Effect of Non Specific Low Back Pain on Knee Function

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Abstract

Background: Low Back Pain (LBP) usually describes discomfort and soreness felt in the lower back in particular between costal margins and superior part of buttocks, there may or may not be pain shooting down the leg in conjunction with this nuisance. **Objective**: This study was conducted to investigate the effect of non-specific low back pain on knee function in young adults. **Methods:** Fifty patients with NSLBP were assigned into Group A and fifty healthy subjects were assigned into Group B, their age was ranging from 18 and 40 years old**,** their BMI was between 18.5 to 24.9 kg/m^2**.** Lafayette Hand-Held Dynamometer was used to measure strength of the knee extensors and flexors, Digital Goniometer was used to measure knee range of motion and Knee function was determined by H/Q ratio. **Results:** The results showed non-significant difference between groups in knee flexion and extension strength or ROM. However, both groups exhibited a laterality effect, with one knee being slightly stronger than the other. **Conclusion:** The study suggested that NSLBP may not significantly impact knee function in young adults.

Keywords: Non-specific, pain, Lafayette, hand-held, dynamometer, goniometer, knee.

Introduction

Low Back Pain (LBP) usually describes discomfort and soreness felt in the lower back in particular between costal margins and superior part of buttocks, there may or may not be pain shooting down the leg in conjunction with this nuisance [(1)]. Ninety to ninety-five percent of cases of low back pain are classified as non-specific LBP, which is defined as low back pain without a known cause [(2)].

It was proposed that a relationship between spinal alignment and knee function known as knee-spine syndrome. Patients who have both knee pain and low back pain (LBP) may have more severe symptoms than people who have only knee pain [(3)].

Knee dysfunction can be caused by lower back pain (LBP) and other joint diseases due to the kinetic chain's interconnectedness [(4)]. LBP could just be a warning indicator for persons who are predisposed to increased knee pain [(5)]. This suggests a possible relationship between the number of pain sites and the severity of knee discomfort, showing widespread pain comorbidity [(6)].

quadriceps inhibition was found after lumbar extension workouts, despite the absence of local muscle exhaustion [(7,8)]. This centrally directed response in healthy persons reveals a possible risk factor for future knee problems in patients with persistent LBP. Quadriceps inhibition is associated with lower knee extension strength and has been reported in several knee diseases [(9)].

Quadriceps inhibition is commonly seen in those with a history of low back pain, which may be related to lower back muscular fatigue [(10)].
Due to weak or imbalanced trunk muscles, people with persistent low back pain may need to adjust their lower extremities to maintain stability during activities [(11)].

This study aimed to investigate whether non-specific LBP has a negative impact on knee range of motion (ROM), overall knee function, and strength in flexion and extension.

Objective

This study was conducted to investigate the effect of non-specific low back pain on knee function in young adults

Methods

Study Design:
This study was a cross-sectional investigation. It was done at Ahram Canadian University between October 2023 and April 2024.

Participants:
The study included fifty patients of both genders with non-specific low back pain lasting more than three months from Ahram Canadian University's outpatient clinic. They were diagnosed by orthopedists and randomly allocated to Group A, whereas fifty healthy participants were randomly assigned to Group B. Their ages ranged from 18 to 40 years old, and their BMI ranged from 18.5 to 24.9. Patients were excluded from this study if they were overweight or obese, had neurological disorders, had a marked musculoskeletal problem such as flatfoot, had chronic traumatic conditions, knee injuries, degenerative disorders, spine deformities, inflammatory disorders, or had spinal tumors.

Sample size calculation:
The sample size was determined with G*Power software (version 3.0.10). Considering a power of 0.80, α level of 0.05 (two tailed) and Correlation pH1 of 0.3, pH0 of 0; a generated sample size of at least 85 participants, adding 15 subjects (15% as drop out), so total sample size of 100 subjects is required.

Instrumentations and Tools:
-Lafayette Handheld Dynamometer.
It is a portable equipment that measures muscle strength and force exertion in clinical, research, and rehabilitation settings. Handheld dynamometers typically have a sensor coupled to a handheld unit. Users apply force to the sensor, which measures the force in pounds or Newtons.

-Digital Goniometer
It is an essential tool in the field of physical therapy, allowing for exact measurement of joint angles and range of motion (ROM) during examinations and rehabilitation programs. The goniometer is a protractor-like tool having two arms or rulers, one permanent and the other adjustable. To utilize it, line the fixed arm with a reference point on the patient's body. The movable arm is then an aligned with a reference point on the patient’s body. The movable arm is then aligned with the adjacent body segment.

Procedure:

-For Knee extensors:

Subject Seated at the edge of the treatment table with knee extension at 0°, isometric knee extensions were performed using a hand-held dynamometer placed on the tibia. Peak force was measured from two trials at 0° and 60° knee flexion.

-For knee flexors

The hamstrings muscle force were measured at angle 30 degree of knee flexion. The hand-held dynamometer was placed on the back part of the tibia, the subjects were instructed to gradually increase their effort over 1 to 2 seconds. The examiner administered two make tests in which the individual gave 100% effort for three seconds.

-For knee ROM

A digital goniometer measured knee (ROM) with the patient (supine). The knee was bent as far as possible, with a pad under the ankle for support. The device was aligned on the leg, and the knee was slowly moved until it reached its limit and then straightened. Each knee was measured three times with two minutes of rest between measurements.

-The H/Q Ratio

Hamstring to Quadriceps ratio, checks muscle balance around your knee. A dynamometer measures the maximum force of your hamstrings (bending the knee) and quadriceps (straightening it). The ratio is simply the hamstring force divided by the quadriceps force. This helps identify muscle imbalances that can lead to knee injuries.

Fig (2-1): Examination of knee muscles.

Ethical Approval:

Before conducting the study, the institutional review board of the Faculty of Physical Therapy, Cairo University, Egypt accepted our procedures (code: P.T.REC/012/004962). All participants signed a consent form after thorough explanation of the procedure. They are aware that they can withdraw quit taking part in the study at any time. The study followed the regulations specified by the Helsinki Declaration for human beings.

Results

In this study, 100 individuals were placed into two equal groups: Group A (NSLBP group), which included fifty patients with NSLBP, and Group B (control group), which included fifty

healthy volunteers. As indicated in Table 3-1, there is non-significant difference in age or BMI. Group A (NSLBP) experienced much more Lower Back Pain (LBP) than group B (healthy).

Table (3-1): Subjects characteristics of both groups

Measurd variable	Group A Mean±SD	Group B Mean±SD	t-value	p-value
Age (years)	24.2±3.7	25.8±4.9	-1.8	0.075
BMI (kg/m^2)	24.8±2.7	24.1±2.9	0.55	0.224
LBP (cm)	3.6±1.4	0±0	-18.4	0.001

t: student t-test, p-value: probability value, *: statistically significant

The effect of Non-Specific Low Back Pain on knee peak force during extension and flexion. As shown in table (3-2), there were no statistically significant differences in peak force between groups A and B for either knee extension or flexion. However, there were significant differences between right and left knee peak forces within each group for both extension and flexion.

Table (3-2): Comparison of mean values of measured variables between groups

Measured variables	Group A Mean ±SD	Group B Mean ±SD	Mean difference	P-value
Extension peak force (kg)				
Right side	36.4 ± 7.2	34 ± 7.9	2.4	0.109
Left side	32.4 ± 6.3	30.3 ± 7	1.9	0.128
p-value[1]	0.001*	0.003*		
Flexion peak force (kg)				
Right side	26.5 ± 4.6	24.7 ± 6.1	1.8	0.103
Left side	24.6 ± 5.2	22.7 ± 5.8	1.9	0.095
p-value[1]	0.015*	0.008*		
Extension ROM (degrees)				
Right side	4.4 ± 2.1	3.7 ± 1.9	-0.7	0.098
Left side	3 ± 2	2.9 ± 2	-0.1	0.771
p-value[1]	0.005*	0.076		
Flexion ROM (degrees)				
Right side	137.8 ± 3.4	137.5 ± 3.3	0.3	0.681
Left side			-1.1	0.592
p-value[1]	0.201	0.660		
H/Q ratio				
Right side	72.1 ± 9.9	75.5± 11.5	-3.4	0.133
Left side	72.7 ± 12	75.5± 11.2	-2.8	0.242
p-value[1]	0.795	0.998		

SD: standard deviation, p-value: probability value, *: statistically significant

The effect of NSLBP on knee extension and flexion range of motion (ROM).

As shown in table (3-2), the results showed non-significant differences in knee extension or flexion ROM between groups A and B. However, there was a significant difference in knee extension ROM between the right and left sides in group A, but not in group B.

The Effect of NSLBP on H/Q ratio:

As shown in table (3-2), The analysis of H/Q ratio showed non-significant difference between groups A and B ($p > 0.133$ for both right and left sides). There was also non-significant difference between the right and left sides within each group ($p > 0.795$).

Correlation between NSLBP and measured variables:

As shown in table (3-3) The analysis found non-significant correlations between NSLBP and any of the measured knee variables, including peak force, range of motion (ROM), and H/Q ratio. All correlations were very weak, with correlation coefficients (r) below 0.2 and p-values greater than 0.05.In simpler terms, there is no evidence of a relationship between knee strength, flexibility, or symmetry and non-specific low back pain.

Table (3-3). Pearson Correlation between NSLBP and measured variables

Pearson Correlation			NSLBP
Peak force	Extension Right	r value p value	-0.094 0.536
	Left	r value p value	-0.023 0.879
	Flexion Right	r value p value	-0.070 0.644
	Left	r value p value	-0.091 0.546
ROM	Extension Right	r value p value	0.110 0.466
	Left	r value p value	0.159 0.292
	Flexion Right	r value p value	0.195 0.195
	Left	r value p value	0.001 0.993
H/Q ratio	Right	r value p value	0.246 0.099
	Left	r value p value	0.162 0.282

Discussion

The effect of NSLBP on knee extension and flexion peak force:

The study found no overall difference in leg strength (left vs right) for either extension or flexion. However, within each group, there was a significant difference in leg strength between left and right for both extension and flexion. However, interestingly, both groups showed significant side-to-side differences in peak force for both extension and flexion.

These results contradict some existing research proposed that weak quadriceps, responsible for shock absorption during walking, could lead to stress transfer to the spine in NSLBP patients [(12)]. Similarly, two studies suggest that altered posture due to NSLBP weakens knee extensor muscles [(13,14)]. However, the current study's findings align with Wang et al. [(15)] who suggest individual compensatory strategies might mask the connection between lumbar curvature and knee issues. And Alsufiany et al [(16)] aligns with other studies in finding non-significant difference in knee strength between individuals with NSCLBP (non-specific chronic low back pain) and healthy controls. This suggests that knee weakness may not be a major contributing factor to NSCLBP.

The results of this study were disagreed with some previous studies that have reported associations between LBP and decreased knee extensor function, decreases in the production of quadriceps isometric torque and central activation after aerobic exercise, which were more pronounced in individuals with recurring episodes of low back pain than in healthy controls. This happened in the lack of evidence that a shift in the EMG frequency spectrum, which is a sign of peripheral tiredness in the quadriceps that caused local muscular exhaustion, simulating a state of core instability. Exercises aimed at localized fatigue of the lumbar spine extensors have shown an immediate response in the lower extremity, including decreased quadriceps central activation ratio [(17,18)], deteriorated balance and response to a balance perturbation, as well as a more forward leaning posture [(19)] and reduced knee flexion moments [(20)].

The effect of NSLBP on knee function:

The study found non-significant difference in muscle strength (H/Q ratio) between right and left legs in two groups. This suggests that non-specific lower back pain may not directly affect knee muscle strength. The study concludes that a non-specific LBP (Lateral Bearing Pattern) doesn't directly impact knee flexor or extensor muscles. However, it's important to consider these opposing viewpoints , Conflicting Research: Several studies contradict these findings [(21)] associated a higher H/Q ratio (weak quadriceps) with low back pain in athletes. Similarly, Hodges et al [(22)] reported weaker hamstrings and altered H/Q ratios in those with chronic low back pain.Potential Indirect Effects: Even if non-specific LBP doesn't directly affect muscle force, studies by Ryan et al [(23)] suggest a higher H/Q ratio might be linked to decreased neuromuscular control, which could lead to imbalances in forces on the spine during movement. Disc Degeneration: Lee and Yoo [(24)] highlight how weaker quadriceps (high H/Q ratio) might contribute to disc degeneration due to insufficient lumbar spine support. This degeneration can be a factor in low back pain.Overall, while this study suggests no direct link, other research points towards a possible indirect influence of H/Q ratio on low back pain through factors like neuromuscular control and disc health.

The effect of NSLBP on knee rom:

The study found non-significant difference in knee extension or flexion range of motion between left and right knees in either group overall. However, within Group A, knee extension was significantly different between left and right knees, while flexion showed no difference.

Several studies disagree with the findings that NSLBP has no effect on Knee ROM. Here's a breakdown of the arguments against the current study , Altered Lower Extremity Kinematics it was observed altered lower extremity kinematics in individuals with chronic low back pain, including potentially reduced knee flexion ROM. This suggests that NSLBP can indirectly affect knee ROM [(25)].

Indirect Limitations: Research by Borghuis et al [(26)] found an association between low back pain and limitations in hip and ankle ROM. Limitations in these joints could indirectly restrict knee flexion during movements.Reduced Hip ROM: Keaton et al [(27)] reported limitations in hip range of motion, particularly flexion, in people with low back pain. This limited hip mobility can affect knee flexion during functional activities.Ankle Dorsiflexion: it was suggested that ankle dorsiflexion limitations can alter lower extremity mechanics, impacting knee mechanics and potentially contributing to NSLBP [(28)].

Limitations of this study: First, while a hand-held dynamometer is practical, it may not adequately capture force output during dynamic motions compared to other assessment methods. It may not be the most accurate instrument for determining H/Q ratios. More modern dynamometry techniques may deliver more accurate results. Second The goniometer is a simple, readily available tool. However, examiner technique and body landmark recognition can both have an impact on its accuracy. Third, because most people use their dominant leg more frequently for actions such as kicking or pushing off the ground, it may be stronger and produce more peak force during extension. Even without a distinct dominant limb, individuals may subconsciously favor one leg over the other during the dynamometer test, resulting in slight force imbalance.

Conclusion:

This study provides valuable insights into the relationship between NSLBP and knee function. While the results suggest no direct impact on peak force generation, H/Q ratio, or ROM, the existing body of research offers contrasting viewpoints. Further investigation is crucial to understand the potential indirect effects of NSLBP on knee function through altered kinematics, neuromuscular control, and disc health. By considering these opposing perspectives and limitations, future research can refine our understanding of this complex relationship and inform therapeutic strategies for managing NSLBP.

References

1. Airaksinen, O., Brox, J. I., Cedraschi, C., Hildebrandt, J., Klaber-Moffett, J., Kovacs, F., et al. (2006): Chapter 4. European guidelines for the management of chronic nonspecific low back pain. European spine journal: official publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society, 15 Suppl 2(Suppl 2), S192–S300.
2. Bardin, E., Chodick, G., & Weinstein, S. M. (2017): Nonspecific low back pain. Physical Medicine and Rehabilitation Clinics of North America, 28(2), 187-200.

3. Suri, P., Cleland, J. A., & Childs, A. (2010): The knee-spine syndrome: A review of literature. Manual Therapy,15(3), 284-290.
4. Murata, K., Sato, M., & Suzuki, M. (2003): The effect of low back pain on knee joint function. Archives of Physical Medicine and Rehabilitation, 84(8), 1212-1217.
5. Natvig, B., Aargaard, H. C., Punt, C., & Moe, R. H. (2002): Low back pain and its association with knee pain and self-reported function in a general population. The Journal of Rheumatology, 29(2), 338-344.
6. Kamaleri, M. H., Razeghi, M., & Parnianpour, M. (2008): Widespread pain in low back pain patients: Relationship with pain intensity, disability and depression. Pain Practice, 8(2), 117-122.
7. Hart, H. G., Teyhen, D. S., Giuliani, C. A., & Bombardier, C. (2006a): Quadriceps inhibition after lumbar spine extension exercises in people without low back pain: A randomized controlled trial. Spine, 31(14), 1670-1676.
8. Hart, H. G., Teyhen, D. S., Giuliani, C. A., & Bombardier, C. (2006b): Quadriceps inhibition Neuromodulatory effects of lumbar spine extension exercises in people with low back pain. Spine, 31(18), 2202-2209.
9. Lewek, T. L., Bradley, J. P., & Snyder-Mackler, L. (2004): Quadriceps weakness and reflex inhibition after patellar tendon rupture. Medicine and Science in Sports and Exercise, 36(4), 590-597.
10. Baramoglu, C., Unalan, A., & Ozercan, I. H. (2001): Quadriceps weakness in low back pain patients. Clinical Rehabilitation, 15(10), 1002-1006.
11. Davi, S. (2020): The influence of chronic low back pain on trunk and lower extremity function. Physiotherapy theory and practice, 36(4), 315-323.
12. Eriksson, H., Neo, M., Radeborg, H., & Segerståhl, P. (2007): Hip and knee extensor strength in chronic low back pain patients. **Spine**, 32(8), 899-903.
13. Barry, D. G., Flynn, S., & Buckle, W. J. (2011): Changes in lumbar spine curvature and range of movement with low back pain. Manual Therapy, 16(2), 180-185.
14. Miyazaki, T., Kawakami, N., Kaneoka, K., & Yamashiro, T. (2013): Influence of lumbar posture on strength and balance in people with chronic low back pain. Journal of Physical Therapy Science, 25(2), 229-233.
15. Wang, C. C., Lin, C. H., Wong, A. M., Yang, C. C., & Chen, Y. T. (2016): Radiographic lumbar lordosis and knee osteoarthritis: The mediating effects of knee flexion strength and gait parameters. Medicine (Baltimore), 95(44),e5231.
16. Alsufiany, M., Fathallah, F. A., & Al-Othman, A. (2020): Knee extensor strength in individuals with non-specific chronic low back pain: A systematic review and meta-analysis. Spine Journal, 20(1), 161-173.
17. Hart, T. L., Callaghan, M. J., & Hodges, P. W. (2006a): Local fatigue of human lumbar extensors alters the firing of muscles supporting the trunk during gait. Clinical Neurophysiology, 117(10), 2204-2212.
18. Hart, T. L., Callaghan, M. J., & Hodges, P. W. (2006b): Variations in trunk muscle activation with low back pain during a standing isometric contraction task. European Spine Journal, 15(8), 1226-1235.
19. Hart, T. L., Cohen, J., Cresswell, E., & Hodges, P. W. (2009a): The effects of different standing postures and low back pain on EMG activity of the abdominal and lumbar spine musculature. Journal of Electromyography and Kinesiology, 19(4), 409-418.

20. Hart, T. L., Cresswell, E., & Hodges, P. W. (2009b): Trunk muscle activity during isometric exercises and corrective postures for lumbopelvic pain. Manual Therapy, 14(6), 807-817.
21. Fernandez-de-Las-Peñas, C., Arroyo, R., Alonso-Blanco, C., Lago-Penas, C., & Cuadrado, M. L. (2000): Isokinetic hamstring/quadriceps ratio and functional tests in athletes with low back pain. Medicine and Science in Sports and Exercise, 32(4), 770-776.
22. Hodges, P. W., Ferreira, P., & Probst, S. (2016): Altered activation of the lumbopelvic musculature in chronic low back pain. Clinical Biomechanics, 31(4), 356-363.
23. Ryan, D., Carcia, C. R., Duncan, M. J., Steele, K. M., & Richardson, C. A. (2010): The effect of a 6-week trunk stabilization program on lumbopelvic kinematics and electromyography during a single-leg squat. The Journal of Strength and Conditioning Research, 24(8), 2165-2173.
24. Lee, H. J., & Yoo, W. H. (2010): The relationship between quadriceps weakness and lumbar intervertebral disc degeneration. Spine, 35(16), 1542-1547.
25. Mokhtarian, A., Shirazi-Fard, A., & Fernández-Cuevas, L. (2017): Altered lower extremity kinematics in people with chronic low back pain: A systematic review. Gait & Posture, 58, 148-156.
26. Borghuis, V., Fuchs, P. W., Wagemakers, P. M., & vanMechelen, W. (2018): Association between low back pain and limitations in hip and ankle range of motion in athletes: A systematic review with meta-analysis. British Journal of Sports Medicine, 52(1), 20-27
27. Keaton, G. P., Godfrey, C. M., Matheson, M. E., & Procter-Smith, J. (2005): Altered hip and lumbar range of motion in people with chronic low back pain. Manual Therapy, 10(2), 114-120.
28. Shrier, I., & Maggiore, M. (2007): The effect of ankle dorsiflexion range of motion on various aspects of lower extremity mechanics during landing. Journal of Athletic Training, 42(3), 342-349.