J Rehabil Med 2003; 35: 217–220

FUNCTIONAL INDEPENDENCE IN PERSONS WITH SPINAL CORD INJURY IN HELSINKI

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Objective: **To estimate the functional independence of persons with spinal cord injury according to the Functional Independence Measure motor items.**

Design: **The study design was cross-sectional.**

Subjects: **All adult citizens of Helsinki with traumatic spinal cord injury were identified. The final study group consisted of 121/152 subjects (80%).**

Methods: **Functional Independence Measure assessments and American Spinal Cord Association examinations were performed on all subjects by the same experienced group including a physician and a physiotherapist.**

Results: **The most assistance-craving items were climbing stairs and bladder management. There were no significant differences between the genders. Subjects with tetraplegia needed significantly more assistance in all motor items except walking/wheelchair locomotion, where there was no significant difference. Subjects with tetraplegia in American Spinal Injury Association Impairment Scale D had higher Functional Independence Measure scores, more functional independence, than subjects in American Spinal Injury Association Impairment Scale A–C, the difference being significant.**

Conclusion: **Because of new information, the results of this study may provide better possibilities for planning and co-ordinating rehabilitation measures and social services.**

Key words: spinal cord injury, Functional Independence Measure, activities of daily living, prevalence.

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Submitted November 5, 2002; Accepted April 17, 2003

INTRODUCTION

The functional independence of persons with spinal cord injury (SCI) is significantly lower than that of the population in general. SCI usually causes severe locomotor disability, due to paralysis of the muscles. Depending on the level and completeness of the lesion, a person with SCI can be completely independent or need total assistance in all the activities of daily living (ADL) (1). Other consequences of SCI, such as sensory alterations, spasticity, pain and neurogenic bladder, also influence the degree of the disability (2) and reduce functional independence.

In order to plan and develop health care and social resources, it is essential to know the functional state of the population with SCI. Assessment of the need for rehabilitation programs should be automatic. For severely disabled people, social services of various types, such as assistance with personal care, housing, transportation and equipments, are also necessary. The availability of these services is usually regulated by several authorities, depending on the legislation of the country.

Prevalence data about the functional independence of persons with SCI would be useful to the authorities who make and co-ordinate plans for social services. It has also been proposed that functional outcome assessment should be included in the SCI follow-up protocol (3).

The key questions still unanswered are: What proportion of the population with SCI require total assistance in core life activities; what are their demographic characteristics; and what other factors affect the severity of their functional dependence.

The Health Committee of Helsinki decided to evaluate the present health status and social situation of persons with SCI. In 1998 the Committee started a programme to identify all adult citizens of Helsinki who had permanent neurological deficits because of traumatic SCI. The aim of this Helsinki Spinal Cord Injury Study (HSCIS) was to determine the number of SCI persons involved and to evaluate their needs. This was done in order to develop the health care and social services and, if necessary, to create a lifelong follow-up system. No reports with a similar study design have been published previously.

Helsinki, the capital city and also the biggest city in Finland, lies on the south coast of the country. At the cross-section date of the study (January 1, 1999) there were 546,000 inhabitants in Helsinki.

The aims of this study were to evaluate the functional independence of the population with SCI to assess the proportion of the population with SCI, who are independent or are in need of total assistance in ADL, and to find out whether there are differences in functional independence between the sexes and how the level and completeness of the lesion affects disability.

SUBJECTS AND METHODS

The study design was cross-sectional. The subjects to be included in the

ISSN 1650–1977
DOI 10.1080/16501970310009963

HSCIS were identified from the registers of the Käpylä Rehabilitation Centre, Helsinki University Central Hospital, and the local organization for disabled people. Local health centres were informed about the study, residential service houses were contacted and announcements were published in patient magazines. In order to carry out the study as a whole, permission was requested from the Ethics Committee, Helsinki University Central Hospital, as well as from the Ministry of Social Affairs and Health of Finland.

A total of 152 cases of SCI were found. This means a prevalence of 28 per 100,000 inhabitants. The subjects were invited to a clinical visit lasting from 2.5 to 4 hours. During the visit, a medical history was taken and the medical status, including the ASIA (American Spinal Injury Association) classification (4), Functional Independence Measure (FIM™) interviews (5), and possible medical interventions, were noted. The subjects met the doctor, the physiotherapist and, when needed, a nurse. The data were gathered between September 1999 and February 2001, and at least 1 year after each subject's injury. Altogether 125 subjects made a clinical visit.

The FIM™-assessments and ASIA examinations were performed on all subjects by the same experienced group including a physician and a physiotherapist. FIM™ interviews involved detailed and time-consuming questioning of the subjects about their home environment and the precise way in which ADL were performed.

For personal reasons, the ASIA classification was not applied to 4 subjects, thus the final study group comprised 121/152 subjects (80%). A total of 26/121 (21%) of the subjects were female and 95/121 (79%) were male. The mean age of the subjects during the follow-up was 49 (SD 13) years and the mean time since the injury was 18 (SD 11) years. Altogether 43% of the subjects ($n = 52/121$) had a complete lesion and 57% ($n = 69/121$) had an incomplete lesion. A total of 46% of the subjects ($n = 56/121$) had tetraplegia (27% of the females and 52% of the males) and 54% ($n = 65/121$) had paraplegia (73% of the females and 48% of the males).

The FIM™ is designed to measure the severity of the disability and to determine the burden of care in ADL (6). It is an 18-item assessment that evaluates a person's independence in ADL. The score for individual items ranges from 1 to 7: a FIM™ item score of 1 is categorized as "total assistance"; a score of 7 is "complete independence". In a certain item a person is classified as:

- "independent" when there is no need for a helper (scores 7–6);
- "modified dependent" when the subject expends 50% or more of the effort (scores 5–3); and
- "complete dependent" when the subject expends less than 50% of the effort (scores 1–2).

FIM™ has 2 scales, 1 including 13 motor items and another with 5 cognition items. The motor items can be further divided into 3 sub-scales: "self-care" (6 items, scores range from 6 to 42), "sphincter control" (2 items, scores range from 2 to 14) and "mobility" (5 items, scores range from 5 to 35). These 3 motor sub-scales were used in this study.

The ASIA classification is widely used in SCI medicine to describe the level and completeness of the lesion. These standards have been endorsed by the International Spinal Cord Society. In an ASIA examination, both the motor and sensory components are tested clinically (4).

The term tetraplegia refers to impairment or loss of motor and/or sensory function in the cervical segments. In paraplegia, these segments are intact and the lesion is more caudal in the spinal cord.

The ASIA Impairment Scale (AIS) reflects the completeness of the lesion:

- A = a complete lesion, no sensory or motor function is preserved in the lowest sacral segments;
- B = sensory incomplete lesion (including segments S4-S5), but no motor function below the neurological level;
- C = sensory and motor incomplete but more than half of the 10 pairs of key muscles have strength of less than 3 on a scale 0–5;
- D = sensory and motor incomplete, at least half of the key muscles have strength of greater or equal to 3;
- E = sensory and motor function normal

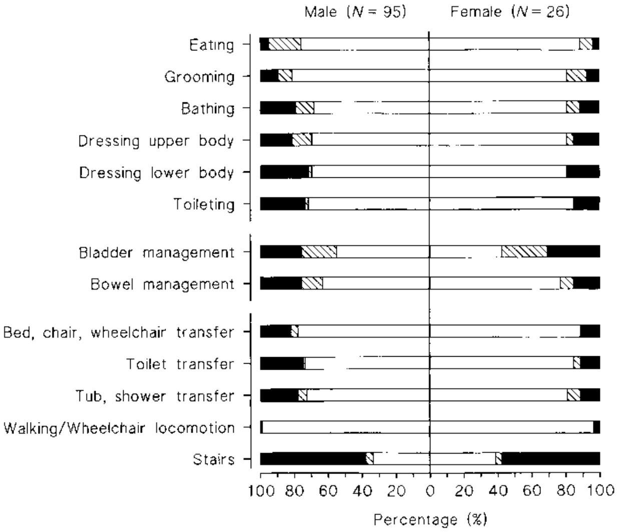

Fig. 1. Distribution of "independent" (open), "modified dependent" (hatched) and "complete dependent" (solid columns) subjects according to the Functional Independence Measure in each motor item in both females and males. The first 6 items form a "self care" sub-scale, the next 2 items a "sphincter control" sub-scale, and the last 5 items a "mobility" sub-scale.

The results were expressed as means or medians with the standard deviation (SD), range, or interquartile range (IQR). Comparison of FIM™ scores between groups with different AISs were performed with the Kruskal-Wallis analysis of variance, the *post hoc* comparisons were made using the Dwass-Steel-Chritchlow-Flinger method. Measures with a discrete distribution were expressed as counts (%) and analysed by χ^2, Fisher's exact test or by Fisher-Freeman-Halton test. We evaluated the normality of the variables by Shapiro-Wilk statistics. No adjustment was made for multiple testing. The alpha level was set at 0.05 for all tests.

RESULTS

There were no statistically significant differences between the genders according to the FIM™ in each motor item (Fig. 1.). The items for which assistance was needed most were moving on stairs and bladder management. A total of 65% of the whole study group needed assistance (FIM™ score 1–5) on stairs and 48% with bladder management. The most difficult item in the self-care sub-scale was bathing: 29% of the subjects needed assistance. A total of 98% of the study group were independent (FIM™ score 6–7) in locomotion on a level surface. The next easiest tasks were grooming (81% independent), bed/chair/wheelchair transfers (80% independent) and eating (79% independent).

There was no statistically significant difference in the walking/wheelchair locomotion item between tetraplegia and paraplegia according to the FIM™ (Fig. 2.). On the other hand, in all the other 12 items there was a statistically significant difference ($p < 0.01$). Naturally, subjects with tetraplegia needed more assistance than those with paraplegia. A total of 20% ($n = 11/56$) of the subjects with tetraplegia used indoor electric wheelchairs.

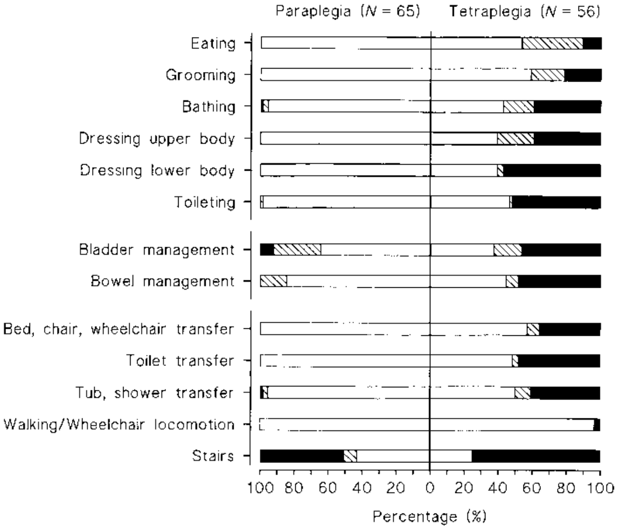

Fig. 2. Distribution of the "independent" (open), "modified dependent" (hatched) and "complete dependent" (solid columns) subjects according to the Functional Independence Measure in each motor item in both tetraplegia and paraplegia.

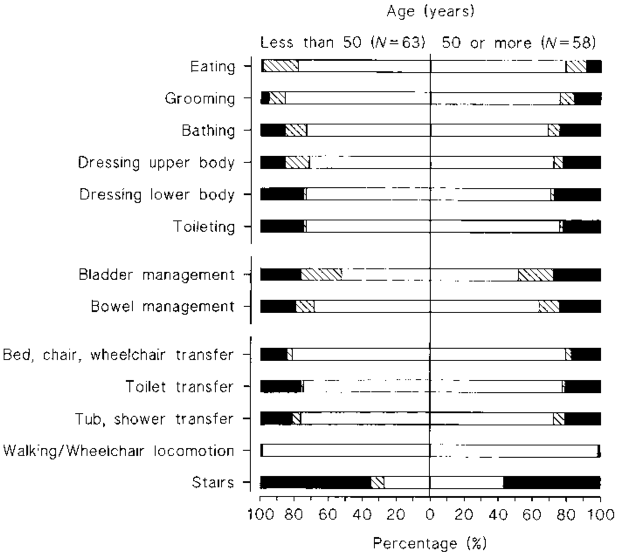

Fig. 3. Distribution of "independent" (open), "modified dependent" (hatched) and "complete dependent" (solid columns) subjects according to the Functional Independence Measure in each motor item, both in subjects age less than 50 years and the subjects age 50 years or more.

There was no statistical significant difference between the age-groups according to the FIM™ in each motor item (Fig. 3.).

In tetraplegia there was a statistically significant difference in all sub-scales between the groups with different AISs (Table I). After *post hoc* testing, the difference was localized between the AIS group D and the other AIS groups.

In paraplegia there were no statistically significant differences between the AIS groups in the self care or sphincter control sub-scales. In the mobility sub-scale there was a statistically significant difference between the AIS groups. After *post hoc* testing, the difference was localized between the AIS group D and the other AIS groups.

DISCUSSION

A reasonable effort was made to find as many subjects with SCI as possible. The final study group comprised 80% ($n = 121/152$) of the whole population with traumatic SCI.

The ASIA classification and FIM™ interviews were carried out by the same clinically experienced team. This study offers an opportunity to estimate the functional independence of persons with SCI on a prevalence basis.

The FIM™ is currently the most widely accepted method in use in the rehabilitation institutes in Europe and USA (6, 7). Studies have confirmed the high reliability of the motor FIM™ in many impairment groups, including SCI (8). The FIM™ has also been introduced into the National Spinal Cord Injury Database, following reliability testing (9). FIM™ motor items appear to reflect the functional status of SCI individuals well, whereas cognition items are not informative for detecting changes over time (7). A very strong correlation has been reported between observational rating and questioning of the FIM™ (10).

Table I. *Comparison of the Functional Independence Measure sub-scales "self care", "sphincter control" and "mobility" between each American Spinal Injury Association Impairment Scale in both tetraplegia and paraplegia. IQR = interquartile range*

	ASIA Impairment Scale					
	A Median (IQR)	B Median (IQR)	C Median (IQR)	D Median (IQR)	*p*-value	Multiple comparison*
Tetraplegia						
Self care	17 (12, 27)	18 (10, 30)	27 (7, 39)	42 (31, 42)	<0.001	A/D, B/D, C/D
Sphincter control	2 (2, 8)	3 (2, 13)	5 (2, 12)	13 (12, 14)	<0.001	A/D, B/D, C/D
Mobility	12 (10, 20)	11 (10, 24)	24 (8, 26)	32 (26, 34)	<0.001	A/D, B/D, C/D
Paraplegia						
Self care	42 (40, 42)	42 (40, 42)	42 (40, 42)	42 (42, 42)	0.053	
Sphincter control	12 (11, 13)	12 (10, 13)	13 (10, 14)	14 (10, 14)	0.26	
Mobility	27 (26, 30)	29 (26, 32)	28 (26, 32)	33 (32, 35)	<0.001	A/D, B/D, C/D

* Dwass-Steel-Chritchlow-Flinger method; ASIA = American Spinal Injury Association.

In this study, no statistically significant differences were noted between the genders, although the relatively smaller proportion of females with tetraplegia (27% in females compared with 52% in males) may have affected the situation.

In Fig. 2, the dramatic difference in need of assistance between tetraplegia and paraplegia is clearly seen.

Interestingly 35% of the subjects with paraplegia ($n = 23/65$) needed assistance in bladder management and 15% ($n = 10/65$) in bowel management. These findings show the most problematic ADL in persons with intact upper limb function.

In walking/wheelchair locomotion item, the FIMⓉⓜ is not sensitive enough in the chronic phase of SCI because of its ceiling effect. This has also been reported in other studies (1). In this study there was no significant difference between tetraplegia and paraplegia. The FIMⓉⓜ measures disability, but is dependent on the environment. The locomotion item functions well at home but has limitations in places with poor accessibility, such as outdoors.

Surprisingly, age did not have significant effect on functional independence.

The AIS was used in this study in order to measure the effect of the completeness of the lesion on the functional outcome. As expected, the subjects in AIS group D had significantly higher FIMⓉⓜ scores, more functional independence, in most of the items than the subjects in the other AIS groups.

Subjects with tetraplegia in the AIS groups A and B seem to be closer to each other than in groups A to C or B to C. However there was no statistically significant difference between tetraplegia in groups A and C. This could be explained by the limited number of cases in this study. The need for a personal carer is usually obvious in tetraplegia in the AIS groups A and B, but it should also always be taken into account in the AIS group C.

In the self care and sphincter control items, all the AIS groups scored almost equally in the paraplegia group. Only in mobility item did subjects in the AIS group D score significantly higher than the others. In paraplegia the subjects in the AIS group C have no advantage in functional independence over the subjects in the AIS groups A and B.

In conclusion, this study assesses and classifies the functional independence of persons with SCI in Helsinki. The results provide tools for local and national authorities to enhance planning and co-ordination of rehabilitation interventions as well as for social services. The accurate data about the epidemiology and the need for assistance with personal care of the whole population of persons with SCI create a basis for these plans. Legislation varies from country to country and the results of this study should be taken into account accordingly. However, more detailed prevalence data for the sub-groups of SCI, their demographic characteristics and the factors influencing the functional outcome are needed.

ACKNOWLEDGEMENT

This study was sponsored by the Finnish Cultural Foundation.

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