Journal of Health Study and Medicine
2019, nr 4
ss. 21-44
DOI 10.36145/JHSM2019.28

# Evaluating Functional Abilities of People with Spinal Cord Injuries at Later Stages of Rehabilitation

**Katarzyna Kaźmierczak**[1]
https://orcid.org/0000-0001-9450-8005

**Przemysław Lisiński**[1]

[1] Department and Clinic for Rehabilitation and Physiotherapy, Karol Marcinkowski University of Medical Sciences, Poznan, Poland



**Address for correspondence**

Katarzyna Kaźmierczak
Department and Clinic for Rehabilitation and Physiotherapy
Karol Marcinkowski University of Medical Sciences
28 czerwca 1956 No 135/147, 61-545 Poznan, Poland
e-mail: kkazmierczak@ump.edu.pl

## Abstract

***Purpose:*** *The Motor impairments patients with spinal cord injury affect their functional abilities and restrict independence in performing everyday activities. This paper collates data about the times patients required assistance with daily activities, the people who would normally provide such help, and about those aspects of daily living where caregiver assistance was the most needed.*

***Aim:*** *Aim of this study was to present different functional abilities in people with spinal cord injuries and indication of the determinants of this condition*

***Materials and methods:*** *The study included 75 people, who had experienced incomplete traumatic spinal cord injury at least 12 months before this study. The patients were categorized into groups according to injury location. Functional ability was assessed with the Barthel Index and an interview questionnaire. Injury locations were determined with patients' medical records.*

***Results:*** *There were significant differences ($p<0.05$) between the groups in how they self-assessed their functional independence. On average, subjects with SCI required 4.7±8.8 hours of assistance daily. The three groups differed in the degree of demonstrated functional independence ($p<0.001$).*

***Conclusions:*** *People with SCI are not fully independent to perform activities of daily living by themselves. Supporting a patient's self-management usually becomes the responsibility of their immediate family.*


***Key words:*** *function, spinal cord injury, self-assessment, people with disabilities, activities of daily living*

## Introduction

The precondition for performing even the least complex of activities is a healthy nervous system (information pathways) and the musculoskeletal system (the performative system). It is these neural pathways that get partially or completely damaged in spinal cord injuries. A spinal cord injury entails physical, psychological and social consequences [1,2]. Even incomplete SCI, the prevailing type in clinical practice, leads to serious disabilities. Such disability restrains the ability to perform ADL and renders patients dependent on other people's help and care [3].

Nursing and rehabilitation of a patient after spinal cord injury is a very difficult and complex process. It requires extensive knowledge and experience from the entire therapeutic team. Naturally, the patient's self-service ability depends on the level of spinal damage. Patients with damage in the upper sections require more help from other people and are most at risk of developing complications. The degree of independence also depends on early treatment, proper care combined with education, and properly targeted rehabilitation aimed at mastering new movement patterns based on compensatory mechanisms. Nursing care plays an important role in facilitating and accelerating the rehabilitation process and in adapting to life in a changed situation. He accomplishes these goals through a properly planned and conducted care process and proper education of the patient and family [4].

Beingable to satisfy one's life needs independently (e.g. performing self- care activities) not only has a positiveeffect on the hysical and mental state of a person with SCI it also motivates them to further actively engage in day-to-day life [5]. Undoubtedly, SCI reduces functional abilities and transforms everyday routines. These patients' disabilities mostly manifest as impaired motor functions. These dysfunctions include paresis or quadriplegia as well as loss of sensation [6,7].

The extent to which parts of the body are affected by reduced sensory and motor functions depends on the anatomical location of the injury. The disabilities suffered by patients with cervical cord injury (tetraplegia,

tetraparesis) are greater than those with lower spine sections injured (i.e. thoracic or lumbar cords – paraplegia, paraparesis) [8,9].

Functional ability is understood here as the capacity to maintain autonomy in performing activities of daily living [10]. In this sense, functional ability includes e.g. independence in preparing and consuming food, being mobile, changing body position, having control over the excretory system, maintaining body hygiene, using the toilet, or self-dressing [10,11]. It needs to be emphasized again that functional ability relies on retained motor functions.

Overall, paraplegics are more independent due to the fact they actively use their upper limbs, and so they typically enjoy greater autonomy. They can actively participate in daily living activities, and if they use a wheelchair with some skill, they are able to meet their needs by themselves to a large degree [5,12-14]. For instance: patients who demonstrate higher autonomy with regards to e.g. locomotion or wheelchair-to-bed transfers are people with injuries in lower spinal cord sections and those who after intense rehabilitation learnt to independently perform transfers. Not having to rely on other people's care is a source of considerable freedom in planning and executing activities of daily living [5,15-17]. Therefore, tetraplegia is the most severe of motor impairments, as it renders SCI patients dependant on the help and care provided by other people.

Undoubtedly, what results from the previous studies of a person with a higher level of spinal cord injury will show a greater reduction in motor and sensory abilities, thus it will undoubtedly condition their level of functional independence. However, it is worth paying attention to how functional fitness affects other areas of the person's life. Is there a relationship between the level of injury and the actual functional efficiency of these patients affects their ability to work. Does the number of family members in some way determine the degree of independence of a person after SCI. It is interesting that people with a large family do not receive excessive help, which can adversely affects the development of their functional ability.

## Material and methods

### *Aim*

The project's main aim was to present different functional abilities in people with spinal cord injuries and indication of the determinants of this condition. 3 groups of different SCI levels were examined and compared (C – cervical, TH-thoracial and L – lumbar groups).

The study presents:

1. Self-assessment of functional independence.
2. The daily activities that required assistance from other people.
3. The usual caregivers.
4. Daily amounts of essential care time for different SCI patients.

### *Data source and sample population*

The study subjects were people who sustained incomplete spinal cord injury and were treated patients in the neurological rehabilitation ward for paresis or limb paralysis. The study encompassed people aged 18-60 who were at the time adapting to post-traumatic changes one year or more after the injury [18,19]. After reviewing a given patient's motor and sensory impairments using ASIA's assessment criteria (American Spinal Injury Association) a doctor would determine incomplete spinal cord injury [17]. Age and date of sustaining injury were obtained from patients' medical records.

### *Clinical measures*

Functional ability was established with the Barthel Index (BI). The scale measures the extent to which a patient is able to independently perform activities of daily living such as dressing, bathing, controlling urination and defecation, maintaining personal hygiene, moving up and down stairs or consuming food. A given patient's functional ability is assessed depending on the degree to which they can independently carry out a given activity. The highest possible score is 100 points, which suggests complete independence, whereas the lowest is 0 points and represents a person completely dependent on others [18].

Interviews with SCI patients provided information about their current professional life, number of family members, and self-reported level of dependence on other people's help with everyday activities. Additionally, subjects indicated the number of hours daily they required assistance and who would normally provide it. The subject's answers were recorded on an interview questionnaire form.

From among 122 hospitalized persons, only 75 were finally included in the study (met admission criteria and agreed participate). The studied group was divided into three subgroups depending on the level of spinal cord injury where 25 had cervical (C=25), 25 thoracic (Th=25), and 25 lumbar (L=25) cord injury.

The research project was submitted to and approved by the Bioethics Committee

***Statistical analysis***

Statistical data were compiled using PQStat ver. 1.6.8 statistical packages together with the Microsoft Excel 2000 spreadsheet.

To measure the differences between values in the ordinal scale, non-parametric testing was applied. The Mann-Whitney test was used to compare two groups of independent variables and the Kruskal-Wallis test to compare a few of such groups. For multiple comparisons, the post-hoc test and the Dunn-Sidak correction were applied. Non-parametric tests were used to assess the relations between variables in the nominal scale. Depending on the number of variables and number of group members, the $Chi^2$ (RxC) test was applied and, for smaller groups, the accurate Fisher (RxC) test.

The following assessment criteria were employed when comparing the three groups of different injury locations (C, Th, L): $p<0.05$ for statistically significant correlations, $p<0.01$ for highly significant statistical correlations, and $p<0.001$ for the most statistically significant correlations.

## Results

The average age of the subjects was 34. In line with with the study inclusion criteria, they were adapting to post-traumatic changes, i.e. one year or more had elapsed after the injury [19,20]. The average time between sustaining the injury and the day of the study was comparable between the three groups and amounted to 7 years. A detailed breakdown of individual groups is presented in Table 1.

Analysis of marital status (single, married, divorced) prior and post injury did not reveal any differences between the groups. Three persons got married after injury, and two divorced. Details are shown in Table 2.

The groups differed significantly in how subjects self-assessed their independence or dependence ($p<0.05$; Man-Withney test). The cervical cord injury group was the one with with the lowest self-reported independence (Table 3).

The number of hours daily of essential help varies considerably between the compared groups ($p<0.05$, Kruskal-Wallis test). The most significant differences were found in average care times required by people in the cervical cord injury group and the lumbar group ($p<0.05$, Kruskal--Wallis with a post-hoc Dunn-Sidak test). Detailed results are presented in Table 4.

People who are typically committed to providing assistance and care for patients with cervical and thoracic cord injuries are family members and friends. More than half of the patients with the lowest injury position (lumbar cord) declared sufficient levels of independence and no need for caregivers (Table 5).

The majority of spinal cord injury patients in the current study are wheelchair-bound. With regards tomobility aids most often used in given groups, there were significant differences found between patients using wheelchairs and other orthotics aids such as walking frames or crutches ($p<0.05$; Man-Withney test). Active wheelchair is the prevailing type of wheelchairs used by post-SCI patients. Results are presented in Table 6.

In the examined groups, independence in daily living activities was inversely proportional to the height of the spinal cord injury position. Poorest functional abilities and highest caregiver dependence were exhibited by people with spinal cord injury located in the cervical spine. Analysis of obtained BI measures showed highly significant differences compared to individual groups ($p<0.001$; Kruskal-Wallis test). Those differences were found between the cervical and the lumbar group ($p<0.001$; Kruskal-Wallis test with post-hoc Dunn Sidak test) as well as the thoracic and the lumbar group ($p<0.05$; Kruskal-Wallis test with post-hoc Dunn Sidak test). Measured levels of functional ability per group are shown in Table 7.

In percentage terms, the subjects reported activities related to urinary control as the most challenging ones when performed unassisted (86.7%). Using the stairs (40%) and maintaining personal hygiene (38.7%) were the two next aspects preventing independence from other people's assistance. The highest level of functional independence, on the other hand, was observed in two areas: food consumption (78.7%) and dressing/undressing (66.7%). No relevant differences between the groups were found in terms of being mobile (on even surfaces) as well as defecation control. However, self-reported independence varied significantly ($p<0.01$; Chi2 test) between the groups with regard to movement across surfaces, maintaining hygiene and using the toilet and highly significantly ($p<0.001$; Chi2 test) in the remaining BI areas. Details of independence characteristics of studied patients per injury group is presented in Table 8.

We investigated whether a patient's functional ability affects their employment. BI-measured functional ability among professionally active people and the unemployed were similar. It was found that only cervical spine injury affected patients' functional ability affected employment. Table 9 outlines results on the connection between functional ability and employment.

There was no correlation between numbers of family members and patients' functional ability (according to BI measures) (Table 10).

Table 1. Characteristics of spinal cord injury patient

| | C x (SD) | Th x (SD) | L x (SD) | Total x (SD) |
|---|---|---|---|---|
| Age at examination | 35.4 (±9.3) | 5 (±9.5) | 33.4 (±9.7) | 34.3 (±9.6) |
| Age at injury | 28.5 (±9.5) | 26.5 (±10.4) | 26.4 (±9.1) | 27.2 (±9.7) |
| Time after injury (years) | 6.9 (±3.9) | 7.6 (±4.9) | 7.0 (±4.2) | 7.2 (±4.3) |

n: number of persons' x: arithmetic mean SD – standard deviation; C – cervical, Th – thoracial; L – lumbar

Table 2. Marital status before and after spinal cord injury

| Marital status | C n (%) | | Th n (%) | | L n (%) | | Total n (%) | |
|---|---|---|---|---|---|---|---|---|
| | Prior to injury | After injury | Prior to injury | After injury | Prior to injury | After injury | Prior to injury | After injury |
| Single | 17 (68%) | 15 (60%) | 19 76%) | 17 (68%) | 20 (80%) | 19 (76%) | 56 (74.7%) | 51 (68%) |
| Marital relationship | 8 (32%) | 9 (36%) | 6 (24%) | 7 (28%) | 5 (20%) | 6 (24%) | 19 (25.3%) | 22 (29,3%) |
| Divorced | - | 1 (4%) | - | 1 (4%) | - | - | - | 2 (2.7%) |

n: number of persons; C – cervical, Th – thoracial; L – lumbar

Table 3. Number of patients self reporting functional independence

| Independent person | C n (%) | Th n (%) | L n (%) | Total n (%) |
|---|---|---|---|---|
| No | 20 (80%) | 15 (60%) | 11 (44%) | 46 (61.3%) |
| Yes | 5 (20%) | 10 (40%) | 14 (56%) | 29 (38.7%) |

n: number of persons; C – cervical, Th – thoracial; L – lumbar

Table 4. Number of care hours

| | n (%) | x | SD |
|---|---|---|---|
| C | | | |
| 0 h | 5 (20%) | 7.4 | 8.8 |
| 1-8 h | 13 (52%) | | |
| 9-15 h | 1 (4%) | | |
| ≥16 h | 6 (24%) | | |
| Th | | | |
| 0 h | 10 (40%) | 3.9 | 6.8 |
| 1-8 h | 11 (44%) | | |
| 9-15 h | 2 (8%) | | |
| ≥16 h | 2 (8%) | | |
| L | | | |
| 0 h | 14 (52%) | 2.8 | 6.0 |
| 1-8 h | 9 (36%) | | |
| 9-15 h | | | |
| ≥16 h | 2 (8%) | | |
| Mean average | | | |
| 0 h | 29 (38.7%) | 4.7 | 7.5 |
| 1-8 h | 33 (44%) | | |
| 9-15 h | 3 (4%) | | |
| >16 h | 10 (13.3%) | | |

n: number of persons; x: arithmetic mean, SD: standard deviation; C – cervical, Th – thoracial; L – lumbar

Table 5. Caregiver

| | C n (%) | Th n (%) | L n (%) | Total n (%) |
|---|---|---|---|---|
| Family | 14 (56%) | 12 (48%) | 10 (40%) | 36 (48%) |
| Family and friends | 6 (24%) | 3 (12%) | 1 (4%) | 10 (13.3%) |
| Not applicable (independent person) | 5 (20%) | 10 (40%) | 14 (56%) | 29 (38.7%) |

n: number of persons; C – cervical, Th – thoracial; L – lumbar

Table 6. Mobility Aid

| | C n (%) | Th n (%) | L n (%) | Total n (%) |
|---|---|---|---|---|
| Other (crutches, walking frame) | 2 (8%) | 2 (8%) | 9 (36%) | 13 (17.3%) |
| Wheelchair | 23 (92%) | 23 (92%) | 16 (64%) | 62 (82.7%) |
| Orthopaedic wheelchair | 2 (8%) | 3 (12%) | | 5 (6.7%) |
| Active wheelchair | 16 (64%) | 19 (76%) | 16 (64%) | 51 (68%) |
| Active wheelchair and electrical wheelchair | 5 (20%) | 1 (4%) | | 6 (8%) |

n: number of persons; C – cervical, Th – thoracial; L – lumbar

Table 7. Barthel Index measures of functional abilities per group

| | x | SD | min | max |
|---|---|---|---|---|
| C | 47.4 | 22.1 | 15 | 80 |
| Th | 59.2 | 20.7 | 15 | 85 |
| L | 78.4 | 15.2 | 50 | 100 |
| Mean average | 61.7 | 23.2 | 15 | 100 |

n: number of persons; x: arithmetic mean; SD: standard deviation; min: lowest value; max: highest value; C – cervical, Th – thoracial; L – lumbar

Table 8. BI-measured independence in performing activities of daily living per group

| | C n (%) | Th n (%) | L n (%) | Total n (%) |
|---|---|---|---|---|
| **Food consumption** | | | | |
| Unable to eat by themselves | 2 (8%) | | | 2 (2.7%) |
| Help is needed with slicing, spreading butter, etc. | 11 (44%) | 2 (85) | 1 (4%) | 14 (18.7%) |
| Independent, self-reliant | 12 (48%) | 23 (92%) | 24 (96%) | 59 (78.7%) |
| **Being mobile (getting from bed to chair and back/sitting down)** | | | | |
| Unable, no sitting balance | 1 (4%) | 3 (12%) | | 4 (5.3%) |
| More help is needed (physical, from one-two people), can sit | 2 (8%) | 12 (48%) | 1 (4%) | 15 (20%) |
| Little help (verbal or physical) | 7 (28%) | 5 (20%) | 6 (24%) | 18 (24%) |
| Independent | 8 (32%) | 13 (52%) | 18 (72%) | 39 (52%) |
| **Maintaining personal hygiene** | | | | |
| Needs help with personal activities | 16 (64%) | 7 (28%) | 6 (24%) | 29 (38.7%) |
| Independent with washing face, combing, brushing teeth, shaving (with implements provided) | 9 (36%) | 18 (72%) | 19 (76%) | 46 (61.3%) |
| **Using the toilet** | | | | |
| Dependent | 8 (32%) | 2 (8%) | 1 (4%) | 11 (14.7%) |
| Partly needs help | 8 (32%) | 7 (28%) | 1 (4%) | 16 (21.3%) |
| Independent | 9 (36%) | 16 (64%) | 23 (92%) | 48 (64%) |
| **Bathing, washing whole body** | | | | |
| Dependent | 17 (68%) | 8 (32%) | 3 (12%) | 28 (37.3%) |
| Independent | 8 (32%) | 17 (68%) | 22 (88%) | 47 (62.7%) |
| **Mobility (even surfaces)** | | | | |
| Immobile or can cover <50 m | 5 (20%) | 2 (8%) | 1 (4%) | 8 (10.7%) |
| Up to 50 m with mobility aid or independent on wheelchair | 14 (56%) | 15 (60%) | 11 (44%) | 40 (53.3%) |
| Walks with help of one person >50 m | 4 (16%) | 2 (8%) | 3 (12%) | 9 (12%) |

| | | | | |
|---|---|---|---|---|
| Independent, also using mobility aid, at distances larger than 50 m | 2 (8%) | 3 (12%) | 10 (40%) | 15 (20%) |
| **Walking up and down stairs** | | | | |
| Not independent | 15 (60%) | 11 (44%) | 4 (16%) | 30 (40%) |
| Needs physical help and assistance | 9 (36%) | 12 (48%) | 8 (32%) | 29 (38.7%) |
| Independent | 1 (4%) | 2 (8%) | 13 (52%) | 16 (21.3%) |
| **Dressing and undressing** | | | | |
| Dependent | 3 (12%) | – | 1 (4%) | 4 (5.3%) |
| Needs some help | 13 (52%) | 7 (28%) | 1 (4%) | 21 (28%) |
| Independent, also with buttoning, zipping, lacing, etc. | 9 (36%) | 18 (72%) | 23 (92%) | 50 (66.7%) |
| **Controlling defecation / anal sphincter** | | | | |
| Has no control over defecation or excretion needs to be provoked | 2 (8%) | 9 (36%) | 4 (16%) | 15 (20%) |
| Sporadic uncontrolled defecation | 14 (56%) | 8 (32%) | 10 (40%) | 32 (42.7%) |
| Has control over defecation | 9 (36%) | 8 (32%) | 11 (44%) | 28 (37.3%) |
| **Controlling urination/ urethral sphincter** | | | | |
| Can't control urination or is catheterized | 18 (72%) | 18 (72%) | 5 (20%) | 41 (54.7%) |
| Sporadic uncontrolled urination | 5 (20%) | 6 (24%) | 13 (52%) | 24 (32%) |
| Has control over urination | 2 (8%) | 1 (4%) | 7 (28%) | 10 (13.3%) |

n: number of persons; C – cervical, Th – thoracial; L – lumbar

Table 9. Functional ability (BI-measured) and patient's employment

| | Employed | | | | | Unemployed | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | BI | | | | | BI | | | |
| | n | x | SD | min | max | n | x | SD | min | max |
| C | 12 | 58.3 | 19.6 | 20 | 80 | 13 | 37.3 | 19.9 | 15 | 80 |
| Th | 7 | 68.6 | 14.4 | 40 | 85 | 18 | 55.6 | 21.9 | 15 | 85 |
| L | 9 | 78.9 | 16.7 | 60 | 100 | 16 | 78.1 | 14.8 | 50 | 100 |
| Total | 28 | 67.5 | 19.1 | 20 | 100 | 47 | 58.2 | 23.8 | 15 | 100 |

n: number of persons; x: arithmetic mean; SD: standard deviation; min: lowest value; max: highest value; C – cervical, Th – thoracial; L – lumbar

Table 10. Functional ability (BI-measured) and number of family members

| | | BI | | | |
|---|---|---|---|---|---|
| Number of family members | n (%) | x | SD | min | max |
| **C** | | | | | |
| ≤2 | 7 (28%) | 45.0 | 21.0 | 20 | 75 |
| 3-4 | 11 (44%) | 51.0 | 23.9 | 15 | 80 |
| ≥5 | 7 (28%) | 44.3 | 28.0 | 20 | 80 |
| **Th** | | | | | |
| ≤2 | 9 (36%) | 66.7 | 20.6 | 15 | 85 |
| 3-4 | 16 (64%) | 55.0 | 20.0 | 15 | 85 |
| ≥5 | | | 23.0 | 20 | 80 |
| **L** | | | | | |
| ≤2 | 10 (40%) | 86 | 12.9 | 60 | 100 |
| 3-4 | 9 (36%) | 74.4 | 15.9 | 50 | 100 |
| ≥5 | 6 (24%) | 72.7 | 14.4 | 60 | 95 |
| **Total** | | | | | |
| ≤2 | 26 (34.7%) | 68.3 | 24.1 | 15 | 100 |
| 3-4 | 36 (48%) | 58.6 | 22.0 | 15 | 100 |
| ≥5 | 13 (17.3%) | 56.9 | 23.5 | 20 | 95 |

n: number of persons; x: arithmetic mean; SD: standard deviation; min: lowest value; max: highest value; C – cervical, Th – thoracial; L – lumbar

## Discussion

Due to functional disability of patients with spinal cord injuries, one of the top treatment challenges is to achieve maximal level of motor ability (as possible from the perspective of patoanatomy), as it positively impacts other aspects of life. Anticipating achieving daily independence by SCI patients is an important component of the rehabilitation process and is therefore considered a priority in treatment [21]. Literature reveals that people after spinal cord injuries demonstrate different functional abilities depending on age, extent and location of injury, as well as other factors [17,22,23].

### *Functional independence*

As emphasized in the introduction, functional disability in post-SCI patients means incomplete or complete loss of self-reliance and independence in everyday life. Our tests showed that more than 60% of people after SCI reported the need for assistance by another person with daily activities which they were able to do by themselves prior to injury (see Table 3). Similar proportions of independence and dependent people with spinal cord injury were found in studies by Silva et al. (59.5% of independent patients) and Coura et al. (46% of independent patients) [24,25]. Different results were presented by Garrett [26]. Among his SCI patients a mere 10% reported no need for help from caregivers with activities of daily living. The study included 35 people. It is possible, therefore, that should Garrett's subject group was larger, the results would be different.

### *Hours of help required*

Due to considerable impairment of motor functions in patients with higher spine segments injured, those with cervical spine injury need more assistance time from caregivers for self-care (hygiene, dressing, undressing, locomotion) than paraplegics [11,25,26]. Our study led to similar results, where people in the C group required almost twice as much time of daily support than people with only lower limbs and/or torso paralysed.

***Caregiver***

The presented results (Table 5) include interesting characteristics of people helping post-SCI patients. In nearly 50% of cases, close family members are the ones who provide SCI patients with necessary help. It is worth noting, however, that over half of the subjects live outside marital relationships. Therefore, the responsibility to offer care is borne by parents, siblings, and/or children of SCI patients. Also Khazaeipour et al. showed that most often caregivers come from the patient's family [27]. In 35% of cases they are spouses, 37% are parents, and in merely 5.9% the nurse was the caregiver.

***Functional ability based on the Barthel Index***

The average number of points determining functional ability in the BI was 62 for all subjects. This corresponds to the lower threshold of mild functional dependence [18]. Similar results were reported by Menon et al. who examined SCI and its implications for Indian citizens [28].

The examined group showed a correlation between the level of independence and injury location. People with cervical spine injury showed moderate dependency (mean BI value of 47 points) [18]. Other studies also reported higher functional dependency in the case of cervical spine injuries compared to thoracic and lumbar injuries [29,30].

***Patients' independence in ADL based on the Barthel Index***

It is worth considering which everyday activities are the most difficult ones to perform individually by SCI patients. Our study found that regardless of injury location, SCI patients most often required help with micturition control (86.7% of subjects) followed by mobility on stairs (78.7% of subjects). For instance Coura et al. used a similar SCI group size (75 people) and showed greatest dependence with waling on stairs (92%) and moving on flat surfaces (82.7%) [25]. Whereas when we compare our results with the Brazilian study, we see that for dressing/undressing patients showed comparable, high degree of independence [29]. Our subject group, likewise in the study by Coura et al. the highest independence

was found in people self-assessing their food consumption (78.7% and 93.3%, accordingly) [24,25].

The only difference in results between our study and that of Coura's team regards assessments of independence in maintaining personal hygiene [25]. Our study found 88% of SCI subjects declared independence in activities such as washing face, cleaning teeth, shaving, whereas the study by Coura et al. reported only 36% [25].

Analysing independence with regard to injury location using the BI, we found significant differences between the three groups we examined (C, Th, L). Namely, people with cervical spine injury are more dependant than paraplegics mainly with regards to activities such as miction (72% of C subjects did not control urination or were catheterized), washing, bathing (68%), maintaining personal hygiene 64%). People with better functional abilities were members of the lumbar (L) group. Subjects in the L group are fully independent with food consumption (96%), dressing and undressing (92%), washing and bathing (88%). This is certainly the result of their current motor abilities, which are on the other hand determined by pathomechanism and the height at which the spinal cord injury occurred [31].

***Functional ability in relation to other factors***

We decided to investigate SCI patient's size of family. The number of family members was of little significance for the degree of functional ability. As in the case of some cited studies over half of people with SCI were part of a 3 or 4-person family [27,32].

The BI-measured functional ability of professionally active and inactive people was comparable. The only clear difference in BI results as compared with the employed and unemployed was observed in the cervical injury group. Here, people who did work scored 60 on the BI, whereas the unemployed's mean score was 37. Many authors have demonstrated similar impact of the injury and its severity on functional ability [27,33,34].

Analyzed employment and people after SCI gave an interesting picture. Referring to the anatomical motor and sensory fitness associated with

core damage, it seems that with lower spinal cord injury, so that with greater sraveness preserved they will probably have greater functional abilities compared to high level injuries (tetraplegic). As we can see from our research, in the studied group of patients after SCI is the opposite – a definitely greater percentage of people with lumbar damage is unemployed. This fact undoubtedly requires further research. What can be the cause of this condition – whether intensive rehabilitation and stays on medical stays, or maybe the availability of permanent care (also financial) of other people or institutions, or incomplete acceptance of acquired disability to undertake professionalism and work often in a different industry than the original one. This is an interesting area for further multifaceted research to find the explanation of this observation.

**Conclusions**

The greatest therapeutic challenge is disability resulting from injuries to the cervical section of the spinal cord. This type of disability results in the need for assistance with activities of daily living. Activities that usually demand support from others include: miction control, mobility on stairs, and personal hygiene. Supporting a patient's self-management usually becomes the responsibility of their immediate family. Since using the stairs is the most challenging one out of all the functional limitations, it is crucial to consider architectural adaptation of a SCI patient's dwelling.

**Limitations**

The study carried out does have some limitations, and one of them includes self-reported data. The subjects were asked, inter alia, to describe their functional independence. The accuracy and reliability of the self-reported data was not verified. The provided statements may be exaggerated and not entirely reflect actual behaviour

**Acknowledgements**
We thank all the persons with SCI who participated in this study.

**Source of Funding**
None

**Disclosure statement**
The authors report no conflicts of interest.

**References**

1. Dryden DM, Saunders LD, Rowe BH et al. Depression following traumatic spinal cord injury. Neuroepidemiology 2005; 25: 55-61. doi: 10.1159/000086284.

2. van den Berg ME, Castellote JM, Mahillo-Fernandez I, de Pedro-Cuesta J. Incidence of spinal cord injury worldwide: a systematic review. Neuroepidemiology 2010; 34: 184-92.

3. Burns AS, Marino RJ, Kalsi-Ryan S et al. Type and Timing of Rehabilitation Following Acute and Subacute Spinal Cord Injury: A Systematic Review. Global Spine J 2017; 7: 175S-194S. doi: 10.1177/2192568217703084.

4. Furmańczuk L, Cywińska-Wasilewska G. Assessment of changes in the functional independence of people after spinal cord injury during Active Rehabilitation camps. Physiotherapy 2010; 17: 17-24.

5. Hetz SP, Latimer AE, Martin Ginis KA. Activities of daily living performed by individuals with SCI: relationships with physical fitness and leisure time physical activity. Spinal Cord 2009; 47: 550-554. doi: 10.1038/sc.2008.160.

6. Grossman RG, Frankowski RF, Burau KD et al. Incidence and severity of acute complications after spinal cord injury. J Neurosurg Spine 2012; 17: 119-28. doi: 10.3171/2012.5.AOSPINE12127.

7. Bedi PK, Arumugam N, Chhabra HS. Effectiveness of Activity-Based-Therapy in Comparison with Surface Spinal Stimulation in People with Traumatic Incomplete Spinal Cord Injury for Activation of Central Pattern Generator for Locomotion: Study Protocol for a 24-Week Randomized Controlled Trial. Asian Spine J 2018; 12: 503-510. doi: 10.4184/asj.2018.12.3.503.

8. Elliott TR, Uswatte G, Lewis L, Palmatier A. Goal instability and adjustment to physical disability. J Counsel Psychol 2000; 47: 251-65.

9. Bond LM, McKerracher L. Cervical spinal cordinjury: tailoringclinical trialendpoints to reflectmeaningfulfunctional improvements. Neural Regen Res 2014; 9: 1493-7. doi: 10.4103/1673-5374.139470.

10. Behrman AL, Harkema SJ. Physical rehabilitation as an agent for recovery after spinalcord injury. Phys Med Rehabil Clin N Am 2007; 18: 183-202. doi: 10.1016/j.pmr.2007.02.002.

11. Nas K, Yazmalar L, Şah V, Aydın A, Öneş K. Rehabilitation of spinal cord injuries. World J Orthop 2015; 6: 8-16. doi: 10.5312/wjo.v6.i1.8.

12. Fires JM. Criticalrehabilitation of the patient with spinal cord injury. Crit Care Nurs Q 2005; 28: 179-87.

13. Levels of injury. In: Understanding spinal cord injury by Stepherd Center 2011: 4-7 [Internet]. Available from: http://www.spinalinjury101.org/files/20180308/Spinal%20Cord%20Injury%20101%20DVD%20Companion%20Booklet.pdf [cited 11.11.2019].

14. Kaźmierczak K, Lisiński P. Leisure time physical activity of people with chronic spinal cord injuries. Clin Neurol Neurosurg 2018; 170: 7-12. doi: 10.1016/j.clineuro.2018.04.013.

15. Barbareschi G, Cheng T, Holloway C. Effect of technique and transfer board use on the performance of wheelchair transfers. Healthc Technol Lett 2018; 5: 76-80. doi: 10.1049/htl.2017.0075.

16. Mortenson WB, Miller WC, Backman CL, Oliffe JL. Association between mobility, participation, and wheelchair-related factors In long--term care residents who use wheelchairs as their primary means of

mobility. J Am Geriatr Soc 2012; 60: 1310-5. doi: 10.1111/j.1532--5415.2012.04038.x.

17. Rauch A, Fekete C, Oberhauser C, Marti A, Cieza A. Participation in sport in persons with spinal cord injury in Switzerland. Spinal Cord 2014; 52: 706-11. doi: 10.1038/sc.2014.102.

18. Martin Ginis K, Jörgensen S, Stapleton J. Exercise and Sport for Persons With Spinal Cord Injury. PM R 2012; 4: 894-900. doi: 10.1016/j.pmrj.2012.08.006.

19. Burns AS, Marino RJ, Flanders AE, Flett H. Clinical diagnosis and prognosis following spinal cord injury. Handb Clin Neurol 2012; 109: 47–62. doi: 10.1016/B978-0-444-52137-8.00003-6.

20. Fawcett JW, Curt A, Steeves JD et al. Guidelines for the conduct of clinical trials for spinal cord injury as developed by the ICCP panel: spontaneous recovery after spinal cord injury and statistical power needed for therapeutic clinical trials. Spinal Cord 2007; 45: 190-205. doi: 10.1038/sj.sc.3102007.

21. Haas B, Playford ED, Ahmad AQ, Yildiran T, Gibbon AJ, Freeman JA. Rehabilitation goals of people with spinal cord injuries can be classified against the International Classification of Functioning, Disability and Health Core Set for spinal cord injuries. Spinal Cord 2016; 54: 324-328. doi: 10.1038/sc.2015.155.

22. De Franca IS, Coura AS, Sousa FS, de Almeida PC, Pagliuca LM. Quality of Life In patients with spinal cord injury. Rev Gaucha Enferm 2013; 34: 155-63.

23. Blanek L, Carmagnani MIS, Ferreira LM. Quality of Life and Self-esteen of persons with paraplegia living In Sao Paulo, Brazil. Qual Life Res 2009; 18: 15-8. doi: 10.1007/s11136-008-9411-9.

24. Silva RA, Reis PAM, Carvalho ZMF, Pinheiro AKB. Ximenes LB, Olveira MAA. Analysis of Risk Factors Sociodemographic for the Functional Dependence of Adults with Spinal Cord Injury. J Biomem Sci Eng 2015; 8: 287-294.

25. Coura AS, França IS, Enders BC, Barbosa L, Souza JR. Functional disability of adult individuals with spinal cord injury and its association with socio-demographic characteristics. Rev Lat Am Enfermagem 2012; 20: 84-92.

26. Garret A. Impact of spinal cord injury in affective relationship: a ualitative analysis of the subjects' perceptron. IJFPSS 2012; 2: 1-6. doi: 10.1179/2045772313Y.0000000174.

27. Khazaeipour Z, Norouzi-Javidan A, Kaveh M, Khanzadeh Mehrabani F, Kazazi E, Emami-Razavi SH. Psychosocial outcomes following spinal cord injury in Iran. J Spinal Cord Med 2014; 37: 338-345.

28. Menon N, Gupta A, Khanna M, Taly AB. Ambulation following spinal cord injury and its correlates. Ann Indian Acad Neurol 2015; 18: 167-70. doi: 10.4103/0972-2327.150605.

29. Wehman P, Wilson K, Parent W, Sherron-Targett P, McKinley W. Employment satisfaction of individuals with spinal cord injury. Am J Phys Med Rehabil 2000; 79: 161-9.

30. Chan SK, Man DW. Barriers to returning to work for people with spinal cord injuries: a focus group study. Work 2005; 25(4): 325-32.

31. Maynard Jr FM, Bracken MB, Creasey G et al. International standards for neurological and functional classification of Spinal Cord Injury. American Spinal Injury Association. Spinal Cord 1997; 35: 266-274.

32. Soopramanien A, Soopramanien K. A medico-social survey of Romanians with spinal cord injury. Paraplegia 1995; 33: 49-54.

33. Anderson CJ, Vogel LC. Employment outcomes of adults who sustained spinal cord injuries as children or adolescents. Arch Phys Med Rehabil 2002; 83: 791-801.

34. Hess DW, Ripley DL, McKinley WO. Tekswbury M. Predictorsfor return to work after spinal cord injury: a 3-year multicenter analysis. Arch Phys Med Rehabil 2000; 81: 359-63.