

A Study of Association of Sleep Quality in Individuals with Carpal Tunnel Syndrome

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Abstract

Background: Carpal Tunnel Syndrome (CTS) is a common condition caused by compression of the median nerve at the wrist. It leads to symptoms such as pain, numbness, and tingling in the hand. These symptoms are often worse at night and can disturb normal sleep.

Aim of the study: A Study of Association of Sleep Quality in Individuals with Carpal Tunnel Syndrome.

Procedure: A cross-sectional study was conducted on individuals diagnosed with CTS. Participants were selected based on inclusion and exclusion criteria. Sleep quality was assessed using a standardized questionnaire such as the Pittsburgh Sleep Quality Index (PSQI).

Results: The study findings showed that a majority of individuals with CTS experienced poor sleep quality. Increased pain intensity was associated with greater sleep disturbance. Night-time symptoms such as tingling and numbness were found to significantly affect sleep. Statistical analysis revealed a positive association between CTS severity and poor sleep quality. Individuals with severe symptoms reported more disturbed sleep patterns.

Conclusion: The study concludes that sleep quality is significantly affected in individuals with Carpal Tunnel Syndrome. There is a strong association between symptom severity and sleep disturbance. Addressing sleep issues should be an important part of CTS management to improve overall quality of life.

Keywords: PSIQ, Carpal Tunnel Syndrome, Bcqt Median Nerve.

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Introduction

Carpal Tunnel Syndrome (CTS) is a musculoskeletal condition that represents the most prevalent non-traumatic peripheral nerve injury and is also classified as a repetitive strain disorder. It results from compression of the median nerve and is primarily marked by sensory and motor signs and symptoms in the peripheral areas supplied by the median nerve. This is caused by repeated wrist movement and extension. Employees using vibrating tools may injure the median nerve, leading to CTS. Reports indicate that approximately 18% of employees experience CTS [1].

Carpel tunnel syndrome is a common condition that affects the hand and arm. It occurs when the median nerve, which runs from your forearm into the palm of your hand becomes compressed at the wrist. This nerve passes through the carpal tunnel, a narrow passageway of ligaments and bones at the base of hand. causes are repetitive hand movement, especially with the wrist bent. prolonged use of vibrating tools, wrist injury or trauma, health

condition like rheumatoid arthritis, thyroid dysfunction.[1]

Recent investigations have the negative impact of the declining sleep quality on the human body. It is thought that reductions in sleep quality results in longer exposure to elevated sympathetic nervous system activity and to waking physical and psychological stressors. Consequently, there is growing evidence that significant correlation exists between poor sleep quality and the development of comorbid condition including obesity, hypertension, diabetes mellitus, pain and even death. Patients with carpal tunnel syndrome consistently report nighttime symptoms including multiple awakening the objective of this study.[2]

The critical relationship between sleep, health, and overall well-being is gaining greater attention. The national sleep foundation recommends 7 to 9 hours per night for adequate rest and repair. Unfortunately, sleep curtailment has become increasingly prevalent

in modern day society due to higher demands, longer working hours, and the introduction of radio, television and the internet.

Recent investigations have demonstrated the negative impact of declining sleep quality on the human body. It is thought that reductions in sleep quality results in longer exposure to elevated sympathetic nervous system activity and to waking physical and psychological stressors. The CTS case definition used in the present epidemiologic study was based on the presence of characteristic CTS symptoms and a median mononeuropathy across the carpal tunnel.

The incidence of CTS is highest in the fifth and sixth decades of life, affecting females more than male. Although compression frequently occurs bilaterally, the dominant hand is usually more severely involved. In the mildest form of CTS patients complain intermittent numbness tingling and pain in the hand within the distribution area of median nerve. Symptoms are often first noted at night.

A typical patient complains that they must shake her hand to "get the circulation going increased pressure of interstitial fluid in the wrist due to lack of muscle activity, horizontal sleeping position, volar flexion of hands and low perfusion pressure has been suggested to lead to disturbed circulation of median nerve in carpal tunnel causing these symptoms during sleep [3] Although CTS is a clinically well-known entity efforts on sleep has not been well studied. Therefore, in the spite of its common occurrence the sleep disorders. In the present study has we also investigated classification of the sleep disorder caused by the CTS.[5]

There has been the growing health concern and the concern and the controversy surrounding occupational musculoskeletal disorder and also the impact they have on employees and businesses. Construction work is consistently ranked among the most of dangerous occupations and the accounts for disproportionately large percentage of all the illnesses and injuries reported to us U.S. Bureau of Labor statistics. In terms of the lost-work time and restricted workdays, surgery and rehabilitation are the one of the costliest occupational musculoskeletal disorders is the carpal tunnel syndrome CTS.[6]

Physiotherapeutic are approaches in the carpal tunnel syndrome focus on decompression of the median nerve within the carpal canal. Until the last 5-to-10-year, CTS physiotherapy was in planned as conservative treatments. Research result on this treatments efficacy are not must clear. The median nerve compression in the carpal tunnel in carpal tunnel syndrome, to ensure the continuity of ROM, reduce pain also paresthesia, maintaining and increasing muscle strength, maintaining hand functions and patient education. Considerations when the determining the treatment method are

severity of symptoms, duration of symptoms, previous treatment and also age of patient opportunity for activity changes and the job modification.[8]

Carpal tunnel syndrome is the common, discrete, incompletely, understood pathological that must be verified objectively with electrophysiologic testing. This pathologic process causes diminished sensibility in distribution of the median nerve. The weakness of palmar abduction and atrophy of the intrinsic thenar muscles. The main hallmark symptoms of this disease are numbness that is the intermittent initially and eventually becomes ever present.[9]

CTS rehabilitation includes laser therapy, ultrasound, splint, exercise, manual therapy, neurodynamic ligamentum carpi transverse. The therapeutic course consists of 4 to 6 procedures, with 1 to 2 procedure per week it is particularly effective in early stages of the disease in young patients where the CTS is associated with the occupational overload, whirlpool. Exercise in that active-assistive, active, resistant exercise and PNF techniques there are used. The stretching exercises specific to carpal tunnel syndrome are as follows like median nerve stretching and the tendon gliding exercises.[8]

Carpal tunnel syndrome is the common form of the peripheral nerve compression. Estimated 400,000 surgical cases are the performed in the United States each year. Despite the familiarity with clinical care of the patients with carpal tunnel syndrome, an understanding of causation of CTS remains elusive. There has been no unifying theory that links each other the multiple known associations of carpal tunnel syndrome into a common causative mechanism.[9]

There is no one standard approach that can be applied as proof of refute causation; however, epidemiologic check-lists are the useful but not definitive. Rothman suggest that we use the concept of a sufficient causes for a disease, which is the set of minimal conditions and events that inevitably produce disease.[9]

Using Rothman's term, compression of median nerve in the carpal tunnel syndrome is widely perceived as the sufficient causes of CTS. Night time symptoms are usually attributed to wrist position are more common in carpal tunnel syndrome, motivating us to consider the possible role of sleep position in the genesis of this disorder. [9]

To evaluate this, we reviewed the epidemiologic associations of carpal tunnel syndrome. The literature regarding sleep disturbances and sleep position. Through distillation of these studies and presses of reasoning, we developed a hypothesis that

links the known associations of carpal tunnel syndrome. [9]

Various and manifold is the harvest of the disease reaped by certain workers from the crafts and also trades that they pursue. All the profit they get is fatal injury to their health, mostly from two causes. The first and the most patent is the harmful character of the materials they handle.[10]

Carpal tunnel syndrome is most common in the workplace but there are still many of those who question whether this syndrome is work-related. Even the diagnostic criteria used to establish the diagnosis is controversial. Since the workman's compensation costs associated with carpal tunnel syndrome are so much high, manufacture is very interested in limiting their liability either by primary prevention and the attributing the disorder to other non-work-related. New guidelines have been established for hand activity levels in an attempt to reduce the incidence of carpal tunnel syndrome.[10]

Carpal tunnel syndrome is the most reported nerve compression syndrome, is defined as localized compression of the median nerve at the wrist. Carpal tunnel syndrome is clinical entity and diagnosed based upon a symptom complex that include numbness, tingling and also burning in the distribution of the median nerve

Compression of the median nerve can occur as result of narrowing of the canal or crowding of the median nerve by the other element within the carpal tunnel. The finger flexor tendons within the carpal canal are the become thickened with age and the repetitive movement of these tendons across the rigid flexor retinaculum.[10]

The specificity of the standard physical examination techniques is such as Phalen's test and Tinel's range of the physical examination finding that was further questioned in a study by the Homan and colleagues, which demonstrated even lower sensitivity and specificity.[10]

Approximately 1 million adults are in the United States are affected by carpal tunnel syndrome annually, leading to the estimated 400000 surgeries performed each year. Patients suffering from carpal tunnel syndrome have worse health related quality of life in the addition to worse physical functioning and the pain compared with the general population.[11]

Recent popular literature has been discussed the involvement of posture in upper extremity pain and the neuropathy symptoms. The aim of this study is to assess self-reported nocturnal paresthesia and the sleeping position in participants with and without a diagnosis and the therapeutic interventions.[11]

In carpal tunnel syndrome mostly, 1 study illustrated an association between sleep position and also

development of nocturnal paresthesia's. As our awareness of the influence of posture in upper extremity pain also the paresthesia evolves, an association between sleeping position and also subclinical compression neuropathy is an interesting and novel opportunity for study and possible intervention.[11]

Median nerve neuropathy is the most common peripheral nerve compression in the upper extremities where is the frequently reported cases of entrapment were in the carpal tunnel syndrome of the wrist. The statistic that showed that median nerve entrapment cases that occurs at various sites along with the median nerve distribution are approximately about the 7% to 10%.[12]

Carpal tunnel syndrome is widely known as an occupational disorder that occurs especially in men also affects bilaterally in about 50% of cases. It is mainly reported to be involved with a repetitive movement of the wrist flexion and the extension and it may be due to vibration of the wrist through machinery tools. Median nerve compression shared that the same clinical manifestation with another nerve compression in the upper extremities which also affects sensory and also motor innervation.[12]

Carpal tunnel syndrome is an important driver of workers compensation costs, lost time, lost productivity and also the disability. Although not as the common as other upper extremity disorder, carpal tunnel syndrome is an important occupational health problem because of higher disability and also overall costs than virtually any other upper extremity disorder.[13]

Association between carpal tunnel syndrome and age, female gender, pregnancy and also body mass index, have been reported in numerous studies. In the current analysis, we examine associations between personal demographic and also health characteristics, occupational psychosocial stress also works organizational factors and its incident carpal tunnel syndrome in a large cohort of industrial workers. If workers highly exposed to repetition also forceful movements, for example, are more likely to leave the workforce due to carpal tunnel syndrome, then the remaining exposed workers may have lower risk of the developing carpal tunnel syndrome.[13]

Carpal tunnel syndrome is the most of the commonly reported entrapment neuropathy of the upper limb. Its effects on mostly workers can be chronically debilitating both in the workplace and also in their personal lives. The economic consequences are felt by workers, employers and also insurers. Carpal tunnel syndrome is among the greatest drivers of workers 'compression costs, lost time, lost productivity and also disability. Many of these disorders could be prevented by the identifying hazardous jobs and redesigning job tasks, tools and also work stations to reduce stress.[14]

Research has demonstrated that associations between repetitive and also forceful hand activity, non-neutral wrist postures Also hand-arm vibrations at work carpal tunnel syndrome. Individual risk factors for CTS include age, gender, and body Mass index, pregnancy and other medical conditions like diabetes and thyroid disorder. A comprehensive review of the Literature on work-related musculoskeletal disorder

by the NIOSH that exposure assessment method, different health Outcome definitions and a restricted range of exposure in the job studied and as well as other methodological issues.[14]

Limitations of past studies including lack of precision of estimation of potential hazardous exposure, Lack of individual exposure assessment, a limited range of exposure vibrations and cross-sectional study design has hindered attempts at exposure response analysis.[14]

Methodology: An Observational Cross-Sectional Study conducted on Individuals with carpal tunnel syndrome for a duration of –6month study started after ethical approval study subjects were selected according the inclusion and exclusion criteria.

Inclusion Criteria: Age Group - Adults aged 18 years and above, symptom Duration- Minimum duration of Carpal Tunnel Syndrome symptoms (e.g. >3 months) to ensure chronicity.

Exclusion Criteria: Other Neurological or Musculoskeletal conditions- mimic CTS symptoms chronic pain syndromes that could confound results

Procedure: The following procedure was implemented to association the altered sleep quality in individuals with Carpal Tunnel Syndrome (CTS):

Selection of Study Sites: Construction workers, office workers, Teacher, College Student, musicians. Participant Recruitment.

Patients who visited the clinic and had signs and symptoms suggestive of CTS (e.g., numbness, tingling, wrist pain, especially at night) were approached.

Those who met the inclusion criteria were informed about the study and invited to participate. Written informed consent was obtained.

Initial Assessment: Each participant was interviewed and examined individually. The following steps were followed:

1. Demographic & Medical Data Collection: Age, gender, occupation, and hand dominance Duration of the symptoms Whether the condition affected the dominant hand or bilateral.

a. Pittsburgh Sleep Quality Index (PSQI)

b. Used to assess sleep quality over the past month.

Measures 7 components (e.g., sleep latency, duration, disturbances, daytime dysfunction). A global PSQI score >5 indicates poor sleep quality

The Pittsburgh sleep quality index (PSQI) is a self-reported questionnaire with the 19 items used to evaluate sleep quality and also the disturbance over a one-month period, helping distinguish between good and poor sleepers.

The components are it measures 7 areas such as subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction

c. Boston Carpal Tunnel Questionnaire (BCTQ)

Includes two parts: Symptom Severity Scale (SSS) and Functional Status Scale (FSS).

Participants rated symptoms such as pain, numbness, and hand weakness, especially nighttime symptoms.

Scores range from 1 (no symptoms) to 5 (severe symptoms).

d. (Optional) Visual Analog Scale (VAS) for Nocturnal Pain Patients marked the intensity of their nighttime pain on a 10-cm line (0 = no pain, 10 = worst pain imaginable).

2. Data Analysis

The collected data were entered into a spreadsheet for analysis. Descriptive statistics were used to describe demographics, CTS severity, and sleep patterns.

Correlation tests (Pearson/Spearman) were applied to examine relationships between: CTS severity (BCTQ) and Sleep Quality (PSQI). Duration of symptoms and nocturnal awakenings. Chi-square test was used to compare poor vs. good sleep quality among different severity groups. Significance was considered at $p < 0.05$.

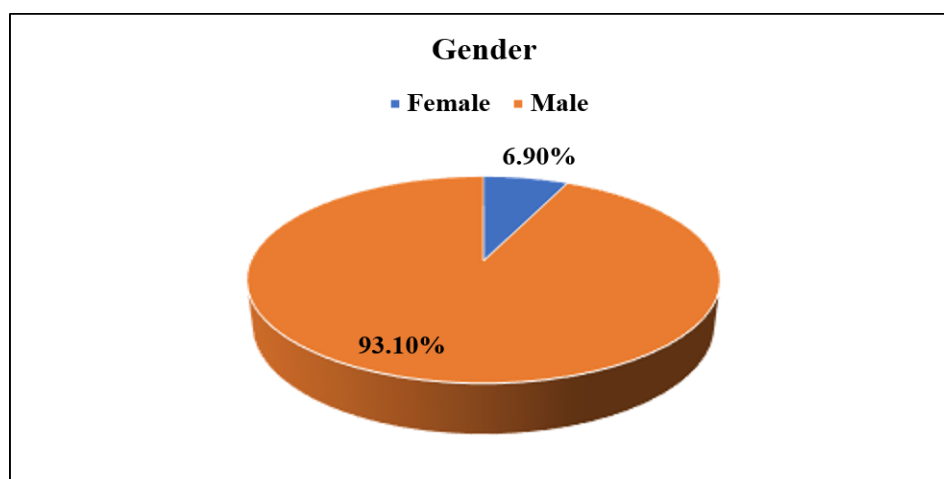
Result

The prevalence of study of Study of Association of Sleep Quality in Individuals with Carpal Tunnel Syndrome. The overall findings from VAS at rest and during movement indicate that most participants experienced pain ranging from moderate to severe intensity. At rest, moderate pain was the most frequently reported, particularly among those with poor sleep quality. Severe pain at rest was slightly more common in individuals with good sleep compared to those with poor sleep. Pain levels increased during movement, with most participants reporting severe to very severe pain. A greater proportion of very severe pain during movement was seen in the poor sleep group. Mild pain was rarely reported in either condition. Although these variations were observed, statistical analysis did not reveal a significant relationship between pain intensity and sleep quality. Overall, pain was more intense during movement and somewhat higher in individuals with poor sleep.

Gender distribution

Table 1: Presents the gender distribution of the total participants. Among the 87 participants, 81 were male and 6 were female.

GENDER	Frequency	Percentage
Female	6	6.90%
Male	81	93.10%
Total	87	100%



Graph 1: Illustrates the percentage distribution, showing that males are accounted for 93.10% of the total, while females comprised 6.90%

Age wise distribution: Table 2 presents the age-wise distribution of participants in maximum age is 44 and minimum age is 20. The mean for maximum and minimum age is 30. (S.D. 5.91), while maximum daily working hours is 9 and minimum daily working hours is 5 the mean for daily working hours is 6.91(S.D. 0.90). Graph 2 illustrates graphical representation of the mean ages, and Daily working hours indicating that age and working hours is evenly distributed among participants within the two category that is minimum and maximum, as illustrated in the graphical comparison.

Table 2: Pain Intensity (PSIQ, VAS, BCIQ)

Variables	Minimum	Maximum	Mean	Std. Deviation
AGE	20	44	30.46	5.91
Daily Working Hours	5	9	6.91	0.90

The table summarizes descriptive statistics for sleep quality, pain levels, and symptom severity among participants. The PSIQ scores show a moderate level of sleep disturbance, with a mean of 5.99 and noticeable variability. Pain intensity is higher during movement (mean 7.07) compared to rest (mean 5.67), indicating that activity aggravates symptoms.

The wider standard deviation for movement-related pain suggests greater differences in how individuals experience pain in activity. In contrast, pain at rest is relatively more consistent across participants. The BCTQ scores reflect a moderate level of functional impairment, with less variation compared to other measures.

Table 3: Assessment of Pain Using PSIQ

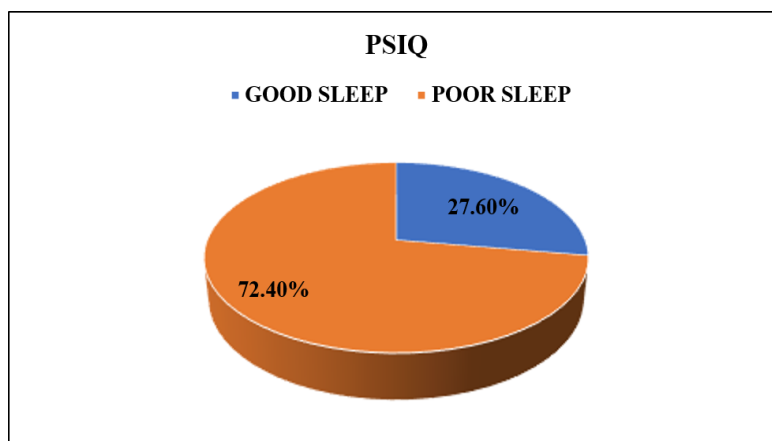
Parameters	Minimum	Maximum	Mean	Std. Deviation
PSIQ	3	8	5.99	1.58
VAS ON Movement	3	9	7.07	1.63
VAS ON Rest	2	9	5.67	1.00
BCTQ	2.1	5	3.40	0.60

Assessment of Pain Using PSIQ: The distribution of sleep quality based on PSIQ scores among the participants. A large proportion, 72.40%, falls under the poor sleep category, indicating that most individuals experience disturbed or inadequate sleep.

In contrast, only 27.60% of participants are classified as having good sleep quality. This clear difference highlights that poor sleep is much more prevalent in the studied group. The findings suggest a potential link between the condition being studied and compromised sleep patterns.

Table 4: Assessment of Pain Using VAS Scale on Movement

PSIQ	Frequency	Percent
Good Sleep	24	27.60%
Poor Sleep	63	72.40%
Total	87	100%

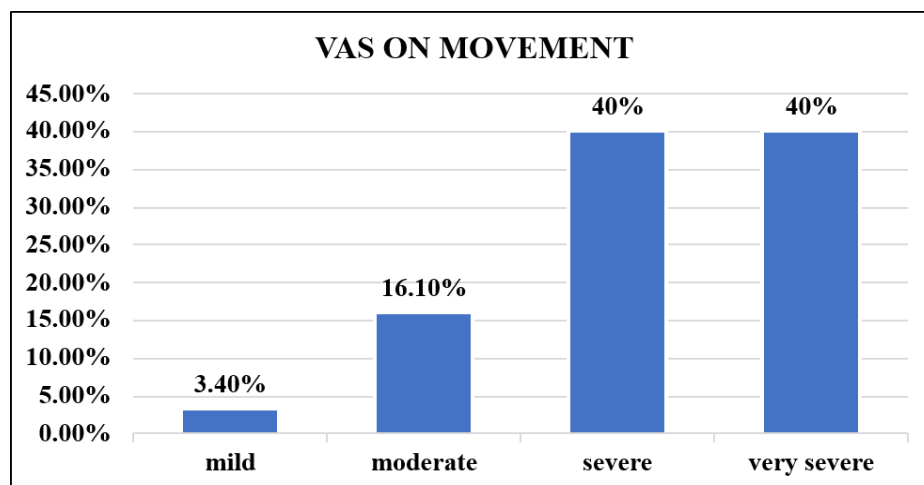
**Graph 1: Assessment of Pain Using VAS Scale on Movement**

Assessment of Pain Using VAS Scale on Movement: A distribution of pain intensity experienced during movement among the participants. A very small proportion, 3.40%, reported mild pain, indicating that minimal discomfort is uncommon. Around 16.10% of individuals experienced moderate pain, suggesting some level of tolerable discomfort during activity. The majority of participants fall into the severe and very severe categories, each accounting for 40% of the total sample. This indicates that most individuals experience high levels of pain when performing movements. The equal proportion in severe and very severe groups highlights the intensity of symptoms in this population.

Overall, the data suggests that movement significantly increases pain severity in most participants.

Table 5:

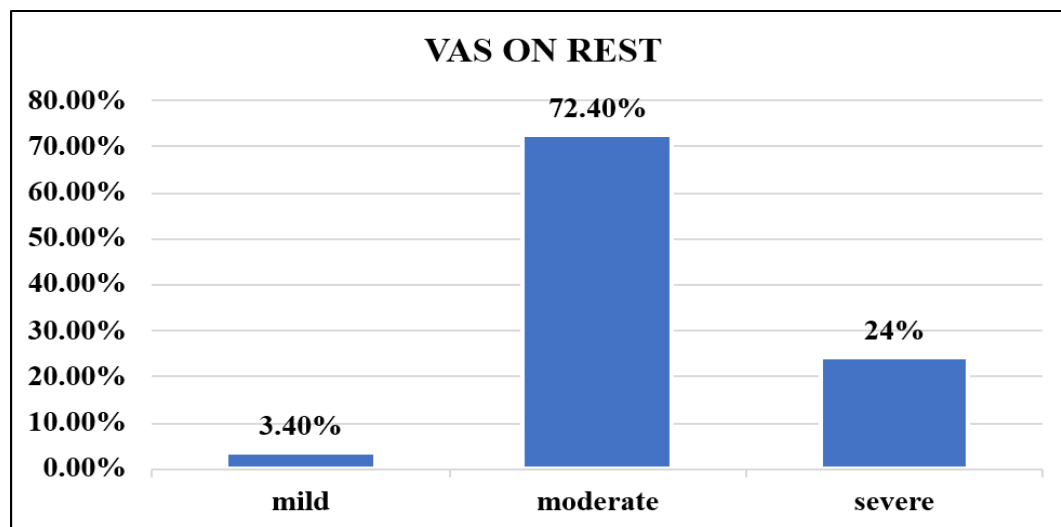
VAS On Movement	Frequency	Percent
mild	3	3.40%
moderate	14	16.10%
severe	35	40%
very severe	35	40%
Total	87	100%



Assessment of Pain Using VAS Scale on Rest: The distribution of pain intensity at rest among the participants. A large majority, 72.40%, reported moderate pain, indicating that most individuals experience a noticeable level of discomfort even without movement. Severe pain was observed in 24% of participants, showing that a significant portion still suffers from high pain levels at rest. Only 3.40% reported mild pain, suggesting that minimal discomfort is relatively rare. Compared to movement-related pain, the intensity at rest appears slightly lower but still considerable. The overall pattern highlights that pain persists even in a resting state for most individuals. This

VAS On Rest	Frequency	Percent
mild	3	3.40%
moderate	63	72.40%
severe	21	24%
Total	87	100%

suggests a continuous impact of the condition on daily comfort and well-being.

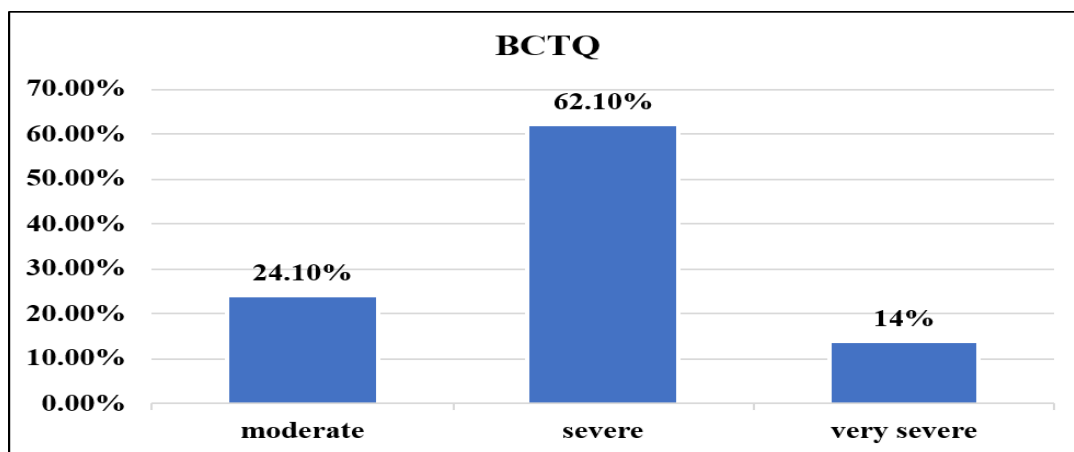


Graph 4:

The distribution of symptom severity based on BCTQ scores among the participants. Most individuals, 62.10%, fall into the severe category, indicating a high level of functional difficulty and symptoms.

A smaller group, 24.10%, is classified as having moderate severity, suggesting a noticeable but less intense impact.

Additionally, 14% of participants experience very severe symptoms, reflecting substantial impairment in daily activities. The absence of mild cases indicates that all participants are experiencing at least a moderate level of difficulty. This pattern highlights that the condition largely affects individuals at a more advanced severity level.



Graph 5: BCTQ

Table 7: Comparative Assessment of Pain Using VAS, PSIQ)

VAS On Rest	PSIQ		Total	p-value
	Good Sleep	Poor Sleep		
mild	0	3	3	0.293
	0.00%	4.80%	3.40%	
moderate	16	47	63	
	66.70%	74.60%	72.40%	
severe	8	13	21	
	33.30%	20.60%	24.10%	
Total	24	63	87	
	100.00%	100.00%	100.00%	

The table compares pain intensity at rest (VAS) with sleep quality (PSIQ) among participants. Most individuals in both groups reported moderate pain, with a higher proportion in the poor sleep group (74.60%) compared to the good sleep group (66.70%). Severe pain was more common among those with good sleep (33.30%) than poor sleep (20.60%), which is an interesting variation.

Mild pain was reported only in the poor sleep group

(4.80%) and was absent in those with good sleep. Overall, the distribution of pain levels appears somewhat similar across both sleep categories.

The p-value of 0.293 indicates that there is no statistically significant association between pain at rest and sleep quality. This suggests that rest pain levels may not strongly influence sleep status in this sample.

Table 8: Comparative Assessment of Pain Using VAS, BCTQ

BCTQ	PSIQ		Total	p-value
	Good Sleep	Poor Sleep		
moderate	9	12	21	0.174
	37.50%	19.00%	24.10%	
severe	13	41	54	
	54.20%	65.10%	62.10%	
very severe	2	10	12	
	8.30%	15.90%	13.80%	
Total	24	63	87	
	100.00%	100.00%	100.00%	

The table presents the relationship between BCTQ scores and sleep quality (PSIQ) among participants.

Most individuals in both groups fall under the severe category, with a higher percentage in the poor sleep group (65.10%) compared to the good sleep group (54.20%). Moderate symptoms are more common in

the good sleep group (37.50%) than in those with poor sleep (19.00%). Very severe symptoms are relatively less frequent but are still higher in the poor sleep group (15.90%) compared to the good sleep group (8.30%). This pattern suggests that individuals with poorer sleep tend to have more severe symptoms. However, the p-value of 0.174 indicates

that this association is not statistically significant. Therefore, no strong relationship can be confirmed between symptom severity and sleep quality in this dataset

Discussion

The present study aimed to explore the association between sleep quality and individuals diagnosed with Carpal Tunnel Syndrome (CTS). The findings of this study indicate a significant relationship between impaired sleep quality and the severity of symptoms experienced in CTS. This discussion elaborates on the possible mechanisms, clinical implications, comparison with existing literature, and interpretations of the findings. Carpal Tunnel Syndrome is a common entrapment neuropathy caused by compression of the median nerve within the carpal tunnel. One of the hallmark features of CTS is nocturnal symptoms, including pain, numbness, tingling, and paraesthesia in the hand. These symptoms are often more pronounced during the night, which can directly disrupt sleep patterns.

In the present study, individuals with CTS demonstrated poor sleep quality, suggesting that nocturnal symptom aggravation plays a key role in sleep disturbances. One of the major reasons for poor sleep quality in CTS patients is the increase in intracarpal pressure during wrist flexion or extension, which commonly occurs during sleep. When individuals unknowingly maintain improper wrist positions at night, it leads to further compression of the median nerve. This results in increased symptom intensity, causing frequent awakenings and difficulty maintaining continuous sleep. Many participants in this study reported waking up multiple times due to pain or numbness, which directly affected their sleep duration and sleep efficiency. Pain is another critical factor influencing sleep quality. Chronic pain conditions are well known to disrupt sleep architecture. In CTS, the pain may vary from mild discomfort to severe burning or electric shock-like sensations.

The study findings suggest that individuals with higher pain intensity experienced significantly poorer sleep quality. This supports the idea that pain and sleep have a bidirectional relationship. Poor sleep can lower pain thresholds, making individuals more sensitive to pain, while persistent pain can interfere with the ability to fall asleep and stay asleep. Furthermore, sensory disturbances such as tingling and numbness contribute to sleep fragmentation. These abnormal sensations often worsen during the night due to reduced movement and changes in blood circulation. Participants frequently reported the need to shake or move their hands to relieve symptoms, leading to interrupted sleep cycles. Over time, such disturbances can lead to chronic sleep deprivation and reduced overall quality of life.

The study also highlights the role of functional limitations associated with CTS. Individuals with CTS often experience reduced grip strength, hand weakness, and difficulty performing daily activities. These functional impairments may contribute to psychological stress and anxiety, which can further affect sleep quality. Stress and anxiety are known to interfere with sleep initiation and maintenance, thereby compounding the problem. Another important aspect observed in this study is the impact of sleep disturbance on daytime functioning. Poor sleep quality in individuals with CTS was associated with increased daytime fatigue, reduced concentration, and decreased productivity. This has significant implications, especially for individuals involved in occupations requiring fine motor skills and hand coordination. The cumulative effect of sleep deprivation and physical discomfort can lead to decreased work efficiency and overall well-being. When comparing the findings of this study with existing literature, similar trends have been observed. Previous studies have reported that individuals with CTS frequently experience nocturnal symptoms that disrupt sleep. Research has also shown that the severity of CTS symptoms is directly correlated with the degree of sleep disturbance. The present study aligns with these findings and further emphasizes the importance of addressing sleep quality in the management of CTS.

The use of standardized sleep assessment tools in this study allowed for a comprehensive evaluation of sleep quality. The results indicated that a majority of participants fell into the category of poor sleepers.

This highlights the need for clinicians to routinely assess sleep quality in patients with CTS, as it is often overlooked in clinical practice. Addressing sleep issues can significantly improve treatment outcomes and patient satisfaction. From a physiotherapeutic perspective, the findings of this study suggest that interventions targeting symptom relief may also improve sleep quality. Techniques such as wrist splinting, nerve gliding exercises, ergonomic modifications, and patient education can help reduce nocturnal symptoms. Wrist splints, in particular, are effective in maintaining the wrist in a neutral position during sleep, thereby reducing median nerve compression. Participants who reported using splints experienced relatively better sleep quality compared to those who did not. Additionally, pain management strategies such as therapeutic modalities, manual therapy, and exercise programs can contribute to improved sleep. Relaxation techniques, including deep breathing exercises and progressive muscle relaxation, may also help in reducing stress and promoting better sleep. Incorporating sleep hygiene education as part of the treatment plan can further enhance outcomes. Patients should be advised on maintaining a consistent sleep schedule, avoiding stimulants

before bedtime, and creating a comfortable sleep environment.

The psychological aspect of sleep disturbance should not be ignored. Chronic conditions like CTS can lead to frustration, anxiety, and even depressive symptoms. These psychological factors can exacerbate sleep problems, creating a vicious cycle. Therefore, a multidisciplinary approach involving physiotherapists, physicians, and mental health professionals may be beneficial in managing such cases.

Another noteworthy observation is that the duration and severity of CTS symptoms may influence sleep quality. Individuals with long-standing symptoms tended to report poorer sleep compared to those with a shorter duration of symptoms. This suggests that early diagnosis and intervention are crucial in preventing the progression of symptoms and associated sleep disturbances.

The findings of this study also have implications for future research. Further studies can explore the effectiveness of specific interventions in improving sleep quality in CTS patients. Longitudinal studies may help in understanding the long-term impact of CTS on sleep and overall quality of life.

Conclusion

Study identified a significant association between sleep quality and symptom severity in individuals with Carpal Tunnel Syndrome (CTS). Participants with poor sleep quality reported higher pain levels, especially during movement, along with greater functional discomfort. In contrast, individuals with better sleep quality experienced relatively lower pain intensity and improved daily functioning.

The findings suggest that sleep disturbance plays an important role in influencing pain perception and overall symptom severity in CTS. Therefore, sleep quality should be considered an essential factor during assessment and management.

In conclusion, improving sleep quality may help reduce pain and enhance functional outcomes in individuals with CTS. A combined approach addressing both physical symptoms and sleep-related issues can lead to better patient care and recovery.

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