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IMPACT OF FATIGUE ON COMMUNITY PARTICIPATION AND QUALITY OF LIFE IN PATIENTS WITH SPINAL CORD INJURY

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ABSTRACT

Background: Spinal cord injury (SCI) is a life-altering condition that often leads to long-term physical, psychological, and social challenges. Among the various secondary complications associated with SCI, fatigue is one of the most commonly reported yet under-recognized symptoms. Persistent fatigue may negatively influence an individual's ability to participate in daily activities and may significantly affect their overall quality of life.

Aim and Objective: The present study aimed to evaluate the impact of fatigue on participation and quality of life in individuals with spinal cord injury living in Mumbai.

Method: A cross-sectional observational study was conducted among 138 individuals diagnosed with spinal cord injury. Participants were recruited through convenience sampling. Fatigue was assessed using the Fatigue Severity Scale (FSS)**.** Participation levels were evaluated using the Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P), and quality of life was assessed using the World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire. Functional independence was measured using the Spinal Cord Independence Measure (SCIM)**.** Data were analysed using IBM SPSS software. Descriptive statistics were calculated, and correlation analysis was performed to determine the relationship between fatigue, participation, and quality of life.

Results: The findings of the study indicated a high prevalence of fatigue among individuals with spinal cord injury. Higher fatigue levels were significantly associated with reduced participation and poorer

quality of life across multiple domains. A moderate negative correlation was observed between fatigue severity and participation scores, as well as between fatigue and quality of life domains. Individuals reporting greater fatigue demonstrated lower functional independence and decreased engagement in social and daily activities.

Conclusion: Fatigue has a significant negative impact on participation and quality of life in individuals with spinal cord injury. The findings highlight the importance of assessing fatigue as a routine component of rehabilitation and implementing targeted interventions to manage fatigue in order to improve participation and overall well-being in this population.

Keywords: Spinal cord injury, fatigue, participation, quality of life, rehabilitation, physiotherapy.

INTRODUCTION

Background and Significance:

Spinal cord injury (SCI) is a highly debilitating neurological disorder, which causes severe motor, sensory, and autonomic losses, which impact all spheres of life of the individual, including their physical, psychological, and social activity. World Health Organization (WHO) has estimated that 250,000-500,000 people worldwide experience an SCI in a year, where the developing countries report more prevalence rates because of road traffic accidents, falls and violence. The incidence of SCI is on the increase in India and the annual incidence is estimated at about 15-20/million population. In addition to the direct physical effects, SCI has significant long-term psychosocial problems that limit independence and involvement in the community, eventually affecting the quality of life (QoL) of the individual.

Although mobility and independence in the activities of daily living are mostly considered the main focus of rehabilitation programs, little or no emphasis is usually paid to secondary complications which have a major impact on the long-term outcomes. Fatigue has been mentioned as one of the most popular but least discussed issues among them. Fatigue in people with SCI is multifactorial and multifaceted symptom which goes beyond normal fatigue. It is a continued feeling of physical and psychological fatigue disrupting normal functioning, social interaction, and well-being.

The interdependence of fatigue and community participation and the QoL is especially important in the Indian setting, as the barriers imposed on the environment, insufficient access, and sociocultural perspective on disability, complicate the reintegration of the post-rehabilitation into the community even further. The city of Mumbai is among the densely populated towns in India, where the challenges of high population density and poor accessibility are unique due to the absence of socioeconomic

advantages. The investigation of fatigue interaction with participation and QoL among this group of individuals is crucial to the development of context-specific rehabilitation plans.

Hit and Miss of Spinal Cord Injury:

Trauma or disease on the spinal cord causes injury to the spinal cord which causes either a partial or a complete injury to the sensory, motor, and autonomic functions below the site of injury. The severity is determined by the level of the impairment (cervical, thoracic, lumbar, and sacral) and the completeness of the injury that is categorized by The American Spinal Injury Association (ASIA) Impairment Scale. The most common ones are road traffic accidents, falls, sports-related trauma, and the acts of violence, and other non-traumatic causes like infections, tumors, and degenerative conditions also play a role.

SCI causes a sequence of secondary complications such as spasticity, chronic pain, pressure ulcers, urinary tract infection, and fatigue that may decrease the health outcomes and limit participation. The rehabilitation aims at maximizing the independent self-care and mobility and reintegration of individuals into the family, social, and economic life. However, even with the advances in principles of acute care and rehabilitation, a chronic and little discussed issue of fatigue may impede the complete community and occupational participation.

Fatigue in Spinal Cord Injury:

Fatigue is one of the most common and painful secondary complications that occur after SCI, with up to 80% mentioned. It is defined by a feeling of excessive exhaustion, lack of energy and decreased ability to sustain mental and physical processes. Fatigue may be classified as being primary (as a direct result of neurological injury) or secondary (as a result of pain, poor sleep, drugs and physical deconditioning). The mechanisms of fatigue are complicated and include the changes of the motor unit recruitment, autonomic dysfunction, hormonal imbalance, and psychological factors, including depression and anxiety.

In comparison with the normal tiredness, fatigue in SCI is chronic and weakly associated with objective muscle strength, which emphasizes the importance of central and psychosocial aspects. Being chronic, it may decrease motivation, engagement in rehabilitation, as well as participation in the daily activity, which lowers QoL. Research indicates that fatigue may linger years after the injury even when the person has a good physical recovery, reflecting the enduring effect of fatigue on functioning and well-being.

Fatigue in SCI is widely measured by means of Fatigue Severity Scale (FSS), which evaluates the impact of fatigue on physical, psychological, and cognitive aspects. Even though fatigue is the dominating issue in low- and middle-income societies such as in India, its perception and effects are poorly researched since such contextual elements as cultural beliefs, resource availability, or infrastructural presence can change the perception and outcomes of fatigue.

SCI Community-based participation and quality of life:

Engagement of the community is an important indicator of effective rehabilitation and long term adaptation following SCI. It involves participating in social, vocational, recreational, and familial activities, which is the involvement of an individual into his or her surroundings. The participation, according to the International Classification of Functioning, Disability and Health (ICF) represents the interaction between individual capabilities and the environmental facilitators/barriers. Social stigma, inaccessible physical infrastructure, and employment barriers, however, usually limit people with SCI.

Quality of life is multidimensional construct, which denotes the perception a person has towards his or her physical health, psychological condition, social life and environmental conditions. It has been shown that patients with SCI tend to have lower QoL than in the general population, mainly because they have persistent pain, limited mobility, exhaustion, and restrictions on their participation in everyday activities. The significant factors of QoL are the level of injury, functional independence, employment, and psychosocial adaptation. Interventions that encourage participation, independence and emotional resilience through rehabilitation have been proven to improve QoL outcomes.

These problems have been compounded by infrastructural and social obstacles in India. Inappropriate public space design, inadequate vocational training and poor social attitudes towards disability cut opportunities of meaningful involvement. As a result, despite successful functional recovery, a significant number of individuals cannot support social reintegration and continue living a full life, which reduces their QoL and well-being.

Association between Fatigue, Participation, and Quality of Life.

Fatigue is an important factor in influencing participation and QoL following SCI. Constant exhaustion restricts movement and social life, work and leisure, as well as interactions of people. It also impacts on mental concentration and drive that results in lack of interest in rehabilitations and communal engagements. Researchers have always been able to discover a high degree of correlation between

fatigue severity and a reduced degree of participation and QoL. In addition, fatigue keeps the cycle of diminished activity and deconditioning, which further worsens its health and social interaction effects.

This is further mediated by psychological and social factors. Patients with fatigue can lose social networks, which have an effect of isolation, depression, and lowering the quality of life. In contrast, significant social and community involvement can also be used to mediate the consequences of fatigue through mood, self-efficacy, and increased purpose. Therefore, the issue of fatigue in the rehabilitation is critical to completing the holistic recovery and successful community inclusion.

NEED FOR STUDY

Despite of global recognition of fatigue as a major determinant of post-SCI outcomes, research on its effects within the Indian population remains scarce. Urban settings such as Mumbai introduce unique challenges—ranging from environmental and infrastructural barriers to cultural and socioeconomic disparities—that influence the daily experiences of individuals with SCI. Physical inaccessibility, inadequate assistive services, and high environmental demands can exacerbate fatigue and limit participation opportunities.

Existing rehabilitation programs in India emphasize mobility and independence but often overlook subjective symptoms like fatigue and their impact on social reintegration. Furthermore, cultural perceptions of disability and limited awareness about fatigue as a clinical concern may lead to underreporting and under treatment. Therefore, investigating how fatigue influences participation and QoL among individuals with SCI living in Mumbai is critical for tailoring effective rehabilitation and policy interventions.

This study aims to fill the existing research gap by systematically examining the relationship between fatigue, community participation, and QoL among persons with SCI residing in Mumbai. The findings are expected to guide clinicians, rehabilitation specialists, and policymakers in developing comprehensive, context-specific strategies to enhance overall well-being and societal inclusion.

REVIEW OF LITERATURE

1. Impact of fatigue on the health-related quality of life in persons with spinal cord injury (Wijesuriya et al., 2012)

This matched-group study compared 41 individuals with chronic SCI (mean ~16.5 years since injury) to 41 able-bodied controls, using the Iowa Fatigue Scale and SF-36. It found over 50% of the SCI group had elevated fatigue, which was significantly associated with lower HR-QoL. Interestingly, among the SCI group those with *low* fatigue had HR-QoL similar to able-bodied controls. Fatigue levels were not tied to injury level, completeness or community integration, but a shorter time since injury was linked to higher fatigue.

This study underlines that fatigue is a key determinant of quality of life in SCI, independent of injury severity, and supports inclusion of fatigue assessment in SCI rehabilitation research.

Limitations: Small sample size and cross-sectional design limit generalizability.

2. Prevalence of fatigue and associated factors in a spinal cord injury population: Data from internet-based and face-to-face surveys (Fekete et al., 2017)

In this large survey of 253 persons with SCI, clinically significant fatigue (FSS ≥4) was present in approximately one-third of respondents. The study found fatigue was significantly correlated with depression and pain, but *not* with injury level or completeness.

This highlights fatigue prevalence in SCI and its links with psychosocial factors rather than strictly neurological ones, pointing to the importance of assessing mood and pain when studying fatigue.

Limitations: Self-reported design and lack of longitudinal follow-up.

3. The course of fatigue after acute spinal cord injury (Gorgey et al., 2016)

In a prospective cohort of 52 traumatic SCI patients assessed at admission, discharge and 6 months post discharge, fatigue measured via FSS and MFIS-SCI remained relatively stable (~50% had clinically significant fatigue at admission and 6 months). There was no relation to injury level or completeness.

This emphasizes that fatigue emerges early in SCI rehabilitation and persists into community living, supporting the need for early fatigue screening and intervention.

Limitations: Did not explore psychosocial or environmental factors influencing fatigue.

4. Fatigue and spinal cord injury: a qualitative analysis (Brown et al., 2009)
Through focus groups with 29 persons with SCI (various levels), this study explored lived experience of fatigue. Participants described physical, cognitive and emotional dimensions of fatigue, impact on daily life (e.g., giving up pleasurable activities to conserve energy), and key contributing factors including pain, poor sleep, depression, medications, and effortful self-care.

The study enriches understanding of how fatigue is experienced in SCI and offers insights into potential intervention targets (e.g., sleep quality, pain management).

Limitations: Qualitative sample limited to Western population; lacks quantitative correlations.

5. Factors associated with fatigue in people with spinal cord injury: a systematic review and meta-analysis (Teixeira-Silva et al., 2022)
This meta-analysis reviewed associations between fatigue and 17 factors in SCI populations. Strongest positive associations were with anxiety (r = 0.57), stress (r = 0.54), depression (r = 0.47) and pain (r = 0.34); a modest negative association was found with participation (r = –0.32) and physical activity (r = –0.17). Age, sex, education and time since injury showed no significant association.

This study is pivotal as it quantifies the link between fatigue and participation in SCI.

Limitations: Inclusion of heterogeneous studies with varying methodologies.

6. Fatigue in persons with subacute spinal cord injury who are dependent on a manual wheelchair (van der Scheer et al., 2015)
In 36 persons with sub-acute SCI (dependent on a manual wheelchair) mean age 43, 31% had significant fatigue (FSS >4). Interestingly, fatigue was higher in those with *incomplete* lesions versus complete. Peak oxygen uptake had a trend toward association with fatigue levels.

This suggests that physical fitness and physiological capacity may relate to fatigue in early SCI community transition; it adds nuance to the injury level/injury completeness debate.

Limitations: Small cohort and limited to wheelchair-dependent individuals.

7. Association between sleep quality and participation in people with spinal cord injury: A preliminary study (Conti et al., 2022)
This cross-sectional Italian study with 55 outpatients used sleep quality (PSQI) and a participation

measure (USER-Participation). They found that poorer sleep quality was significantly associated with lower participation frequency (β = –0.30) and lower satisfaction with participation (β = –0.49). Age, hours slept and time since injury were also associated with participation satisfaction.

Although this study focuses on sleep rather than fatigue per se, the strong link with participation suggests that fatigue-related phenomena (like poor sleep) influence community reintegration.

Limitations: Did not directly measure fatigue; small sample size.

8. Physical activity is related to lower levels of pain, fatigue and depression in individuals with spinal cord injury: A correlational study (Eriksson et al., 2008)

In 49 community-dwelling manual wheelchair users with chronic SCI (mean injury duration 11.8 years), higher heavy intensity physical activity was associated with lower fatigue, pain and depression.

This underscores the modifiable factor of physical activity in fatigue management and subsequent community participation and QoL.

Limitations: Cross-sectional design; causality cannot be established.

9. Quality of life in and after spinal cord injury rehabilitation: a longitudinal multicentre study (Post & van Leeuwen, 2014)

In 292 patients recruited from multiple European centres, QoL measured via WHOQOL-BREF was tracked from 6 weeks to 2 years post-injury. Physical domain scores improved most; culture impacted psychological and environmental domains; participants and their close persons had similar changes in QoL over time.

This study provides longitudinal baseline data on QoL trajectory post-SCI and frames how fatigue might influence these trajectories in later community living.

Limitations: Did not analyze fatigue as a variable affecting QoL.

10. How does fatigue affect participation in the community? (ICORD blog summarising research, 2016)

Although not a peer-reviewed journal article, this summary presents findings that among persons with SCI, 53.8% experienced fatigue monthly and 18.6% daily; fatigue alone accounted for significant

difference in community participation scores, and when combined with pain and depression the explanatory power improved.

Limitations: Non-peer-reviewed and based on self-reported data.

OUTCOME MEASURES

1. FATIGUE SEVERITY SCALE-

The Fatigue Severity Scale (FSS) is a widely used self-reported questionnaire designed to assess the severity of fatigue and its impact on daily functioning. It is commonly used in neurological conditions, including spinal cord injury. The scale consists of 9 statements that evaluate how fatigue interferes with motivation, physical activity, exercise, work, family, and social life.

Each item is rated on a 7-point Likert scale, where 1 indicates strong disagreement and 7 indicates strong agreement. The final score is calculated as the mean of all nine items, resulting in a score ranging from 1 to 7. Higher scores represent greater fatigue severity. A mean score of ≥4 is generally considered indicative of clinically significant fatigue.

Reliability- The instrument shows high internal consistency with a Cronbach's alpha of 0.89, and good test–retest reliability with an intraclass correlation coefficient (ICC) of 0.84 (95% CI: 0.74–0.90). (Hubert A. Anton., et al 2006)

Validity- Construct validity was supported by significant correlations with related measures, including the Visual Analogue Scale for fatigue (r = 0.67), Center for Epidemiologic Studies Depression Scale (r = 0.58), and the SF-36 vitality subscale (r = −0.48). Additionally, the scale demonstrated acceptable discriminative ability with an area under the ROC curve of 0.799, along with 75% sensitivity and 67% specificity, supporting its validity for assessing fatigue severity in individuals with spinal cord injury. (Hubert A. Anton., et al 2006)

2. WORLD HEALTH ORGANISATION QUALITY OF LIFE BREF SCALE-

The WHO Quality of Life – BREF (WHOQOL-BREF) is a standardized questionnaire developed by the World Health Organization to measure an individual's perception of quality of life across different domains. It consists of 26 items, including two general questions related to overall quality of life and health.

The scale assesses four domains:

- Physical Health
- Psychological Health
- Social Relationships
- Environment

Items are scored on a 5-point Likert scale, and raw scores for each domain are transformed to a 0–100 scale. Higher scores indicate better quality of life in the respective domain.

Reliability- The results for reliability of the WHOQOL-BREF showed satisfactory internal consistency, with a Cronbach's alpha value of 0.73, indicating acceptable reliability of the instrument for assessing quality of life among individuals with spinal cord injury. (França, I. S. X., et al 2011)

Validity- Validity was assessed using multiple linear regression analysis, which examined the relationship between the WHOQOL-BREF domains and perceived quality of life. The social relations ($R^2 = 0.28$; $p < 0.000$) and environment ($R^2 = 0.71$; $p < 0.008$) domains showed significant correlations with quality of life, supporting the instrument's validity. (França, I. S. X., et al 2011)

3. UTRECHT SCALE FOR EVALUATION OF REHABILITATION-PARTICIPATION-

The Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P) is a questionnaire used to assess participation in daily life among individuals undergoing rehabilitation. It evaluates both the objective level of participation and the individual's subjective satisfaction with participation.

The scale consists of three subscales:

- Frequency – measures how often individuals participate in work, leisure, and social activities.
- Restrictions – assesses the extent to which health problems limit participation.
- Satisfaction – evaluates how satisfied individuals are with their participation.

Scores from each subscale are converted to a standardized score ranging from 0 to 100. Higher scores indicate greater participation frequency, fewer participation restrictions, and higher satisfaction with participation.

Reliability- The USER-Participation scale demonstrated acceptable psychometric properties. Internal consistency showed Cronbach's alpha values of 0.615 for Frequency, 0.715 for Restriction, and 0.695 for Satisfaction subscales. Test–retest reliability showed ICC values of 0.755, 0.849, and 0.846 respectively, indicating good to very good reliability. (Amir Javanmard et al., 2024)

Validity- Face validity and content validity were established through evaluation by patients and expert panels. Additionally, discriminant validity was confirmed as the scale significantly differentiated

between individuals with spinal cord injury and healthy participants ($p < 0.001$). (Amir Javanmard et al., 2024)

4. SPINAL CORD INDEPENDENCE MEASURE-

The Spinal Cord Independence Measure (SCIM) is a functional assessment tool specifically developed to evaluate independence in activities of daily living among individuals with spinal cord injury.

The scale consists of three subscales:

- Self-Care (feeding, grooming, bathing, dressing)
- Respiration and Sphincter Management
- Mobility (room and toilet mobility, indoor and outdoor mobility)

The total score ranges from 0 to 100, with higher scores indicating greater functional independence. The SCIM is considered more sensitive to functional changes in individuals with spinal cord injury compared to general functional assessment scales.

Reliability : High inter-rater reliability with total agreement above 80% in most SCIM III tasks; Pearson correlation coefficients between raters exceeded 0.9, and intraclass correlation coefficients were above 0.94 (Itzkovich et al., 2007)

Validity: Strong correlation with the Functional Independence Measure (FIM), with a Pearson correlation coefficient of 0.790. (Itzkovich et al., 2007)

AIM AND OBJECTIVES

Aim:

The primary purpose of this study is to examine the impact of fatigue on community participation and quality of life among individuals with spinal cord injury living in Mumbai.

Objectives:

1.To assess the levels of fatigue in individuals with spinal cord injury using Fatigue severity scale (FSS).

2. To evaluate the degree of community participation among individuals with spinal cord injury using Utrecht Scale for Evaluation of Rehabilitation-Participation (USERP) scale.

3. To determine the quality of life in individuals with spinal cord injury using World Health Organization Quality of Life-BREF (WHO-QOL) scale.

4. To analyze the correlation between fatigue and quality of life.

5. To analyze the correlation between fatigue and community participation.

6. To analyze the correlation between quality of life and community participation in spinal cord injury patients.

METHODOLOGY

Study design: Observational study

Study population: Patients with spinal cord injury

Type of sampling: Purposive sampling

Sample size: 138

Sampling calculation: Test family- z tests - correlations: two independent pearson r's

Analysis: A priori: compute required sample size

Inputs: Tail(s) = Two

Effect size d = 0.63

α err prob = 0.05

Power (1-ß err prob) = 0.95

Output: Critical z = 1.9599640

Sample size group 1 = 69

Sample size group 2 = 69

Total sample size = 138

Actual Power = 0.9514532

Duration of study: 1 year

Setting for research work: Nanavati Max SuperSpeciality Hospital, Spinal cord injury rehabilitation centers in Mumbai

INCLUSION CRITERIA

1. Patients who sustain with SCI since 1 year.
2. Individuals with intact cognition and communication skills (understanding Basic English).

3. Patients with mean score of 4 or more on Fatigue severity scale.

EXCLUSION CRITERIA

1. Individuals unable to be accurately assessed using the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI).
2. Individuals with orthopaedic or other neurological injury that would alter expected recovery/outcomes following SCI.

Ethical Approval:

- The thesis was commenced after obtaining approval from the Departmental Research Committee. No. - SOP/DRC/25/030

Patient Screening and Recruitment Based on Eligibility Criteria:

- This step involved selecting patients who meet specific criteria for the study. These eligibility criteria might include factors such as all adult individuals with spinal cord injury and Individuals with intact cognition and communication skills (understanding of Basic English).
- Only those who met these predefined criteria were enrolled in the study.

Patient Education and Informed Consent:

- Patient education was done in a language the patient was comfortable with after which an informed consent was taken.
- In cases of online meetings online recording was done with permission.

Demographic Data Collection:

- This involved gathering personal and health-related information from the patients (such as age, gender, occupation, address, Level of Injury, ASIA, Education, Cause, Years since SCI) to better understand the characteristics of the study population and analyze data effectively.

In-person interviews:

- The interviews were conducted face-to-face, which may have allowed for more personalized interactions and better data collection in some instances.

Interview Duration and Breaks:

- Each interview lasted approximately 45 minutes.

- 5-minute breaks between questionnaires was given.

Questionnaires:

No.	Name	Measure	Objective and interpretation
1.	FSS	Fatigue levels	A 9-item self-report scale rated on a 7-point Likert scale. Higher mean scores indicated greater fatigue severity.
2.	WHOQOL-BREF	Quality of life	A questionnaire, which assesses physical, psychological, social, and environmental domains. Items are scored on a 5-point Likert scale, and raw scores for each domain are transformed to a 0–100 scale. Higher scores indicate better quality of life in the respective domain.
3.	USER-P	Community participation	A questionnaire used to assess participation in daily life among individuals undergoing rehabilitation. It evaluates both the objective level of participation and the individual's subjective satisfaction with participation. Scores from each subscale are converted to a standardized score ranging from 0 to 100. Higher scores indicate greater participation frequency, fewer participation restrictions, and higher satisfaction with participation.
4.	SCIM	Independence	A functional assessment tool specifically developed to evaluate independence in activities of daily living among individuals with spinal cord injury. The total score ranges from 0 to 100, with higher scores indicating greater functional independence.

Table no. 1- Questionnaire

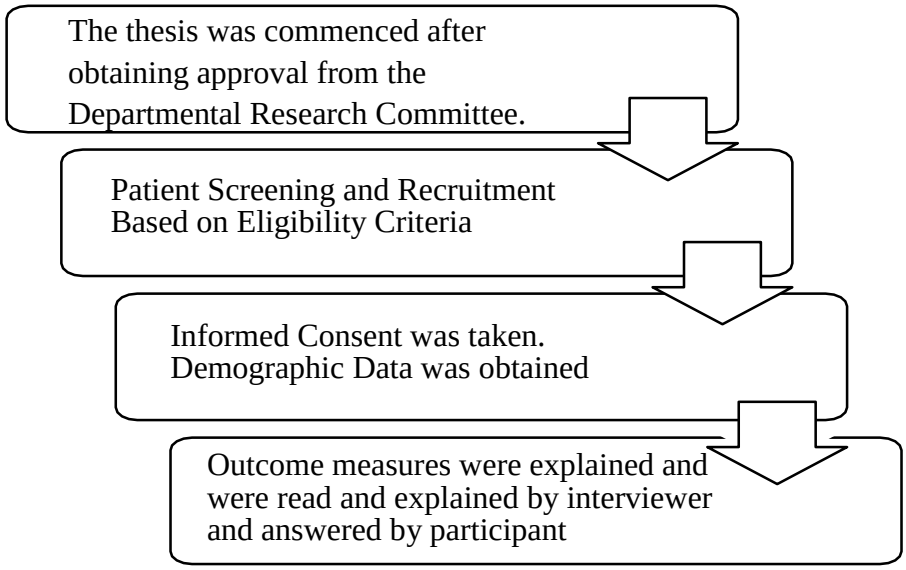


Figure no. 1- Procedure flow chart

Fig. no. 2

Fig. no. 3

Figure 2 & 3- Interview with patients

STATISTICAL ANALYSIS

1. Demographic Characteristics-

A total of 138 participants with spinal cord injury were included in the study. The mean age of the participants was 30.60 ± 8.49 years, with an age range of 18 to 80 years, indicating a predominantly young adult population. Gender distribution showed a higher proportion of males compared to females. The majority of participants were classified under ASIA grades reflecting varying degrees of neurological impairment.

2. Descriptive Statistics of Study Variables-

The mean fatigue severity (FSS Mean) score was 5.48 ± 0.69, suggesting that most participants experienced moderate to severe fatigue.

The mean WHOQOL Total score was 52.79 ± 11.10, indicating a moderate level of perceived quality of life.

Participation levels measured using USER-P showed:

- USERP Frequency-A: 49.93 ± 13.71
- USERP Frequency-B: 46.29 ± 13.49
- USERP Restriction: 42.85 ± 12.00
- USERP Satisfaction: 47.97 ± 13.16

These values suggest moderate participation levels with noticeable restrictions.

Functional independence measured by SCIM showed:

- SCIM Total: 54.05 ± 6.81
- Subscales indicated moderate independence in self-care, respiration/sphincter management, and mobility.

Overall, the sample demonstrated moderate fatigue, moderate participation levels, and moderate functional independence.

3. Normality Testing-

Shapiro-Wilk test revealed that most variables were normally distributed ($p > 0.05$), except USERP-Frequency B ($p = 0.033$), which showed deviation from normality.

Accordingly:

- Pearson correlation was used for normally distributed variables.
- Spearman correlation was used for USERP-Frequency B.

This ensured appropriate statistical application.

4. Correlation Analysis-

1. Fatigue and Quality of Life-

A moderate negative correlation was observed between fatigue and quality of life ($r = -0.381$, $p < 0.001$).

This indicates that higher fatigue levels were associated with lower quality of life.

2. Fatigue and Participation-

Fatigue showed significant negative correlations with:

- USERP Frequency-A ($r = -0.349$, $p < 0.001$)
- USERP Restriction ($r = -0.247$, $p = 0.004$)
- USERP Satisfaction ($r = -0.232$, $p = 0.006$)

Spearman analysis revealed:

- Fatigue and USERP Frequency-B ($rho = -0.245$, $p = 0.004$)

These findings suggest that as fatigue severity increases, participation levels decrease, particularly in activity frequency and satisfaction domains.

3. Fatigue and Functional Independence-

A strong negative correlation was found between fatigue and SCIM Total ($r = -0.684$, $p < 0.001$).

Fatigue also showed significant negative correlations with SCIM subdomains:

- Self-care
- Respiration & sphincter management
- Mobility

This indicates that patients with greater fatigue demonstrated lower functional independence.

4. Participation and Quality of Life-

Positive correlations were observed between quality of life and participation domains:

- WHQOL and USERP Frequency-A ($r = 0.318$, $p < 0.001$)

- WHQOL and USERP Restriction ($r = 0.469$, $p < 0.001$)
- WHQOL and USERP Satisfaction ($r = 0.412$, $p < 0.001$)

This suggests that higher participation is associated with better quality of life.

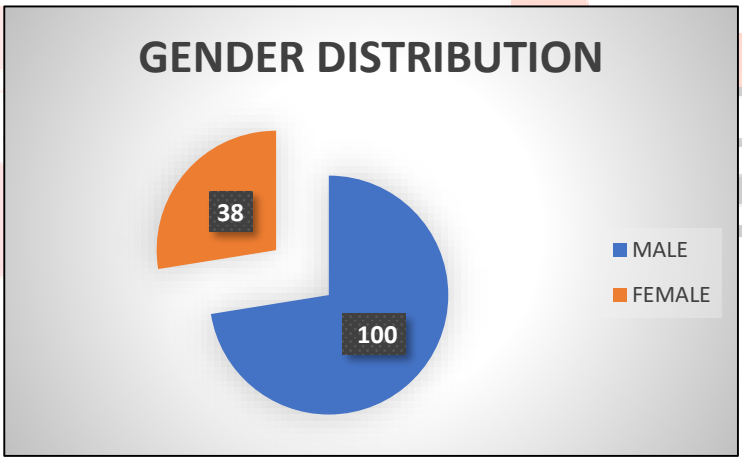
Overall Interpretation

The findings of this study demonstrate that fatigue plays a significant role in influencing participation and functional independence in individuals with spinal cord injury. Increased fatigue is associated with reduced activity frequency, greater participation restrictions, lower satisfaction, and decreased functional independence. Furthermore, reduced participation and functional limitations significantly impact overall quality of life.

These results highlight the multidimensional impact of fatigue in spinal cord injury and underscore the importance of fatigue management in rehabilitation to improve participation and quality of life outcomes.

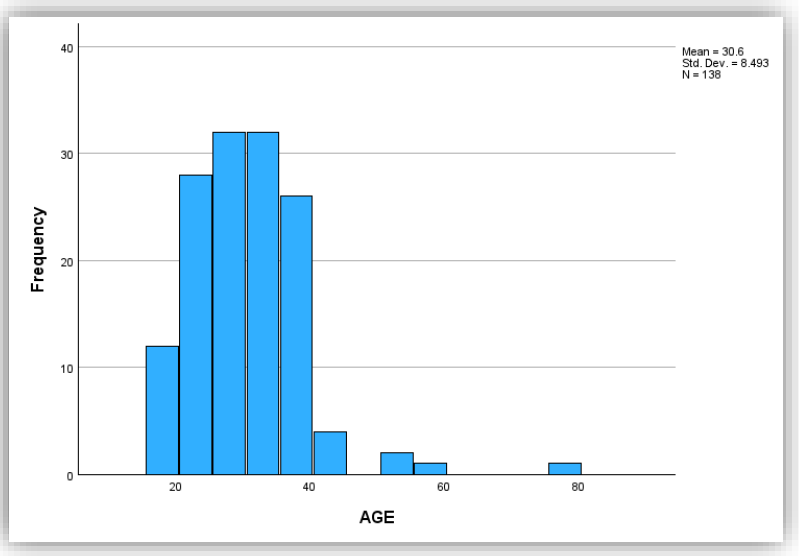
RESULTS

GRAPH 1- GENDER DISTRIBUTION



The gender distribution graph shows that the majority of participants in the study were **male (72.5%)**, while **females constituted 27.5%** of the sample. This indicates that spinal cord injury was more prevalent among males in the study population.

GRAPH 2- AGE DISTRIBUTION



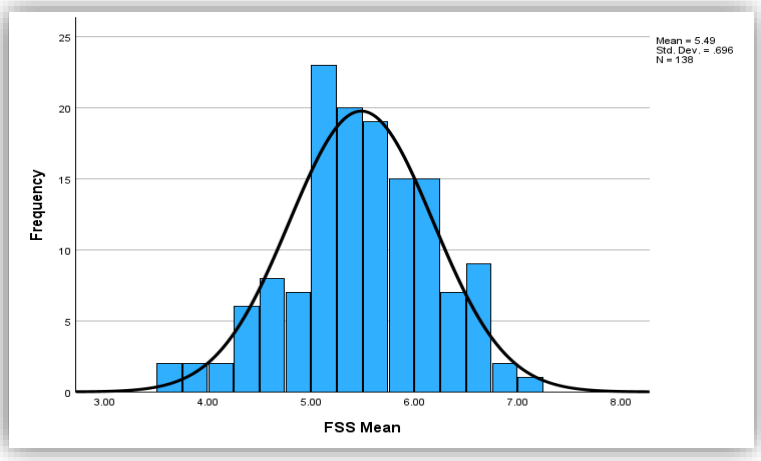
The age distribution graph shows that most participants were **young adults**, with a **mean age of 30.60 ± 8.49 years** and an age range of **18–79 years**. This suggests that spinal cord injury predominantly affects individuals in the productive age group

TABLE 1- DEMOGRAPHIC TABLE

Variable	N	Mean ± sd / n (%)	Min–max
Age	138	30.60 ± 8.49	18–79
Gender	138	Male: 72.5% Female: 27.5%	-
Asia score	138	A- 70.3% B- 26.1% C- 3.6%	-

Table 1 presents the demographic characteristics of the study participants. A total of **138 individuals with spinal cord injury** were included in the study. The **mean age was 30.60 ± 8.49 years**, with ages ranging from **18 to 79 years**, indicating that the majority of participants were young adults. The gender distribution showed a **higher proportion of males (72.5%) compared to females (27.5%)**. With respect to neurological severity, most participants were classified as **ASIA grade A (70.3%)**, followed by **ASIA grade B (26.1%)** and **ASIA grade C (3.6%)**, indicating that a large proportion of the sample had complete spinal cord injury.

GRAPH 3- FSS DISTRIBUTION



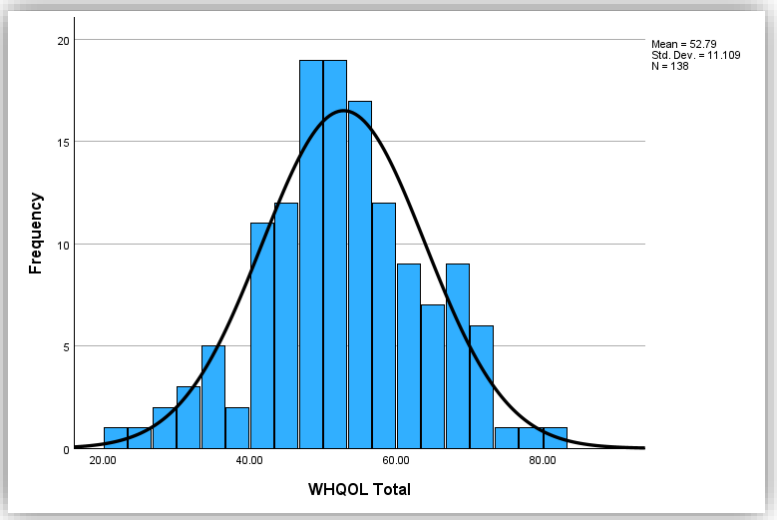
The graph representing **Fatigue Severity Scale (FSS)** scores shows that most participants reported **moderate to severe levels of fatigue**, with a mean score of **5.48 ± 0.69**. This indicates that fatigue is a common symptom among individuals with spinal cord injury.

TABLE 2- DESCRIPTIVE STATISTICS OF OUTCOME MEASURES

Variable	Mean	SD	Minimum	Maximum
FSS Mean	5.48	0.69	3.5	7
WHQOL Total	52.79	11.10	21.11	80.18
USERP-Freq A	49.93	13.71	11.94	80.39
USERP-Freq B	46.29	13.49	10	75.22
USERP-Restriction	42.85	12.00	15.04	78.34
USERP-Satisfaction	47.97	13.16	10.81	84.13
SCIM-Total	54.05	6.81	38.4	73.65

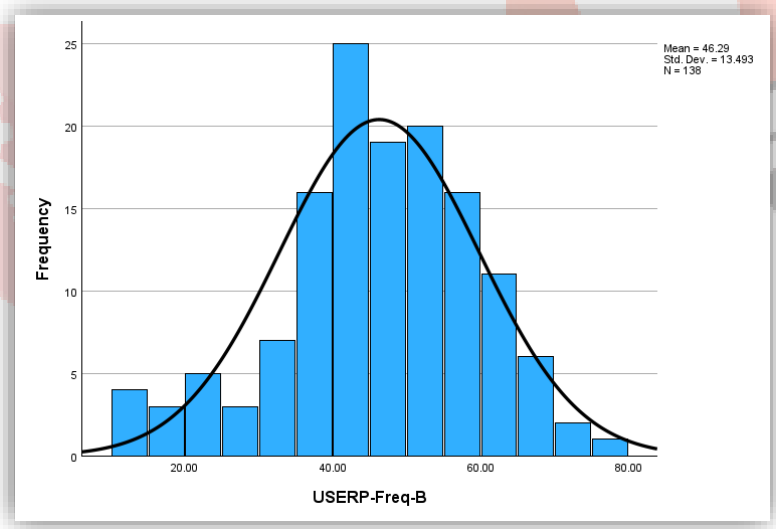
Table 2 summarizes the descriptive statistics of the study variables. The **mean Fatigue Severity Scale (FSS) score was 5.48 ± 0.69**, indicating that participants experienced moderate to severe fatigue. The **mean WHOQOL score was 52.79 ± 11.10**, suggesting a moderate level of perceived quality of life. Participation levels measured using USER-P showed mean scores of **49.93 ± 13.71 for Frequency A**, **46.29 ± 13.49 for Frequency B**, **42.85 ± 12.00 for Restriction**, and **47.97 ± 13.16 for Satisfaction**, indicating moderate participation with some degree of restriction. Functional independence assessed using SCIM had a **mean score of 54.05 ± 6.81**, suggesting moderate levels of independence in daily activities.

GRAPH 4- WHOQOL DISTRIBUTION



The WHOQOL distribution graph demonstrates that participants had a **moderate level of quality of life**, with a mean score of **52.79 ± 11.10**. This suggests that spinal cord injury has a noticeable impact on overall quality of life.

GRAPH 5- USER-P FREQUENCY B DISTRIBUTION



The distribution of **USER-P Frequency B** scores indicates **moderate participation levels** among the participants, with a mean score of **46.29 ± 13.49**. This suggests that individuals with spinal cord injury experience some limitations in participation in daily activities.

TABLE 3- NORMALITY TESTS-

VARIABLE	SHAPIRO-WILK P VALUE	NORMAL / NOT NORMAL
FSS	0.291	Normal
WHQOL	0.696	Normal
USERP-Freq A	0.086	Normal
USERP-Freq B	0.033	Not Normal
USERP-Restriction	0.697	Normal
USERP-Satisfaction	0.629	Normal
SCIM TOTAL	0.326	Normal

Table 3 presents the results of the **Shapiro–Wilk test for normality**. Most variables, including **FSS, WHOQOL, USER-P Frequency A, USER-P Restriction, USER-P Satisfaction, and SCIM Total**, showed **normal distribution (p > 0.05)**. However, **USER-P Frequency B showed a non-normal distribution (p = 0.033)**. Based on these results, **Pearson correlation was used for normally distributed variables, while Spearman correlation was applied for USER-P Frequency B**.

TABLE 4 – PEARSON CORRELATION MATRIX-

VARIABLES	FSS	WHOQOL	USER-P FREQ A	USER-P R	USER-P S	SCIM
FSS	1	-0.381	-0.349	-0.247	-0.232	-0.684

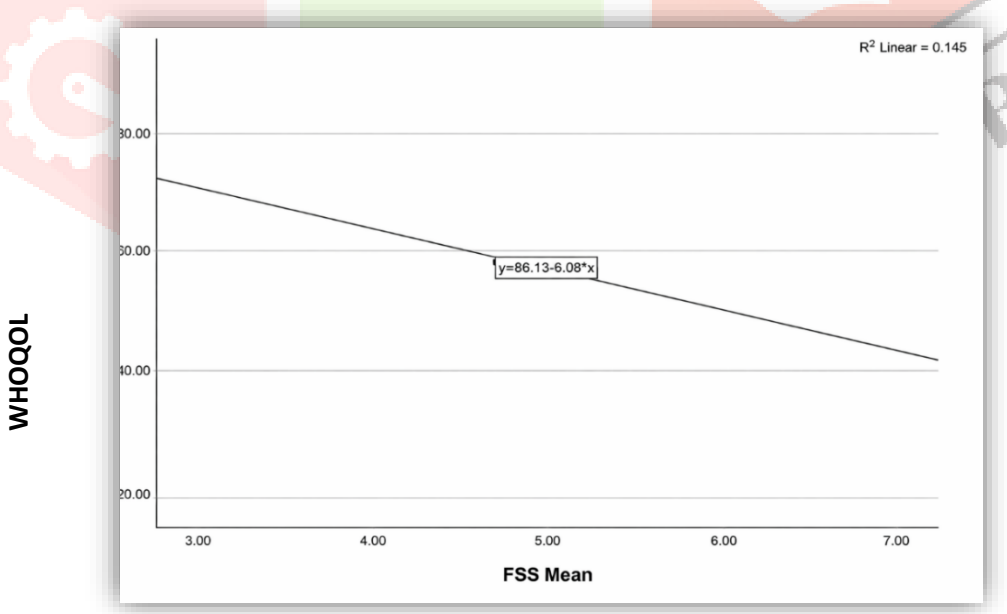
Table 4 shows the **Pearson correlation between fatigue and other study variables**. Fatigue demonstrated a **moderate negative correlation with quality of life (r = -0.381)**, indicating that higher fatigue levels are associated with poorer quality of life. Fatigue also showed **negative correlations with participation domains**, including **USER-P Frequency A (r = -0.349)**, **USER-P Restriction (r = -0.247)**, and **USER-P Satisfaction (r = -0.232)**, suggesting that increased fatigue is associated with reduced participation. A **strong negative correlation was observed between fatigue and SCIM total score (r = -0.684)**, indicating that higher fatigue is strongly associated with lower functional independence.

TABLE 5- SPEARMAN CORRELATION (ONLY FOR USERP FREQ B)

VARIABLES	rho	P value
FSS VS USER-P FREQ B	-0.245	0.004
WHOQOL VS USER-P FREQ B	0.247	0.003

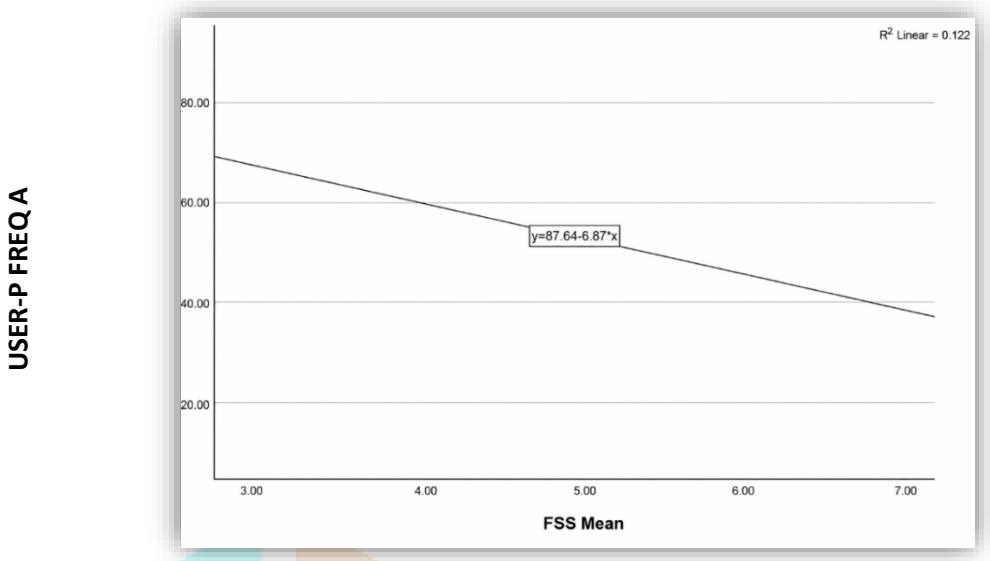
Table 5 presents the **Spearman correlation analysis for USER-P Frequency B**, as this variable was not normally distributed. The results show a **weak negative correlation between fatigue and USER-P Frequency B (rho = -0.245, p = 0.004)**, indicating that increased fatigue is associated with reduced participation frequency in certain activities. Additionally, a **weak positive correlation was observed between WHOQOL and USER-P Frequency B (rho = 0.247, p = 0.003)**, suggesting that higher participation frequency is associated with better quality of life.

GRAPH 6- CORRELATION BETWEEN FSS AND WHOQOL



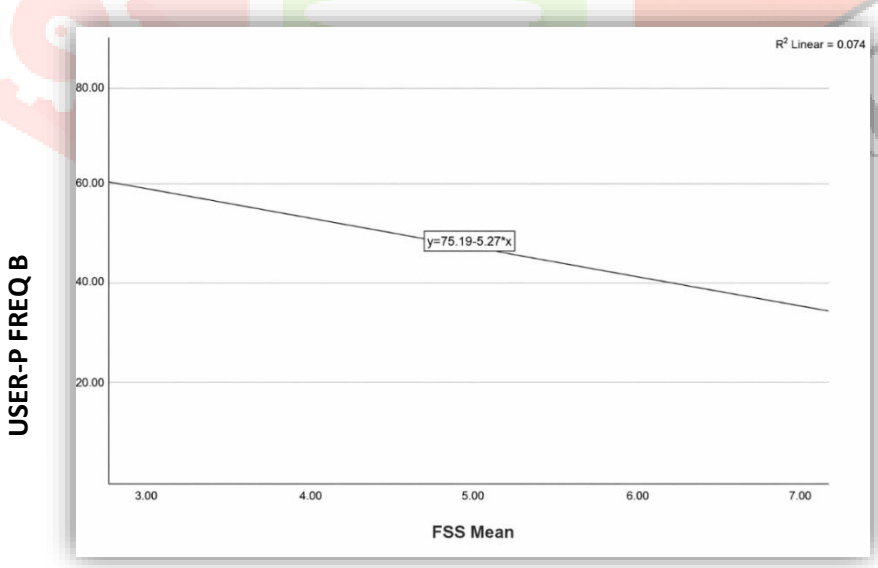
The graph shows a **moderate negative correlation between fatigue and quality of life (r = -0.381)**. This indicates that **as fatigue increases, quality of life tends to decrease** among individuals with spinal cord injury.

GRAPH 7- CORRELATION BETWEEN FSS AND USER-P FREQUENCY A



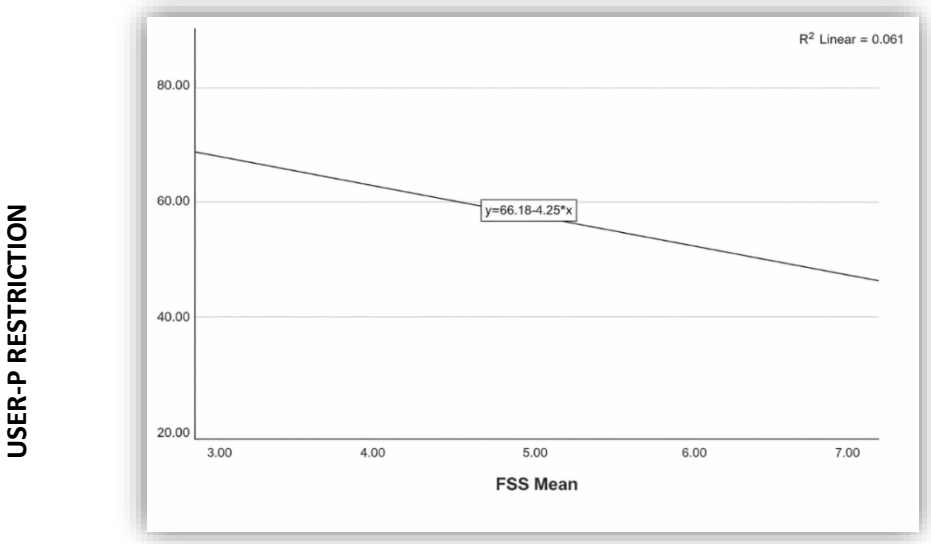
This graph demonstrates a **negative correlation between fatigue and participation frequency A (r = -0.349)**. It suggests that **higher fatigue levels are associated with reduced frequency of participation in daily activities**.

GRAP H 8- CORRELATION BETWEEN FSS AND USER-P FREQUENCY B



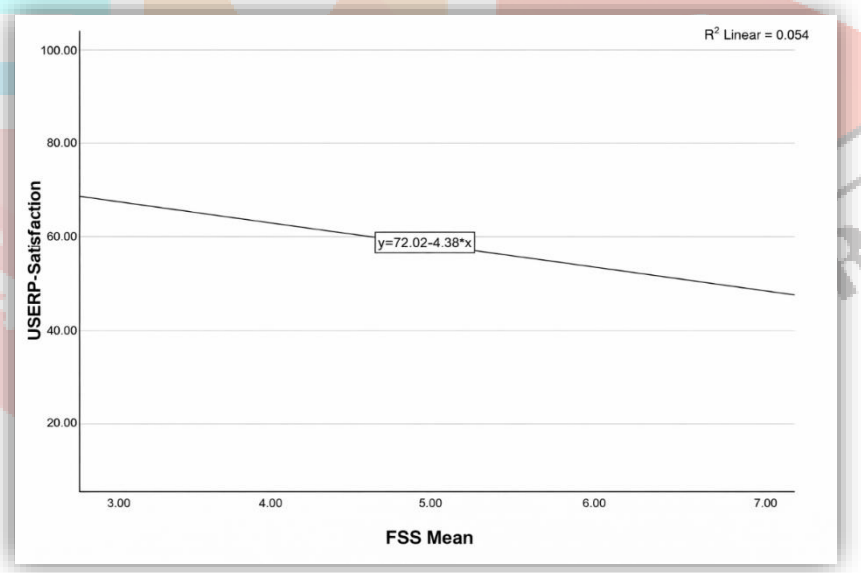
The graph indicates a **weak negative correlation between fatigue and participation frequency B (rho = -0.245)**. This suggests that **increased fatigue slightly reduces participation frequency in certain activities**.

GRAPH 9- CORRELATION BETWEEN FSS AND USER-P RESTRICTION 2



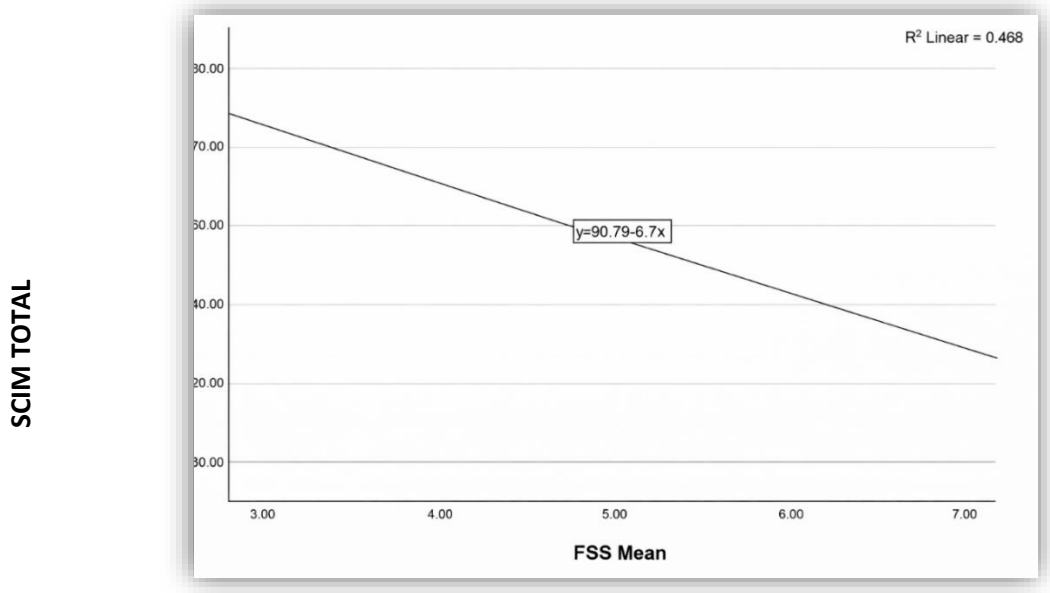
The graph shows a **negative correlation between fatigue and participation restriction (r = -0.247)**. This suggests that **greater fatigue is associated with increased participation limitations** in individuals with spinal cord injury.

GRAPH 10- CORRELATION BETWEEN FSS AND USER-P AND SATISFACTION 3



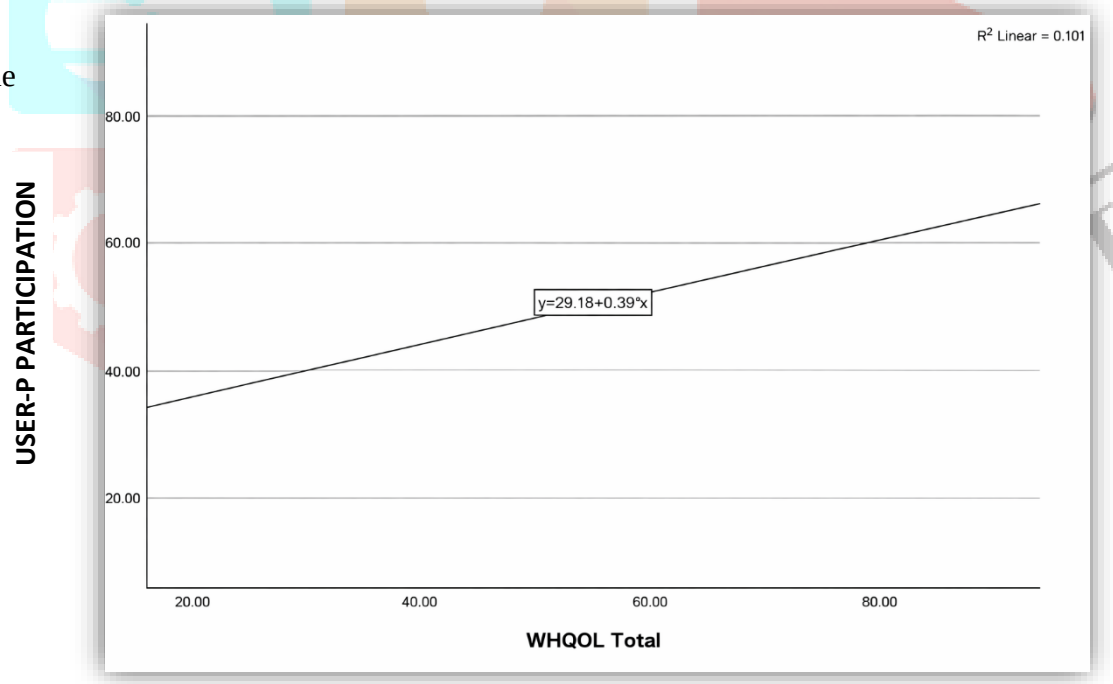
This graph demonstrates a **negative correlation between fatigue and participation satisfaction (r = -0.232)**. This indicates that **higher fatigue levels are associated with lower satisfaction in participation**.

GRAPH 11- CORRELATION BETWEEN FSS AND SCIM TOTAL



The graph shows a **strong negative correlation between fatigue and functional independence (r = -0.684)**. This suggests that **higher fatigue levels are strongly associated with lower functional independence** in individuals with spinal cord injury.

GRAPH 12- CORRELATION BETWEEN WHOQOL AND PARTICIPATION



The graph demonstrates a **positive relationship between quality of life and participation**. This indicates that **higher levels of participation are associated with better perceived quality of life** among individuals with spinal cord injury.

DISCUSSION

Spinal cord injury (SCI) is a life-altering disorder that compromises the physical functioning, autonomy, social integration, and general well-being. Fatigue is one of the most frequent yet least frequently acknowledged symptoms of people with SCI due to its variety of secondary complications. Fatigue may cause a tremendous disruption in daily affairs, decrease engagement in social and community activities, and adversely affect the quality of life. The current research was conducted to investigate the effects of fatigue on the quality of life and participation in patients with spinal cord injury. The sample size considered was 138 individuals with different outcome measures being used including Fatigue Severity Scale (FSS) World Health Organization Quality of life Scale (WHOQOL), Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P), and Spinal Cord Independence Measure (SCIM).

The research results offer valuable knowledge of the variables of fatigue, participation, functional independence and quality of life among people with Spinal Cord Injury.

Demographic Characteristics

Gender Distribution (Graph 1)

Gender of the participants included in the study is represented in the graph 1 in the results section. There were 138 respondents with 72.5 percent males and 27.5 percent females, which means that the spinal cord injury was more common in males in this study.

The result is compatible with a number of epidemiological studies conducted globally since it is evident that spinal cord injuries are more common among men than women. The increased rate among the males is usually explained by their greater exposure to high-risk jobs, road traffic injuries, sports injuries, and physical labour.

According to a study, conducted by Singh et al. (2014), males constitute the majority of the cases of the spinal cord injury, almost 70-80% of the cases worldwide. The same trends have been recently observed in developing nations whereby young men are more exposed to occupational hazards and transportation accidents. (1)

Such a gender ratio implies that the rehabilitation services and community reintegration programs should be created based on the occupational and social roles traditionally undertaken by young adult males.

Age Distribution (Graph 2)

Graph 2 is a plot that illustrates the distribution of the participants involved in the study in terms of age. The average age of the participants was 30.60649 years with the minimum age of 18 and the maximum age of 80.

The findings have shown that most of the people with spinal cord injury in the current research were in the young adult group. This is not the first time the same was found whereby in a previous study conducted by Hande DN et al., (2024) it is stated that SCI is mostly common among people in the age bracket of 21 and 40 years.

The most fruitful stage in life is generally young adulthood during which people are usually employed, educated, have family duties, and socialize. Hence, maintaining a spinal cord injury within this age bracket may bring a lot of consequences to the autonomy of the individual, chances of getting employment and social roles.

The patients who have sustained spinal cord injury in most developing countries are aged between 29 and 35 years as indicated by Jazayeri et al. (2015), which is very consistent with the current research (2).

These results show the significance of early rehabilitation programs to be used in restoring independence and encouraging community involvement among this relatively young generation.

Determination of the Fatigue levels among the population under the study:

Distribution: Fatigue Severity Scale (Graph 3)

In graph 3, the distribution of the fatigue levels in terms of the Fatigue Severity Scale (FSS) are given. The average fatigue score of the current study was 5.48 with a standard deviation of 0.69 meaning that the majority of the respondents had moderate to severe fatigue.

One of the most frequent complications that have been reported as secondary to spinal cord injury is fatigue. It can be caused by the combination of factors such as reduced physical conditioning, chronic

pain, sleeping disorders, autonomic dysfunction, drug reactions, and such psychological factors as depression or stress.

According to Fawkes-Kirby et al. (2008), close to 57 percent of people with spinal cord injury develop widespread fatigue that seriously distracts normal daily functions. (3)

The average fatigue level is quite considerable in the current study, which indicates that fatigue is a significant aspect of SCI management that should be addressed by clinicians and rehabilitation professionals.

Possible effective fatigue management strategies include physical conditioning programs, energy conservation strategies, sleep management strategies, and psychological support.

Determination of Quality of Life among the Study Population:

WHOQOL Distribution (Graph 4)

Graph 4 indicates the quality of life scores distribution using the WHOQOL scale. The average score of the WHOQOL in the current study was 52.79 + 11.10 implying an average perceived quality of life amongst the respondents.

Quality of life is a multidimensional notion that comprises physical health, psychological well-being, social relationships and environmental factors. Spinal cord patients encounter numerous issues including loss of mobility, reliance on caregivers, economic problems, and social impediments, some of which can be influential on their entire life satisfaction.

It should be pointed out, though, that quality of life is not determined by physical functioning only. The psychological adaptation, social support and community participation are also important in influencing the way people view their well-being.

Study by Post and Van Leeuwen (2012) established that persons with SCI are capable of attaining a good quality of life in spite of their severe physical disabilities particularly when they can continue to be vigilantly involved in social and community life. (4). Therefore, it should be noted that intervention should be assessed and planned in order to obtain Quality of life in the individuals with SCI.

Evaluation of Study Population Inclusion:

USER-P Frequency B Distribution (Graph 5)

Graph 5 is the distribution of the levels of participation measured with the help of USER-P Frequency B domain. The average USER-P Frequency B was 46.29 and 13.49 had a mean score of 46.29 with the standard deviation being 13.49, which showed that there were moderate levels of participation among the individuals.

Participation is viewed as the engagement of a person in everyday life, which is work, learning, socialization, and community participation. Following spinal cord injury, most people have impediments that restrict their participation fully in the society.

These obstacles can be physical constraints, physical inaccessibility, transportation, and stigma. Consequently, the levels of participation can decline despite the fact that some degree of functional autonomy is attained among persons.

A research by Whiteneck and Dijkers (2009) emphasized that the limitations to participation are frequent following the spinal cord injury and that they can have a considerable influence on the outcomes of long-term rehabilitation. (5) In a similar manner, this research provides also an insight on the limitations to community participation after a spinal cord injury.

Correlation of Fatigue and Quality of life:

Correlation between FSS and WHOQOL (Graph 6)

The relationship between fatigue and quality of life is shown in Graph 6. The findings indicated a medium negative relationship (r = -0.381) between WHOQOL scores and FSS.

It implies that the greater the fatigue, the worse the quality of life of the people with spinal cord injury.

Fatigue may disrupt most facets of everyday living such as physical activities, work performance, social interaction and emotional well being. In case people feel constantly tired, they can lessen their involvement in the activity, becoming isolated and experiencing a loss of satisfaction with their lives.

These results are also in line with the study carried by Fawkes-Kirby et al. (2008) that proved that fatigue is a major cause of decreased quality of life in persons with SCI. (6)

Thus, fatigue treatment in rehabilitation can lead not only to the improvement of physical functioning but also to the increase of psychological well-being and general life satisfaction.

Correlation of Fatigue and Participation:

Correlation between FSS and USER-P Frequency A (Graph 7)

Graph 7 demonstrates the correlation between fatigue and the frequency of participation under the USER-P Frequency A. The findings indicated that there was a medium negative relationship (r = -0.349).

This shows that the greater the level of fatigue, the lower the rate of engagement in daily activities.

Patients who have extreme fatigue might not want to engage in physical activities or activities that will need constant attention. In the long run, this decrease in the level of activity may result in further deconditioning and diminished social interactions.

Lidal et al. (2013) also reported similar results and discovered that fatigue also lowers the participation in activities in people with a spinal cord injury. (7)

Correlation between FSS and USER-P Frequency B (Graph 8)

Graph 8 indicates the correlation between the fatigue and the USER-P Frequency B using Spearman correlation. The findings indicated that there was a strong negative correlation (rho = -0.245).

This means that the higher the fatigue severity, the less often it is participated in. The strength of correlation is moderate and even mild but still the correlation is statistically significant.

This observation is another support of the theory that fatigue is one of the obstacles to the active engagement in daily life activities.

Correlation between FSS and USER-P Restriction (Graph 9)

Graph 9 indicates the correlated level of fatigue with the level of restriction of participation. The findings showed that the score of FSS has a negative relationship with USER-P Restriction (r = -0.247).

This shows that the more the fatigue, the more the participation restrictions.

Participation limitations can occur whereby the individuals are physically incapable of doing anything because of exhaustion. These restrictions may in the long run result in loss of independence and lack of participation in social and work functions.

These results indicate that fatigue needs to be managed to reduce the limitations of participation.

Correlation between FSS and USER-P Satisfaction (Graph 10)

The relation between the fatigue and the satisfaction with the participation is depicted in Graph 10. The outcomes showed that there was a negative correlation (r = -0.232).

This means that the people with greater levels of fatigue were less satisfied with the level of their participation.

Although persons may experience some activities, constant fatigue can decrease the pleasure or satisfaction of the activities.

This brings to the fore the psychological effects of the fatigue besides its physiological effects.

Connection of Fatigue and Functional Independence:

Correlation between FSS and SCIM Total (Graph 11)

Graph 11 demonstrates the dependence of fatigue and functional independence as calculated using Spinal Cord Independence Measure (SCIM).

The findings showed that there is a significant negative relationship between functional independence and severity of fatigue (r = -0.684).

This result indicates that those with higher fatigue levels have less independence in doing activities like caring about themselves, mobility as well as sphincter management.

Exhaustion can also limit the physical ability to do these tasks on their own, which means that they will be more dependent on caregivers.

According to a study conducted by Bauman and Spungen (2017), fatigue may have a major impact on functional performance and the level of daily activity in people who have suffered spinal cord injury. (8)

Correlation of Participation and quality of life:

Correlation between WHOQOL and USER-P Participation (Graph 12)

Graph 12 illustrates the correlation between quality of life and the levels of participation. The findings revealed positive relationships between WHOQOL and various participation areas, such as the USER-P Frequency A, Restriction, and Satisfaction.

This suggests that those people who engage in more activities in their day to day lives are those who report a good quality of life.

Being involved enables one to keep social contacts, play serious roles and have a feeling of purpose. These are important factors leading to psychological wellbeing and satisfaction of life.

Dijkers (2010) notes that participation happens to be among the most crucial quality of life determinants in a disabled person (including spinal cord injury). (9)

Summary of Key Findings:

The general data of the current research point to the important role played by fatigue in determining participation, functional independence, and quality of life in persons with a spinal cord injury.

The respondents in the study exhibited moderate to severe fatigue, moderate levels of participation and moderate functional independence. Analysis of correlation showed that fatigue was negatively related to quality of life, frequency of participation, satisfaction on participation and functional independence.

The biggest correlation of these relationships was found between fatigue and functional independence (SCIM). This implies that fatigue could have a severe impact on the performance of a person to carry out everyday tasks on their own.

Also, it was revealed that participation has a positive relationship with quality of life, which means that the active involvement in everyday life activities could be encouraged to enhance the overall well-being.

These results prove the idea that fatigue is not the secondary symptom but the significant factor to be taken into consideration in rehabilitation results of spinal cord injury.

The present study highlights that fatigue is a common and significant problem experienced by individuals with spinal cord injury. The findings demonstrate that higher levels of fatigue are associated with reduced participation in daily, social, and productive activities, as well as poorer quality of life. Individuals who reported greater fatigue tended to show lower engagement in community and occupational roles and experienced greater limitations in physical and psychological well-being.

The results emphasize that fatigue should not be overlooked during the rehabilitation of patients with spinal cord injury. Since fatigue can influence multiple aspects of life, including independence, participation, and overall well-being, it is important for rehabilitation professionals to routinely assess and address fatigue during treatment planning. Effective fatigue management strategies may help improve functional outcomes, enhance participation, and ultimately improve the quality of life of individuals living with spinal cord injury.

Overall, the study reinforces the need for a holistic rehabilitation approach that focuses not only on physical recovery but also on managing secondary complications such as fatigue. Addressing fatigue may play a crucial role in promoting greater independence, social integration, and better long-term outcomes for individuals with spinal cord injury.

LIMITATIONS

Despite providing important insights, the present study has certain limitations. First, the cross-sectional design of the study limits the ability to establish a causal relationship between fatigue, participation, and quality of life in individuals with spinal cord injury. Second, the study relied primarily on self-reported questionnaires, which may be influenced by subjective perception, recall bias, or response bias. Third, the study population was limited to individuals with spinal cord injury living in Mumbai**,** which may restrict the generalizability of the findings to other regions or populations with different socio-demographic or healthcare backgrounds. Additionally, potential psychological and lifestyle factors such as depression, sleep disturbances, physical activity levels, and social support were not separately assessed, which may also influence fatigue levels and quality of life. Finally, the study did not perform

longitudinal follow-up**,** which could have provided deeper understanding regarding changes in fatigue and participation over time.

FUTURE SCOPE OF STUDY

Future research can expand upon the findings of the present study in several ways. Longitudinal studies can be conducted to better understand the long-term relationship between fatigue, participation, and quality of life in individuals with spinal cord injury. Future studies may also include larger and more diverse populations from multiple regions**,** which would improve the generalizability of the results. Researchers may further explore the influence of psychological factors such as depression, anxiety, sleep quality, and coping strategies on fatigue in this population. Interventional studies can also be conducted to evaluate the effectiveness **of** fatigue management strategies, physiotherapy interventions, lifestyle modifications, and rehabilitation programs in reducing fatigue and improving participation and quality of life. Additionally, combining objective functional assessments with self-reported measures may provide a more comprehensive understanding of the impact of fatigue in individuals with spinal cord injury.

CONCLUSION

Spinal cord injury is a life-changing condition that can lead to multiple long-term physical and psychosocial challenges. Among these, fatigue is a commonly reported but often under-recognized symptom that may significantly affect an individual's daily functioning and overall well-being. The present study aimed to examine the impact of fatigue on participation and quality of life in individuals with spinal cord injury living in Mumbai.

A cross-sectional study was conducted among individuals diagnosed with spinal cord injury. Fatigue was assessed using the Fatigue Severity Scale (FSS)**,** participation was evaluated using the Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-P)**,** quality of life was measured using the WHOQOL-BREF, and functional independence was assessed using the Spinal Cord Independence Measure (SCIM). Data were analyzed using statistical methods to determine the relationship between fatigue, participation, and quality of life.

The findings indicated that fatigue is highly prevalent among individuals with spinal cord injury and has a significant negative influence on participation and quality of life. Higher fatigue levels were associated with reduced engagement in daily and social activities and lower overall well-being. These results highlight the importance of recognizing fatigue as a critical factor affecting rehabilitation outcomes in individuals with spinal cord injury.

In conclusion, the study emphasizes the need for rehabilitation professionals to incorporate fatigue assessment and management strategies as part of comprehensive rehabilitation programs. Addressing fatigue may help improve participation, independence, and overall quality of life in individuals living with spinal cord injury.

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