Original Article

Functional Outcome of Patients with Post-Acute Traumatic Spinal Cord Injury after a 6-month Home-Based Rehabilitation Program and its Related Factors

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ABSTRACT

Objectives: The study aimed to evaluate the effectiveness of home-based rehabilitation programs on the functional outcomes of patients with traumatic spinal cord injuries in the post-acute phase and analyze factors associated with improved functional outcomes.

Study design: Prospective cohort study

Setting: Phatthalung Hospital, Thailand

Subjects: Patients with traumatic spinal cord injuries had a home-based rehabilitation program and 6-month follow-up at a rehabilitation outpatient clinic from April 2022 to January 2023.

Methods: The demographic and medical information was retrieved from the medical record. The Spinal Cord Independence Measure version III was used to evaluate patients' functional outcomes at the program's start and the end of the 6-month follow-up period. The Thai-HADs questionnaire was assessed at the 6-month follow-up period. The chi-square and Fisher's exact tests were used to evaluate the factors related to improved functional outcomes.

Results: A total of 76 patients participated in this study, with 76.3% of patients being men and mean (SD) age of 47.49 (14.85) years. The SCIM scores of 63.16% of patients increased throughout the follow-up period. Age, body mass index, neurological level of injury, level of paralysis, complications related to spinal cord injuries, frequency of encounter with therapists, frequency of self-exercise, and depressive symptoms were statistically significant factors associated with improved functional outcomes.

Conclusions: Home-based rehabilitation has benefits for patients with traumatic spinal cord injuries. Many factors are associated with improved functional outcomes. Healthcare workers and community support can help patients reach the highest level of independence and better reintegrate into their families and communities.

Keywords: functional independence, spinal cord injury, home care, rehabilitation

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Introduction

Spinal cord injury (SCI) is a dangerous disorder that can result in temporary or permanent disability and neurological defects. It impacts not only the patient's quality of life but also the family, community, and healthcare system.[1] The estimated incidence of traumatic spinal cord injury in developed countries was 10.4-130.6 cases per million people annually.[2,3] There are few epidemiologic studies of people with spinal cord injuries and the number of patients who received rehabilitation in Thailand, as no national data for the whole country exists.

Most motor function recovery occurs in the first six months after injury.[4] The neurological level and capacity of spared muscle groups to perform specific tasks like activities of daily living (ADL) influence the positive predictor for good functional goals and predicted outcomes.[5] Rehabilitation goals after SCI include maximizing physical independence, becoming independent in the direction of care, and preventing secondary complications.[6] Starting rehabilitation as soon as possible is encouraged. In 2019, the Ministry of Public Health implemented a health service system called intermediate care (IMC), aimed at patients with spinal cord injuries as one of the issues ensuring access to a six-month continuous rehabilitation program. The IMC program includes an intermediate-intensive IPD program, an OPD-based program, and home health care.[7] With difficult transportation, financial problems, and the limitation of inpatient rehabilitation services in rural areas, home-based rehabilitation programs were prescribed to patients.

Various people or environmental elements may influence functional outcomes, including age, complications, family support, and financial situation.[8] A prior study found that the physical environment, social factors (culture, economy, and healthcare system), the severity of the disability, and secondary complications all impact how successfully home-based rehabilitation patients perform.[9] Numerous studies have addressed difficulties such as poor continuity of care, limited access to public facilities, a lack of accessibility owing to architecture, and living independently.[10-17]

This study aimed to evaluate the effectiveness of home-based rehabilitation programs on the functional outcomes of patients with traumatic spinal cord injuries at the end of the 6-month follow-up period. In addition, this study aims to

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evaluate the factors associated with improved functional outcomes.

Methods

Study design

The Ethics Committee of Phatthalung Hospital approved this prospective cohort study research, clinical trial registration number 05/2022.

Participants

From April 2022 to January 2023, all patients with traumatic spinal cord injuries of any age and duration from onset within three months who consulted the Rehabilitation Medicine Department at Phatthalung Hospital were enrolled in the study. They participated in a home-based rehabilitation program, were able to encounter a therapist at an outpatient clinic every two weeks, and completed a 6-month follow-up program. All participants signed informed consent and assent papers. Patients were excluded if they failed to attend the 6-month follow-up visit or passed away while the study was ongoing. Patients who missed more than two consecutive outpatient appointments with a therapist were considered dropouts.

Several studies have revealed that 80-90% of patients with traumatic spinal cord injuries may have seen improved functional results during the first six months after their injury.[4,5,8,9,18] The sample size calculation was based on the previous studies by with Stata version[14,19] which used a two-sample comparison of proportions to compare the functional outcomes of the two separate groups (the ratio of increased functional score to remaining/decreased score was 9:1). For an alpha level of 0.05, a power of 80%, a one-sided test, and an estimated drop-out rate of 20% (10% to cover loss to follow-up and an additional 10% to cover exclusion for other reasons). We, therefore, included 76 cases in the study.

Materials

The Spinal Cord Independence Measure III (SCIM III) is a clinician-rated tool that was developed specifically to measure the level of independence in overall daily life activities for individuals with SCI.[20, 21] It comprised 19 items across three subscales: self-care (feeding, grooming, bathing, and dressing), respiratory and sphincter management, and mobility. Mobility is subdivided into 'room and toilet' and 'indoors and outdoors'. The total score ranges between 0 and 100, where 0 indicates total dependence, and 100 indicates complete independence.

The Thai version of the hospital anxiety and depression scale (Thai-HADs), a self-administered questionnaire, was employed to determine the anxiety and depression symptoms of the participants.[22] It comprised 14 items: seven for anxiety assessment and seven for depression assessment. Each item was on a four-point scale ranging from 0 to 3. A score of 8-10 suggested borderline anxiety or depressive symptoms, and a score of 11 indicated clinical anxiety or depression.

Study protocol

1. After receiving approval from the hospital's Ethical Review Board, those who met the inclusion criteria were asked to participate in the study.
2. After signing the informed consent form, the patients were registered, and the following baseline variables from their medical records were collected: age, gender, etiology, level of paralysis (tetraplegia and paraplegia), completeness of injury, other underlying diseases, complications, and health insurance scheme.
3. The rehabilitation program included the following;

- Physical and occupational therapy: 0.5-hour sessions with each therapist in an outpatient clinic every two weeks. Breathing exercises, ROM exercises, mobility in bed, transfer, ambulation, ADL, and assistive or adaptive equipment application were taught to the patient and primary caregiver.
- The physiatrist reviewed and changed the rehabilitation program at the outpatient clinic every four weeks. A physiatrist advised about dietary and fluid management, a bowel training program, a scheduled voiding program, and skin care.
- The rehabilitation nurse advised the abdominal massage, clean intermittent self-catheterization (CISC) training, and ulcer care.
- Patients were instructed to do a home exercise program (as prescribed by therapists) for at least 30 minutes twice daily while being monitored or assisted by a primary caregiver.
- They had to keep a logbook record to guarantee adherence to the home program. On a weekday, patients could phone the therapist with questions or concerns.
- A physiatrist evaluated the SCIM III score at the start of the program (SCIMinitial) and the end of the 6-month follow-up period (SCIMfollowup). SCIM III score changes were classified into two categories: SCIMup (patients whose SCIM score increased at the 6-month follow-up period) and SCIMdown (patients whose SCIM score decreased or unchanged at the follow-up period).
- The Thai-HADs questionnaire was assessed at the 6-month follow-up period. Patients scoring higher than seven were considered to have depressive symptoms and will be referred to the psychology department.

Outcome measurements

The primary purpose of this study was to evaluate the effectiveness of home-based rehabilitation programs on the functional outcomes of patients with traumatic spinal cord injuries at the end of the 6-month follow-up period using SCIM III. Moreover, the secondary purpose was to evaluate the factors related to improved functional outcomes.

Statistical analysis

Demographic and clinical data were reported as percentages, mean, and standard deviations (SD). The overall SCIM III score and its subdomains were observed at the program's

start and the end of the 6-month follow-up period, and the Wilcoxon signed-rank tests were used to analyze the statistical significance of the median change. The chi-square and Fisher's exact tests were used to find factors associated with improved functional outcomes in patients' demographic and clinical characteristics.

Statistical significance was set at $p < 0.05$. Statistical analysis was conducted using Stata version 14.0.

Results

From April 2022 to January 2023, 81 individuals with traumatic SCI were consulted and participated in this study at the Rehabilitation Medicine Department. During the 6-month follow-up period, four people failed to follow up, and one died (6%). They resulted in 76 patients for analysis, as shown in Figure 1.

Table 1 displays the clinical and demographic features of the 76 patients. Most (76.3%) were men. Range: 18-78 years; mean (SD) age: 47.49 (14.85) years. 47.37% of cases had average body mass indices. The three most common causes of injury were assault (15.79%), falls (32.89%), and transport (42.11%). Most patients are classified as having neurological level of injury (NLI) type D (46.06%). 43.42% had comorbid diseases; the three most common were hypertension (69.69%), dyslipidemia (51.51%), and diabetes mellitus (36.36%). At the 6-month follow-up period, 90.79% of patients had a medical history of spinal cord injury complications; the three most common were pressure injury (84.06%), musculoskeletal issues (43.48%), and urinary tract infection (26.08%). 57.89% never miss a two week therapy appointment. 64.47% reported having done the home program every day. 52.63% had feelings of depression. 47.37% had feelings of anxiety. Only 30.26% had enough income to cover their expenses and had savings. Moreover, 53.95% opted for the health insurance scheme through the disability scheme under universal health coverage.

SCIM III was used to measure the functional outcomes. As shown in Table 2, the Wilcoxon signed-rank test was used to examine differences in total score and all subdomains at the start of the program (SCIMinitial) and the end of the 6-month follow-up (SICM follow-up).

Patients in the SCIMup group had a rise in their SCIM score after the 6-month follow-up period, whereas those in

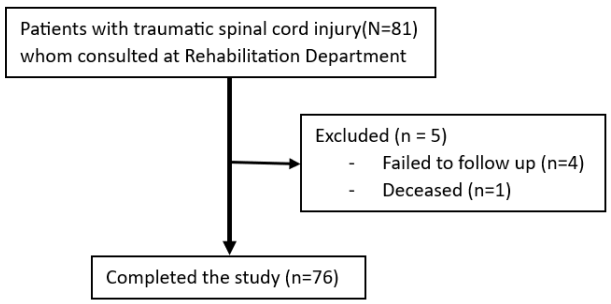


Figure 1. Schematic flow diagram of the study

Table 1. Demographics and clinical characteristics of patients with spinal cord injuries

Characteristics	Value (N = 76)
Gender	
Male	58 (76.32)
Age (yrs)[1]	47.49 (14.85)
Body mass index (BMI)[2]	
Underweight	19 (25.00)
Normal	36 (47.37)
Overweight	21 (27.63)
Cause of injury[2]	
Transport	32 (42.11)
Falls	25 (32.89)
Sports and leisure	5 (6.58)
Assault	12 (15.79)
Others	2 (2.63)
Neurological level of injury (NLI) according to ASIA impairment scale (AIS)[2]	
C1-8; ASIA A, B, C	18 (23.68)
T1-S5; ASIA A, B, C	23 (30.26)
All D	35 (46.06)
Level of paralysis[2]	
Paraplegia	42 (55.26)
Tetraplegia	34 (44.74)
Comorbid diseases (n = 33)[2]	33 (43.42)
Hypertension	23 (69.69)
Dyslipidemia	17 (51.51)
Diabetes mellitus	12 (36.36)
Cardiovascular	7 (21.21)
Psychiatric	2 (6.06)
Complication (n = 69)[2]	69 (90.79)
Pressure injury	58 (84.06)
Musculoskeletal problems	30 (43.48)
Urinary tract infection	18 (26.08)
Respiratory impairment	14 (20.29)
Pain	9 (13.04)
Frequency of encounter with the therapist (every 2 weeks)[2]	
Never missed session	44 (57.89)
Occasionally (not drop out)	32 (42.10)
Frequency of home program (logbook diary)[2]	
Every day	49 (64.47)
Every other day	13 (17.11)
Uneven	14 (18.42)
Thai-HADs (depression)[2]	
Feeling of depression	40 (52.63)
Thai-HADs (anxiety)[2]	
Feeling of anxiety	36 (47.37)
Income adequacy[2]	
Not enough	17 (22.37)
Enough for basic needs only	36 (47.37)
Enough for needs and have savings	23 (30.26)
Health insurance scheme[2]	
Universal health coverage (UHC)	16 (21.05)
Self-pay	6 (7.89)
Civil servant medical benefit scheme (CSMBS)/ Social security scheme (SSS)	13 (17.11)
Disability scheme under universal health coverage	41 (53.95)

[1]Mean (standard deviation, SD); [2]number (%)

the SCIMdown group had a decrease or no change in their SCIM score.

According to the study's findings, the SCIMup group had statistically significant increases in all subdomains and the total SCIM score (p 0.05). In addition, 28 patients (36.84%) were in the SCIMdown group, with a statistically significant decrease or unchanged score in all items (p 0.05).

The chi-square and Fisher's exact tests have been used to evaluate the relationship between factors and an improved functional outcome, as shown in Table 3. Age, body mass index (BMI), neurological level of injury (NLI), level of paralysis, spinal cord injury complications, frequency of sessions with therapy, self-exercise frequency, and depressive symptoms were found to be statistically significant factors associated with improved functional outcomes.

Discussion

This study aims to assess the effectiveness of home-based rehabilitation programs on patients with traumatic spinal cord injuries who underwent a 6-month rehabilitation period at the Rehabilitation Department of Phatthalung Hospital regarding functional outcomes.

At the start of the program, the median SCIM score of all patients was 32.71, and it got statistically significantly higher to 58.89 at the end of the 6-month follow-up period. As in all subdomains, the score at the end of the 6-month follow-up period also showed significant increases. This data may indicate that a home-based rehabilitation program would benefit people with traumatic spinal cord injuries.

In contrast to earlier studies where patients receiving hospital-based programs enhanced their functional results by as much as 80-93%, this study found that 63.16% of patients improved their functional outcomes throughout the home-based program.[4,7,10,15] Early, intensive rehabilitation therapy following the acute phase is associated with good functional improvement.[16-18] Functional recovery following SCI is anticipated to happen most quickly during inpatient rehabilitation due to spontaneous neurological recovery and the intensity of training.[23,24] Staying in a rehabilitation center was positively associated with improved rehabilitation outcomes.[25,26] To assist patients in achieving better functional outcomes. This study required patients to visit their therapist at the outpatient clinic every two weeks and document their home program adherence in their logbooks. However, the improvements in functional independence were not as big as in the hospital-based program. That would result from home-based programs' limitations, such as environmental barriers to exercise at home, caregivers, and the inadequate intensity of the home program.

In this study, 36.84% of patients were grouped in the SCIMdown group, with a statistically significant lower total score, respiration and sphincter subdomain, and room and toilet subdomain from the program's start. While the self-care subdomain and mobility indoor and outdoor subdomain were statistically significantly unchanged from the program's start. The finding could explain this that 82.15% of SCIMdown patients were classified as having C1-8 ASIA A, B, and C (NLI), which affect all motor functions of muscle below the level of the cervical spine, including certain aspects of upper extremity function, trunk function, lower extremity function, and other motor functions related to all subdomains. Also, the respiratory and sphincter subdomain and mobility subdomain correspond to the functions of the cervical NLI. Respiratory impairment, musculoskeletal problems (joint stiffness, swelling, and pain), neurogenic bowel or bladder issues, transfer or ambulation difficulties, and other spinal cord injury sequelae

Table 2. Comparing SCIM III scores at the start of the program (initial) and at the end of the 6-month follow-up (follow-up).

Items of SCIM	Overall (n = 76)		SCIMup (n = 48)		SCIMdown (n = 28)	
	Mean (95% CI)	*p*-value	Mean (95% CI)	*p*-value	Mean (95% CI)	*p*-value
Total score		0.001*		0.001*		0.003*
Initial	32.71(30.61-41.76)		41.68 (10.14-44.38)		35.43 (11.73-38.55)	
Follow up	58.89(26.18- 60.59)		68.94 (12.57-86.27)		31.13 (9.39-36.69)	
Self-care		0.001*		0.001*		0.003*
Initial	8.04(6.43-10.05)		8.21 (3.29-10.07)		8.37(2.44-10.78)	
Follow up	14.79(9.47-18.03)		14.98(2.84-19.43)		8.37(3.64-10.56)	
Respiration & sphincter		0.001*		0.001*		0.003*
Initial	14.73(13.50-24.44)		20.36(3.66-23.15)		18.11(5.99-28.06)	
Follow up	28.23(17.28-35.58)		30.23(4.43-36.99)		17.02 (5.35-22.78)	
Room & toilet		0.001*		0.010*		0.000*
Initial	3.12(2.68-7.43)		3.93(2.06-6.09)		2.86(1.42-4.57)	
Follow up	7.48(6.04-11.84)		8.00(2.33-9.26)		2.50(1.31-3.34)	
Mobility indoor & out-door		0.001*		0.002*		0.040*
Initial	4.96(3.14-7.57)		3.56(1.63-6.93)		9.81(1.02-11.83)	
Follow up	16.28(11.32-25.37)		15.73(0.56-23.78)		9.81(1.20-11.09)	

The data were analyzed using Wilcoxon signed rank test (statistic significant at $p < 0.05$)

SCIMup (patients whose SCIM score increased at the end of the 6-month follow-up period)

SCIMdown (patients whose SCIM score decreased/unchanged at the end of the follow-up period)

Table 3. Factors associated with improved functional outcome

Factors	Group		*p*-value
	SCIMup (n = 48)	SCIMdown (n = 28)	
Gender			
Male	37 (77.08)	21 (75.00)	0.837*
Age (years)			0.024*
40 or less	19 (39.58)	11 (39.29)	
41-60	23 (47.92)	12 (42.86)	
More than 60	6 (12.50)	5 (17.85)	
Body mass index (BMI)			0.027*
Underweight	13 (27.08)	6 (21.43)	
Normal	27 (56.25)	9 (32.14)	
Overweight	8 (16.67)	13 (46.43)	
Neurological level of injury (NLI)			0.009**
C1-8; ASIA A, B, C	17 (35.42)	23 (82.15)	
T1-S5; ASIA A, B, C	21 (43.75)	3 (10.71)	
All D	10 (20.83)	2 (7.14)	
Level of paralysis			0.008
Paraplegia	32 (66.67)	10 (35.71)	
Tetraplegia	16 (33.33)	18 (64.29)	
Comorbid disease			0.301**
None	25 (52.08)	16 (57.14)	
1-2 diseases	14 (29.17)	4 (14.29)	
3 or more	9 (18.75)	8 (28.57)	
Complications related to spinal cord injuries			0.029**
None	18 (37.50)	5 (17.86)	
1-2 complications	21 (43.75)	9 (32.14)	
3 or more	9 (18.75)	14 (50.00)	
Frequency of encounter with the therapist (every 2 weeks)			0.038*
Never missed session	31 (64.58)	13 (46.43)	
Occasionally (not drop out)	17 (35.42)	15 (53.57)	
Frequency of self-exercise (logbook diary)			0.032*
Everyday	34 (70.84)	15 (53.57)	
Every other day	7 (14.58)	6 (21.43)	
Uneven	7 (14.58)	7 (25.00)	
Thai-HADs (depression)			0.004*
Feeling of depression	20 (41.67)	20 (71.43)	
Thai-HADs (Anxiety)			0.102**
Feeling of anxiety	20 (41.67)	16 (57.14)	
Income adequacy			0.326*
Not enough	10 (20.83)	7 (25.00)	
Enough for basic needs only	23 (47.92)	13 (46.42)	
Enough for needs and have savings	15 (31.25)	8 (28.57)	
Health insurance scheme			0.413**
Universal health coverage (UHC)	11 (22.92)	5 (17.86)	
Self-pay	4 (8.33)	2 (7.14)	
Civil servant medical benefit scheme (CSMBS)/Social security scheme (SSS)	10 (20.83)	3 (10.71)	
Disability scheme under universal health coverage	23 (47.92)	18 (64.29)	

*The data were presented as numbers (percent) and analyzed using the Chi-square test, **Fisher's exact test (statistic significant at $p < 0.05$)
SCIMup (patients whose SCIM score increased at the end of the 6-month follow-up period)
SCIMdown (patients whose SCIM score decreased/remained unchanged at the end of the follow-up period)

are all possible. Prior studies discovered that patients who experienced complications had secondary complications that were considered to have negatively impacted functional outcomes.[10,15,17] As this study found, 82.14% of patients in the SCIMdown group had complications from spinal cord injury, compared to only 47.92% in the SCIMup group.

After using the Chi-square test and Fisher's exact test to evaluate the relationship between factors and improved functional outcomes, there were eight factors with statistically significant relationships to improved functional outcomes at the 6-month follow-up: age, body mass index (BMI), neurological level of injury (NLI), level of paralysis, complications related

to spinal cord injuries, frequency of encounter with a therapist, frequency of self-exercise, and depressive symptoms.

The elderly population's neurological recovery fails to improve functional mobility, which is related to reduced cardiovascular endurance and other medical conditions. It has been reported that older patients with SCI have less potential than younger patients to translate neurological improvements into functional recovery.[27,28] An injury at a younger age can result in better functional outcomes.[29,30] According to a previous study, people aged 35-55 showed the most remarkable improvement. In contrast, those aged 70 and older showed the least.[31] As the percentage of young patients in the SCIMup group was higher in this study than in the SCIMdown group, it is recommended that age appropriate individualized treatment techniques for patients be employed to meet their needs better and achieve their rehabilitation goals.

Previous studies indicated that being overweight was one of the risk factors for more significant spinal cord complications, mobility problems, and community transportation barriers.[23,29,32,33] In this study; the SCIMdown group had a higher percentage of overweight patients than the SCIMup group. Thus, the SCIM score's function related to the mobility subdomain is diminished.

The most significant predictor of functional recovery was the neurological level of injury (NLI).[5] Patients with high levels of SCI have poorer potential for neurological recovery. Patients with lower levels of injury have better outcomes for traumatic spinal cord lesions.[5,8] Patients with lower neurological levels of the lesion (thoracic and lumbar compared to cervical) are six times more likely to see improvement in their Functional Independence Measure (FIM) score.[33] In this study, 82.15% of patients in the SCIMdown group were classified in C1-8 ASIA A, B, and C, compared to only 35.42% in the SCIMup group. The greater the severity of spinal cord damage, the smaller the capacity of the spared muscle group. The muscles needed to perform specific tasks in activities of daily living (ADL) were diminished, which was related to difficulty maintaining function.

Five quantitative studies identified a variety of health complications, including pain, pressure injury, neurogenic bladder, urinary tract infection (UTI), spasticity, contracture, tightness, and sleep problems, as critical factors in reducing mobility and community participation in individuals with spinal cord injuries.[31,34-37] According to Jansen MP et al.'s study, the majority of patients in the home-based program who had problems had to return to the inpatient section for treatment, which negatively influenced functional outcomes.[38] Similarly to this study, 82.14% of the SCIMdown group experienced spinal cord injury sequelae due to their inability to enhance functional outcomes.

According to this study, more frequent therapy sessions are related to better functional outcomes. In the SCIMup group, 64.58% of patients never missed a session, compared to 46.43% in the SCIMdown group. These findings agree with prior studies, which found that patients with the same level of injury who participated more actively in rehabilitation sessions had higher functional outcomes than those who were less active.[38,39] The skills and knowledge obtained from the rehabilitation team are more impactful on independent functional mobility when they can be applied in a community setting.[40-43] When the patients visited the therapist or physiatrist, they likely obtained program revisions that personalized and appropriated themselves.

The World Health Organization (WHO) recommends at least 150 minutes per week of moderate-intensity aerobic activity (or 75 minutes per week of vigorous-intensity aerobic activity) and muscle-strengthening activities twice weekly.[44] The International Spinal Injury Society (ISCoS) recommends that for cardiorespiratory fitness and muscle strength benefits, adults with SCI should engage in at least 20 minutes of moderate to vigorous intensity aerobic exercise 2 times per week, and three sets of strength exercises for each major functioning muscle group at a moderate to vigorous intensity two times per week (a strong recommendation). Moreover, for cardiometabolic health benefits, adults with SCI should engage in at least 30 minutes of moderate-to-vigorous-intensity aerobic exercise three times per week (a conditional recommendation).[45] People with SCI most frequently experience intrapersonal (e.g., a lack of energy, motivation, or knowledge) and environmental or organizational (e.g., a lack of accessible or affordable fitness facilities, equipment, and knowledgeable staff).[46,47] Those chronically inactive or unable to reach standard exercises are also at risk for poor metabolic and cardiovascular health and secondary problems such as pressure injury, infections, and depression.[48-50] In this study, patients in the SCIMup group revealed that 70.84% of patients claimed to do daily home exercises daily, compared to 53.57% in the SCIMdown group. Noncompliance with a home program or inadequate self-exercise may impact functional outcomes.

Depression is the most frequent psychiatric condition following a spinal cord injury, with a wide range of prevalence estimates from 8.8% to 60% among inpatients and those in the community.[51] Previous research found a relationship between depression and functional independence.[51,53,54] Because traumatic SCI can suddenly deteriorate function, untreated depressive symptoms may persist continuously and have a negative impact on health-related quality of life.[32,33,38,51] This includes secondary conditions that result in less functional gains, decreased functional independence, increased secondary complications, and reduced life expectancy.[52,53] Short-term rehabilitation goals should include early diagnosis and treatment of depressive symptoms within 2-4 weeks. In this study, only 41.67% of patients in the SCIMup group re-ported having depressive symptoms, compared to 71.43% in the SCIMdown group. Depression symptoms might interfere with a person's capacity to participate in activities and make them less motivated to participate in rehabilitation programs.

Therefore, several variables, such as age, body size and weight, associated injuries and complications, motivation, family support, premordid lifestyle, educational background, financial situation, healthcare system, and community facility could affect functional outcomes in patients who received home-based rehabilitatio.[5,8,15,17,53] Opportunities at home and in the community, barriers to accessing rehabilitation care, and a lack of health centers to treat secondary complications may limit home-based rehabilitation. In this study, 66.67% of patients in the SCIMup group versus 35.71% in the SCIMdown group had paraplegia. This study proposed home-based rehabilitation program may be more suitable for paraplegia patients than tetraplegia patients.

Limitations of this study were

1. Some patients were excluded from this study because they could not adhere to the follow-up protocols during the program, which was carried out in a provincial hospital. With the development of telemedicine, medical staff can interact with patients in their homes via communication technologies (such as smartphones or realtime video feeds over the Internet). Future studies should include this intervention as part of home-based rehabilitation.

2. Because this study was conducted in a home-based rehabilitation environment, essential factors such as program maintenance, caregiver concerns, and community integration were not addressed. Future research should be considered as a result.

Conclusions

In conclusion, patients with severe spinal cord injuries who attended home-based rehabilitation revealed improved functional outcomes. From this study, factors related to improved functional outcomes were age, body mass index (BMI), neurological level of injury (NLI), level of paralysis, complications related to spinal cord injuries, and depressive symptoms. The frequency of encounters with therapists and self-exercise sessions are additional environmental factors. The program should be considered for patients with paraplegia or those with lower neurological levels of lesions who require a maintenance therapy program. However, in the home-based program, the physiatrists should be concerned about the comprehensive care and investigation for neurogenic bladder, e.g., cystometry or ultrasound kidneys, ureters, and urinary bladder (KUB), or renal function evaluation. Also, early detection of secondary complications and depressive symptoms is essential for early treatment and assessment of other factors related to improved functional outcomes in planning for better recovery.

Disclosure

The authors declare that they have no conflicts of interest.

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