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Original Research Article

Quality of Sleep and the Factors Affecting It in Adults with Traumatic Spinal Cord Injury: A Cross Sectional Study

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Conflict of interest: Nil

Abstract:

Background: In this study, we assessed the quality of sleep and the factors affecting it, in adults with traumatic spinal cord injury.

Methods: The observational cross- sectional study was carried out for a period of one year in 100 adults with TSCI who satisfied the selection criteria and visited the Department of PMR, at a tertiary care centre, Kerala, India. They were assessed for quality of sleep using the Pittsburgh Sleep Quality Index (PSQI). They were also interviewed and examined for extent of injury and for the presence of specific symptoms or signs peculiar to the study population. The presence or absence of these factors were compared with the quality of sleep to find out if they had any relationship to the same.

Results: SPSS version 25 data analyser was used to assess the variables. Chi square test was used to compare the results. On relating with sleep quality, the following factors: (1) AIS status, (2) duration of SCI, (3) flexor spasms, (4) bowel accidents, (5) anxiety, (6) depression, (7) bed mobility and (8) ambulatory ability were found to be of significance, while the factors: (1)extent of injury, (2)pain and (3) spasticity were not found to be statistically significant.

Conclusions: (1) 47% of the study population had disturbed sleep with a PSQI score of more than 5. (2) Patients with AIS D were 1. three times more likely to have undisturbed sleep compared to AIS A. (3) Patients with duration of SCI of more than one year were 1.56 times more likely to have undisturbed sleep compared to patients with duration less than one year. (4) Patients with flexor spasm were 3.67 times more likely to have disturbed sleep compared to those without. (5) Patients with bowel accidents were 3.67 times more likely to have disturbed sleep compared to those without. (6) Patientswith anxiety were 3.73 times more likely to have disturbed sleep compared to those without. (7) Patients with depression were 8.33 times more likely to have disturbed sleep compared to those without. (8) Patients with bed mobility were 4.88 times more likely to have undisturbed sleep compared to those without. (9) Patients with ambulatory ability were 17.3 times more likely to have undisturbed sleep compared to those without.

Keywords: Quality of Sleep; TSCI; Pittsburg Sleep Quality Index; Factors Affecting Quality of Sleep.

Introduction

The global annual incidence of Traumatic SCI is increasing yearly. The physical, social, and occupational well-being of patients is severely impacted by traumatic spinal cord injury (SCI). Even though there are a number of sleep related problems reported by these traumatic SCI patients, these are less addressed. Also, reported studies assessing the quality of sleep among traumatic SCI patients are very less from our country.

So in this background, this study was conducted to assess the quality of sleep among patients with traumatic spinal cord injury and also to determine the factors affecting it, which may help to provide a better choice for sleep related problems. The study might also help in early addressal of the problem by physiatrists and initiation of early interventions and rehabilitation strategies to improve the sleep quality among the patients with traumatic spinal cord injury.

In humans, the spinal cord starts at the base of the skull at the foramen magnum and enters the spinal canal at the level of the first cervical vertebra. It

ends at the level of the lower border of the L1 vertebral body. It is shielded by the bony vertebral column that surrounds it. [1,2]

Spinal cord injury (SCI) is defined as damage to the spinal cord that temporarily or permanently causes changes in its function. SCI is divided into traumatic and non-traumatic etiologies [3] Injury can happen at any level of the spinal cord and can be complete or incomplete. Complete injuries result in the complete loss of sensation and muscle function at lower sacral segments. The symptoms can range from numbness to paralysis, including bowel or bladder incontinence, depending on the site and extent of the damage. The long-term prognosis can be quite variable, ranging from complete recovery to permanent tetraplegia or paraplegia. Muscle atrophy, loss of voluntary motor control, stiffness, spasticity, pressure injuries, urinary tract infections, and respiratory issues can all be complications.

In traumatic SCI, the original insult causes cell death and sets off a complicated chain of secondary injuries that results in inflammation, ischemia, and the cyclical death of neurons and glial cells. Following this cascade, the spinal cord's organisation and structural architecture alter, leading to the development of cystic cavities and glial scars. Because of the weak intrinsic recovery potential of the spinal cord due to the glial scar and cystic cavities, poor endogenous remyelination, and poor axonal regeneration, SCI results in long-term neurological impairments. [3,4]

The Asia Impairment Scale (AIS) stratifies a SCI into five categories of severity, labeled A through E, based on the degree of motor and sensory loss. A Spinal Cord Injury that results in the absence of any sensory or motor function in the sacral segments S4– S5 would have an AIS category of A and be designated as complete. For a SCI where sensation is preserved in the sacral segments S4–S5 (sacral sparing) but there is no VAC (Voluntary Anal Contraction) or motor function more than three segments below the motor level, the AIS is B. For a SCI where sensation is preserved in the sacral segments S4–S5, there is VAC or motor function more than three segments below the motor level, but more than half the key muscles below the Neurological Level of Injury (NLI) have a muscle grade <3, the AIS is C. For individuals with AIS B, the presence of non-key muscles greater than three segments below the motor level indicates an AIS C. Non- key muscle can be used only to differentiate AIS B from AIS C. For a SCI where sensation is preserved in the sacral segments S4–S5 and at least half the key muscles below the NLI have a muscle grade ≥3, the AIS is D. When sensory and motor function is normal, the AIS is E. AIS categories B through E designate incomplete injuries.

Poor sleep quality is a commonly reported problem by SCI patients, but remain under-recognized, underdiagnosed, and thus remain untreated for the majority of patients. People with SCI who experience sleep problems have significantly worsened daytime functioning and quality of life. [5,6] Younger patients with SCI are reported to have more sleep related problems than older individuals. [6] A study done by Shirin Shafazand et al titled Sleep Complaints and Sleep Quality in Spinal Cord Injury: A Web-Based Survey concluded that insomnia, sleep apnea, and poor sleep quality are common in individuals with chronic SCI; often coexisting. There is a need for increased screening for sleep problems among SCI patients. [7]

The Pittsburg Sleep Quality Index (PSQI) is a self-rated questionnaire which assesses sleep quality and disturbances over a one-month time interval. Nineteen individual items generate seven component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of medications for sleep and daytime dysfunction. The sum of scores for these seven components yields one global score (range 0 to 21). A global score greater than 5 indicates sleep disturbance.

Aims and Objectives

To assess the quality of sleep and the factors affecting it, in adults with traumatic Spinal Cord Injury

Materials and Methods

This was a hospital-based observational cross sectional study conducted among 100 patients with Traumatic Spinal Cord Injury, at the Department of Physical Medicine and Rehabilitation, at a tertiary care centre, Kerala, India, using the Pittsburg Sleep Quality Index, for one year, after obtaining clearance from the Institutional Ethics Committee and written informed consent from the study participants.

Inclusion Criteria

1. Patients with traumatic Spinal Cord Injury of duration more than 3 months.
2. Patients between 18 - 65 years of age with traumatic Spinal Cord Injury.
3. Patients with SCI of AIS grades A, B, C or D.

Exclusion Criteria

- Presence of cognitive deficit.
- Presence of other neurological diseases like cerebro-vascular accident, cerebral palsy and traumatic brain injury.
- Presence of sleep disturbances prior to injury.
- Pregnant women.
- Patients with psychosis.
- Patients with obstructive sleep apnoea prior to the injury to the spinal cord.

Statistical Analysis: The data collected were analysed using the software, SPSS version 25. The assessment of variables was done with Chi-square test and risk estimate was done using odds ratio. A p-value <0.05 was considered as statistically significant.

Results

Table 1: Prevalence of normal and disturbed sleep

Sleep	N
Normal	53
Disturbed	47

Out of the 100 patients with TSCI, 53% and 47% had undisturbed and disturbed sleep respectively.

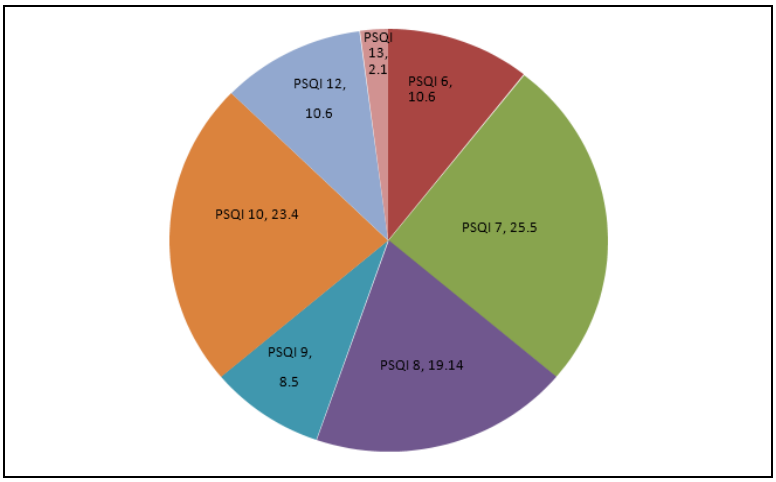

Figure 1: PSQI Score

Out of the 47 patients with disturbed sleep, 10.6 %, 25.5%, 19.1%, 8.5%, 23.4%, 10.6% and 2.1% had PSQI scores of 6, 7, 8, 9, 10, 12 & 13 respectively. There were no patients with PSQI scores of 14 and above.

Table 2: PSQI Score & AIS - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23.152[a]	3	0.000
Likelihood Ratio	25.057	3	0.000
N of Valid Cases	100		
a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is .94.			

Table 3: PSQI Score & Duration - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.730[a]	1	0.009		
ContinuityCorrection[b]	5.662	1	0.017		
Likelihood Ratio	6.920	1	0.009		
Fisher's Exact Test				0.011	0.008
Linear-by-LinearAssociation	6.663	1	0.010		
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.04.					
b. Computed only for a 2x2 table					

Table 4: PSQI Score & Flexor Spasm at Night - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.368[a]	1	0.012		
ContinuityCorrection[b]	5.187	1	0.023		
Likelihood Ratio	6.490	1	0.011		
Fisher's Exact Test				0.014	0.011
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.87.					
b. Computed only for a 2x2 table					

Table 5: PSQI Score & Bowel Accidents at Night - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.368[a]	1	0.012		
ContinuityCorrection[b]	5.187	1	0.023		
Likelihood Ratio	6.490	1	0.011		
Fisher's Exact Test				0.014	0.011
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.87.					
b. Computed only for a 2x2 table					

Table 6: PSQI Score & Anxiety - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.083[a]	1	0.001		
ContinuityCorrection[b]	8.849	1	0.003		
Likelihood Ratio	10.248	1	0.001		
Fisher's Exact Test				0.002	0.001
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 22.09.					
b. Computed only for a 2x2 table					

Table 7: PSQI Score & Depression - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	22.834[a]	1	0.000		
ContinuityCorrection[b]	20.929	1	0.000		
Likelihood Ratio	23.752	1	0.000		
Fisher's Exact Test				0.000	0.000
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 19.27.					
b. Computed only for a 2x2 table					

Table 8: PSQI Score & Bed Mobility - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.900[a]	1	0.000		
ContinuityCorrection[b]	11.435	1	0.001		
Likelihood Ratio	13.189	1	0.000		
Fisher's Exact Test				0.000	0.000
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is16.45.					
b. Computed only for a 2x2 table					

Table 9: PSQI Score & Ambulatory Ability - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	26.053[a]	1	0.000		
ContinuityCorrection[b]	23.801	1	0.000		
Likelihood Ratio	28.460	1	0.000		
Fisher's Exact Test				0.000	0.000
N of Valid Cases	100				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is12.69.					
b. Computed only for a 2x2 table					

Discussion

The estimated annual global incidence of SCI is 40-80 cases per million population, and up to 90% of these SCI are due to traumatic causes. Sleep disturbances are more prevalent in people with spinal cord injury (SCI) than in the general population and they probably cause a decline in the quality of life and societal engagement. A common patient-reported consequence in populations with chronic SCI is poor sleep quality.

In the present study sample, out of a total popula-

tion of 100, 53 had normal sleep and 47 had disturbed sleep as per the Pittsburgh Sleep Quality Index (PSQI). Mean age (44.26±13.8 vs. 44.28±11.6) and gender distribution were found to be comparable.

In a previous cross-sectional study conducted on sleep disturbance using the PSQI in 180 chronic SCI patients, January et al based on logistic regression model, reported that tetraplegia was not a significant predictor of sleep disturbance. [8] This study shows similar results. However, other studies, for eg, a study by Tugba Aydin et al, on sleep quality in individuals with short- duration chronic SCI, it was found that tetraplegia was a strong associated factor for sleep disturbance. [9] One reason why our study differs from that of Tugba Aydin et al could be because the persons with central cord injury who were ambulant were also included among the tetraplegic individuals.

AIS grades and sleep quality were found to be statistically significant by p value. AIS D patients were 1.3 times more likely to have undisturbed sleep than AIS A patients, as per odds ratio as well. However, as per odds ratio, this was not so for AIS C, with AIS A as reference. This disparity could probably be due to insufficient sample size.

A study by Jensen et al (2009) showed no relationship between SCI duration and sleep disturbance. [6] However in the present study, duration of SCI and sleep quality were found to be statistically significant. As per odds ratio, patients with TSCI of duration more than one year were 1.56 times more likely to have undisturbed sleep than those with duration of less than or equal to one year.

The present study shows that sleep disturbance is not associated with neuropathic pain which is unexpected. One possible reason for this might be that, the patients were on drugs like pregabalin and gabapentin, which decreases the likelihood of sleep disruption.

Spasticity was not found to be a significant factor affecting sleep quality. This might be due to the effect of the antispastic medication Baclofen, which is known to cause sleepiness and hence decreases the likelihood of sleep disruption. Presence of flexor spasms on the other hand was found to be a significant factor affecting sleep quality in this study. Patients with flexor spasms at night were 3.67 times more likely to have disturbed sleep compared to those without flexor spasms at night. There are few studies comparing the effect of flexor spasms on sleep quality.

In a study by Chin-Wei Liu et al, neurogenic bowel dysfunction was found to be associated with health related QOL, especially physical functioning, in persons with SCI. [10] In the present study, patients with bowel accidents at night were 3.67 times more likely to have disturbed sleep compared to those without bowel accidents at night.

In a cohort study by Sher-Wei-Lim et al, individuals with TSCI were found to have a higher risk of anxiety and depression compared to other health conditions group. [11] In a meta-analysis by J Le & D Dorstyn, significant minority of individuals with SCI, expressed disorders or symptoms of anxiety that persist over time. [12] In the present study, patients with anxiety were 3.73 times more likely to have disturbed sleep compared to those without anxiety.

Previous studies suggest that depression affects between 19 & 26 % of individuals with SCI which is about three times higher than that of the general population (McDonald et al, 2018). [13] In yet another study by Fogelberg et al, a correlation was found between depression and sleep in individuals with SCI. [14] This corresponds with our study findings of statistically significant association between depression and quality of sleep. We also found that, patients with TSCI and depression were 8.3 times more likely to have disturbed sleep compared to those without depression.

In a study by Andreane Richard-Denis et al, mobility subscore was the only functional aspect, significantly associated with all QOL domains (physical, psychological, social and environmental). [15] In the present study, the study population with bed mobility and ambulatory ability had better quality of sleep. Patients with bed mobility were 4.88 times more likely to have better sleep compared to those without bed mobility and patients with ambulatory ability were 17.3 times more likely to have better sleep compared to those without ambulatory ability.

Conclusions

The present study led to the following conclusions.

1) 47% of the adults with TSCI had disturbed sleep with a PSQI score of more than 5.
2) Patients with AIS D were 1.3 times more likely to have undisturbed sleep compared to AIS A.
3) Patients with duration of SCI of more than one year were 1.56 times morelikely to have undisturbed sleep compared to patients with duration of SCI less than or equal to one year.
4) Patients with flexor spasm at night were 3.67 time more likely to have disturbed sleep compared to those without flexor spasms at night.
5) Patients with bowel accidents at night were 3.67 times more likely to have disturbed sleep compared to those without bowel accidents at night.
6) Patients with anxiety were 3.73 times more likely to have disturbed sleep compared to those without anxiety.
7) Patients with depression were 8.33 times more

likely to have disturbed sleep compared to those without depression.

8) Patients with bed mobility were 4.88 times more likely to have undisturbed sleep compared to patients without bed mobility.
9) Patients with ambulatory ability were 17.3 times more likely to have undisturbed sleep compared to patients without ambulatory ability.
10) Factors like extent of injury, pain and spasticity that were expected to affect sleep quality were not found to be statistically significant in this study.

Limitations of the study

1) The sample size was small.
2) The study didn't use any objective tools such as Polysomnography (PSG) for assessment of sleep.
3) The use of baclofen, pregabalin and gabapentin was a confounder.

Abbreviation

TSCI- Traumatic Spinal Cord Injury

AIS- ASIA Impairment Scale

NLI- Neurological Level of Injury

QOL- Quality of Life

PSQI-Pittsburg Sleep Quality Index

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