring Tightness, Quadriceps Tightness, Iliopsoas Tightness, Low Back Pain, Musculoskeletal Disorders

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INTRODUCTION

Muscular tightness leads to restricted range of motion (ROM). The cause of muscle tightness is the decreased ability of muscles to deform. Recognition of reduced muscle elasticity leads to the formation of muscle tightness, postural disturbance, and musculoskeletal problems (Bhimani and Hang, 2022). The prevalence of muscular tightness in the U.S. population reaches 54% of women and 44% of men. About 72% of medical students have muscular tightness, whereas 56% experience pain-associated muscle tightness. The prevalence of muscle tightness increases with age and affects millions of individuals' worldwide (Bhimani and Hang, 2022). Reduced agility is one of the major contributors to the global disability burden, affecting millions of individuals. Other contributors include muscle discomfort, hamstring tightness, quadriceps tightness, iliopsoas tightness, low back pain, and other musculoskeletal disorders (Bouziri *et al.*, 2023). The prevalence rate of muscle tightness among women exceeds that of men and increases with age in different populations and regions (Bhimani and Hang, 2022). The impact

of muscle tightness extends beyond physical discomfort, as it is associated with low back pain, reduced agility, and functional disability. Muscle imbalance, postural dysfunction, contractures, pain, stiffness, and gait disturbances negatively affect quality of life (Urits, *et al.*, 2019). Exercise in many forms is used to increase mobility and decrease stiffness and is crucial for physical rehabilitation. Stretching improves joint range of motion, muscle flexibility, agility, and balance, while reducing disability and improving function (Seif *et al.*, 2015). This research examined the relationship between muscle tightness, pain, disability, and agility among medical students (Bhimani *et al.*, 2017).

MATERIALS AND METHODS

Study population

The study's participants were medical students in the 19-25 age range. Participants were chosen to evaluate the relationship between pain intensity, low back pain-related impairment, and

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agility in this age group and the tightness of the hamstring, quadriceps, and iliopsoas muscles. This was a cross-sectional survey and non-probability purposive sampling technique was used.

Inclusion and exclusion criteria

Participants who took part in this study were medical students aged from 19-32 years, in good health, with no history of serious musculoskeletal disorders or injuries impacting the lower body. Participants were required to be without any conditions that could hinder the evaluation of muscle tightness, pain intensity, disability, and agility.

Ethical approval

The present study was conducted after approval from the PIRMS ethics review committee (PGC-ERC 2025-18/25). To preserve confidentiality, we coded each patient using a study ID number and removed identification. And a consent form was signed from each participant.

Data collection

Data were collected through face-to-face interview using a structured Roland Morris Disability Questionnaire, Numeric Pain Rating Scale and Hexagonal Agility Test. The tools were used to evaluate pain intensity, disability related to low back pain, and agility among medical students.

DATA COLLECTION PROCEDURE

Numerical Rating Scale

0–10 NRS was administered to evaluate pain intensity. The participants were asked to indicate their pain intensity from zero (no pain) to 10 (worst pain)

Roland Morris Disability Questionnaire (RMQ)

The Roland-Morris Disability Questionnaire is especially sensitive for diagnosing mild to moderate disability caused by acute, subacute or chronic low back pain. The Roland-Morris Disability Questionnaire (RMQ) relies on 24 questions to measure the level of disability being experienced by those suffering from low back pain. It is a discussion of things like how patients are active physically, sleep patterns, emotional and social, routines of eating, and regularity in pain episodes. The RMQ score ranges from 0 – the point with a severe lack of disability to severe disability at 24.

Agility Test: (Hexagon Agility Test)

Agility was measured using the Hexagon Agility Test. A hexagon with 60 cm sides was marked on the floor, and a force platform was placed at the center. Six signals (S1 to S6) were placed 18 cm outside each side of the hexagon.

Participants started at the center, facing S6, with knees slightly bent. At the “GO” command, they hopped over each side toward the signals in sequence (S1 to S6), always returning to the center. Feet had to stay together, and participants landed on their forefeet. One circuit was completed after hopping toward S6 and returning. Each trial included three full circuits. The total time was recorded using the force platform, starting when force dropped by 5% and ending with the final contact. If you jump the wrong line or land on a line the test is to be restarted. The second incident of jumping the wrong line or landing on the line

negates the test and a ‘no time’ is recorded and considered as non-intact.

Thomas Test

A procedure used to assess if a patient experiences tightness in the rectus femoris or iliopsoas muscles. The patient is placed supine on the plinth. The subject is then instructed to bring both knees to their chest and hold the limb that is not being tested with their hands. The examiner subsequently passively lowers the limb being tested to the plinth. Should the limb remain elevated, a hip flexor contracture is indicated? To distinguish between the muscles, the examiner then passively extends the knee, which places the rectus femoris on slack. If the test limb descends to the table, this indicates that the rectus femoris is shortened. If the test limb stays elevated with the knee flexed, this indicates that the iliopsoas is shortened.

Ely's Test

A procedure to assess whether a patient experiences shortening of the rectus femoris muscle. The patient is situated in a prone position. The examiner actively bends the knee of the limb being tested. If the same-side buttock lifts off the surface, the result is positive.

Straight Leg Raise (Lasegue) Test

(sciatic nerve) the patient lies in a supine position while the therapist passively flexes the hip, maintaining the knee in an extended position to the end range. Perform, hold, relax muscle stretch

A) If this increases the ROM, it is most likely due to tight hamstrings.

B) If this does not affect pain, it may indicate nerve root impingement or irritation.

Statistical analysis

Data were analyzed using SPSS version 23.0 with descriptive statistics and inferential tests (chi-square). Descriptive statistics summarized variable and clinical data. Inferential statistics were used to analyze associations between demographic and clinical factors, including Roland-Morris Low Back Pain Disability scores. Statistical significance was set at $p < 0.05$.

RESULTS

A total of 114 medical students were assessed during the study period. Based on the gender and marital status distribution, 26% (30/114) of the participants were female and 24% (27/114) were male. In terms of marital status, 43% (49/114) of the students were unmarried, while 7% (8/114) were married (Fig 1). During study period percentage of female was high as compared to the male gender.

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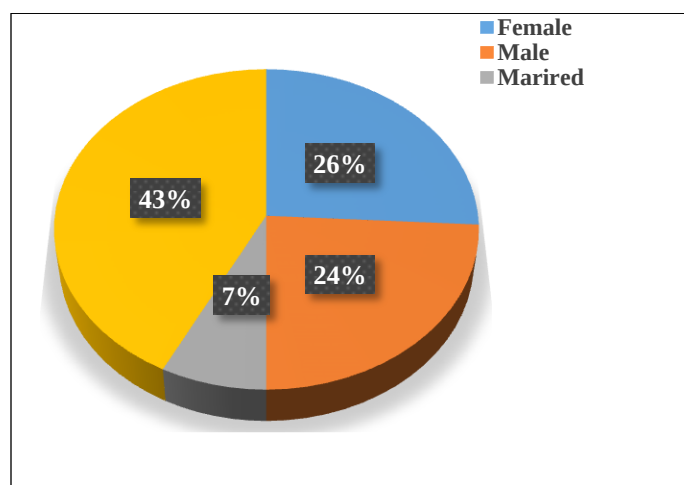


Figure 1: Distribution of Participants Based on Gender and Marital Status

Age-wise distribution of medical students included 19, 21, 22, and 25 years (table 1). Among all participants, the majority 42.1% (48/114) belonged to the 22 years of age, followed by 34.2% (39/114) in the 25-year. The 19-year participants accounted for 12.3% (14/114), while the minimum 11.4% (13/114) students were observed in the 21-year-old. The mean age of the students was 22.54 ± 2.009 years. This distribution indicates predominance of older students, particularly those aged 22 and 25 years.

Table 1: Distribution of Participants Based on Age

S. No	Variable	Frequency (%)
1	19	14/114(12.3)
2	20	0/114(0)
3	21	13/114(11.40)
4	22	48/114(42.1)
5	23	0/114(0)
6	24	0/114(0)
7	25	39/114(34.2)
8	Mean± SD	22.5±2.009

Among the participants, MBBS students were primarily in the fifth year with 9 students (7.9%). MLT students were predominantly in the third year with 27 students (23.7%) and only 1 student (0.9%) in the second year. DPT students showed a significant proportion in both the third year with 11 students (9.6%) and the fifth year with 30 students (26.3%). BSN students were spread across the first year with 10 (8.8%), second year with 12 (10.5%), third year with 1 (0.9%), and fifth year with 10 (8.8%), with the highest representation in the second year. Pharmacy students were exclusively represented in the fourth year with 13 students (11.4%) (Fig 2).

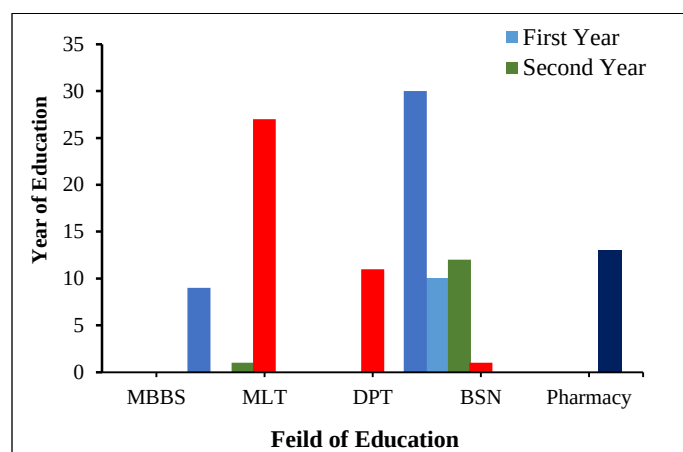


Figure 2: Distribution of Students Across Fields of Education and Year of Study

On the Numeric Rating Scale NRS scale 16/114 (0.14%) individuals reported mild pain, 60/114 (0.52%) moderate pain and 63/114 (0.55%) severe pain, indicating a predominance of higher pain intensity among participants. The RMDQ scale shows 15/114 (0.13%) individuals with mild disability, 36/114 (0.31%) with moderate disability and 30/114 (0.26%) with severe disability. Suggesting that moderate level of disability is most common among medical students, severe disability is also notably present. The Hexagonal agility test reveals that 100/114 (0.877%) individuals were classified as intact, while 14/114 (0.12%) were non-intact. The majority of participants maintained functional agility despite varying levels of pain and disability (Fig 3).

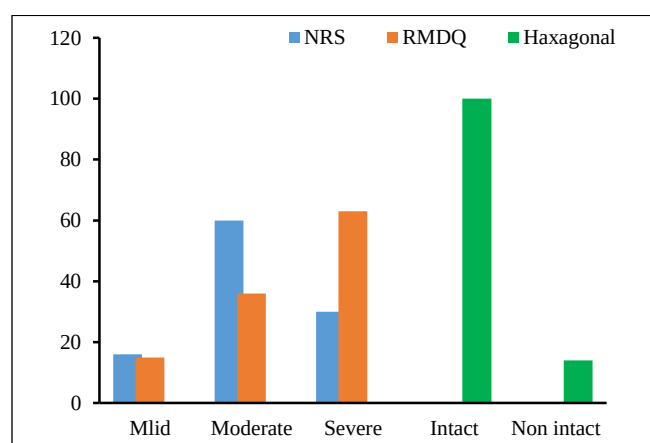


Figure 3: Distribution of Pain Severity, Level of Disability, and Agility among Participants

Male students more frequently reported severe pain with severe disability, whereas females reported comparatively moderate pain with severe disability. The relationship was statistically significant for pain ($X^2 = 21.813$, $p < 0.01$) and for disability ($X^2 = 6.283$, $p = 0.043$). In contrast, the association between gender and agility, measured through the Hexagonal Agility Test, was not statistically significant ($X^2 = 7.372$, $p = 0.07$), indicating that

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agility performance is not strongly influenced by gender differences. Marital status did not demonstrate any significant association with pain, disability, or agility ($p > 0.05$), implying that whether an individual is married or unmarried does not directly impact musculoskeletal pain, functional disability, or agility levels. As both groups belonged to a similar age range and academic background, marital status likely had no direct physiological link with these outcomes. Age was also found to have no influence on the results, as there were no differences in the results for participants varying between the ages of 19 to 25 years old related to pain, disability, or agility ($p > 0.05$). For this group of young adults, it seems that the level of pain, disability, or agility is independent of age as everyone experiences similar stress related to their studies. The field of education also showed no significant association. Although participants from DPT, MLT, BSN, Pharm D, and MBBS programs displayed minor variations in the distribution of pain, disability, and agility scores, these differences were not statistically significant for pain ($X^2 = 5.233$, $p = 0.732$), disability ($X^2 = 16.780$, $p = 0.32$), or agility ($X^2 = 8.437$, $p = 0.077$), suggesting that academic discipline does not inherently determine physical outcomes. Musculoskeletal tightness and its consequences may instead be more closely related to individual posture, physical activity, and ergonomic habits than to the specific field of study. Similarly, the level of education (year of study) did not exhibit significant associations with pain ($X^2 = 10.601$, $p = 0.225$), disability ($X^2 = 13.959$, $p = 0.083$), or agility ($X^2 = 6.152$, $p = 0.188$). Although higher frequencies of severe pain and disability were observed among third- and fifth-year students, progression through academic years alone did not substantially influence musculoskeletal pain or functional ability, even though increased academic workload and clinical responsibilities in higher years may contribute to slightly higher frequencies of pain and disability (Table 2) which leads to low back pain, disability, and reduced agility (Huygaerts *et al.*, 2021). Hamstring tightness limits pelvic motion and contributes to low back pain by increasing stress on spinal muscles (Javed *et al.*, 2022).

In this study, a total of 114 medical students were assessed, with a slightly higher percentage of female participants compared to males, which is consistent with previous studies showing increased female participation in medical education (Lucas and Sohi, 2024). The majority of participants belonged to the 22–25 years age group, reflecting the typical academic pattern of medical students (Ul Ain *et al.*, 2018).

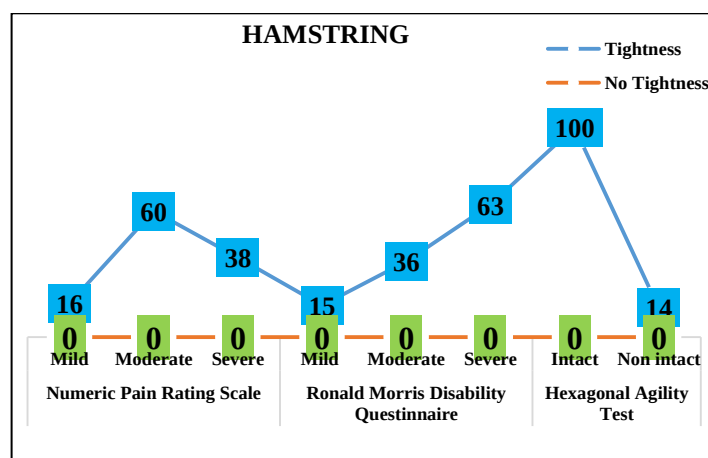


Figure 4: Distribution of Pain Severity, level of Disability, and Agility with Hamstring Muscle

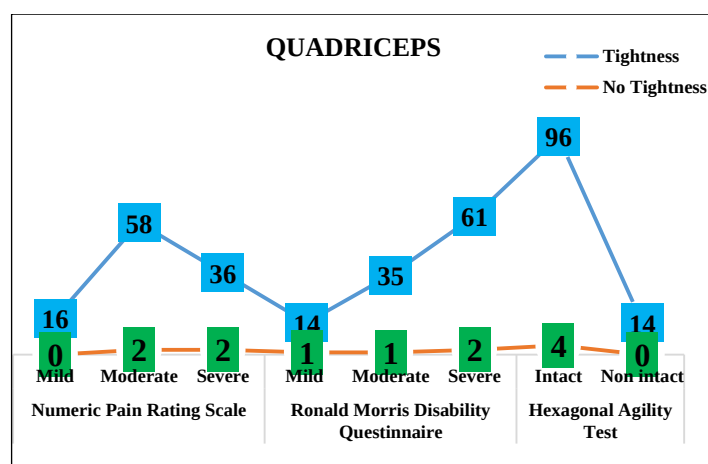


Figure 5: Distribution of Pain Severity, level of Disability, and Agility with Quadriceps Muscles

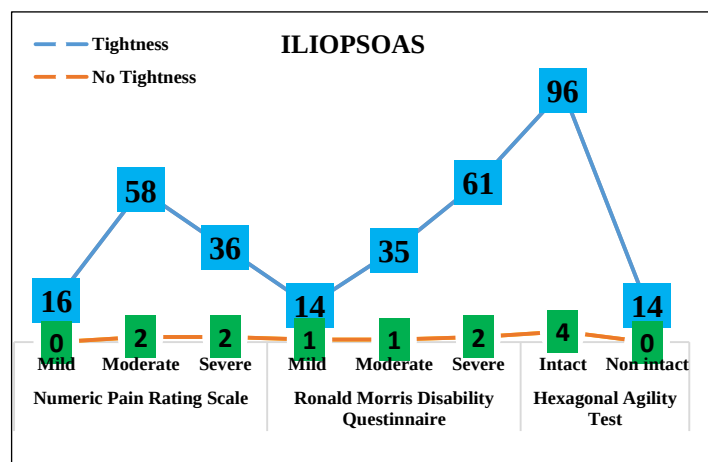


Figure 6: Distribution of Pain Severity, level of Disability, and Agility with Iliopsoas Muscle

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Table 2: Association of Demographic Characteristics with Pain, Disability, and Agility among Medical Students

S. No	Variable	Numeric Pain Rating Scale (NPRS)			Roland Morris Disability Questionnaire (RMDQ)			Hexagonal Agility Test	
		Mild	Moderate	Severe	Mild	Moderate	Severe	Intact	Non Intact
1.	Gender								
	Male	(0.017%)	(0.210%)	(0.25%)	(0.026%)	(0.184%)	(0.27%)	(0.464%)	(0.0175%)
	Female	(0.12%)	(0.315%)	(0.078%)	(0.10%)	(0.1315%)	(0.28%)	(0.412%)	(0.105%)
	X ² value P value	21.813 <0.01			6.283 0.043			7.372 0.07	
2.	Marital Status								
	Married	(0.017%)	(0.0701%)	(0.06%)	(0.017%)	(0.0614%)	(0.070%)	(0.1315%)	(0.0175%)
	Unmarried	(0.12%)	(0.45%)	(0.27%)	(0.11%)	(0.254%)	(0.48%)	(0.745%)	(0.105%)
	X ² value P value	0.560 0.756			0.856 0.652			0.05 0.944	
3.	Age								
	19	(0.017%)	(0.035%)	(0.070%)	(0.017%)	(0.035%)	(0.070%)	(0.114%)	(0.0087%)
	21	(0.026%)	(0.078%)	(0.008%)	(0.008%)	(0.0614%)	(0.043%)	(0.114%)	(0%)
	22	(0.043%)	(0.245%)	(0.13%)	(0.061%)	(0.149%)	(0.2%)	(0.350%)	(0.070%)
	25	(0.052%)	(0.166%)	(0.12%)	(0.043%)	(0.070%)	(0.22%)	(0.298%)	(0.043%)
	X ² value P value	6.035 0.419			6.035 0.419			3.031 0.387	
4.	Field of Education								
	DPT	(0.061%)	(0.157%)	(0.14%)	(0.035%)	(0.078%)	(0.24%)	(0.324%)	(0.035%)
	MLT	(0.017%)	(0.149%)	(0.078%)	(0.070%)	(0.078%)	(0.09%)	(0.184%)	(0.016%)
	BSN	(0.043%)	(0.096%)	(0.061%)	(0.017%)	(0.0877%)	(0.09%)	(0.192%)	(0.008%)
	Pharm D	(0.008%)	(0.078%)	(0.026%)	(0%)	(0.061%)	(0.052%)	(0.114%)	(0%)
	MBBS	(0.008%)	(0.043%)	(0.026%)	(0.008%)	(0.008%)	(0.061%)	(0.061%)	(0.0175%)
	X ² value P value	5.233 0.732			16.780 0.32			8.437 0.077	
5.	Level of Education								
	First year	(0.017%)	(0.0175%)	(0.052%)	(0.080%)	(0.026%)	(0.052%)	(0.078%)	(0.008%)
	Second year	(0.026%)	(0.078%)	(0.008%)	(0.008%)	(0.070%)	(0.035%)	(0.114%)	(0%)
	Third year	(0.035%)	(0.184%)	(0.12%)	(0.070%)	(0.087%)	(0.18%)	(0.27%)	(0.070%)
	Fourth year	(0.008%)	(0.07%)	(0.026%)	(0%)	(0.061%)	(0.052%)	(0.114%)	(0%)
	Fifth year	(0.052%)	(0.166%)	(0.12%)	(0.043%)	(0.070%)	(0.22%)	(0.29%)	(0.043%)
	X ² value P value	10.601 0.225			13.959 0.083			6.152 0.188	

DISCUSSION

Muscle tightness is common among medical students due to prolonged sitting, poor posture, and reduced physical activity. The findings of this study showed that moderate and severe pain and disability were most common among participants, which can be explained by prolonged sitting, academic workload, and poor posture (Encarnación-Martínez *et al.*, 2023). Most participants maintained intact agility despite pain and disability, which may be due to young age and regular daily activities (Unuvar *et al.*, 2024).

Gender showed a significant association with pain and disability, while marital status, age, field of education, and level of education showed no significant association, indicating that musculoskeletal symptoms are influenced more by posture and lifestyle factors than demographic variables (Naqvi *et al.*, 2019).

Hamstring tightness was the most frequently observed muscle tightness among participants, followed by quadriceps and iliopsoas tightness, due to prolonged sitting and reduced physical activity (Law *et al.*, 2009). Regular exercise, stretching, and posture correction play an important role in reducing pain, disability, and improving agility among medical students (Encarnación-Martínez *et al.*, 2023).

Analysis of muscle tightness revealed that all students with hamstring tightness (n=114) reported pain and disability, with 16 (14.0%) experiencing mild pain, 60 (52.6%) moderate pain, and 38 (33.3%) severe pain. Disability was reported as mild in 15 (13.1%), moderate in 36 (31.5%), and severe in 63 (55.2%). Agility was intact in 14 (12.3%) and non-intact in 100 (87.7%). For quadriceps tightness, 102 students were affected, with pain distributed as mild in 16 (15.7%), moderate in 52 (51.0%), and severe in 34 (33.3%); disability was mild in 14 (13.7%), moderate in 34 (33.3%), and severe in 54 (52.9%). Agility was intact in 13 (12.7%) and non-intact in 89 (87.3%). In quadriceps non-tightness cases (n=12), pain was mild in 0, moderate in 8 (66.7%), and severe in 4 (33.3%); disability was mild in 1 (8.3%), moderate in 2 (16.7%), and severe in 9 (75%); agility was intact in 1 (8.3%) and non-intact in 11 (91.7%). Similarly, for iliopsoas tightness (n=102), pain and disability distributions were identical to quadriceps tightness, with agility intact in 89 (87.3%) and non-intact in 13 (12.7%). In iliopsoas non-tightness (n=12), pain, disability, and agility distributions mirrored quadriceps non-tightness, indicating consistent patterns across these muscle groups.

CONCLUSION

The findings of this study highlight that muscle tightness significantly correlated with increased pain intensity and disability among medical students. Gender was significantly associated with pain and disability, while marital status, age, field of education, and level of education did not demonstrate statistically significant relationships. Muscle tightness, particularly involving the hamstring, quadriceps, and iliopsoas muscles, was identified as a prevalent musculoskeletal concern.

Higher NPRS and RMDQ scores were linked with greater muscle tightness, while agility performance remained mostly intact. Preventive and rehabilitative measures, including regular stretching routines, ergonomic corrections, and physiotherapy-guided flexibility training, are recommended to improve functional ability and quality of life.

The limitation of this study include as it is a cross sectional survey and due to limited time the sample size is small, which might not generalize to the whole population.

REFERENCES

- Bhimani R.H., J. E. Gaugler and C. Skay (2017) Understanding symptom experiences of muscle tightness from patients' and clinicians' perspectives. *J. Clin. Nurs.* 26,1927-1938. doi: 10.1111/jocn.13506.
- Bhimani, R. and J-T.Y. Hang (2022) Prevalence and Characteristics of Muscle Tightness in Young Adults. *Orthop Nurs.* 41,221-226. doi: 10.1097/NOR.0000000000000817.
- Bouziri, H., Y. Roquelaure, A. Descatha, W. Dab and K. Jean (2023) Global burden of musculoskeletal disorders. *BMJ Public Health.* 1, e000353. doi: 10.1136/bmjph-2023-000353
- Encarnación-Martínez, A., A. García-Gallart, P. Pérez-Soriano, I. Catalá-Vilaplana, J. Rizo-Albero and R. Sanchis-Sanchis (2023) Effect of Hamstring Tightness and Fatigue on Dynamic Stability and Agility in Physically Active Young Men. *Sensors (Basel)* 23, 1633. doi.org/10.3390/s23031633
- Huygaerts, S., F. Cos, D.D. Cohen, J.Calleja-González, R. Pruna, P.E. Alcaraz and A.J. Blazevich (2021) Does Muscle-Tendon Unit Structure Predispose to Hamstring Strain Injury During Running? A Critical Review. *Sports Med.* 51, 215-224. doi: 10.1007/s40279-020-01385-7
- Javed, A., Fatima, U. ND Jadoon I.J. (2022) Prevalence of Upper Cross Syndrome In Medical Students of Women Medical College, Abbottabad, Khyber Pakhtunkhwa, Pakistan. *J. Women Med. Dent. Coll.* 1, 24-30. doi.org/10.56600/jwmdc
- Law R.Y.W., L.A Harvey, M.K. Nicholas, L.Tonkin, M. De Sousa and D.G. Finnis (2009) Stretch exercises increase tolerance to stretch in patients with chronic musculoskeletal pain: a randomized controlled trial. *Phys. Ther.* 89, 1016-1026. doi: 10.2522/ptj.20090056.
- Lucas, J.W. and I. Sohi. (2024) Chronic Pain and High-impact Chronic Pain in U.S. Adults, 2023. NCHS Data Brief, (518):CS355235. doi: 10.15620/cdc/169630
- Naqvi, R., N. Arshad, M. Imran, A.A. Aftab and S. Batool (2019) Prevalence of hamstring tightness among university students in Lahore, Pakistan. *Rawal Medical J.* 44. 4, 853-856.

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- Seif, H.E A. Alenazi, S.M. Hassan, S.J. Kachanathu and A.R. Hafez (2015) The Effect of Stretching Hamstring, Gastrocnemius, Iliopsoas and Back Muscles on Pain and Functional Activities in Patients with Chronic Low Back Pain: A Randomized Clinical Trial. *Open J. Therapy Rehab.*, 3,139-145. doi:10.4236/ojtr.2015.34019
- Ul Ain, A.Q., F. Shoukat, M. Hamna, A.Ahmed and M.Fatima (2018) Musculoskeletal pain and discomfort among medical students of University of Lahore, Pakistan. *R.M.J.* 43,252-256.
- Unuvar, B.S., H. Gercek, O. Tufekci, M.S.Torlak and O. Erbas (2024) The relationship between lower extremity muscle tightness and pain and disability in individuals with non-specific chronic low back pain. *Work*. 79, 323-330. doi: 10.3233/WOR-230547.
- Urits, I., A. Burshtein, M.Sharma, L. Testa, P.A. Gold, V. Orhurhu, O. Viswanath, M.R. Jones, M.A. Sidransky, B. Spektor and A.D. Kaye (2019) Low Back Pain, a Comprehensive Review: Pathophysiology, Diagnosis, and Treatment. *Curr. Pain Headache Rep.* 23, doi: 10.1007/s11916-019-0757-1.

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