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RESEARCH ARTICLE

ENVIRONMENTAL BARRIERS IN COMMUNITY REINTEGRATION FOLLOWING SPINAL CORD INJURY: A CROSS-SECTIONAL STUDY

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Abstract: ***Background***: Spinal Cord Injury (SCI) can be considered a serious neurological problem that entails substantial impairments not only physically but socially as well. Even with improvements in rehabilitation therapy for people with SCI, most still face difficulties with their community integration because of numerous environmental barriers. Those barriers range from the lack of proper infrastructure to attitude problems and poor transportation services, as well as inadequate policies and lack of community-based rehabilitation programs. In developing nations such as India, the issue of environmental barriers remains relevant and challenging.***Objective:***To evaluate environmental barriers influencing community reintegration among individuals with spinal cord injury using the Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF) hindi version.***Methods:***This research work is a descriptive, cross-sectional observational study carried out on 80 patients having traumatic and non-traumatic SCI from Smt. Sindhutai E. Vikhe Patil Spinal Cord Injury Rehabilitation Centre. These participants were screened using the CHIEF-SF questionnaire. The data obtained were then analyzed using descriptive statistics. Comparison among the various demographics and injury categories with respect to the environmental barriers was made using independent t-test and one-way ANOVA.Results:The mean score for environmental barriers using CHIEF-SF scale was 2.87 ± 1.14, suggesting moderate to severe barriers to the environment. Barriers related to transport and physical access showed high mean scores. The study found statistically significant higher scores among participants having complete spinal cord injuries, low education levels, unemployment, and long-term use of wheelchairs ($p<0.05$). A multiple regression analysis identified employment status, extent of injury, availability of transport services, and time since injury as important factors for environmental barriers (Adjusted $R^2=0.48$, $p<0.001$).Conclusion:The environment plays a crucial role in the process of community integration among those living with SCI. Access problems, transportation difficulties, and social attitudes continue to be critical barriers for people living with SCI in India. Rehabilitating individuals with SCI should not only address their physical well-being but also involve the environment.

Keywords: Spinal cord injury; Community reintegration; Environmental barriers; CHIEF-SF; Disability; Accessibility; Rehabilitation; India.

INTRODUCTION

Spinal cord injury (SCI) is among the most debilitating neurological conditions, resulting in long-term motor, sensory, and autonomic impairments that substantially affect an individual's functional independence and social participation. The World Health Organization estimates that approximately 250,000 to 500,000 new cases of SCI occur globally each year, predominantly due to road traffic accidents, falls, violence, and sports injuries.1,2,3.SCI imposes profound physical, psychological, social, and economic consequences not only on affected individuals but also on families and healthcare systems.4 Recent estimates from the Global Burden of Disease (GBD) 2019 study suggest approximately 0.9 million new cases and over 20 million prevalent cases of SCI worldwide, underlining the immense global health burden.5

In India, the burden of SCI is increasing due to rapid urbanization, poor traffic safety measures, industrial accidents, and inadequate trauma care systems. Epidemiological studies report an incidence ranging from 20–40 cases per million population annually, with the majority affecting young adult males in their economically productive years.6 Beyond physical disability, individuals with SCI frequently encounter unemployment, social exclusion, depression, financial dependency, and reduced quality of life.4

Modern rehabilitation aims not only to improve physical functioning but also to facilitate successful community reintegration.7 Community reintegration refers to the process by which individuals resume meaningful participation in social, vocational, recreational, and family roles after rehabilitation.8 However, the ability to reintegrate into society is often hindered by environmental barriers rather than the impairment itself.9

The International Classification of Functioning, Disability and Health (ICF) framework conceptualizes disability as an interaction between health conditions and

contextual factors, including environmental and personal determinants.1 Environmental barriers can either facilitate or restrict participation depending on the accessibility and inclusiveness of the surrounding environment.9
Environmental barriers affecting individuals with spinal cord injury (SCI) include inaccessible buildings and public spaces.9,10

Lack of wheelchair-friendly transportation is another major obstacle to mobility and community participation among individuals with SCI.10,11

Social stigma and negative attitudes significantly affect psychosocial adjustment and social participation after SCI.12,13
Limited employment opportunities are commonly reported among persons with SCI due to physical, social, and workplace barriers.14,15

Inadequate healthcare and rehabilitation services contribute to poor long-term outcomes and reduced quality of life in individuals with SCI.16,1

Weak implementation of disability-related policies further restricts accessibility, inclusion, and equal participation in society.

International studies have consistently demonstrated that environmental barriers negatively influence independence, community participation, psychosocial adjustment, and quality of life among individuals with SCI.1 Whiteneck et al. reported that inaccessible transportation systems and inadequate public infrastructure significantly restrict participation in daily activities.9 Similarly, Fekete et al. found that environmental barriers contribute substantially to reduced social integration across multiple countries.17

In the Indian context, infrastructural limitations, limited enforcement of accessibility standards, and cultural misconceptions regarding disability pose unique challenges. Despite the enactment of the Rights of Persons with Disabilities (RPwD) Act, 2016, accessibility and inclusion remain inadequate in many urban and rural settings.
The Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF) Hindi version is a validated instrument designed to measure perceived environmental barriers across domains including accessibility, transportation, attitudes, services, and policies.18 However, limited research has examined environmental barriers among Indian individuals with SCI using standardized outcome measures.

Therefore, the present study aimed to evaluate environmental barriers influencing community reintegration among individuals with SCI and identify demographic and injury-related factors associated with higher environmental barrier burden..

MATERIALS AND METHODS

Study Design: A cross-sectional observational study

Study Setting: The study was carried out at the Smt. Sindhutai E. Vikhe Patil Spinal Cord Injury Rehabilitation Centre, Dr.VVP Pravara Rural Hospital, Loni, Maharashtra India and SCI survivors Home.

Study Population: Individuals diagnosed with traumatic or non-traumatic SCI who had completed inpatient rehabilitation and were residing in the community were recruited.

Sample Size: A total of 80 participants were included based on feasibility and comparable studies evaluating environmental barriers in SCI populations (Calculated by OpenEpi software)

Sampling Technique: Purposive sampling was used to recruit eligible participants from rehabilitation registries and community rehabilitation networks.

Inclusion Criteria were Individuals aged ≥18 years, Diagnosed with traumatic or non-traumatic SCI, Minimum 3 months post-discharge from inpatient rehabilitation, Community-dwelling individuals and Willing to provide informed consent

Exclusion Criteria were Severe cognitive impairment, Severe psychiatric illness, Acute hospitalization or unstable medical conditions and Unwillingness to participate

Outcome Measure: Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF)Hindi version
The CHIEF-SF is a validated 12-item questionnaire assessing environmental barriers across five domains:

1. Physical/Structural Barriers
2. Attitudinal/Support Barriers
3. Services/Assistance Barriers
4. Work/School Policy Barriers
5. Transportation/Natural Environment Barriers

Each item measures:

- Frequency (0–4)
- Magnitude (0–2)

Composite scores are calculated as:
CHIEF-SF Score = Frequency × Magnitude
Higher scores indicate greater environmental barriers.

Data Collection Procedure
Ethical approval was obtained from the Institutional Ethics Committee prior to data collection. (PIMS/IEC/-DR/2025/299) Eligible participants were identified from rehabilitation records and contacted telephonically or during follow-up visits.

After obtaining informed consent, demographic and injury-related data were recorded, including: Age, Gender, Educational status, Occupation, Marital status, Type of SCI, Level of injury, Duration since injury and Wheelchair dependency

The CHIEF-SF questionnaire was administered through face-to-face interviews

Statistical Analysis
Data analysis was performed using SPSS version 26.0.

Descriptive Statistics
- Mean and standard deviation for continuous variables
- Frequency and percentages for categorical variables

Inferential Statistics
- Independent t-test for comparison between two groups
- One-way ANOVA for comparison across multiple groups
- Pearson correlation analysis for relationships between continuous variables
- Multiple linear regression analysis to identify predictors of environmental barrier scores

The level of statistical significance was set at $p < 0.05$

RESULTS

Demographic and Clinical Characteristics

Table 1. Demographic and Clinical Characteristics of Participants (n = 80)

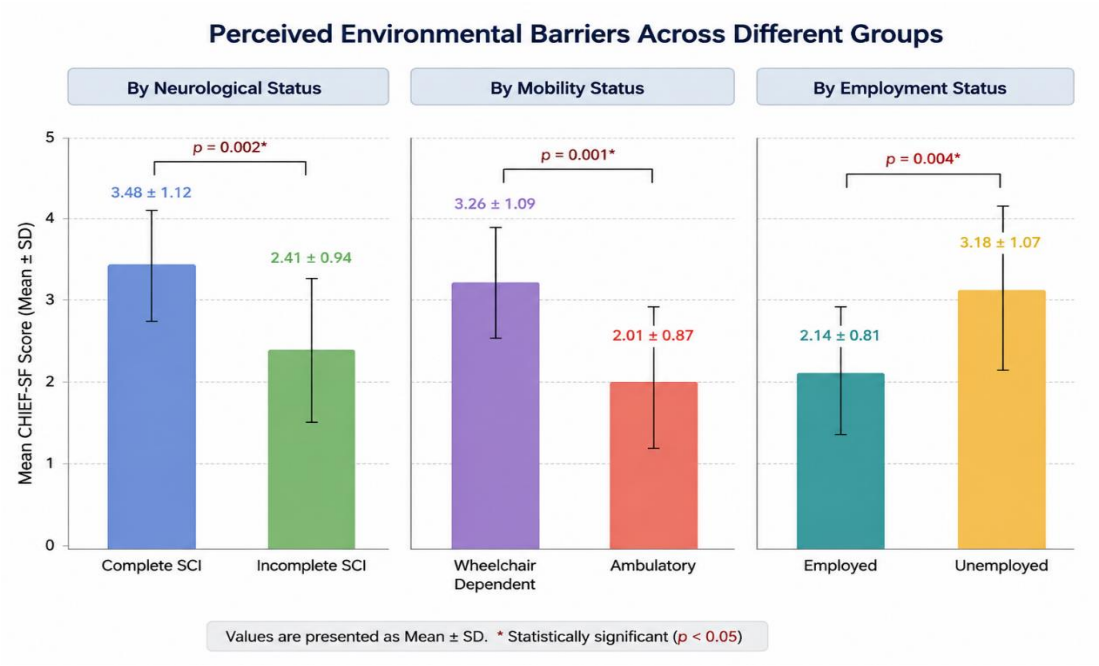
Variable	Frequency (%)
Age (years)	36.8 ± 11.4
Male	61 (76.3%)
Female	19 (23.7%)
Traumatic SCI	58 (72.5%)
Non-traumatic SCI	22 (27.5%)
Complete SCI	34 (42.5%)
Incomplete SCI	46 (57.5%)
Cervical Injury	29 (36.3%)
Thoracic Injury	38 (47.5%)
Lumbar Injury	13 (16.2%)
Wheelchair dependent	57 (71.2%)
Employed	24 (30.0%)
Unemployed	56 (70.0%)

CHIEF-SF Scores Across Domains

Table 2. Mean CHIEF-SF Domain Scores

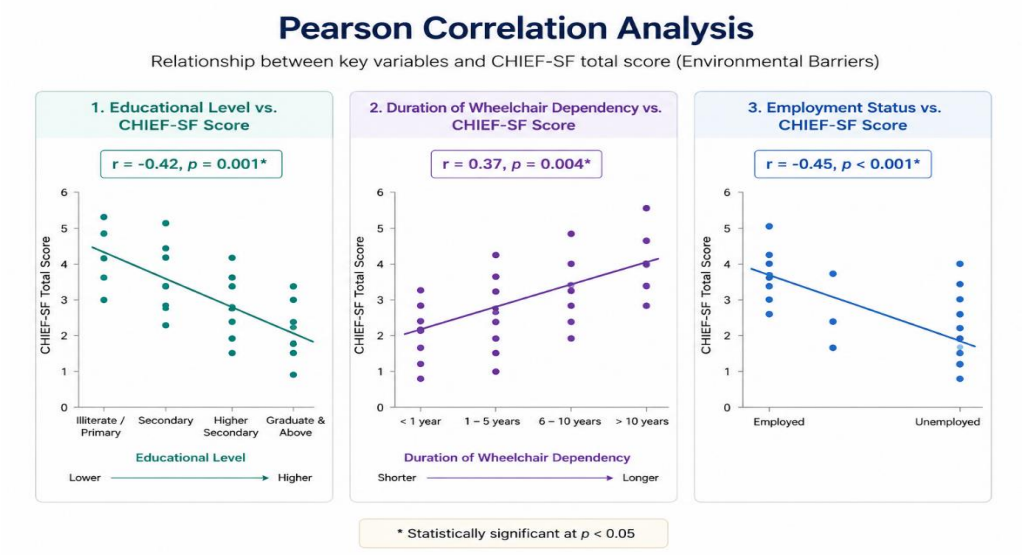
Domain	Mean ± SD
Physical/Accessibility	3.46 ± 1.28
Transportation/Natural Environment	3.71 ± 1.19
Services/Assistance	2.64 ± 1.02
Attitudes/Support	2.38 ± 0.94
Work/School Policies	2.17 ± 1.11
Total CHIEF-SF Score	2.87 ± 1.14

Transportation and physical accessibility barriers demonstrated the highest scores, indicating these were the most significant perceived barriers



Graph 1. Comparison of Total CHIEF-SF Scores Across Clinical Variables

Participants with complete injuries, wheelchair dependency, and unemployment experienced significantly higher environmental barriers

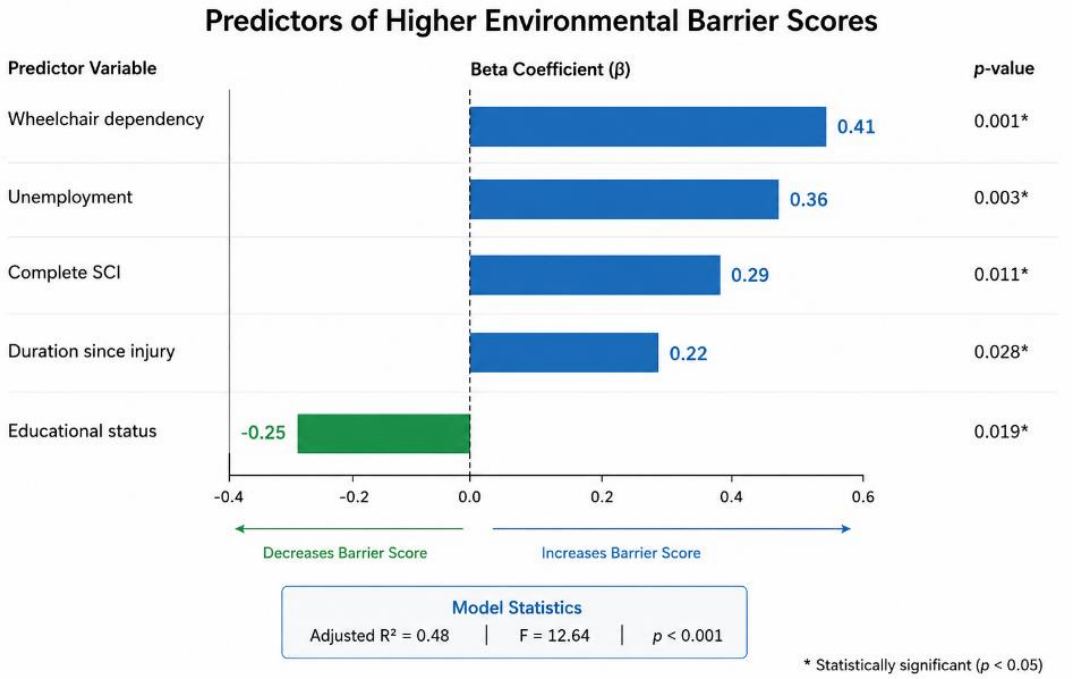


Graph 2 shows correlation between Key variables and CHIEF-SF Score

Pearson correlation analysis demonstrated:

- Negative correlation between educational level and CHIEF-SF score (r = -0.42, p = 0.001)
- Positive correlation between duration of wheelchair dependency and environmental barriers (r = 0.37, p = 0.004)
- Negative correlation between employment status and total barrier scores (r = -0.45, p < 0.001)

Multiple Linear Regression Analysis



Graph 3. Predictors of Higher Environmental Barrier Scores

The regression model explained 48% of the variance in environmental barrier scores

DISCUSSION

The present study evaluated environmental barriers influencing community reintegration among individuals with spinal cord injury (SCI) using the Craig Hospital Inventory of Environmental Factors – Short Form (CHIEF-SF) hindi version. The findings demonstrated that individuals with SCI continue to encounter substantial environmental restrictions despite completion of inpatient rehabilitation. The overall CHIEF-SF scores indicated moderate-to-severe environmental barriers, emphasizing that successful rehabilitation extends beyond physical recovery and requires accessible and inclusive community environments.

Transportation and physical accessibility barriers emerged as the most prominent environmental challenges in the present study. Participants frequently reported difficulties related to inaccessible public transport, absence of ramps and elevators, uneven road surfaces, inaccessible toilets, and poorly adapted public infrastructure. These findings are consistent with the study conducted by Whiteneck et al., which identified transportation accessibility as one of the strongest determinants of participation among individuals with disabilities.9 Similarly, Chan et al. reported that environmental accessibility significantly influences social participation and independence among individuals with SCI.19

The predominance of transportation-related barriers in the current study reflects the infrastructural limitations commonly observed in developing countries, particularly India. Although the Government of India Rights of Persons with Disabilities (RPwD) Act, 2016 mandates accessibility and equal participation, implementation remains inconsistent across healthcare institutions, educational facilities, workplaces, and public spaces.20 Joseph et al. reported similar findings in South India, highlighting that inaccessible environments and inadequate transportation systems substantially restrict social participation among persons with SCI.21

Participants with complete SCI reported significantly higher environmental barrier scores compared to those with incomplete SCI. This finding may be attributed to increased dependence on wheelchairs and caregivers among individuals with complete injuries. Greater functional impairment increases the interaction between disability and inaccessible environments, thereby limiting independent mobility and participation. Fekete et al. similarly observed that individuals with severe SCI experienced reduced participation and greater environmental restrictions across multiple countries.17 Wheelchair dependency was identified as a significant predictor of higher environmental barrier scores. Individuals dependent on wheelchairs often encounter substantial obstacles related to mobility, transportation, and architectural accessibility. Inaccessible sidewalks, lack of curb cuts, narrow pathways, and inaccessible buildings contribute significantly to social isolation and dependency. These findings align with those of Cao et al., who reported that environmental barriers negatively

affect health outcomes and participation among individuals living with chronic SCI.22
Employment status also demonstrated a significant association with environmental barriers. Unemployed participants perceived greater environmental challenges than employed individuals. This may reflect the reciprocal relationship between accessibility and socioeconomic participation. Environmental barriers reduce access to workplaces, vocational training, and transportation, thereby contributing to unemployment. Conversely, unemployment may reduce financial capacity to obtain assistive technologies, adaptive transportation, and environmental modifications. Lidal et al. emphasized that return to work following SCI is strongly influenced by environmental accessibility, vocational support, and societal attitudes.23

Educational status showed a negative correlation with environmental barrier scores, suggesting that individuals with higher educational levels perceived relatively fewer barriers. Education may enhance awareness regarding disability rights, social welfare schemes, assistive technologies, and coping strategies. Educated individuals may also possess improved self-advocacy skills and greater access to employment and support networks. Similar observations have been reported in rehabilitation literature, where education has been associated with improved social participation and psychosocial adaptation following SCI. 24

Attitudinal barriers were moderately prevalent among participants and included experiences of stigma, pity, overprotection, discrimination, and social exclusion. Negative societal attitudes continue to represent major challenges for individuals with disabilities, particularly in low- and middle-income countries. Social stigma may reduce confidence, discourage participation in public life, and negatively influence mental health outcomes. Post and van Leeuwen (2012) highlighted that psychosocial adjustment following SCI is strongly influenced by societal acceptance and social support.24

The findings of the present study strongly support the International Classification of Functioning, Disability and Health (ICF) framework proposed by the World Health Organization (WHO, 2001). According to the ICF model, disability is not solely determined by physical impairment but results from interactions between health conditions and contextual environmental factors. Therefore, reducing disability requires both medical rehabilitation and removal of environmental barriers.25

The present study has important implications for rehabilitation practice and public health policy. Rehabilitation programs should incorporate community reintegration strategies, environmental accessibility assessments, vocational rehabilitation, psychosocial support, and caregiver education. Community-based rehabilitation (CBR) initiatives may further improve participation by addressing accessibility and social inclusion at the community level.1

From a policy perspective, there is an urgent need to strengthen implementation of universal design principles and accessibility standards in India. Public transportation systems, healthcare facilities, educational institutions, workplaces, and recreational spaces should adopt disability-inclusive infrastructure. Awareness campaigns promoting disability rights and social inclusion are also essential to reduce attitudinal barriers.

The strengths of the present study include the use of a validated and internationally recognized assessment tool, evaluation of multiple environmental domains, and focus on the Indian rehabilitation context. However, certain limitations should be acknowledged. The cross-sectional design limits causal interpretation, while purposive sampling and single-center recruitment may affect generalizability. Self-reported responses may also be influenced by recall and perception bias.

Future multicentric longitudinal studies with larger sample sizes are recommended to evaluate long-term effects of environmental barriers on participation, mental health, and quality of life. Interventional studies assessing the effectiveness of accessibility modifications and community-based rehabilitation programs are also warranted..

CONCLUSION

This research concludes that the environmental barriers play a vital role in influencing the process of reintegration into the community for people with spinal cord injuries. The transportation issues, unavailability of accessibility in physical environment, unemployment, lack of services, and negative attitude of society still remain hindrances after the rehabilitation period.

People with complete spinal cord injury and wheelchair-dependent have reported a high degree of environmental barriers, indicating that disabilities are not just physical impairments but are greatly impacted by environment and contextual aspects. These results corroborate with the International Classification of Functioning, Disability and Health (ICF) model proposed by the WHO (2001).

The results emphasize the need for development of disability-friendly infrastructure, accessible transportation, vocational rehabilitation, and better implementation of the Rights of Persons with Disabilities Act (2016). Cooperation between rehabilitation therapists, government officials, urban planners, and community members is required to design environments which provide equal opportunities.

Overcoming such barriers through rehabilitation strategies and interventions will help enhance independence, psychosocial functioning, employment

participation, and quality of life among people suffering from spinal cord injuries.

Clinical Implications
Environmental factors play an important role in influencing community integration for individuals suffering from spinal cord injury. The major environmental factors found responsible for participation restriction included problems related to transport, physical environment, employment, and use of wheelchairs.

This study emphasizes the importance of creating infrastructure and implementing universal design policy along with providing rehabilitation services in India. The focus of rehabilitation should be shifted to overcoming environmental and social barriers in addition to gaining back functions at hospitals.

An audit of health care and public facilities should be done for making them accessible to everyone. The policymakers should strictly follow the guidelines of the RPwD Act for reducing environmental barriers and enhancing social participation.

Future Recommendations:
Conduct multicentric longitudinal studies across urban and rural regions. Evaluate the effectiveness of accessibility interventions on participation outcomes. Investigate relationships between environmental barriers and mental health outcomes.

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Conflict of Interest
The authors declare no conflict of interest.

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Ethical Approval
Ethical approval was obtained from the Institutional Ethics Committee prior to commencement of the study. Written informed consent was obtained from all participants.

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