



The Effect of High-Velocity, Low-Amplitude Thrust (HVLAT) Manipulation versus Standard Care on Pain and Functional Recovery in Patients with Lateral Epicondylalgia: A Randomized Controlled Trial Across Occupational Cohorts

Anjali Agarwal¹, Zia Abbas Naqvi², Sunil Kumar³, Sumit Asthana⁴, Gowrishankar Potturi⁵

1- Research Scholar, Era University, Lucknow.

2- Professor, Department of Physiotherapy, Era University, Lucknow.

3- Professor & HOD, Department of Orthopaedics, UPUMS, Saifai.

4- Professor & HOD, Department of Physiotherapy, Era University, Lucknow.

5- Associate professor & HOD, Department of Physiotherapy, UPUMS, Saifai.

Corresponding Author: Anjali Agarwal, Research Scholar, Department of Physiotherapy, Era University, Lucknow.

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KEYWORDS

Dynamometer, High velocity low amplitude thrust, Lateral epicondylalgia, Occupations.

ABSTRACT:

Background & Purpose: Lateral epicondylalgia (LE), or tennis elbow, is an overuse syndrome causing pain and tenderness at the lateral elbow, often affecting repetitive motion workers. This study examines LE incidence across occupational groups and the impact of HVLAT on physical outcomes.

Methodology: 234 subjects satisfied inclusion criteria and were enrolled in the study after satisfying inclusion criteria conducted at two medical institutions, the participants were assessed for pain, disability, and grip strength using the Visual Analog Scale, PRTEE, and handheld dynamometer. Participants were categorized into occupational groups, and outcomes were measured at baseline, post-intervention, and three-month follow-up.

Statistical analysis: The incidence of lateral epicondylalgia across various occupations was reported as a percentage. To assess the effects of high-velocity low-amplitude thrust (HVLAT) on different occupations concerning various physical dimensions of recovery, all data were expressed as Mean \pm SD. Statistical analysis was performed using repeated measures ANOVA.

Results: The incidence of lateral epicondylalgia (LE) was observed to be higher among white-collar sedentary workers. High-velocity low-amplitude thrust (HVLAT) demonstrated promising outcomes across all occupational groups; however, blue-collar workers exhibited significant improvements in pain reduction and functional independence, whereas healthcare workers showed notable enhancement in hand grip strength.

Conclusion: This study highlights a higher risk of lateral epicondylalgia (LE) among white-collar workers. Addressing LE requires workplace interventions such as ergonomic modifications, task rotation, strengthening exercises, and training. Incorporating high-velocity low-amplitude thrust (HVLAT) alongside conventional physiotherapy is recommended to effectively reduce pain, improve grip strength, and enhance functional independence.

Introduction:

Lateral Epicondylalgia (LE), or 'tennis elbow', can be described as a musculoskeletal disorder in which pain and tenderness around the lateral aspect of the elbow include the epicondyle, particularly the extensor carpi radialis brevis (ECRB) tendon origin site. It is common

among people who work repetitively moving forearm and wrist and thus falls under overuse syndrome common among athletes, manual labour, and desk job workers.¹ This condition is clinically important because it affects physical capacity as well as quality of life, causing incapacity to attend work and perform everyday activities.² LE is the most common arm musculoskeletal



disorder and is known to forcefully attach onto the extensor carpi radialis brevis which provides wrist stability during grip activity with the forearm. This is not only found in tennis athletes but also employees with recurrent radial deviation of wrist extension in domains like construction work, plumbing, and typing.³ Overall, LE has a 10 percent cut-off in the general population with milder to moderate cases appearing in women within the ages of 35 and 54, which correlates to working age for many people⁴. This condition increases the risk for patients' withdrawal from their daily activities and turns chronic if there are no medical interventions.

Research studies have added that LE is not simply an inflamed tissue but degenerative changes processes involving tendon collagen matrix which is termed as tendinosis.⁵ The degenerative changes include collagen's fibers orientation disorder, vascularity increment, and fibroblasts existence which in turn cause the pain and dysfunction of the tendon.⁶

LE pathophysiology is complex and multifactorial, encompassing excessive mechanical load, oxidative stress, and changes in pain processing in the central nervous system.¹ It is managed, however, in most cases in the first instance, using conservative methods like physical therapy. Most of the time, LE has been treated conservatively with physiotherapy, NSAIDs, or corticosteroid injections, but it is essential to comprehend the pathophysiology for targeted treatment development.^{7, 8}

The clinical manifestation of lateral epicondylitis includes pain that is located over the lateral epicondyle area and increases when the wrist is extended and the forearm is rotated upwards against resistance. The pain may also be felt further down the forearm, making it even more difficult to diagnose and treat.⁹ The causal mechanisms that initiate and maintain the degenerative changes within the tendons of the elbow joint are numerous and are believed to include mechanical, cellular, and neurologic components. Microtrauma to the tendon as a result of functional overload may activate an abnormally high healing response with increased production of non-collagen matrix proteins and a recruitment of vascular and neuronal growth stimuli.¹⁰

Recent studies have moved away from the traditional view of lateral epicondylitis as tendon pathology and have included central sensitization as a possible

mechanism. Patients suffering from chronic lateral epicondylitis have been found to have increased pain hypersensitivity which indicates altered pain processing pathways.⁸ This phenomenon indicates that lateral epicondylitis cannot be seen as only a disease of a particular site but stems from hyperexcitability of the central nervous system which makes treatment a challenge and may lead to chronic pain conditions.¹¹

AIM: To find out the incidence of lateral epicondylalgia and the effects of HVLAT on various physical dimensions of recovery among various occupational groups.

OBJECTIVES:

1. To find out which occupation is more prevalent for tennis elbow
2. To analyse the effects of HVLAT on pain among various occupational groups.
3. To analyse the effects of HVLAT on Hand grip Strength among various occupational groups.
4. To analyse the effects of HVLAT on functional independence among various occupational groups.

Materials and Methods:

The study was conducted at physiotherapy OPD of Uttar Pradesh University of Medical Sciences, Saifai, Etawah, U.P and Era University, Lucknow. The study got ethical approval from Era University, Lucknow, Reg.no: ECR/717/inst/UP/2015/RR-21 and the trial is registered with CTRI, Reg.no: CTRI/2021/11/038156. The study was conducted from 23/11/2021 to 30/08/24. A total of 280 subjects attending Physiotherapy or Orthopaedics OPD with chief complaint of pain over the lateral epicondyle were screened for eligibility for recruiting in the study.

234 subjects satisfied inclusion criteria and were enrolled in the study. Both male and female subjects with the complain of local tenderness over the lateral epicondyle, pain on gripping, resisted wrist movements with elbow extension, a positive Cozen's and Mill's test were included in the study.

Both male and female subjects with any other explanation of the pain around elbow, comorbidity that adversely affect prognosis, no consent and presence of any contraindication for the method of treatment were excluded from the study.



All subjects were given an informative booklet in English and Regional language. This booklet contains home exercises with pictorial illustrations. The subjects were proscribed from taking any other treatment for lateral epicondylalgia. The subjects were permitted to take medications or therapeutic measures for the comorbidities if any.

To analyse the incidence of lateral epicondylalgia, all participants of this study were categorized into five occupational groups, as mentioned in Table 1. To evaluate the effects of high-velocity low-amplitude thrust (HVLAT) on various physical dimensions of recovery, participants were randomly assigned to one of two intervention groups: the HVLAT group and the conventional physiotherapy group. The present study focused exclusively on data from the HVLAT group for analysis.

S. No.	Occupational Groups	Occupations Included
1	Blue collar workers	carpenter, driver, plumber, electrician, farmer, mechanic, peon
2	White collar (sedentary) workers	teacher, desk worker, computer operator
3	White collar (mobile) workers	marketing executive
4	Housewife	housewife
5	Healthcare workers	doctor, nurse, pharmacist, ward boy

Table 1: Occupations included in various occupational groups

Outcome Measures: The following outcome measures were used to assess the patient's recovery at different point of time i.e. before intervention (T₀), Post intervention (T₁) and at three months follow up (T₂).

1. Visual Analog Scale (VAS): The pain intensity was recorded by using VAS which is a highly valid and reliable tool for assessing pain intensity.
2. Patient Rated Tennis Elbow Evaluation (PRTEE): The **Patient-Rated Tennis Elbow Evaluation (PRTEE)** is a self-reported tool

used to assess pain and disability in patients with lateral epicondylalgia (tennis elbow). The assessment involves completing the PRTEE questionnaire, which is divided into two fundamental subscales: one for **pain** and other for **disability**. Both subscales contribute to the overall score and provide a comprehensive evaluation of the patient's functional disability related to activities that specifically impact the elbow.

3. Hand held Dynamometer: It was used to measure the hand grip strength of the subjects.

Statistical Analysis:

The incidence of lateral epicondylalgia across various occupations was reported as a percentage. To assess the effects of high-velocity low-amplitude thrust (HVLAT) on different occupations concerning various physical dimensions of recovery, all data were expressed as Mean \pm SD. Statistical analysis was performed using repeated measures ANOVA with SPSS software to determine significance.

Results:

The demographic features of the enrolled subjects as per their occupations were described in Table-2 at baseline (T₀).

Occupation	Age (Mean \pm SD)	BMI (Mean \pm SD)	Male : Female	Days of onset of Pain (Mean \pm SD)
Blue collar workers *	38.42 \pm 4.71	23.99 \pm 3.32	41:1	28.57 \pm 10.01
White collar (sedentary) workers [#]	35.89 \pm 3.91	24.12 \pm 5.61	57:32	30.70 \pm 12.52
White collar (mobile) workers @	35.21 \pm 4.15	25.40 \pm 4.37	19:0	26.31 \pm 12.78



Housewife ^s	37.35 ± 3.22	23.58 ± 3.14	0:42	37.97 ± 10.36
Healthcare workers [^]	36.52 ± 4.03	24.10 ± 3.99	19:23	25.23 ± 9.56

Table 2: Demographic Data at Baseline (T0)

Occupational Incidence Of Lateral Epicondylalgia :

In our study 234 subjects have participated from various occupations. The subjects are grouped in accordance with their style of working which is tabulated in Table- 3 . The most common occupations were Blue collar workers, white collar (sedentary) workers, white collar (mobile) workers, housewife and healthcare workers. From our study we found that incidence of lateral epicondylalgia is most common in white collar (sedentary) workers like teachers, office worker and computer operators and least found in white collar (mobile) workers like marketing executives.

Occupation	No. of Subjects	Percentage
Blue collar workers*	42	17.94%
White collar (sedentary) workers [#]	89	38.03%
White collar (mobile) workers [@]	19	8.11%
Housewife ^s	42	17.94%
Healthcare workers [^]	42	17.94%

*carpenter, driver, plumber, electrician, farmer, mechanic, peon

[#]teacher, desk worker, computer operator

[@]marketing executive

^shousewife

[^]doctor, nurse, pharmacist, ward boy

Table 3: Occupational Incidence of Lateral Epicondylalgia

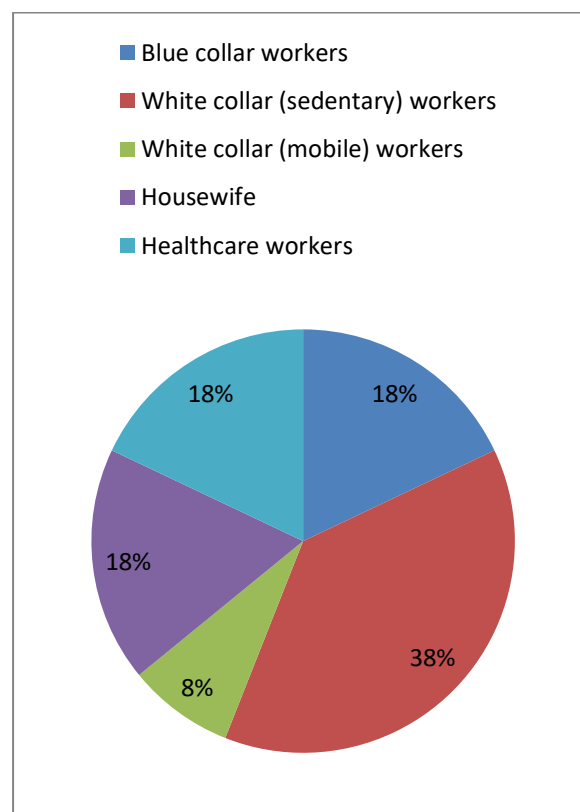


Fig 1: Occupational Incidence of Lateral Epicondylalgia

Analysis of Role of HVLAT in Reducing Pain in Various Occupations:

Scrutiny of pain by using VAS was done in various occupations after giving HVLAT. All the data was expressed in Mean±SD and was analysed for statistical significance by using Repeated measures ANOVA.

Time Interval	Blue Collar*	White collar(Sedentary)*	White collar (Mobile)*	Housewife*	Healthcare Workers*
Pre-Intervention(T ₀)	7.66 ±1	7.59±0.97	7.62 ±1.06	7.2±1.05	7.88 ±1.02
Post-Intervention(T ₁)	3.75 ±1.07	3.87±1.24	4.1±1.12	3.45±1.14	4±1.37



3 months Follow up (T ₂)	1.95 ±0.9	2.06±0.9	2.25 ±0.8	1.85± 0.87	2.05 ±0.7
	5	6	8		2

*Mean+/-SD

Table 4: VAS scores among various occupations at different time intervals

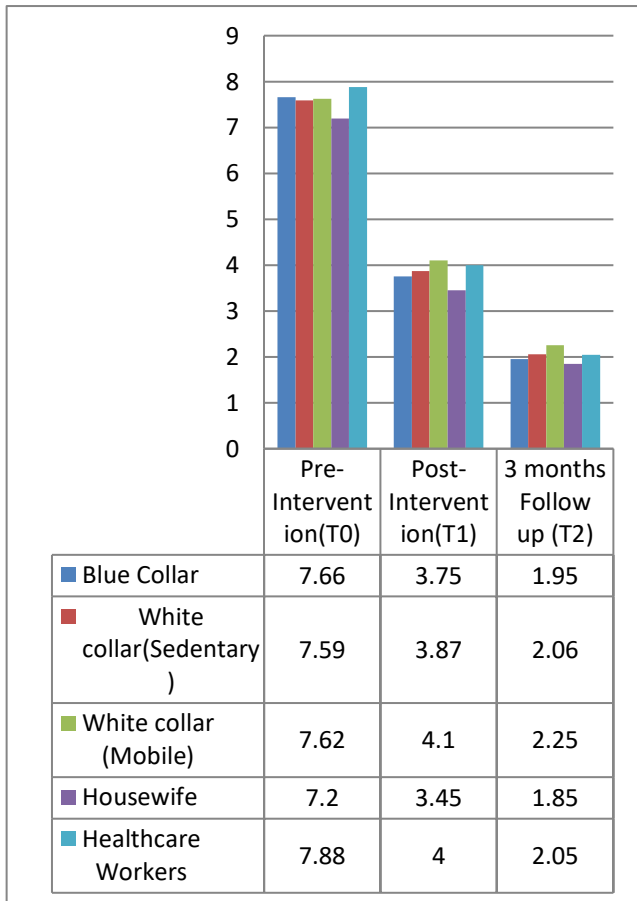


Fig 2: Analysis of Role of HVLAT in Reducing Pain in Various Occupations suffering from Lateral Epicondylalgia

Source	D F	Sum of Square	Mean Square	F statistic	P-value
Between Occupations	4	0.4866	0.1216	8.2826(4,8)	<0.05

Between Treatments	2	80.4509	40.2255	2738.8421(2,8)	<0.05
Error	8	0.1175	0.01469		
Total	14	81.055	5.7896		

Table 5: Comparison of Role of HVLAT in Reducing Pain in Various Occupations

On analysis, we found that the HVLAT technique showed improvement over time in all occupations. But, there was statistical difference between different occupations on reducing pain by HVLAT, blue collar workers responded well.

Analysis of Role of HVLAT in Improving Functional Independence in Various Occupations:

The analysis of functional independence by using PRTEE was done in various occupations after giving HVLAT. All the data was expressed in Mean±SD and was analysed for statistical significance by using Repeated measures ANOVA.

	Blue Collar*	White collar(Sedentary)*	White collar (Mobile)*	Housewife*	Healthcare Workers*
Pre-Intervention(T ₀)	75.16 ±10.38	73.87±10.23	74.12 ±10.11	69.55 ±12.36	75.83±9.88
Post-Intervention(T ₁)	42.45 ±9.17	44.53±9.63	41.25 ±9.26	40.1±11.77	44±0.40
3 months Follow up (T ₂)	27.29 ±7.50	28.72±7.30	26.5±7.72	24.8±8.79	25.44±7.55

*Mean+/-SD

Table 6: PRTEE scores among various occupations at different time intervals

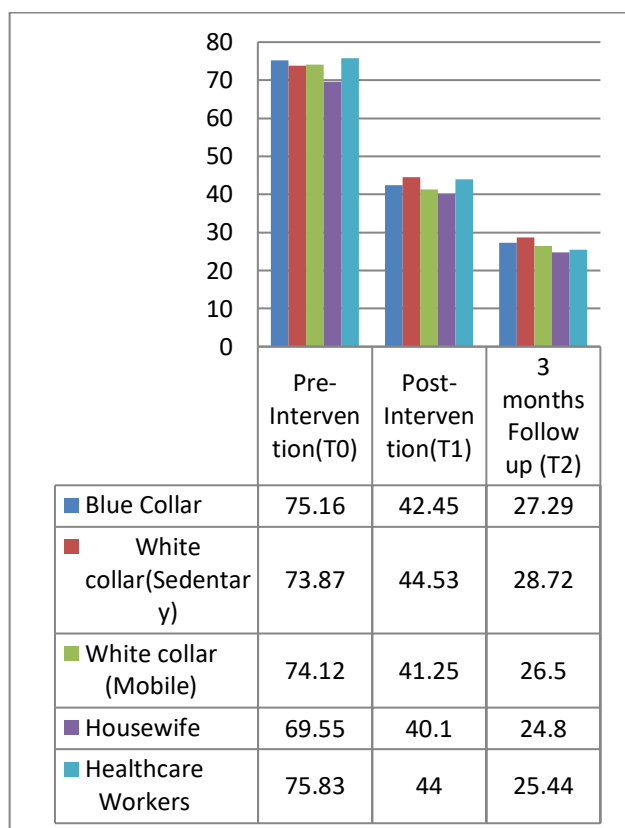


Fig 3: Analysis of Role of HVLAT in Improving Functional Independence in Various Occupations suffering from Lateral Epicondylalgia

Source	D F	Sum of Square	Mean Square	F statistic	P-value
Between Occupations	4	33.3005	8.3251	4.7259(4, 8)	<0.05
Between Treatments	2	5755.3098	2877.6549	1633.5351(2,8)	<0.05
Error	8	14.0929	1.7616		
Total	14	5802.7032	414.4788		

Table 7: Comparison of Role of HVLAT in Improving PRTEE score in Various Occupations

1. Pre-Intervention (T0) Functional Independence Levels:

The initial functional independence levels (before intervention) are relatively similar across occupational groups, with scores ranging 69.55 to 75.83. This suggests that, prior to treatment; individuals with lateral epicondylalgia across different professions exhibit a comparable degree of functional limitation.

- **Blue-collar workers** have the highest pre-intervention score (75.16), suggesting they might have been more affected by the condition initially.
- **Housewives** have the lowest pre-intervention score (69.55), indicating slightly better functional independence before treatment.

2. Post-Intervention (T1) Changes:

Significant improvements in functional independence are noted post-intervention across all groups. This reflects the short-term efficacy of HVLAT in reducing symptoms and enhancing functional capacity. The extent of improvement varies between occupational groups:

- **Healthcare workers** show the greatest post-intervention improvement, with their score decreasing from 75.83 to 44.00, a substantial reduction in symptoms.
- **Blue-collar workers** experience a notable decrease, with their score dropping from 75.16 to 42.45.
- The improvements among **white-collar sedentary workers** and **white-collar mobile workers** are relatively smaller compared to other groups, indicating that the intervention may be slightly less effective in sedentary populations, likely due to occupational factors that limit movement or exacerbate symptoms.

3. Three-Month Follow-Up (T2):

The three-month follow-up results show further improvement in functional independence compared to post-intervention, suggesting that the effects of HVLAT are fully sustained over time without further intervention.

- **Housewives** and **healthcare workers** have similar and comparatively lower follow-up



scores (24.8 and 25.44, respectively), indicating that these groups have sustained long-term benefits.

- The improvement in follow up scores is observed in **blue-collar workers**, whose score falls to 27.29, reflecting a significant relief in symptoms over time.
- **White-collar sedentary workers** maintain a lower level of functional independence than other groups, with their score decreasing only slightly to 28.72, implying comparatively lower retention of benefits from the intervention in this group.

4. Comparative Occupational Analysis:

- **Physical Demands and Outcomes:** Blue-collar workers and healthcare workers, who often engage in physically demanding tasks, show substantial improvements post-intervention and also retain it during follow-up. This suggests that while HVLAT is effective in alleviating symptoms in the short term as well as in long term irrespective of the physical demands of their occupations relief of symptoms occurred without sustained or additional treatment.
- **Sedentary Occupations:** White-collar sedentary workers exhibit lesser outcomes in the long term compared to more physically active groups.

Analysis of Role of HVLAT in Improving Hand Grip Strength in Various Occupations:

Scrutiny of hand grip strength by using hand held Dynamometer was done in various occupations after giving HVLAT. All the data was expressed in Mean±SD and was analysed for statistical significance by using Repeated measures ANOVA. On analysis, we found that the HVLAT technique showed improvement over time in all occupations. But, there was statistical difference between different occupations in improving hand grip strength by HVLAT, healthcare workers responded well.

	Blue Collar*	White collar(Sedentary)*	White collar (Mobile)*	Hous ewife*	Healt hcare Wor kers*
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Pre-Intervention(T0)	29.58 ±12.32	25.85±9.16	26.25 ±10.93	29.25 ±8.31	22.5 ±6.47
Post-Intervention(T1)	57.29 ±9.88	53.93±9.49	56.25 ±10.93	54.25 ±7.65	53.61 ±7.63
3 months Follow up (T2)	66.87 ±6.22	64.25±7.06	65±9.25	63.5 ±5.40	64.1 ±6.47

*Mean+/-SD

Table 8: Hand Held Dynamometer scores among various occupations at different time intervals

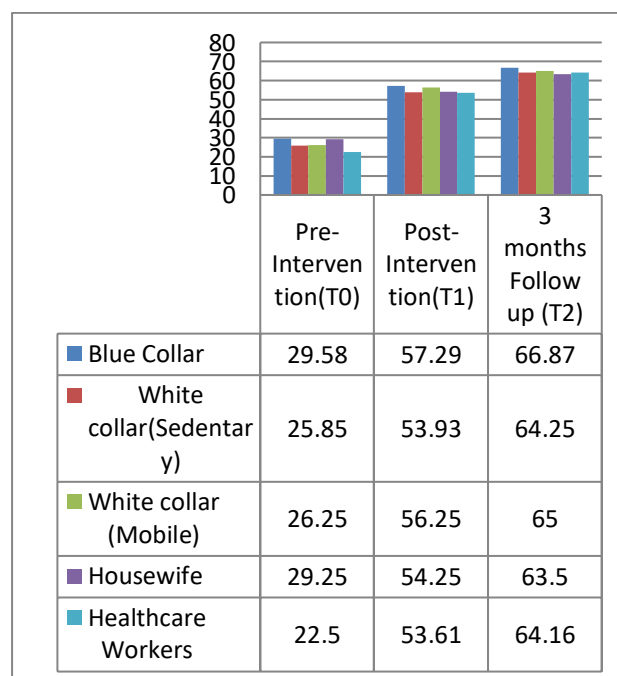


Fig 4: Analysis of Role of HVLAT in Improving hand Grip Strength in Various Occupations suffering from Lateral Epicondylalgia

Source	D F	Sum of Square	Mean Square	F statistic	P-value
Between Occupations	4	32.8555	8.2139	3.7204(4, 8)	<.05



Between Treatments	2	3914.8665	1957.4333	886.5898(2,8)	<0.05
Error	8	17.6626	2.2078		
Total	14	3965.3847	283.2418		

Table 9: Comparison of Role of HVLAT in Improving Hand Grip Strength in Various Occupations

Discussion:

From the analysis we found that the white collar sedentary workers had higher incidence of Lateral epicondylalgia than other occupations. The white collar workers included teachers, desk workers and computer operators. A study by LennartDimberg (1987)¹² concluded that there was no statistically significant difference between the prevalence of lateral epicondyle in blue and white collar workers which are in contrast with our study where we found that white collar sedentary workers had a higher incidence (38.03%) in comparison to blue collar workers (17.94%). Although less physically demanding than manual labour, office work has been linked to LE due to prolonged keyboarding and mouse use. A cross-sectional study by Walker-Bone et al. (2012)⁴ showed a 4–7% prevalence of LE among office workers, especially those who reported extended hours of computer use.

Occupational risk factors include repetitive motions, high force exertion, prolonged static postures and vibration exposure. The high incidence of Lateral Epicondylalgia in white collar sedentary workers could be attributed to prolonged static postures and repetitive motions.¹³

In our study, we found that HVLAT technique showed improvement over time in all occupations, however in Blue collar workers, the pain intensity reduced comparatively higher than other occupational groups. This may be because Blue-collar workers engage in physically demanding tasks that involve repetitive motions, heavy lifting, and sustained awkward postures. These activities often cause biomechanical dysfunctions and joint restrictions, which are directly targeted by HVLAT.¹⁴

In our study, we found that HVLAT technique showed improvement over time in all occupations, however in Healthcare workers, the functional independence increased comparatively higher than other occupational groups.

In our study, we found that HVLAT technique showed improvement over time in all occupations, however in Healthcare workers, the hand grip strength increased comparatively higher than other occupational groups. Usually, healthcare professionals deal with ergonomic issues including extended uncomfortable wrist or elbow positions. HVLAT may provide immediate biomechanical corrections in the upper kinetic chain, translating into a noticeable improvement in grip strength, restore joint proprioception and neuromuscular efficiency.

Conclusion:

The study concludes that white-collar workers are at a higher risk of developing lateral epicondylalgia (LE). The significant burden of LE across occupational groups underscores the need for workplace interventions, including ergonomic modifications, task rotation, strengthening exercises, and education and training programs. Additionally, integrating high-velocity low-amplitude thrust (HVLAT) as an adjunct to conventional physiotherapy is recommended to alleviate pain, enhance hand grip strength, and improve functional independence.

References:

1. Coombes BK, Bisset L, Vicenzino B. Management of lateral elbow tendinopathy: one size does not fit all. *J Orthop Sports Phys Ther.* 2015;45(11):938-949.
2. Vicenzino B, Wright A. Lateral epicondylalgia: new concepts in aetiology and management. *Br J Sports Med.* 2020;54(13):751-752.
3. Thieme H, Morkisch N, Mehrholz J, et al. Mirror therapy for patients with severe arm paresis after stroke—a randomized controlled trial. *Clin Rehabil.* 2013;27(4):314-324.
4. Walker-Bone K, Palmer KT, Reading I, Cooper C. Prevalence and impact of musculoskeletal disorders of the upper limb in the general population. *Arthritis Rheum.* 2012;57(4):624-631.



5. Khan KM, Cook JL, Bonar F, Harcourt P, Astrom M. Histopathology of common tendinopathies. *Sports Med.* 1999;27(6):393-408.
6. Nirschl RP. Elbow tendinosis/tennis elbow. *Clin Sports Med.* 1992;11(4):851-870.
7. Bisset L, Vicenzino B. Physiotherapy management of lateral epicondylalgia. *J Physiother.* 2015;61(4):174-181.
8. Plaza-Manzano G, et al. The role of central sensitization in lateral epicondylalgia. *Pain Pract.* 2020;20(6):636-649.
9. Ciccotti MG, Schwartz MA, Ciccotti MC. Diagnosis and treatment of lateral epicondylitis. *ClinOrthopRelat Res.* 2004;(455):11-19.
10. Alfredson H, Cook J. A treatment algorithm for managing Achilles tendinopathy: new treatment options. *Br J Sports Med.* 2007;41(4):211-216.
11. Rio E, Kidgell D, Purdam C, Gaida J, Cook J, Pearce AJ. Isometric exercise induces analgesia and reduces inhibition in patellar tendinopathy. *Br J Sports Med.* 2014;48(12):1020-1026.
12. Dimberg L. The prevalence and causation of tennis elbow (lateral humeral epicondylitis) in a population of workers in an engineering industry. *Ergonomics.* 1987;30(3):573-579. doi: 10.1080/00140138708969746.
13. Van Rijn RM, Huisstede BM, Koes BW, Burdorf A. Associations between work-related factors and specific disorders at the elbow: a systematic literature review. *Rheumatology (Oxford).* 2009;48(5):528-536. doi: 10.1093/rheumatology/kep013.
14. Punnett L, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *J ElectromyogrKinesiol.* 2004;14(1):13-23. doi: 10.1016/j.jelekin.2003.09.015.