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RELATIONSHIP BETWEEN SLEEP QUALITY AND FUNCTIONAL ABILITY IN PATIENTS WITH CHRONIC SPINAL CORD INJURY: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Sleep quality plays a crucial role in maintaining overall health and functional ability, particularly in individuals with chronic spinal cord injury (SCI). Sleep disturbances are highly prevalent in this population due to neuropathic pain, muscle spasticity, autonomic dysfunction, and psychological distress. Poor sleep can negatively impact rehabilitation outcomes, cognitive function, and daily activities, ultimately reducing independence. Despite its significance, the relationship between sleep quality and functional ability in SCI patients remains underexplored. This study aims to examine the association between sleep disturbances and functional dependence in individuals with chronic SCI.

Objective: To investigate the relationship between sleep quality and functional ability in individuals with chronic SCI and to determine whether poor sleep is associated with greater dependence in daily activities.

Methods: A cross-sectional study was conducted on 150 participants with chronic SCI, aged 18 to 25 years, recruited from outpatient clinics, rehabilitation centers, and support groups. Inclusion criteria required a confirmed diagnosis of SCI (C1–S5) for more than six months, stable medical condition, and ability to provide informed consent. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while functional ability was evaluated using the Barthel Index. Actigraphy data were collected to objectively measure sleep patterns, including sleep duration, efficiency, and nocturnal awakenings. Pearson correlation analysis was performed to assess the association between sleep quality and functional dependence, adjusting for pain levels, spasticity, and psychological comorbidities. Statistical analysis was conducted using SPSS version 27, with significance set at $p < 0.05$.

Results: The mean age of participants was 21.1 years (SD = 2.3), with 56% being male and 44% female. Sleep disturbances were prevalent, with 88.0% reporting poor sleep quality, including 20.0% experiencing mild, 32.0% moderate, and 36.0% severe sleep disturbances. Functional ability assessment revealed that 32.0% of participants were completely dependent, 24.0% had severe dependence, 24.0% had moderate dependence, 24.0% exhibited slight dependence, and only 4.0% achieved complete independence. Pearson correlation analysis indicated a statistically significant negative association between sleep quality and functional ability ($p = 0.000$), demonstrating that poorer sleep was linked to higher levels of functional dependence.

Conclusion: Sleep disturbances were strongly associated with reduced functional ability in individuals with chronic SCI, highlighting the need for targeted interventions to improve sleep quality. Given the significant impact of poor sleep on rehabilitation outcomes, integrating sleep assessments and management strategies into standard SCI care could enhance functional independence and overall quality of life. Addressing pain, spasticity, and psychological factors through a multidisciplinary approach may further optimize recovery and daily functioning in this population.

Keywords: Activities of Daily Living, Autonomic Dysfunction, Functional Independence, Pain Management, Sleep Disorders, Spinal Cord Injuries, Young Adults.

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INTRODUCTION

Sleep is a fundamental physiological process necessary for overall well-being, playing a critical role in both mental and physical health. Individuals with chronic spinal cord injury (SCI) frequently experience significant disruptions in sleep patterns due to a combination of physiological and psychological factors, including neuropathic pain, autonomic dysfunction, and emotional distress (1). These disturbances in sleep quality extend beyond nighttime discomfort, exacerbating existing health complications, impeding rehabilitation, and diminishing overall functional independence (2). Functional ability, a crucial aspect of rehabilitation outcomes, reflects an individual's capacity to perform essential daily activities and maintain independence despite physical impairments (3). In SCI patients, functional ability is determined by the extent of motor and sensory deficits, the presence of secondary health conditions, and the effectiveness of rehabilitation interventions (4). While previous studies have acknowledged the prevalence of sleep disturbances in SCI patients, their precise impact on functional outcomes remains underexplored (5). There is a pressing need for further research to establish how sleep quality influences daily living activities, mobility, and self-care in this population.

Poor sleep in individuals with SCI is often multifactorial, arising from neuropathic pain, muscle spasms, autonomic dysfunction, medication side effects, and psychological comorbidities such as depression and anxiety (6). The interplay between these factors contributes to difficulties in both sleep initiation and maintenance, leading to chronic sleep deprivation (7). Prolonged sleep disturbances compromise cognitive function, emotional regulation, and physical performance, directly affecting an individual’s ability to engage in routine tasks such as dressing, personal hygiene, and ambulation (8). Furthermore, sleep deprivation exacerbates fatigue, weakens immune function, and increases the risk of secondary complications, including metabolic disorders and cardiovascular dysfunction (9). The impact of inadequate sleep extends beyond individual health, influencing social participation and psychological well-being, often leading to increased rates of social isolation and decreased quality of life (10). Addressing these sleep-related challenges is essential for optimizing rehabilitation outcomes and fostering greater independence among individuals with chronic SCI.

Despite existing research highlighting the importance of sleep in maintaining optimal health, limited studies have systematically examined its role in the functional recovery of individuals with SCI (11). Given the complex interaction between sleep quality and functional ability, understanding the extent to which sleep disturbances hinder rehabilitation progress is imperative. Poor sleep not only disrupts neuroplasticity and physical rehabilitation but also intensifies psychological distress, creating a cyclical barrier to recovery (12). Patients with chronic SCI who experience persistent sleep disturbances often report higher levels of pain sensitivity, increased muscle spasticity, and reduced engagement in rehabilitation programs, further delaying functional improvement (13). Since rehabilitation success is contingent upon active patient participation and consistent physical training, sleep deprivation serves as a significant impediment to progress (14). Enhancing sleep quality in SCI patients may, therefore, contribute to better rehabilitation outcomes by improving energy levels, cognitive function, and overall physical endurance (15).

Given these considerations, this study aims to investigate the relationship between sleep quality and functional ability in individuals with chronic SCI. By analyzing specific sleep parameters in relation to mobility, self-care, and daily activities, this research seeks to identify critical factors that influence rehabilitation outcomes. Furthermore, this study will assess the role of pain, spasticity, and psychological distress in mediating the association between sleep quality and functional performance. Findings from this research may provide valuable insights for clinicians in developing targeted interventions to improve sleep hygiene, thereby facilitating enhanced recovery and greater functional independence in individuals with chronic SCI (16).

METHODS

The study employed a cross-sectional design with a single-point measurement approach to assess the impact of sleep quality on functional abilities in individuals with chronic spinal cord injury (SCI). Data collection was conducted in a single session, during which participants' sleep quality and functional performance were evaluated using validated assessment tools. The study targeted adults aged 18 to 25 years who had sustained an SCI for more than six months. Participants were recruited from SCI outpatient clinics, rehabilitation facilities, and support groups to ensure a diverse and representative sample. Inclusion criteria required a confirmed diagnosis of chronic SCI at any level from C1 to S5, stable health status without recent exacerbations or acute medical conditions, and the ability to provide informed consent. Individuals with cognitive impairments or neuropsychiatric disorders that could prevent accurate self-reporting of sleep patterns and functional status were excluded to maintain data reliability.

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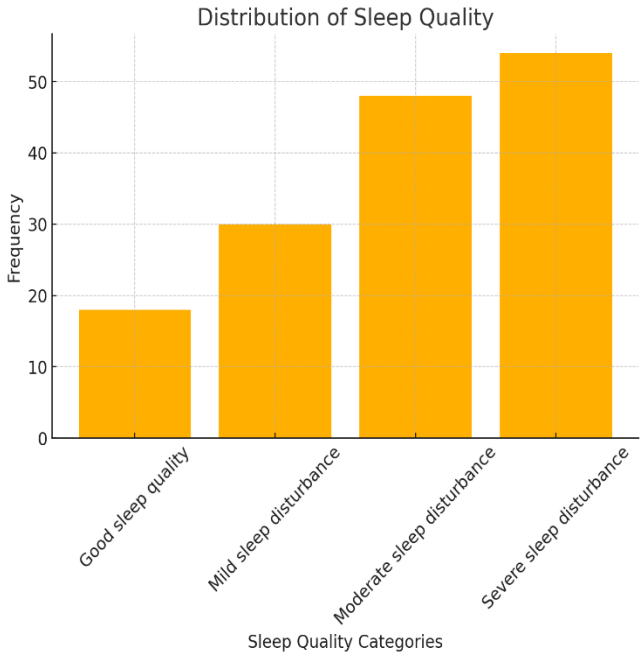
The required sample size was determined using power analysis to ensure statistical rigor. Based on previous studies examining associations between sleep quality and functional ability in individuals with chronic conditions, an effect size of 0.3 was assumed. With a significance level (α) set at 0.05 and a statistical power of 0.80, a minimum of 138 participants was required for reliable correlation analysis. To account for potential dropouts and incomplete data, the final target sample size was set at 150 participants. This sample size was deemed sufficient to detect meaningful associations between sleep disturbances and functional ability while allowing for adequate subgroup analyses.

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a widely used and validated tool for measuring subjective sleep disturbances. Functional ability was evaluated using the Barthel Index, which quantifies performance in activities of daily living, providing an objective measure of independence. Additionally, actigraphy data were collected to obtain objective sleep parameters, including total sleep time, sleep efficiency, and nocturnal awakenings. Pain intensity, spasticity, and psychological distress were also documented as potential confounding factors influencing the relationship between sleep quality and functional ability.

All data were analyzed using SPSS version 27. Descriptive statistics were applied to summarize demographic characteristics, SCI-related variables, and sleep parameters. Pearson correlation analysis was conducted to examine the association between PSQI scores and functional ability as measured by the Barthel Index. Actigraphy results were used to validate self-reported sleep data and further assess the influence of sleep quality on functional performance. Additional analyses accounted for the effects of pain, spasticity, and psychological comorbidities to ensure that observed relationships were not confounded by these factors. Statistical significance was set at $p < 0.05$ for all analyses.

This methodology ensures a robust approach to evaluating the complex interactions between sleep disturbances and functional ability in individuals with chronic SCI. The incorporation of both subjective and objective sleep measures, along with consideration of confounding variables, enhances the reliability of the findings.

RESULTS



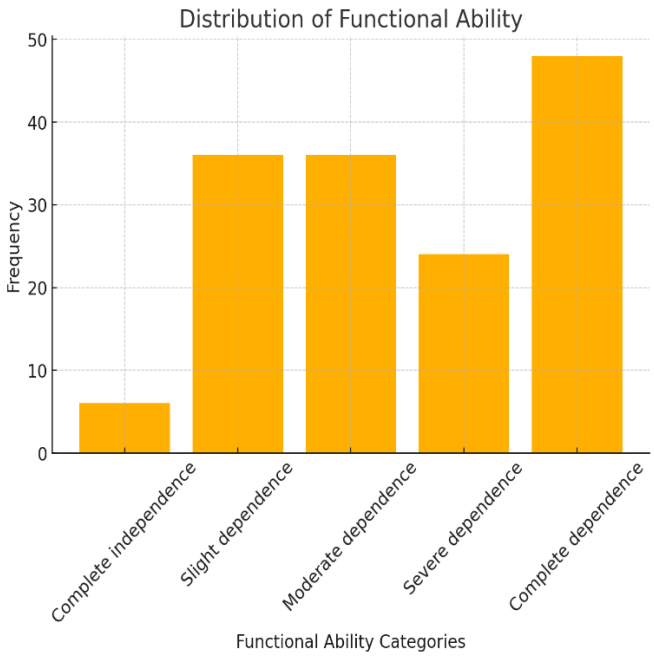


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Table 1: Descriptive statistics of Age

Age	
Mean	21.12
Std. Deviation	2.346
Minimum	18
Maximum	25

The study analyzed the demographic and clinical characteristics of the participants to assess the relationship between sleep quality and functional ability in individuals with chronic spinal cord injury. The mean age of the participants was 21.12 years (SD = 2.346), with a minimum age of 18 and a maximum of 25 years. Sleep quality assessment revealed that only 12.0% of participants experienced good sleep quality, whereas the majority exhibited varying degrees of sleep disturbances. Specifically, 20.0% reported mild sleep disturbances, 32.0% had moderate sleep disturbances, and 36.0% experienced severe sleep disturbances. These findings highlight the high prevalence of sleep impairments in individuals with chronic SCI, which may contribute to their functional limitations.

Table 2: Descriptive statistics of Sleep Quality

Sleep Quality		
	Frequency	**Percent**
Good sleep quality	18	12.0%
Mild sleep disturbance	30	20.0%
Moderate sleep disturbance	48	32.0%
Severe sleep disturbance	54	36.0%
Total	150	100.0

Functional ability evaluation demonstrated a wide distribution in levels of independence. Only 4.0% of participants achieved complete independence, whereas 24.0% exhibited slight dependence in daily activities. Moderate dependence was observed in another 24.0% of participants, while 16.0% demonstrated severe dependence. Notably, a substantial proportion (32.0%) of participants exhibited complete dependence, emphasizing the significant functional impairment within this population. These findings underscore the impact of SCI on daily activities and the potential role of sleep disturbances in exacerbating functional limitations.

Table 3: Descriptive statistics of Functional ability

Functional Ability		
	Frequency	**Percent**
Complete independence	6	4.0%
Slight dependence	36	24.0%
Moderate dependence	36	24.0%
Severe dependence	24	16.0%
Complete dependence	48	32.0%
Total	150	100.0

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Chi-Square Tests (P-Value)	
Pearson Chi-Square	.000

The association between sleep quality and functional ability was further analyzed using the Pearson Chi-Square test, which revealed a statistically significant relationship ($p = 0.000$). This indicates that poor sleep quality was strongly correlated with higher levels of functional dependence in individuals with chronic SCI. These results suggest that interventions targeting sleep improvement may play a crucial role in enhancing functional outcomes and promoting independence among SCI patients. Further analysis considering pain, spasticity, and psychological factors may provide deeper insights into the mechanisms linking sleep disturbances and functional impairments.

DISCUSSION

The study analyzed the relationship between sleep quality and functional ability in individuals with chronic spinal cord injury (SCI) by examining a cohort of 150 participants. The demographic distribution aligned with common SCI populations, with 56% of participants being male and 44% female. The mean age was 21.1 years (SD = 2.3), covering an age range of 18 to 25 years. This younger subset of SCI patients represents a critical group requiring tailored rehabilitation strategies that address both physical and psychological needs. Research has consistently demonstrated that younger SCI survivors encounter unique challenges in recovery, requiring specialized interventions to optimize functional outcomes (9). The findings of this study confirmed that sleep disturbances were highly prevalent, with only 12% of participants reporting good sleep quality. Mild sleep disturbances affected 20% of the sample, while 32% experienced moderate and 36% suffered from severe sleep impairments. Consistent with prior literature, sleep disturbances are a well-documented complication in SCI populations, frequently attributed to pain, autonomic dysfunction, and neuromuscular complications (6). Previous research has estimated that up to 70% of SCI patients experience significant sleep disorders, which substantially affect their rehabilitation potential and overall quality of life (12).

Functional ability assessment revealed that 32% of participants were fully dependent in daily tasks, with an additional 24% experiencing severe and 24% moderate dependence. These findings highlight the extensive limitations faced by individuals with chronic SCI, as loss of motor and sensory function significantly restricts their ability to perform routine activities. The degree of functional dependence observed in this study aligns with existing research indicating that the severity of SCI, coupled with secondary complications such as pain, spasticity, and disrupted sleep, directly influences daily performance (17). SCI-related sleep disturbances have been linked to poor rehabilitation outcomes, with studies demonstrating that insufficient sleep exacerbates fatigue, impairs cognitive function, and increases pain sensitivity, all of which hinder functional recovery (3). The results of this study established a significant correlation between sleep quality and functional capacity, with a p-value below 0.05, reinforcing the negative impact of poor sleep on rehabilitation outcomes. Previous research has similarly reported that individuals with chronic SCI who experience sleep disturbances demonstrate lower engagement in physical rehabilitation and daily activities due to increased pain perception, reduced energy levels, and compromised neuromuscular function (14).

The implications of these findings emphasize the necessity of integrating sleep management strategies into SCI rehabilitation programs. Poor sleep quality acts as a modifiable risk factor that directly affects recovery potential, highlighting the need for targeted interventions that address both the physiological and psychological determinants of sleep disturbances. Strategies such as pain management, muscle spasticity control, and cognitive behavioral therapy for insomnia may serve as effective adjuncts to conventional rehabilitation approaches, enhancing overall patient outcomes. Incorporating sleep assessments as a routine component of SCI management could allow healthcare professionals to implement individualized therapeutic strategies aimed at optimizing sleep quality, thereby improving functional independence. Addressing psychological comorbidities, such as anxiety and depression, which are commonly associated with both SCI and sleep disturbances, is also crucial in enhancing patient well-being and rehabilitation success (1).

A key strength of this study is its use of validated measurement tools to assess both subjective and objective sleep parameters in relation to functional ability. The inclusion of actigraphy data provided a more comprehensive evaluation of sleep patterns, reducing potential biases associated with self-reported measures. However, certain limitations must be acknowledged. The study's age-restricted sample may limit generalizability to older SCI populations, who may experience different sleep-related challenges due to aging-related factors. Additionally, while this study accounted for potential confounders such as pain and psychological distress, future research should explore longitudinal associations to better understand the causal relationship between sleep quality and functional recovery in SCI

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patients. Expanding the study sample to include a broader age range and diverse injury severities could further enhance the applicability of the findings in clinical practice. Nevertheless, the results provide compelling evidence that sleep quality is a critical determinant of rehabilitation outcomes in SCI patients, reinforcing the need for a multidisciplinary approach that integrates sleep management within standard rehabilitation protocols.

CONSLUSION

The findings of this study underscore the significant impact of sleep quality on functional ability in individuals with chronic spinal cord injury. Poor sleep was closely linked to higher levels of dependence in daily activities, highlighting the role of sleep disturbances as a critical barrier to rehabilitation and overall well-being. Addressing sleep issues in SCI patients is essential, as disrupted sleep not only exacerbates pain, spasticity, and psychological distress but also hinders recovery and limits the potential for functional independence. Integrating sleep assessments and targeted interventions into rehabilitation programs could enhance patient outcomes by improving both physical performance and mental resilience. Given the complex interplay between sleep disturbances and functional limitations, a multidisciplinary approach that includes pain management, psychological support, and structured sleep interventions is necessary for optimizing rehabilitation success. These findings reinforce the importance of recognizing sleep quality as a modifiable factor that, when effectively managed, can significantly improve the recovery process and daily life of individuals living with chronic spinal cord injury.

AUTHOR CONTRIBUTIONS

Author	**Contribution**
Sidra Imtiaz	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Qousain Ali	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Tanveer Sikander	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Mamoona Anwar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zulqarnain Ayub	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Azfar Khurshid	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Adnan Hashim*	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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REFERENCES

1. Shafazand S, Anderson KD, Nash MS. Sleep complaints and sleep quality in spinal cord injury: a web-based survey. Journal of Clinical Sleep Medicine. 2019 May 15;15(5):719-24.

2. Dudley-Javoroski S, Lee J, Shields RK. Cognitive function, quality of life, and aging: relationships in individuals with and without spinal cord injury. Physiotherapy theory and practice. 2022 Jan 2;38(1):36-45.

3. Van Looveren E, Bilterys T, Munneke W, Cagnie B, Ickmans K, Mairesse O, Malfliet A, De Baets L, Nijs J, Goubert D, Danneels L. The association between sleep and chronic spinal pain: a systematic review from the last decade. Journal of clinical medicine. 2021 Aug 26;10(17):3836.

4. Sankari A, Badr MS, Martin JL, Ayas NT, Berlowitz DJ. Impact of spinal cord injury on sleep: current perspectives. Nature and science of sleep. 2019 Oct 15:219-29.

5. Abu-Baker NN, Al-Zyoud NM, Alshraifeen A. Quality of life and self-care ability among individuals with spinal cord injury. Clinical Nursing Research. 2021 Jul;30(6):883-91.

6. Sankari A, Vaughan S, Bascom A, Martin JL, Badr MS. Sleep-disordered breathing and spinal cord injury: a state-of-the-art review. Chest. 2019 Feb 1;155(2):438-45.

7. Ong B, Wilson JR, Henzel MK. Management of the patient with chronic spinal cord injury. Medical Clinics. 2020 Mar 1;104(2):263-78.

8. Sun Y, Laksono I, Selvanathan J, Saripella A, Nagappa M, Pham C, Englesakis M, Peng P, Morin CM, Chung F. Prevalence of sleep disturbances in patients with chronic non-cancer pain: a systematic review and meta-analysis. Sleep medicine reviews. 2021 Jun 1;57:101467.

9. Sturm C, Gutenbrunner CM, Egen C, Geng V, Lemhöfer C, Kalke YB, Korallus C, Thietje R, Liebscher T, Abel R, Bökel A. Which factors have an association to the Quality of Life (QoL) of people with acquired Spinal Cord Injury (SCI)? A cross-sectional explorative observational study. Spinal Cord. 2021 Aug;59(8):925-32.

10. Huang H, Young W, Skaper S, Chen L, Moviglia G, Saberi H, Al-Zoubi Z, Sharma HS, Muresanu D, Sharma A, El Masry W. Clinical neurorestorative therapeutic guidelines for spinal cord injury (IANR/CANR version 2019). Journal of orthopaedic translation. 2020 Jan 1;20:14-24.

11. Soyuer F, Kepenek-Varol B. Quality of life and pain. Int J Fam Commun Med. 2019;3(3):110-4.

12. Panuccio F, Galeoto G, Marquez MA, Grassi ML, Scialpi A, Tofani M, Berardi A. General sleep disturbance scale (GSDS-IT) in people with spinal cord injury: a psychometric study. Spinal Cord. 2020 Nov;58(11):1183-8.

13. Conti A, Clari M, Nolan M, Wallace E, Tommasini M, Mozzone S, Campagna S. The relationship between psychological and physical secondary conditions and family caregiver burden in spinal cord injury: a correlational study. Topics in spinal cord injury rehabilitation. 2019 Sep 1;25(4):271-80.

14. Alcántar-Garibay OV, Incontri-Abraham D, Ibarra A. Spinal cord injury-induced cognitive impairment: A narrative review. Neural Regeneration Research. 2022 Dec 1;17(12):2649-54.

15. Felix ER, Cardenas DD, Bryce TN, Charlifue S, Lee TK, MacIntyre B, Mulroy S, Taylor H. Prevalence and impact of neuropathic and nonneuropathic pain in chronic spinal cord injury. Archives of physical medicine and rehabilitation. 2022 Apr 1;103(4):729-37.

16. Tibbett JA, Field-Fote EC, Thomas CK, Widerström-Noga EG. Spasticity and pain after spinal cord injury: impact on daily life and the influence of psychological factors. PM&R. 2020 Feb;12(2):119-29.

17. Budd MA, Gater Jr DR, Channell I. Psychosocial consequences of spinal cord injury: a narrative review. Journal of personalized medicine. 2022 Jul 20;12(7):1178.

18. Distel DF, Amodeo M, Joshi S, Abramoff BA. Cognitive dysfunction in persons with chronic spinal cord injuries. Physical Medicine and Rehabilitation Clinics. 2020 Aug 1;31(3):345-68.

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