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Original Article

Functional ability, perceived exertion and employment of the individuals with spinal cord lesion in Taiwan

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Study design: A survey on functional ability, perceived exertion, and employment was mailed to 190 individuals with spinal cord lesion. Analysis is based on the 91 completed replies.
Objectives: To establish a database of individuals with spinal cord lesions and to assess the effectiveness of training programs designed to improve life quality and employment chances among the individuals with spinal cord lesion.
Settings: Subjects selected from the Spinal Cord Injury Association of the Republic of China (SCIAROC) and from the Asylum Center Spinal Cord Injury (ASCCI) in Taiwan.
Methods: Information was obtained from a survey sent to the subjects who are chosen randomly from the SCIAROC and from all the subjects through ACSCI training program.
Results: Respondents in ACSCI had a higher functional activity level and lower perceived exertion during activities than those in SCIAROC. The employment status is related to the functional independence and level of injury.
Conclusion: The database provides information on functional and employment status of individuals with spinal cord lesion. The present study also demonstrates the efficacy of a vocational training program for individuals with spinal cord lesion in Taiwan.
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Keywords: spinal cord lesion; functional ability; perceived exertion; employment; medical complications; Taiwan

Introduction

Spinal cord lesions are a major health problem.[1] In Taiwan, the exact number of individuals with spinal cord lesions is not known at present. However, the observed average annual incidence of spinal cord injury (SCI) is estimated to be 8.8 per one million people.[2] This survey does not include the unregistered cases. It is estimated in each year, including the unregistered cases, that there are about 700 new SCI victims in Taiwan. The official Spinal Cord Injury Association of the Republic of China (SCIAROC), founded in 1990, has grown rapidly in size in recent years. At present, there are about 1000 members comprising the victims from all walks of life spreading all over the Taiwan island. The association is one of the two sources for information studied in the present survey. The other source of information comes from the Asylum Center Spinal Cord Injury (ACSCI), an official mid-way center for vocational training and counseling for individuals with spinal cord lesions founded in 1994. The capacity for this training center is about 40 members, with the training course of 6 months. Part of the studied cases here are the individuals with spinal cord lesion who are at the completing stage of the ACSCI programs.

The measurement of functional ability of a patient becomes increasingly important. This is because functional ability is an important determining factor of a patient's quality of life and it correlates highly with both physical and mental health.[3] The measurement of functional ability also provides guidelines to the patient's health care and is valuable for health care research. Data used to describe a patient's functional status can be obtained by directly observing the patient or by analyzing the patient-report.[4,5] Either method has its unique advantages and disadvantages.

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The present survey uses a self patient-report questionnaire for analysis and measuring the functional ability of the individuals with spinal cord lesion.[6]

Subjective rating of the intensity of exertion has been used to quantify effort during an activity. The original ratings of perceived exertion scale (RPE) developed by Borg[7] has been used extensively in the health care society. The Borg Scale has been used to record the perceived exertion during different modes of ambulation – walking, auxiliary crutch walking, and running in healthy volunteer women.[8] Little is known, however, about the measurement of functional ability of individuals with a spinal cord lesion using the RPE. This study is the first to use the Borg Scale to rate the perceptual effort in order to analyze quantitatively the functional activities of individuals with a spinal cord lesion. These ratings are important complements to behavioral and physiological measurements of physical performance and capacity. The per-item test-retest reliability was assessed with kappa statistics in 10 individuals with SCI (two had quadriplegia and eight had paraplegia) before conducting the survey. The kappa values for the 13 items range from 0.67 to 0.80.

It is known that individuals with employment have a better life quality and a higher life satisfaction compared to unemployed individuals.[9,10] Krause and Anson[11] studied SCI victims using employment and education as two main factors to determine the outcome of an incident. The employed participants reported adjustment scores higher to that of the unemployed. Krause and Anson also indicated a strong association of education or employment to life quality after an SCI incident. There are relative few studies which looked closely at variables of individuals with a spinal cord lesion in correlation to employment. The purposes of this study are (1) to assess the level of functional abilities and affecting factors of individuals with a spinal cord lesion quantitatively, (2) to assess the intensity of effort to perform functional activities, and (3) to examine variables that are associated with the improvement of employment of individuals with such lesions.

Methods

Participants

Each participant studied by this survey had a clinical diagnosis of a spinal cord lesion. All of the participants live in Taiwan. From the ACSCI and a regional institute of SCIAROC, a pool of potential participants was identified with the participant's name and contact information. A careful screening was performed to ensure the data are not repetitive. A total of 190 subjects were mailed the questionnaires. Among them, 150 were randomly selected from the pool provided by SCIAROC by drawing lots (21.3% of a total of 703 individuals who have no ACSCI trainings) and the remaining 40 individuals from ACSCI training program which is at the completing stage.

The survey was conducted from August to November 1999 through a mailed questionnaire. Along with the questionnaire, a letter was included to describe the purposes of the survey. The questionnaire includes three parts: (1) the demographic data which included age, gender, etiology, time post injury, level of injury (quadriplegia or paraplegia), educational background, and employment status (student, employed or unemployed); (2) the medical complications suffered by the individuals with spinal cord lesion at discharge and at the time of the survey; and (3) the self-reported functional independent level and perceived exertion during activity.

Included in the questionnaire is the self-reported version of the Functional Independence Measure (SRFM).[6] The SRFM is a simple and yet dependable self-gauging method for measuring functional abilities of a SCI victim. There are 13 functional activities used for the present study, each measured by a 4-level scale. A score of '4' indicates that the subject needs no extra time or help to perform a gauged activity. A score of '3' indicates that the subject needs extra time or special tools to perform the activity. A score of '2' indicates that the subject needs some help from another person to perform the activity. Finally, a score of '1' indicates that the subject is unable to perform the activity and is entirely dependent on others' help. From the received data, the intra-class correlation coefficient for SRFM is 0.90 and internal consistency is 0.96.[6]

Also included in the questionnaire is the score of the ratings of perceived exertion (RPE), developed by Borg.[7] The purpose of using the RPE here is to rate the intensity of effort during the 13 different functional activities. The RPE scale consists of numbers ranging from 6 to 19, as shown in Appendix 1. The preset range of these numbers is used and answered by the surveyed subjects in order to rate their perceptions of how much effort they must exert in performing a functional activity. Descriptive words accompanying the numbers, such as hard, very hard, etc., sit together with the questionnaires. Both local symptoms (e.g., muscle aches, cramps, pain, or fatigue) or central symptoms (e.g., feelings of being tired or breathless) are included to reflect the fact that both may contribute to the overall feelings of work performances of individuals with spinal cord lesion.

Data analysis

The raw data was recorded and constructed in Microsoft Excel 2000. The statistical analysis was performed using an SPSS-PC version. The demographic data was calculated by CROSSTABS in order to obtain frequencies and percentages. The independent *t*-test or one-way ANOVA and Newman-Keuls tests were performed to determine the significance of differences in functional levels and perceived intensity of effort during the activities. Furthermore, the Mantel-Haenszel test for linear association was used in determining the association between employment

and functional independence level, number of complications, time since injury, gender, level of education, and level of lesion.

Results

All participating individuals were confirmed to have a disability of spinal cord lesion. Among the 190 questionnaires sent, 91 replies were completed. The low rate of reply may be contributable to the complexity and length of the questionnaire. Among the 91, 55 were from the subjects in the pool of SCIAROC and 36 of ACSCI. The demographic data received from the potential participants are shown in Table 1. Of the 55 participants from SCIAROC, 47 are male and eight are female. In the ACSCI group, 29 are male and seven are female.

Forty-eight per cent of those surveyed were caused by motor vehicle accidents, 20% by falls, 6.6% by sports injury, 7.6% by crush, 2.2% by violence, 7.6% by infection, 4.4% by spinal neoplasm, and 3.3% by vascular malfunction. Quadriplegia (cervical spinal injury) was the diagnosis for 37% of the surveyed, whereas 63% were diagnosed with paraplegia (injury to the thoracic, lumbar, or sacral segments of the cord). Of those subjects who are employed, 100% had paraplegia. Of those unemployed in SCIAROC group, 65% had paraplegia. All those surveyed having quadriplegia are unemployed. Conclusively from the present survey and analysis for SCIAROC group, employment is only related to the level of functional independence ($P<0.01$) and the level of injury ($P<0.01$). Age, gender, number of medical complications, educational level, and time since injury were not related to employment status.

Table 2 and 3 show the number of individuals who suffered from different medical complications at different post-injury times. Of the 55 respondents in

Table 1 Demographic characteristics of subjects ($n=91$)

	SCIAROC[a] (n = 55)		*ACSCI*[b] (n = 36)	
	Quadriplegia (n = 21)	*Paraplegia* (n = 34)	*Quadriplegia* (n = 13)	*Paraplegia* (n = 23)
Gender				
Male	18 (85.7)	29 (85.3)	10 (76.9)	19 (82.6)
Female	3 (14.3)	5 (14.7)	3 (23.1)	4 (17.4)
Age (in years)				
18 – 29	4 (19.0)	6 (17.6)	5 (38.5)	11 (47.8)
30 – 29	7 (33.3)	10 (29.4)	6 (46.2)	4 (17.4)
40 – 49	2 (9.5)	9 (26.5)	2 (15.4)	8 (34.8)
50 – 59	5 (23.8)	6 (17.6)	0 (0)	0 (0)
> 60	3 (14.3)	3 (8.8)	0 (0)	0 (0)
Time post injury				
< 6 mos	0 (0)	0 (0)	0 (0)	0 (0)
6 mos ~ 2yrs	3 (14.3)	3 (8.8)	2 (15.4)	5 (21.7)
2 ~ 5 yrs	5 (23.8)	11 (32.4)	7 (53.8)	6 (26.1)
5 ~ 10 yrs	3 (14.3)	9 (26.5)	4 (30.8)	4 (17.4)
> 10 yrs	10 (47.6)	11 (32.4)	0 (0)	8 (34.8)
Etiology				
Traffic accident	10 (47.6)	13 (38.2)	11 (84.6)	10 (43.5)
Fall	4 (19.0)	9 (26.5)	1 (7.7)	4 (17.4)
Sports injury	3 (14.3)	1 (2.9)	1 (7.7)	1 (4.3)
Crush by heavy objects	0 (0)	3 (8.8)	0 (0)	4 (17.4)
Violence	1 (4.8)	1 (2.9)	0 (0)	0 (0)
Infection	3 (14.3)	2 (5.9)	0 (0)	2 (8.7)
Spinal neoplasm	0 (0)	3 (8.8)	0 (0)	1 (4.3)
Vascular malfunction	0 (0)	2 (5.9)	0 (0)	1 (4.3)
Completeness of paralytic condition				
Complete	3 (14.3)	13 (38.2)	2 (15.4)	9 (39.1)
Incomplete	18 (85.7)	21 (61.8)	11 (84.6)	14 (60.9)
Education background				
Elementary school	2 (9.5)	5 (14.7)	1 (7.7)	1 (4.3)
Junior high school	3 (14.3)	9 (26.5)	5 (38.5)	8 (34.8)
Senior high school	7 (33.3)	8 (23.5)	6 (46.2)	11 (47.8)
⩾college	9 (42.9)	12 (35.3)	1 (7.7)	3 (13.0)
Employment				
Student	0 (0)	1 (2.9)	0 (0)	0 (0)
Employed	0 (0)	11 (32.4)	0 (0)	0 (0)
Unemployed	21 (100)	22 (64.7)	13 (100)	23 (100)

[a]Spinal Cord Injury Association of the Republic of China. [b]Asylum Center Spinal Cord Injury

the SCIAROC group, 49 (89.1%) reported medical complications at discharge. Of the 36 respondents in the ACSCI group, 31 (86.1%) reported medical complications. The four most bothering complications at the time of discharge from hospital for both SCIAROC and ACSCI groups were 'urinary problems', 'numbness/pain', 'pressure sores', and 'spasticity'. More than half of the subjects in the present study suffered from at least one of these four complications at discharge, as shown in Table 2.

Table 2 The most bothering complication in discharge

	SCIAROC (n = 55) *No. (%)*	*ACSCI* (n = 36) *No. (%)*	*Total* (n = 91) *No. (%)*
Urinary problems	42 (76.4)	24 (66.7)	66 (72.5)
Numbness/Pain	35 (63.6)	24 (66.7)	59 (64.8)
Pressure sores	28 (50.9)	21 (58.3)	49 (53.8)
Spasticity	32 (58.2)	17 (47.2)	49 (53.8)
Contractures	12 (21.8)	6 (16.7)	18 (19.8)
Osteoporosis	10 (18.2)	3 (8.3)	13 (14.3)
Respiratory problems	13 (23.6)	9 (25.0)	22 (24.2)
Sexual dysfunction	8 (14.5)	11 (30.6)	19 (20.9)
Others	13 (23.6)	6 (16.7)	19 (20.9)

Subjects who suffered from one or more medical complications after discharge are as follows. In the SCIAROC group, four out of six (66.7%) suffered complications in 6 months to 2 years, 15 out of 16 (93.6%) in 2 to 5 years, 10 out of 12 (83.3%) in 5 to 10 years, and 19 out of 21 (90.5%) in more than 10 years. In the ACSCI group, seven out of seven (100%) in 6 months to 2 years, 12 out of 13 (92.3%) in 2 to 5 years, 6 out of 8 (75.0%) in 5 to 10 years, and seven out of eight (87.5%) in more than 10 years. The number of complications suffered by individuals does not seem to be related to the time post spinal cord lesion, as shown in Table 3.

The self-reported functional independent levels are listed in Table 4. As expected, individuals with paraplegia demonstrate a higher self-reported independence levels than subjects with quadriplegia. In the SCIAROC group, subjects with paraplegia had significantly higher independence levels in all 13 functional activities than subjects with quadriplegia. The 'significantly higher independence level' is defined here by first it is statistically meaningful by a

Table 3 The number of medical complications at different time post injury

	SCIAROC (n = 55)					*ACSCI (n = 36)*				
No. of complications	*At discharge* (n = 49) *No. (%)*	*6 mos ~ 2 yrs* (n = 4) *No. (%)*	*2 ~ 5 yrs* (n = 15) *No. (%)*	*5 ~ 10 yrs* (n = 10) *No. (%)*	*> 10 yrs* (n = 19) *No. (%)*	*At discharge* (n = 31) *No. (%)*	*6 mos ~ 2 yrs* (n = 7) *No. (%)*	*2 ~ 5 yrs* (n = 12) *No. (%)*	*5 ~ 10 yrs* (n = 6) *No. (%)*	*> 10 yrs* (n = 7) *No. (%)*
1	2 (2.5)	1 (25.0)	2 (13.3)	1 (10.0)	2 (10.5)	1 (1.3)	1 (14.3)	3 (25.0)	0 (0)	1 (14.3)
2	8 (10.0)	2 (50.0)	3 (20.0)	5 (50.0)	1 (5.3)	3 (3.8)	1 (14.3)	0 (0)	2 (33.3)	2 (28.6)
3	10 (12.5)	0 (0)	3 (20.0)	1 (10.0)	4 (21.1)	9 (11.3)	4 (57.1)	3 (25.0)	2 (33.3)	1 (14.3)
4	7 (8.8)	0 (0)	1 (6.7)	3 (30.0)	5 (26.3)	7 (8.8)	1 (14.3)	4 (33.3)	1 (16.7)	3 (42.9)
5	17 (21.3)	0 (0)	5 (33.3)	0 (0)	6 (31.6)	9 (11.3)	0 (0)	1 (8.3)	1 (16.7)	0 (0)
6	3 (3.8)	1 (25.0)	0 (0)	0 (0)	1 (5.3)	1 (1.3)	0 (0)	1 (8.3)	0 (0)	0 (0)
7	2 (2.5)	0 (0)	1 (6.7)	0 (0)	0 (0)	1 (1.3)	0 (0)	0 (0)	0 (0)	0 (0)

Table 4 The self-reported functional independent level of subjects from SCIAROC and ACSCI

	SCIAROC		*ACSCI*	
	Quadriplegia (n = 21)	*Paraplegia* (n = 34)	*Quadriplegia* (n = 13)	*Paraplegia* (n = 23)
1. Move around inside your house	$1.6 \pm 1.0^{a,b}$	3.2 ± 1.0^{c}	2.8 ± 1.3^{a}	3.9 ± 0.3
2. Go up and down a flight of stairs	2.0 ± 1.3^{a}	3.1 ± 1.1^{c}	2.7 ± 1.4^{a}	3.8 ± 0.5
3. Transfer to and from your bed or chair	2.0 ± 1.2^{a}	3.1 ± 1.0^{c}	3.0 ± 1.4	3.8 ± 0.5
4. Get on and off the toilet	$1.7 \pm 1.0^{a,b}$	3.4 ± 1.0^{c}	2.8 ± 1.2^{a}	4.0 ± 0.2
5. Transfer from the shower or tub	$1.6 \pm 1.0^{a,b}$	3.2 ± 1.1^{c}	2.8 ± 1.3^{a}	4.0 ± 0.2
6. Eat	$1.5 \pm 1.0^{a,b}$	2.9 ± 1.0^{c}	2.9 ± 1.2^{a}	3.8 ± 0.5
7. Groom (combing hair, brushing teeth, etc.)	$1.5 \pm 1.0^{a,b}$	2.7 ± 1.2^{c}	2.8 ± 1.2^{a}	3.6 ± 0.6
8. Bathe	$1.5 \pm 1.0^{a,b}$	2.6 ± 1.2^{c}	2.6 ± 1.3^{a}	3.6 ± 0.6
9. Dress your upper body	$1.4 \pm 0.8^{a,b}$	3.2 ± 1.0^{c}	3.0 ± 1.1^{a}	3.9 ± 0.4
10. Dress your lower body	$1.6 \pm 1.0^{a,b}$	3.7 ± 0.7	3.3 ± 1.1	3.9 ± 0.4
11. Toilet (dressing and cleaning with toilet use)	$1.5 \pm 1.0^{a,b}$	3.5 ± 0.7^{c}	3.2 ± 1.2	3.9 ± 0.4
12. Manage your bladder	2.8 ± 1.1^{a}	4.0 ± 0.0	3.4 ± 1.0	4.0 ± 0.0
13. Manage your bowels	$2.0 \pm 1.0^{a,b}$	3.7 ± 0.7^{c}	2.8 ± 1.0^{a}	4.0 ± 0.0

[a] $P < 0.05$ for quadriplegia *vs* paraplegia within group. [b] $P < 0.05$ for quadriplegia *vs* quadriplegia between groups. [c] $P < 0.05$ for paraplegia *vs* paraplegia between groups

superscript, appeared in the table, denoting the comparison within groups or between groups. For example, the superscript ''a'' denotes the difference is statistically meaningful ($P<.05$) for comparing quadriplegia and paraplegia within the SCIAROC or ACSCI group. Secondly, the 'significantly higher independence level' also means the independence level is different by one level or more when comparing the average value of levels between groups.

Within the ACSCI group, subjects with paraplegia demonstrated significantly higher independence levels for six activities which included 'move around inside your house', 'go up and down a flight of stairs', 'get on and off the toilet', 'transfer from the shower or tub', 'bathe', and 'manage your bowels'.

For the comparison cross the SCIAROC and ACSCI groups, Table 4 shows individuals with quadriplegia in ACSCI group demonstrate significantly better functional independence than the individuals with quadriplegia in SCIAROC group, except for the activities of 'go up and down a flight of stairs', 'transfer to and from your bed or chair', 'manage your bladder', and 'manage your bowel'. The improvements of the four activities are limited. In other words, this may indicate that the training of the ACSCI program is especially effective for the remaining nine activities for the quadriplegia patients. The table also shows that the paraplegia patients in the ACSCI group demonstrated better functional independence than that of the SCIAROC group in all activities but less impressive than the improvement for patients of quadriplegia. Only one functional activity, 'bathe', was improved by one level in average. This shows that all the functional activities, except 'bathe', for paraplegia patients are already in a relative high level and there is not much room for improvement.

According to the present analysis, the only factor affecting self-reported functional independence levels is the level of injury ($P<0.01$). Age, education, number

Table 5_1 Comparison between age-matching groups in individuals with quadriplegia

	SCIAROC			*ACSCI*		
	18−29 y.o. (n=4)	*30−39 y.o.* (n=7)	*40−49 y.o.* (n=12)	*18−29 y.o.* (n=5)	*30−39 y.o.* (n=6)	*40−49 y.o.* (n=2)
1. Move around inside your house	1.3±0.4	2.6±1.2	1.0±0.0	2.2±1.2	3.3±1.1	2.5±1.5
2. Go up and down a flight of stairs	1.8±1.3	2.6±1.4	2.0±1.0	2.0±1.3	3.3±1.1	2.5±1.5
3. Transfer to and from your bed or chair	1.8±0.8	2.6±1.4	2.0±1.0	2.8±1.5	3.3±1.1	2.5±1.5
4. Get on and off the toilet	1.8±0.8	2.6±1.2	1.0±0.0	2.4±1.0	3.3±1.1	2.5±1.5
5. Transfer from the shower or tub	1.3±0.4	2.4±1.3	1.0±0.0	2.2±1.2	3.3±1.1	2.5±1.5
6. Eat	1.3±0.4	2.4±1.3	1.0±0.0	2.6±1.0	3.3±1.1	2.5±1.5
7. Groom (combing hair, brushing teeth, etc.)	1.8±1.3	1.7±1.2	2.0±1.0	2.8±1.3	3.0±1.2	2.0±1.0
8. Bathe	1.8±1.3	1.7±1.2	2.0±1.0	2.5±1.5	3.0±1.2	1.5±0.5
9. Dress your upper body	1.3±0.4	2.1±1.1[a]	1.0±0.0	2.6±1.0	3.5±0.8	2.5±1.5
10. Dress your lower body	1.5±0.5[a]	2.4±1.4	1.0±0.0	3.2±1.2	3.7±0.7	2.5±1.5
11. Toilet (dressing and cleaning with toilet use)	1.3±0.4[a]	2.3±1.3	1.0±0.0	3.0±1.1	3.5±1.1	2.5±1.5
12. Manage your bladder	3.3±0.8	3.0±1.3	3.0±1.0	3.0±1.3	3.8±0.4	3.0±1.0
13. Manage your bowels	2.0±0.0	2.7±1.3	1.5±0.5	2.6±0.8	3.2±0.9	2.5±1.5

[a] $P<0.05$ between age-matching groups

Table 5_2 Comparison between age-matching groups in individuals with paraplegia

	SCIAROC			*ACSCI*		
	18−29 y.o. (n=6)	*30−39 y.o.* (n=10)	*40−49 y.o.* (n=9)	*18−29 y.o.* (n=11)	*30−39 y.o.* (n=4)	*40−49 y.o.* (n=8)
1. Move around inside your house	3.0±1.0	3.6±0.5	2.6±1.3[a]	4.0±0.0	3.8±0.4	3.8±0.4
2. Go up and down a flight of stairs	2.8±0.9	3.4±0.9	2.3±1.2[a]	3.8±0.4	4.0±0.0	4.0±0.0
3. Transfer to and from your bed or chair	2.8±0.9[a]	3.1±1.1[a]	2.8±1.0	3.9±0.3	4.0±0.0	3.6±0.5
4. Get on and off the toilet	3.3±1.1	3.9±0.3	3.2±1.0	3.9±0.3	4.0±0.0	4.0±0.0
5. Transfer from the shower or tub	3.2±1.1	3.8±0.4	3.0±1.2[a]	3.9±0.3	4.0±0.0	4.0±0.0
6. Eat	2.8±1.1	3.5±0.5	2.3±0.8[a]	3.9±0.3	3.8±0.4	3.9±0.3
7. Groom (combing hair, brushing teeth, etc.)	2.5±1.3	3.5±0.5	2.4±1.3	3.6±0.6	3.8±0.4	3.5±0.7
8. Bathe	2.5±1.3	3.2±0.9	2.4±1.3	3.6±0.6	3.8±0.4	3.5±0.7
9. Dress your upper body	3.2±1.1	3.5±0.7	2.6±1.0[a]	4.0±0.0	4.0±0.0	4.0±0.0
10. Dress your lower body	3.5±1.1	3.9±0.3	3.9±0.3	4.0±0.0	4.0±0.0	4.0±0.0
11. Toilet (dressing and cleaning with toilet use)	3.2±1.1	3.8±0.4	3.4±0.7	4.0±0.0	4.0±0.0	3.9±0.3
12. Manage your bladder	4.0±0.0	4.0±0.0	4.0±0.0	4.0±0.0	4.0±0.0	4.0±0.0
13. Manage your bowels	3.5±1.1	3.8±0.4	3.6±0.7	4.0±0.0	4.0±0.0	4.0±0.0

[a] $P<0.05$ between age-matching groups

of medical complications, time since injury, and gender did not affect the level of independence.

In order to investigate the effect of training among different age groups, the surveyed individuals were grouped into three groups by age as shown in Tables 5-1 and 5-2. For the comparison of quadriplegia patients, the training is shown to be effective in general for all the three age groups, even though the improvement is not impressive. Only the 'dress your lower body' and 'toilet' for the 18–29-year age group and the 'dress your upper body' for the 30–39-year age group show significant improvement by the ACSCI training program, as shown in Table 5-1. On the other hand, the improvement is very impressive for the paraplegia patients of the 40–49-year age group, as shown in Table 5-2. The significant improvements include: 'move around inside your house', 'go up and down a flight of stairs', 'transfer from the shower or tub', 'eat', and 'dress your upper body'.

The subjective ratings of intensity when performing the 13 functional activities are shown in Table 6. In addition, to be statistically meaningful, the subjective rating of intensity is judged 'with greater ease' also be a definition that the rating is reduced by two or more when comparing that of two groups. In the SCIAROC group, individuals with paraplegia perform the 13 functional activities with greater ease than those individuals with quadriplegia, as expected. The improvement is also true in the ACSCI group with the exception of 'transfer to and from your bed or chair' and 'manage your bladder'. Subjects with quadriplegia in the ACSCI group perform the activities with greater ease than individuals with quadriplegia in the SCIAROC group, with the exception of 'go up and down a flight of stairs', 'eat', 'groom', 'bathe' and 'manage your bladder'. However, subjects with paraplegia in the ACSCI group perform only two activities, 'groom' and 'bathe' with greater ease than individuals with paraplegia in the SCIAROC group.

Discussion

Regarding the post-accident unemployment rates of persons with SCI, Lin *et al*.[12] indicated that the unemployment rate was 70.3% in Taiwan. In 1994, Murphy and Athanasou reviewed 24 studies published from 1976 to 1992.[13] The review indicates that the overall return-to-work rate is 39.3%. In the present survey, the unemployment rate is 78.2% for the SCIAROC group. We also find that employment is related to the independence level of functional activities. Persons with a self-reported functional independence score greater than 26 (total 52) have a better chance of employment ($P<0.01$) and this is also related to the level of injury. Consequently, patients with paraplegia are more likely to be employed than patients with quadriplegia. The chance of employment, however, according to the present analysis, is not related to the number of complications.

Krause and Anson[11] looked at life adjustment of SCI victims by using employment and education as the two main factors. The employed participants displayed superior adjustment skills as compared to the unemployed individuals. Krause and Anson therefore distinguished a strong correlation between employment/education and the life quality in respect to SCI victims.[11]

High unemployment rates among the individuals with spinal cord lesion imply that specialized training and job-finding assistance are essential. In Taiwan, many individuals with spinal cord lesions are out of the labor force for months, if not years. Their skills may have become less competitive or even obsolete. Inevitably, self-esteem and confidence in work capability are often diminished. Providing specialized training assistance and guidance in job procurement are essential for improving life quality as well as boosting the self-esteem.

Table 6 The subjective rating of intensity of daily activities

	SCIAROC		*ACSCI*	
	Quadriplegia (n = 21)	*Paraplegia* (n = 34)	*Quadriplegia* (n = 13)	*Paraplegia* (n = 23)
1. Move around inside your house	$15.6 \pm 1.9^{a,b}$	12.0 ± 2.4^{c}	13.1 ± 2.5^{a}	10.5 ± 1.8
2. Go up and down a flight of stairs	$15.2 + 2.3^{a}$	12.6 ± 2.6^{c}	13.3 ± 3.0^{a}	10.7 ± 1.9
3. Transfer to and from your bed or chair	$15.0 \pm 2.5^{a,b}$	12.5 ± 2.4^{c}	12.5 ± 2.8	10.7 ± 1.9
4. Get on and off the toilet	$15.4 \pm 2.3^{a,b}$	11.5 ± 2.7	12.5 ± 2.6^{a}	10.3 ± 1.8
5. Transfer from the shower or tub	$15.5 \pm 2.3^{a,b}$	11.8 ± 2.6^{c}	13.1 ± 2.8^{a}	10.3 ± 1.8
6. Eat	15.8 ± 2.0^{a}	12.7 ± 2.4^{c}	14.1 ± 2.8^{a}	10.8 ± 1.5
7. Groom (combing hair, brushing teeth, etc.)	15.5 ± 2.3^{a}	13.3 ± 2.7^{c}	14.1 ± 2.4^{a}	11.1 ± 1.7
8. Bathe	15.5 ± 2.3^{a}	13.4 ± 2.7^{c}	14.1 ± 2.4^{a}	11.1 ± 1.7
9. Dress your upper body	$15.5 \pm 1.9^{a,b}$	11.5 ± 2.4^{c}	13.0 ± 2.0^{a}	10.3 ± 1.7
10. Dress your lower body	$15.1 \pm 2.1^{a,b}$	10.6 ± 1.9	12.7 ± 2.0^{a}	10.0 ± 1.7
11. Toilet (dressing and cleaning with toilet use)	$15.6 \pm 1.9^{a,b}$	11.4 ± 2.3^{c}	13.6 ± 2.4^{a}	10.3 ± 1.8
12. Manage your bladder	12.4 ± 2.4^{a}	9.8 ± 1.2	11.1 ± 1.7	9.9 ± 1.8
13. Manage your bowels	$14.1 \pm 2.5^{a,b}$	10.3 ± 1.4	12.1 ± 1.9^{a}	9.9 ± 1.7

[a] $P<0.05$ for quadriplegia *vs* paraplegia within group. [b] $P<0.05$ for quadriplegia *vs* quadriplegia between groups. [c] $P<0.05$ for paraplegia *vs* paraplegia between groups

As shown by the present survey, the individuals with spinal cord lesion improve their functional activity independence level and daily activity rating of intensity after training provided by ACSCI. The most impressive improvements for the quadriplegia patients, in respect to rating of intensity during daily activities, are 'move around inside your house', 'transfer to and from your bed or chair', 'get on and off the toilet', 'transfer from the shower or tub', 'dress your upper body', 'dress your lower body', 'toilet', and 'manage your bowels'. For the paraplegia patients, the most improved activities are 'groom' and 'bathe'. These functional activities seem trivial at first glance, but they enhance life quality and self-esteem for individuals with spinal cord lesion.[12,14]

For daily activities, the most impressive improvements for the quadriplegia are 'move around inside your house', 'get on and off the toilet', 'transfer from the shower or tub', 'eat', 'groom', 'bathe', 'dress your upper body', 'dress your lower body' and 'toilet'. For the paraplegia patients, it is only the 'bathe'. The present survey shows that training programs are invaluable to subjects with spinal cord lesion, especially those with quadriplegia, in improving functional and daily activities. This will translate into better employment possibilities and offer better quality of their lives. As an informal disclosure by ACSCI, the employment rate for paraplegic patient reaches to 50 to 60% after the completion of the training program offered by ACSCI, up from 30% for untrained patients. The employment rate for quadriplegic patient reaches 20 to 30% after the same training program, up from almost 0% of untrained patients. In addition to psychosocial consulting, the training program includes functional, strengthening exercise, endurance, and vocational training. This multi-faceted training program greatly enhances employment possibilities for individuals with spinal cord lesion. The vocational training program offered by ACSCI encompasses skills such as Auto-CAT, Computer Programming, Multimedia advertisement design, and jewelry fashion design, to name a few.

Based on the present results, more than 80% of subjects with spinal cord lesion suffer at least one medical complication at the time of hospital discharge. Almost 30% of the participants still suffer from medical complications even after 10 years post injury. The number of complications had no relation to the time post injury. The most disturbing complication for individuals with spinal cord lesion is bladder control either at the time of discharge or at post injury. Urinary incontinence is ranked as the most important factor affecting physical mobility in individuals with spinal cord lesion.[12] Since urinary dysfunction remains one of the most important issues in the life quality for chronic spinal cord lesion patients, an aggressive attitude and approach for urinary management following spinal cord lesion is crucial.

Westgren and Levi[15] studied the quality of life in 320 Swedish SCI patients, of which 176 were paraplegic and 124 quadriplegic. With the exception of physical functioning, no difference in life quality was observed in groups studied in conjunction with the extent of lesion. Several medical complications that are associated with life quality are pain, spasticity, and neurogenic bladder and bowel problems. In the present study, the individuals with paraplegia not only have higher independent functional levels but also perceive less intensity when performing the daily activities. The self-reported independence and perceived intensity are certainly factors in influencing the life quality of individuals with spinal cord lesion.

Even with the rather limited number of completed replies, the present survey contains all the salient features that are important to the present study and provides valuable information in establishing a new database and improving training programs for individuals with spinal cord lesion in future.

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References

1 MaKinley WO, Seel RT, Hardman JT. Nontraumatic spinal cord injury: incidence, epidemiology, and functional outcome. *Arch Phy Med Rehabil* 1999; **80:** 619–623.
2 Chen HY, *et al*. A nationwide epidemiological study of spinal cord injury in geriatric patients in Taiwan. *Neuroepidemiology* 1997; **16:** 241–247.
3 Ota T, *et al*. Functional assessment of patients with spinal cord injury: measured by the motor score and the Functional Independence Measure. *Spinal Cord* 1996; **34:** 531–535.
4 Catz A, *et al*. SCIM – spinal cord independence measure: a new disability scale for patients with spinal cord lesions. *Spinal Cord* 1997; **35:** 850–856.
5 McColl MA, *et al*. Expectations of independence and life satisfaction among ageing spinal cord injured adults. *Disabil Rehabil* 1999; **21:** 231–240.
6 Hoenig H, *et al*. The reliability of a self-reported measure of disease, impairment, and function in persons with spinal cord dysfunction. *Arch Phys Med Rehabil* 1998; **79:** 378–387.
7 Borg G. Psychophysical bases of perceived exertion. *Med Sci Sports Exerc* 1982; **14:** 377–383.
8 Bhambani Y, Clarkson H. Acute physiologic and perceptual responses during three modes of ambulation: walking, axillary crutch walking, and running. *Arch Phys Med Rehabil* 1989; **70:** 445–450.
9 Krause JS, *et al*. Employment after spinal cord injury: an analysis of cases from the model spinal cord injury systems. *Arch Phys Med Rehabil* 1999; **80:** 1492–1500.

10 Wehman P, *et al*. Employment satisfaction of individuals with spinal cord injury. *Am J Phys Med Rehabil* 2000; **79:** 161 – 166.
11 Krause JS, Anson CA. Adjustment after spinal cord injury: relationship to participate in employment or educational activities. *Rehabil Couns Bull* 1997; **40:** 202 – 214.
12 Lin KH, *et al*. Quality of life of spinal cord injured patients in Taiwan: a subgroup study. *Spinal Cord* 1997; **35:** 841 – 849.
13 Murphy G, Athanasou J. Vocational potential and spinal cord injury: a review and evaluation. *J Appl Rehabil Counsel* 1994; **25:** 47 – 52.
14 McKinley WO, Johns JS, Musgrove JJ. Clinical presentations, medical complications, and functional outcomes of individuals with gunshot wound-induced spinal cord injury. *Am J Phys Med Rehabil* 1999; **78:** 102 – 107.
15 Westgren N, Levi R. Quality of life and traumatic spinal cord injury. *Arch Phys Med Rehabil* 1998; **79:** 1433 – 1439.

Appendix 1

The Perceived Ratings of Exertion (RPE)

Score	Description
6	
7	Very, very light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard