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RESEARCH ARTICLE

Prevalence of Carpal Tunnel Syndrome in motorbike mechanics

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) affects approximately 3-5% of the general population.

Objective: The aim was to assess the prevalence of carpal tunnel syndrome among motorbike mechanics and evaluate the diagnostic accuracy of various clinical tests for detecting CTS in this population.

Methods: A cross-sectional study was conducted on 82 mechanics working in different motorbike workshops in the twin cities of Rawalpindi and Islamabad. Those Motorbike mechanics who had more than 1 year of experience were selected, 4 special tests, Upper limb tension 1 (ULTI), Phalen's maneuver, carpal compression test, and tinels sign along with a self-administered Boston Carpal tunnel Questionnaire (BCTQ) were used. Data was collected from individuals aged 18 to 35 years.

Results: A total of 82 motorbike mechanics participated in this research out of which 13 (15.9%) reported the symptoms of CTS. According to the symptom severity scale of BCTQ 36(43.9%) were asymptomatic, 39(47.4%) mild, 7(8.4%) moderate and none of them reported severe or very severe symptoms. According to functional status scale, 63(76.8%) reported no symptoms, 14(17.1%) were mild and 5(6%) moderate and with no severe or very severe symptoms reported. Furthermore, ULT1 accounts 14(17.1%), CCT 12(14.6%), Phalens maneuver 11(13.4%) and Tinel Sign 8(9.8%) for positive symptoms respectively.

Conclusion: This study concluded a low prevalence of carpal tunnel syndrome (CTS) among young to middle-aged motorbike mechanics. However, those working over five hours a day had a higher susceptibility to CTS, regardless of age.

Keywords: Boston carpal tunnel questionnaire, carpal tunnel syndrome, mechanic, motorbike, ULT1

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Introduction:

Carpel tunnel syndrome begins with compression of the median nerve, the most widespread peripheral nerve entrapment disease affecting numerous humans globally.(1) In all entrapment neuropathies, carpel tunnel syndrome contributes 90% in total. In past, it was evaluated that CTS has a 10% lifetime risk.(2) In the same way, there is a high trend of hand or wrist pain, this can be due to twisting of the hand or vigorous handling of automobile parts and working instruments, for example, bolting vehicles nuts needs forceful gripping and often results in strain injury.(3)

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The responsibility for the full range of automotive services required to keep vehicles in fine running condition is on automotive mechanics. Manual handling associated injuries are frequent in the automotive workshop across countries.(3)

In order to investigate the prevalence of cumulative trauma disorder of wrist joint in auto mechanical workers, this study was done on 60 auto mechanical worker who had working experience of more than 5 years, Overall prevalence of CTD in Auto Mechanical Worker (AMW) study is 23.33%.(4) Another cross-sectional survey by Yuling Wang (2021) was carried out in urban city of China to interrogate the prevalence of self-reported wrist/hand symptoms and CTS risk factors in office workers. This study involves 30 workspaces consist of 969 respondents. Study resulted in (9.6%) clinically confirmed prevalence of CTS cases along with the prevalence of wrist and hand symptoms which were (22%) and (15%) respectively.(5)

As automotive services needed full range of responsibility by automotive mechanics to keep vehicles such as motor bike in good condition, manual handling related injuries are common in workshops. Every

year 1 in 14 workshops declare momentous injuries as in repairing or fitting body parts of motor vehicles. Commonly appear injuries in restraint workers had low back and strain/sprain (body stressors) of wrist and knee. Work routine such as alter tires without breaks in poor posture, having limited space, bending forward to perform task, bending under vehicles and so on got workers at high risk for occupational hazards. Excessive grasping of vehicle body parts or equipment, hand twisting, tightening screws/ nuts, welding, painting reported high degree of wrist/hand pain with strain injuries. According to Adeyemi et al (2016) excessive gripping results in muscle contractions forces which first exert in forearm then hand to fingers from tendon. Workers who exposed to wrist/hand related issues such as tendonitis, carpal tunnel syndrome (CTS), etc.; during work associated with repetitive, excessive force in contact with hard surface may develop cumulative trauma disorder.(3)

Pain, paresthesia, and pin and needle sensation specifically in the first three digits of the hand are all evident symptoms of CTS. Sign and symptoms of CTS in early stages include feeling of pins and needles, tingling, low power to grasp, pinch or squeeze things, sharp pain at night result in waking up individual. As the condition get chronic tingling turns into numbness and most symptoms showed as result of excessive reptations of hand movements. Motor and sensory functions got impaired in whole hand. Individuals observed with swelling on affected hands. Deterioration of neuromuscular supplies result in flaccid muscles with no strength and anhidrosis on hand. Usually in acute conditions sign and symptoms are severe painful and reversible but sudden onset may cause irreversible injury depend on level of injury.(6) The quality of life is decreased in individuals experiencing chronic pain. Moreover, patients' mental health is vastly disturbed due to chronic pain. Epidemiology studies have proved that with an increase in pain the risk of depression also increased 4 folds.(7) Struggling in ADLs more than 15% cases such as dressing, holding objects, buttoning, bathing, grasping, carrying objects, writing and housekeeping observed in CTS.(5)

CTS being most usual entrapment disease affects one or more peripheral nerves leads to numbness and weakness of affected body organ. Individuals complaining of aching, unresponsiveness and itching feeling in their hands have CTS 3.8% in average. Deterioration of neuromuscular supplies result in flaccid muscles with no strength and anhidrosis on hand. Usually in acute conditions sign and symptoms are severe painful.(8) Prevalence of CTS in general population according to different countries like, East Africa (12.1%), Ethiopia (29.2%), Sweden (4%), Japan (2.5%-11.0%), USA (2.5%-5.8%), UK (7%), Saudi Arabia (14.4%), China (9.6%)and In India (3.8%) respectively. In Pakistan prevalence of CTS involves (2-3%) and 1 in 5 every symptomatic individual with CTS based on clinical findings.(9)

The reasons of entrapment of median nerve are increased pressure on carpel tunnel because of flexion and extension of wrist and flexion of fingers (Bland et al).(10) In an individual normal pressure is about 2-10mmHg in wrist at carpal tunnel which fluctuate with position of wrist. At initial level 10-fold pressure increase during extension and 8-fold during flexion of wrist. Outcome of sustain repetitive movements of hand and wrist are remarkable risk factors in prevalence of CTS.(11)

According to wrist biomechanics it is capable of doing sagittal and frontal plane movements and rotatory movement.(12) Moreover, according to the recent analysis on the carpal tunnel volume that it did not change with approximately 20 degrees of flexion and extension movements, nevertheless carpal tunnel volume is thought to be decreased with ulnar deviation ranges from -5 degrees to 15 degrees radioulnar deviations. Structural analysis also talks about twisting between the proximal and distal parts of the tunnel which increase in flexion and ulnar deviation movements and can further put pressure on the median nerve.(13)

Overuse syndromes mainly involved upper extremity including shoulder, elbow, wrist, hands with neck and upper back. Most common site of overuse syndrome is wrist which involved in work-related carpal tunnel syndrome.(14) Overuse is termed as frequent microtrauma means damage of myotendinous structure of tissue at microscopic level which caused by excessive, repetitive overloading of stress for prolong durations results in infuriation, swelling or inflammation which leads to reduce the space and entrapment of middle nerve in carpal tunnel by compressing what structures passes through the canal called as carpal tunnel syndrome.(2)

According to several studies CTS can be prevented by work area modifications, ergonomics redesigning, physical therapy, postural education and restoration exercises. From engineering point of view, keyboard, mouse, wrist splints, equipment's should be redesign according to each individual with proper postural education, job rotations, whole work station modification and exercise protocol. Physical therapy includes hand and wrist exercises,

mobilizations, myofascial release and much more which play significant role in prevention of CTS. Thus, combination of occupational health, physical therapy, educational plans and setting of ergonomic factors according to each individual helps in promoting heath of workers plus prevent CTS.(15)

The aim of the study is to find out prevalence of developing CTS in motorbike mechanics in Pakistan. Awareness about the frequency of CTS prevalence with their progression can help them take percentage measures. Early identification of CTS can aid in planning a more effective management protocol for motorbike mechanics to reduce the severity of the symptoms. Education about risk factors can be provided that not only help them with CTS but are also effective in reducing further risk for musculoskeletal problems.

Methods:

This cross-sectional study was approved by the ethical review committee of Riphah International University (RIPHAH/RCRAHSISB/REC-DPT-B/10007). Informed consent was taken from all participants. This study collected data from motorbike mechanic workshops in the twin cities of Rawalpindi and Islamabad. The study, conducted over six months from January to June 2023 with a sample size of 82, used Open Epi for sample size calculation. Parameters included an assumed prevalence (p), a 95% confidence level, a 5% margin of error (d) and a design effect of 1 for simple random sampling. Participants of age group 18-35 years were included. Non- probability convenience sampling was used. Particular members taking place in this study must be a motor bike mechanic, works at least 1 hour per day with minimum experience of one year as a motorbike mechanic. Those having recent wrist trauma, rheumatoid arthritis, proximal median neuropathy, ulnar neuropathy or using steroid are excluded from study.

The Boston Carpal Tunnel Questionnaire (BCTQ) was first used to screen for Carpal Tunnel Syndrome (CTS). It includes two subscales: an 11-question severity scale (rated 1-5), and an 8-question functional limitations scale (also rated 1-5). Severity scores are categorized as asymptomatic [11], mild [12-22], moderate [23-33], severe [34-44], and very severe [45-55]. Functional status is similarly divided: asymptomatic [8], mild [9-16], moderate [17-24], severe [25-32], and very severe [33-40].(16)

Four diagnostic tests ULT1, Phalen's maneuver, carpal compression, and Tinel's sign were also used. The Upper Limb Tension Test 1 (ULNT1) for the median nerve was used to assess mechanical sensitivity in the upper limbs, aiding in the diagnosis of carpal tunnel syndrome (CTS). In this study, ULNT1 showed 93% sensitivity and 6.67% specificity for CTS.(17) To perform ULTT1, the patient lies supine while the clinician depresses the shoulder to prevent scapular movement, followed by 90-degree abduction, 90-degree external rotation, and 90-degree elbow flexion with forearm supination, wrist and finger extension, and thumb abduction. The test takes 1 minute, and pain reproduction along the median nerve indicates a positive result. Key findings for a positive test include ≥10-degree elbow extension, increased pain with neck bending to the opposite side, and reduced pain with neck bending to the same side.(18) This test had 69% percent specificity with 97% sensitivity for CTS diagnosis as it tightens the median nerve.(19)

Carpal Compression Test Median Compression Test or Durkan's test is also another diagnostic test for carpal tunnel syndrome. Test sensitivity and specificity were .36 (95% CI = .17–.54) and .57 (95% CI = 39–.74), respectively.(20) In Durkan's test, the patient places their hand on a flat surface while the clinician applies pressure to the median nerve at the carpal tunnel for 30 seconds. A positive test is indicated by numbness, paresthesia, pain, or tingling along the median nerve. First used by Durkan in 1991 on 40 hands, the test has 71% sensitivity and 22% specificity for CTS, with an average positive response in 16 seconds.(21)

Phalen test for detecting CTS involves the patient flexing their wrists at 90 degrees and pressing the backs of their hands together for 1 minute. A positive result occurs if pain, tingling, or numbness appears in the thumb, index, or middle fingers. First tested by Phalen in 1951 on 80 hands, the test has 100% specificity and 88% sensitivity, with an average positive response time of 26 seconds.(22)

Tinel's sign involves tapping over the median nerve at the wrist to induce tingling or "pins and needles" sensations along the nerve's distribution. With the palm facing down on a flat surface, a positive result is indicated by pain, numbness, or paresthesia during tapping. The test has 100% specificity and 67% sensitivity for CTS.(23) If patient get symptoms as pain, numbness and paresthesia along median nerve distribution while performing test then it is positive for CTS.

The data was analyzed using SPSS version 21, focusing on the descriptive analysis of CTS prevalence, BCTQ symptom severity, and functional status in motorbike mechanics. Correlations between CTS, working hours, and ULT1 were analyzed and presented

using tables, graphs, pie charts, and bar charts.

Results:

The study assessed the prevalence of carpal tunnel syndrome (CTS) among 82 male motorbike mechanics with a mean age of 25 years ± 5.38. Of the participants, 13 (15.9%) were positive for CTS, while 69 (84.1%) were negative. Diagnostic tests used included ULT1, CCT, Phalen's Maneuver, and Tinel's sign. ULT1 had the highest positive rate at 17.1%, followed by CCT at 14.6%, Phalen's Maneuver at 13.4%, and Tinel's sign at 9.8%. Only 3% of subjects had musculoskeletal disorders. Severity and functional status scale results showed 63(76.8%) reported no symptoms, 14(17.1%) were mild and 5(6%) moderate and with no severe or very severe symptoms reported in Table 1. Moreover, Chi-Square tests for CTS showed no significant association with working hours (0.6729), suggesting working hours may not be a major factor reported in Table 2. However, ULT1 had a highly significant association with CTS (0.0000), indicating a strong association in our motorbike population by accounting 14(17.1%) reported in Table 3.

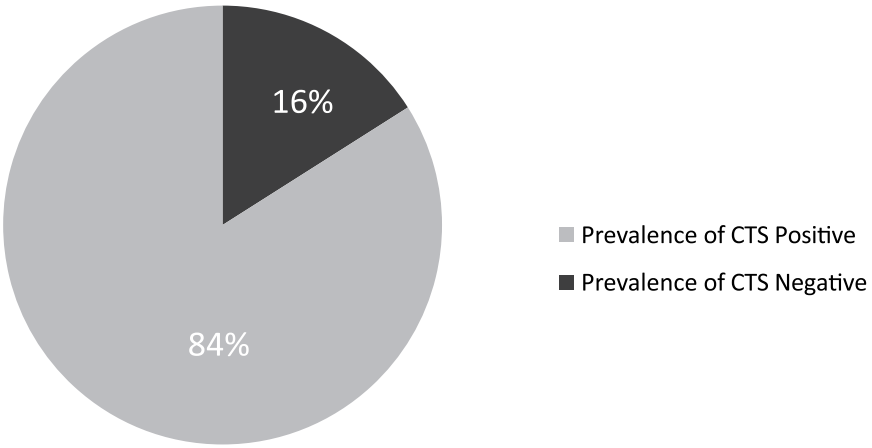

Figure 1: Prevalence of CTS in motorbike mechanic

Table 1: Symptom severity scale and functional status scale data

Scale	Categories				
	N (%)				
	Asymptomatic	Mild	Moderate	Severe	Very severe
Symptom's severity scale	36(43.9%)	39(47.4%)	7(8.4%)	0(0%)	0(0%)
Functional Status Scale	63(76.8%)	14(17.1%)	5(6%)	0(0%)	0(0%)

Table 2: Association of CTS with Working Hours

CTS					
		Positive	Negative	Total	Chi-Square
Working Hours	1-2 hours	0	3	3	0.672
	3-5 hours	0	1	1	
	More than 5 hours	13	65	78	
	Total	13	69	82	

Table 3: Association of CTS with ULT1

CTS Prevalence result		Upper limb tension test 1			
		Negative	Positive	Total	Chi-Square (p-value)
	Positive	1	12	13	<0.001
	Negative	67	2	69	
	Total	68	14	82	

Discussion:

This study conducted to observe the prevalence of CTS in motorbike mechanic which is 15.9% with positive cases according to statistical analysis.

CTS, caused by repetitive wrist movements that compress the median nerve, leads to numbness, tingling, and weakness, affecting daily activities. It is common in professions like dentistry, hairdressing, and butchery. A study in Pakistan found a 10.3% prevalence in butchers, especially those with 3-5 years of experience. Similarly, our study shows that motorbike mechanics with over two years of experience are significantly affected, with 67 (81.7%) testing positive for CTS.(24)

According to a study by Kulkarni in 2020 a 5% positive rate for the carpal compression test among auto mechanical workers, with higher pain reported in older age groups.(4) In current study it is observed that the carpal compression test in motorbike mechanics have 14.6% positive, which is higher than the previous study.

In one of the cross-sectional surveys conducted in 2022, founded a 11.9% CTS prevalence among dexterous individuals, often due to difficulties in writing or holding small objects.(25) Likewise, in our study shows a higher 15.9% prevalence among motorbike mechanics, who frequently use hand strength and fine motor skills to repair motorcycles.

In a study conducted in 2022, founded a 10.3% CTS prevalence in butchers, with those having 3-5 years of experience most affected.(24) In our study, motorbike mechanics with over two years of experience showed a higher prevalence of 15.9%, with 67 (81.7%) testing positive for CTS.

Recent studies have shown that prolonged work hours increase the risk of CTS. In a cross-sectional study done in 2022, 132 dentists found a 21.2% CTS prevalence, with 16.67% testing positive on the Phalen test.(26) In our study of 82 motorbike mechanics, many working long hours, 13.4% tested positive on the Phalen test.

A 2022 study found that musicians have a 37-47% prevalence of playing-related afflictions.(8) In contrast, our study found a 15.9% prevalence of carpal tunnel syndrome among motorbike mechanics due to median nerve compression. This study had limitations, including the lack of access to nerve conduction studies (NCS) and electromyography (EMG) for accurate diagnostics, as well as its restriction to male participants aged 18–35 from Rawalpindi and Islamabad, limiting generalizability to other genders, age groups, or populations. BMI was not analyzed due to missing height and weight measurements. Future studies should incorporate advanced diagnostic tools like NCS and EMG, focus on improving patients' quality of life, and include diverse age groups and genders. Additionally, exploring the association of CTS with BMI and emphasizing ergonomics and posture correction for motorbike mechanics is recommended to minimize injury risks.

Conclusion:

This study concluded that the prevalence of CTS in motorbike mechanics was relatively low. Moreover, individuals working more than five hours a day were found to be at a higher risk of developing CTS, regardless of age.

Disclaimer: The authors declare that this study was the thesis of undergraduate Doctor of Physical Therapy program of Riphah College of Rehabilitation and Allied Health Sciences.

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Omer A: Conceptualized the work and reviewed the manuscript
Karim S: Analyzed the data
Iqbal Z: Collection of the data
Sardar MZ: Collection of the data
Aamar A: Wrote the manuscript