Spinal Cord (2009) 47, 295–300

www.nature.com/sc

ORIGINAL ARTICLE

Incomplete spinal cord injury, exercise and life satisfaction

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Study design: Cross-sectional survey.
Objective: This study investigates the role of physical exercise, perceived exercise mastery and fitness on life satisfaction of a sample of individuals with incomplete spinal cord injury (SCI).
Setting: Sunnaas Rehabilitation Hospital and the Norwegian School of Sport Sciences, Norway.
Methods: A questionnaire measuring life satisfaction, self-rated physical exercise and self-perceptions were mailed to persons with incomplete SCI.
Results: In total, 100 questionnaires were sent out and 69 respondents were included in the study. Of those, 68% performed physical activity regularly once or more a week. Participants who were exercising regularly once a week or more scored significantly higher on the summed life satisfaction scale ($P=0.002$) and on perceived fitness ($P=0.004$), but significantly lower on perceived exercise mastery ($P=0.012$) than those who were non-exercisers.
Conclusion: Participants in this study with incomplete SCI who exercised regularly experienced a significantly higher life satisfaction and perceived exercise fitness, but lower perceived exercise mastery than their inactive peers. Perceived exercise fitness was the psychological variable that contributed meaningfully to life satisfaction in this study.
Spinal Cord (2009) **47**, 295–300; doi:10.1038/sc.2008.117; published online 7 October 2008

Keywords: incomplete spinal cord injury; life satisfaction; physical exercise; self-concept

Introduction

The life expectancy of persons with spinal cord injury (SCI) has increased steadily over the past five decades.[1] A report from Australia concluded that the life expectancy for persons with incomplete SCI and motor functional capabilities below injury level is at least 92% of the normal population.[2] Persons with SCI are faced with the same health risks of ageing as the general population, and among these health risks are those associated with a sedentary lifestyle. On account of the change in physical functioning and ability depending on injury level and severity, the SCI itself possibly contributes to a more sedentary lifestyle compared with before the injury. There are reports on physical activity as an intervention for improved health in persons with SCI.[3,4] However, the literature is still limited and most studies are not distinguishing between complete and incomplete injuries. On account of the potential differences in possible effects of exercise, additional information is needed about the influence of physical exercise on health in SCI persons with incomplete and complete lesions separately.

Mental and social satisfaction with life is included in the health concept used by the World Health Organisation. Life satisfaction is defined as a person's subjective well-being, with cognitive judgments that life and life circumstances are satisfactory.[5] Generally, individuals with SCI seem to demonstrate less satisfaction with life compared to the normal population. In this study, life satisfaction is assumed to be a matter of individual experience that can be measured by the life satisfaction scale.[6] Physical activity is one way of enhancing your physical capacities, also in spite of a SCI. It is therefore of interest to investigate the role of exercise and related factors on life satisfaction.

To establish representativity in the study, we compared the life satisfaction scores with a study of a Swedish SCI population.[7] Sweden and Norway are countries that are comparable as to the life situation for SCI populations. The general population in Norway was used as reference for exercise habits and self-concept.[8,9]

The purpose of this paper was to investigate the role of exercise and perceived exercise mastery and perceived fitness on the life satisfaction of persons with incomplete SCI. We hypothesized that those who exercised regularly would

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Received 8 March 2008; revised 21 August 2008; accepted 24 August 2008; published online 7 October 2008

score higher on life satisfaction and that perceived exercise mastery and perceived fitness would have a positive association with life satisfaction in persons with incomplete SCI.

Methods

The design of the study is a cross-sectional, and the data collection was completed in 2001.

Subjects
Included in the study were persons rehabilitated in Sunnaas Rehabilitation Hospital before 1992 with incomplete SCI classified with American Spinal Injury Association (ASIA) Impairment Scale grade D (AIS-D).[10] Conducted to minimize the bias from general age changes, persons above 60 years of age at injury were excluded as well as persons with inabilities to respond to the questionnaire.

Measures
Scales measuring life satisfaction, self-reported exercise habits, self-reported walking abilities, perceived exercise mastery and perceived exercise fitness were combined in a questionnaire.

Life satisfaction scale
The questionnaire constructed by Fugl-Meyer and co-workers was used to measure global and domain-specific life satisfaction regarding life as a whole (1 item) and in eight domains of life (1 item each).[6] The questionnaire has shown reliability and validity in previous research,[6,11] and the values from a Swedish SCI population were used as comparisons with the study population[7] (Table 3).

Fugl-Meyer and co-workers recommend not to sum up the scores for clinical purposes. They argued that in a rehabilitation setting where therapeutic goal setting is crucial, a summed score can cover up domains that are clinically relevant.[12] In a research setting the same type of clinical considerations may not apply because we want a more general expression of life satisfaction. Therefore, it makes sense to sum up the scores and use a total sum score.

Exercise
The participants answered several questions about their exercise habits. One question was: *How often do you exercise?* Responses were given by selecting from less than once a week to once a week or more. As recommend by Shepard,[13] they had to answer the question for summer and winter separately due to large seasonal variations in Norway. No significant difference in activity level summer and winter was detected, so the mean score exercise level was used. Participants exercising once a week or more were classified as exercisers. In addition, hours of exercise per week were reported.

The level of physical function was reported by self-reported walking distance without getting tired. Three levels of function were described, walking less than 50 m, walking 50–500 m and walking more than 500 m.

The self-perception in exercise questionnaire
Sorensen (1997) constructed a scale to measure self-concept variables that are exercise specific, the Self Perception in Exercise Questionnaire (SPEQ).[9] The scale consists of four subscales. We used two of the subscales in this study; namely perceived exercise mastery (5 items), and perceived fitness (3 items). A mean score for each subscale was computed. Reliability and validity has been demonstrated in previous research.[9]

Procedure
The study was approved by the Regional Medical Research Ethics Committee, Eastern Norway. When the respondents were identified and had given their written consent, background information about injury level and severity, additional injuries and complications were collected by reviewing the medical records from the Rehabilitation Hospital. Two letters were sent prompting replies.

Statistical methods
Descriptive statistics were used to characterize the sample. Data were summarized by mean values and standard deviations (s.d.) or median and range when appropriate. Comparisons of data on life satisfaction, perception of physical mastery and perception of physical fitness for exercisers and non-exercisers were carried out by two-sample *t*-tests and Pearson's χ^2 tests. Comparisons of exercise in the study population and the general population were carried out by confidence intervals (one-sample *t*-tests) due to the large difference in sample sizes. Comparisons of life satisfaction in the study population and the Swedish reference population were carried out by *z*-tests for comparison of two proportions. An open factor analysis with direct oblique rotation was used on the life satisfaction scale to establish subscales. Linear regression analysis was used to study the relationship between life satisfaction and a set of covariates, including gender, age, time since injury, injury level, exercisers versus non-exercisers, exercise hours per week, perceived exercise mastery and perceived fitness.

Results

Subjects
A total of 100 persons fulfilled the inclusion criteria and received the questionnaires. After two reminders, 72 participants (72%) returned the questionnaire. Two respondents were excluded due to wrong diagnoses, and one because of presenile dementia. The final sample consisted of 69 participants. Due to ethical regulations, it is not possible to compare with the non-responders.

Descriptives are given in Table 1. The level of physical function is presented as self-reported walking distance without getting tired. No difference was shown within the subgroups tetraplegia/paraplegia regarding walking distance ($t = 0.96$, d.f. $= 67$, $P = 0.34$).

Table 1 Descriptives of the study population

	Total sample (n = *69*)	*Exercisers* (n = *47*)	*Non-exercisers* (n = *22*)
Tetraplegia (AIS-D)	35	26	9
Paraplegia (AIS-D)	34	21	13
Age mean (s.d.)	48 (13.7)	48 (13.4)	47 (14.6)
Gender			
Male	56	36	20
Female	13	11	2
Time since injury mean (s.d.)	18 (8.1)	18 (8.7)	19 (7.3)
Walking distance (tetraplegia/paraplegia)			
<50 m	13 (7/6)	9 (6/3)	4 (1/3)
50–500 m	22 (9/13)	15 (5/10)	7 (4/3)
>500 m	34 (19/15)	23 (15/8)	11 (4/7)
Exercise hours per week median (range)			
Total sample	1.5 (0–12)	2.3 (1–12)	0
Tetraplegia	1.8 (0–10)	2.7 (1–10)	0
Paraplegia	1.0 (0–12)	1.5 (1–12)	0

Table 2 Comparisons (*t*-test) of scores on life satisfaction and self-perceptions in exercise between exercisers and non-exercisers with SCI

	Total sample SCI n = *69 mean (s.d.)*	*Exercisers SCI* n = *47 mean (s.d.)*	*Non-exercisers SCI* n = *21 mean (s.d.)*	P*
Mean score LiSat	4.6 (7.3)	4.8 (0.7)	4.2 (0.7)	0.002
Satisfaction with:				
Factor 1	4.6 (1.0)	4.8 (0.9)	4.3 (0.9)	NS
Factor 2	4.4 (1.1)	4.7 (0.8)	3.7 (1.3)	0.002
Factor 3	4.9 (0.7)	5.0 (1.0)	4.7 (1.1)	NS
Item economy	4.3 (1.4)	4.7 (1.1)	3.4 (1.8)	0.004
Item leisure time	4.54 (1.02)	4.78 (0.82)	4.0 (1.2)	0.009
Perception of:				
Exercise mastery	2.5 (0.7)	2.4 (0.6)	2. 9 (0.6)	0.012
Exercise fitness	2.1 (0.9)	2.3 (0.9)	1.6 (0.8)	0.004

Abbreviation: SCI, spinal cord injury.
Factor 1 = contacts, sexual life and family life; factor 2 = economy and leisure time; factor 3 = global life satisfaction and activity of daily living.
**P*-values from two-sample *t*-tests.

Life satisfaction

The factor structure of the life satisfaction scale has been debated. To find interpretable patterns in the life satisfaction scale for this population, an exploratory factor analyses was performed. Two of the items (vocation and partner relationship) were excluded initially because so many in the sample were without work (46%) and 30% did not answer the question about partnership relation. The analyses gave a three factor pattern: factor 1, included contacts, sexual life and family life; factor 2, included economy and leisure time and factor 3 included global life satisfaction and activity of daily living. These three factors together explained 72% of the variance. Factor 1 (eigenvalue 2.41) explained 36% of the variance, factor 2 (eigenvalue 1.55) explained 22% of the variance and factor 3 (eigenvalue 1.11) explained 16% of the variance.

The results, given in Table 2, show that the exercisers scored significantly higher on the summed life satisfaction scale ($t = 3.38$, d.f. = 65, $P = 0.002$) and on factor 2 (including economy/leisure time) ($t = 3.41$, d.f. = 65, $P = 0.002$).

Results were compared with a Swedish reference group, a population of persons with SCI.[7] The results are shown in Table 3. Our study group demonstrated significantly higher scores in satisfaction with activity of daily living ($P < 0.01$) than the Swedish SCI group.

Exercise and type of exercise

Distribution of exercisers and hours of exercise per week are presented in Table 1. No significant differences in self-reported exercise habits and hours of exercise per week were discovered between incomplete paraplegia and tetraplegia subjects ($\chi^2 = 1.079$, d.f. = 1, $P = 0.299$).

Types of exercise are given in Table 4. To establish representativity, the results were compared to the general Norwegian population,[8] a Norwegian population of adults

with a comparable grade of cerebral palsy[14] and a population of persons with SCI from UK.[15] The percentage of physically active persons with incomplete SCI was similar to the general population. Persons with incomplete SCI were more physically active than the Norwegian cerebral palsy population and the population of persons with SCI in UK. The types of exercise in this study were similar to the general Norwegian population,[8] except for jogging and Nordic skiing.

Self-perceptions and self-reported physical fitness

As shown in Table 2, the exercisers with incomplete SCI scored significantly higher than the non-exercisers on perceived fitness ($t = 3.11$, d.f. $= 63$, $P = 0.004$), but contrary to the expectations they scored significantly lower on perceived exercise mastery ($t = -2.73$, d.f. $= 57$, $P = 0.012$).

Associations with life satisfaction

A regression with life satisfaction as the dependent variable and gender, age, time since injury, injury level, exercise versus non-exercise, exercise hours per week, perceived exercise mastery (SPEQ mastery) and perceived physical fitness (SPEQ fitness), as independent variables, was performed. The regression model was significant ($R^2_{adj} = 0.23$, $F = 3.429$, $P = 0.004$). Perceived physical fitness ($P = 0.001$) and time since injury ($P = 0.045$) were the only variables that contributed significantly to the life satisfaction in this sample. Entering the variables in different order showed no change in the results.

Table 3 Proportion of individuals with high life satisfaction (score 5–6) in this study compared with a reference groups, *R* = persons with SCI in Sweden

	Incomplete SCI (n = *69*)	*R* (n = *82*)	Z	P*
Global life satisfaction	0.51	0.49	0.24	NS
Financial situation	0.54	0.61	−0.87	NS
Leisure	0.52	0.40	1.47	NS
Contacts	0.70	0.66	0.52	NS
ADL	0.78	0.39	4.85	0.000
Sexual life	0.35	0.34	0.13	NS
Family life	0.75	0.76	−0.14	NS

Abbreviations: ADL, activity of daily living; SCI, spinal cord injury.

Discussion

The most important finding was that those who exercised scored higher on the summed life satisfaction and perceived physical fitness than the non-exercisers as expected. The results support earlier findings showing increased life satisfaction for persons involved in sports or after 4 weeks of adapted physical activity.[15,16] The variables that were most clearly associated with life satisfaction were the perceived physical fitness and time since injury. This may imply that the relationship between life satisfaction and exercise is not a direct one. Psychological factors, such as perception of fitness, may serve as a mediator. This needs further research.

Further, the results of this study showed a positive relationship between exercise and both global and domain-specific life satisfaction scales. Among the various domains included in the life satisfaction scale, financial situation and leisure time explained most of the variation in the total score in our study (Table 2). One can speculate if it is those who are satisfied with their economic status who can afford to be physically active. However, only three of the physically inactive respondents claimed that physical exercise was too expensive. Higher socioeconomic status has generally showed association with a more physically active lifestyle.[17] Our results indicate that persons with incomplete SCI show the same trend.

Time since injury influenced negatively on life satisfaction which is in contrast to previous research.[18] This finding is probably a result of a relatively small sample, a low number of participants injured more than 25 years ago and the fact that an extremely low score in summed score for life satisfaction scale was observed for one person injured more than 25 year ago.

The results of perceived exercise fitness are in accordance with what has been reported for physically active versus physically inactive middle-aged adults without SCI.[9] In that population the physically active persons scored higher on both perceived exercise fitness and exercise mastery. However, in this study the exercisers with incomplete SCI reported significantly lower score on perceived exercise mastery, contrary to the results in Sørensen's study. One explanation may be that it is more difficult to perform different types of exercise for persons with physical limitations, as in the present population. Thus, the exercisers may

Table 4 Proportion of exercisers and type of exercise in this study compared with reference groups

	Incomplete SCI (n = *69*)	*95% CI*	*Physically active in the general Norwegian population* n = *3000*	*Adults with CP* (n = *406*)	*SCI in UK* (n = *985*)
Exercisers	0.68	0.57–0.80	0.65	0.45	0.47
Walking/hiking	0.41	0.29–0.52	0.51		
Bicycling	0.32	0.21–0.43	0.27		
Swimming	0.22	0.12–0.32	0.19		
Strength training	0.19	0.09–0.28	0.14		
Nordic skiing	0.16	0.07–0.25	0.35		
Jogging	0.04	−0.01–0.09	0.30		

Abbreviations: CI, confidence interval; CP, cerebral palsy; SCI, spinal cord injury.

become more aware of their physical limitations and consequently perceive a lower level of exercise mastery. Physically inactive SCI persons do not challenge their physical functioning similar to their more physically active counterparts. Another possible explanation may be related to expectations. Individuals with an incomplete SCI may have higher expectations as to what and how much they can do, and to what extent exercise may restore their function compared to those with complete lesions.

When comparing our present study population with a Swedish SCI population,[7] a difference in the level of life satisfaction was detected regarding activity of daily living (Table 3). However, the reference group included persons with all types of functional levels classified AIS from A to E, probably explaining the difference.

Although it has been described in other studies that disability affects the level of physical activity,[14,15] the proportion of exercisers with SCI in this study is the same as in the general population. Congenital or early acquired injuries in addition to more heterogeneous studied injury groups may explain the differences.

The types of exercise in this study show some differences from the types of exercise in the general Norwegian population.[8] This can be explained by the physical limitations found in persons with incomplete SCI. Both walking/hiking, Nordic skiing and jogging are functionally demanding regarding strength, endurance, flexibility, balance and coordination. Thus, the character of the disability may explain this difference in the choice of exercise methods.

The high response rate probably can be attributed to a well functioning governmental health-care system that the patients trust. Accordingly, they react positively to take part in studies they judge as relevant for themselves.

One weakness of this study is that social desirability may result in over-reporting of exercise.[19] In addition, the physical aspects of the exercise were not reported. In this study, however, the main goal was to examine the role of participation in exercise for mental health/life satisfaction, not to evaluate the aerobic fitness, or training frequency and intensity. Moses *et al*.[20] demonstrated that high intensity is not necessarily the issue for psychological responses. In a controlled trial, 10 weeks of moderate exercise resulted in higher psychological benefits than exercise with high intensity.

In conclusion, in a population of individuals with incomplete SCI, those who exercised scored higher on life satisfaction and perceived physical fitness, but lower on perceived exercise mastery. A regression analysis showed that perceived physical fitness was the only psychological variable that contributed significantly to the variance in life satisfaction.

Acknowledgements

This project has been financed with the aid of EXTRA funds from the Norwegian Foundation for Health and Rehabilitation and Birgit and Rolf Sunnaas Foundation.

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Appendix 1

Life satisfaction scale

How satisfactory are these different aspects of your life? Indicate the number that best suits your situation						
1 = very dissatisfying	4 = rather satisfying					
2 = dissatisfying	5 = satisfying					
3 = rather dissatisfying	6 = very satisfying					
Life as a whole is	1	2	3	4	5	6
My vocational situation is	1	2	3	4	5	6
My financial situation is	1	2	3	4	5	6
My leisure situation is	1	2	3	4	5	6
My contact with friends and acquaintances are	1	2	3	4	5	6
My sexual life is	1	2	3	4	5	6
My ability to maintain my self-care (dressing, hygiene, transfers, and so on) is	1	2	3	4	5	6
My family life is	1	2	3	4	5	6
My partner relationship is	1	2	3	4	5	6

Appendix 2

Self Perception in Exercise Questionnaire, subscales exercise mastery (SPEQ mastery) and exercise fitness (SPEQ fitness)

1 = totally agree	3 = disagree to some extent			
2 = agree to some extent	4 = totally disagree			
SPEQ mastery:				
Somehow, I show what I am good for when I participate in physical activities	1	2	3	4
Physical activity gives me, among other things, a positive feeling of attaining something	1	2	3	4
Physical activity is important to me because it makes me feel I am in control of something	1	2	3	4
I think I am good at more types of physical activities than others	1	2	3	4
I think I can get away from daily stress of life by doing physical activity	1	2	3	4
SPEQ fitness:				
Generally, I am not in good shape	1	2	3	4
It worries me somewhat that I do not manage to keep in good shape	1	2	3	4
I wish I was in far better shape than I am	1	2	3	4