

1 **Incomplete spinal cord injury, exercise and life satisfaction**

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1 **Incomplete spinal cord injury, exercise and life satisfaction**

Abstract and Keywords

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.

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Key words: Incomplete Spinal Cord Injury, Life Satisfaction, Physical Exercise, Self Concept.

Introduction

1
2 The life expectancy of persons with Spinal Cord Injury (SCI) has increased steadily over the
3 past five decades¹. A report from Australia concluded that the life expectancy for persons
4 with incomplete spinal cord injury and motor functional capabilities below injury level is at
5 least 92 % of the normal population². Persons with SCI are faced with the same health risks
6 of ageing as the general population, and among these health risks are those associated with a
7 sedentary life style. Due to the change in physical functioning and ability depending on the
8 injury level and severity, the spinal cord injury itself possibly contributes to a more sedentary
9 lifestyle compared to before the injury. There are reports on physical activity as an
10 intervention for improved health in persons with SCI^{3,4}. However, the literature is still limited
11 and most studies are not distinguishing between complete and incomplete injuries. Because of
12 the potential differences in possible effects of exercise, additional information is needed about
13 the influence of physical exercise on health in SCI persons with incomplete and complete
14 lesions separately.

15 Mental and social satisfaction with life is included in the health concept used by the
16 World Health Organisation. Life Satisfaction is defined as a person's subjective well-being,
17 with cognitive judgments that life and life circumstances are satisfactory⁵. Generally,
18 individuals with SCI seem to demonstrate less satisfaction with life compared to the normal
19 population. In the present study, life satisfaction is assumed to be a matter of individual
20 experience that can be measured by the Life Satisfaction Scale⁶. Physical activity is one way
21 of enhancing your physical capacities, also in spite of a SCI. It is therefore of interest to
22 investigate the role of exercise and related factors on life satisfaction.

23 In order to establish representativity in the study, we compared the life satisfaction
24 scores with a study of a Swedish SCI population⁷. Sweden and Norway are countries that are

1 comparable as to the life situation for SCI populations. The general population in Norway
2 was used as reference for exercise habits and self concept^{8,9}.

3 The purpose of this paper was to investigate the role of exercise and perceived
4 exercise mastery and perceived fitness on the life satisfaction of persons with incomplete SCI.
5 We hypothesized that those who exercised regularly would score higher on life satisfaction
6 and that perceived exercise mastery and perceived fitness would have a positive association
7 with life satisfaction in persons with incomplete SCI.

8 **Methods**

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

10 **Subjects**

11 Included in the study were persons rehabilitated in Sunnaas Rehabilitation Hospital before
12 1992 with incomplete SCI classified with American Spinal Injury Association (ASIA)
13 Impairment Scale grade D (AIS-D)¹⁰. Conducted to minimize the bias from general age-
14 changes, persons above 60 years of age at injury were excluded as well as persons with
15 inabilities to respond to the questionnaire.

16 **Measures**

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

20 **Life satisfaction Scale.**

21 The questionnaire constructed by Fugl-Meyer and co-workers was used to measure
22 global and domain specific life satisfaction regarding life as a whole (1 item) and in 8
23 domains of life (1 item each)⁶. The questionnaire has demonstrated reliability and validity in
24 previous research^{6,11}, and the values from a Swedish SCI population were used as
25 comparisons with the study population⁷ (Table 3).

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

7

8 **Exercise.**

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

16 Level of physical function was reported by self-reported walking distance without
17 getting tired. Three levels of function were described, walking less than 50 metres, walking
18 50 to 500 metres and walking more than 500 metres.

19 **The Self Perception in Exercise Questionnaire**

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

25 **Procedure**

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

6 **Statistical Methods**

7 Descriptive statistics were used to characterize the sample. Data were summarised by
8 mean values and standard deviations (SD) or median and range when appropriate.
9 Comparisons of data on Life satisfaction, perception of physical mastery and perception of
10 physical fitness for exercisers and non-exercisers were done by two-sample t-tests and
11 Pearson's chi-square tests. Comparisons of exercise in the study population and the general
12 population were done by confidence intervals (one-sample t-tests) due to the large difference
13 in sample sizes. Comparisons of life satisfaction in the study population and the Swedish
14 reference population were done by z-tests for comparison of two proportions. An open factor
15 analysis with direct oblique rotation was used on the Life Satisfaction Scale to establish
16 subscales. Linear regression analysis was used to study the relationship between life
17 satisfaction and a set of covariates, including gender, age, time since injury, injury level,
18 exercisers versus non-exercisers, exercise hours pr. week, perceived exercise mastery and
19 perceived fitness.

20 **Results**

21 **Subjects**

22 A total of 100 persons fulfilled the inclusion criteria and received the questionnaires. After
23 two reminders, 72 participants (72%) returned the questionnaire. Two respondents were
24 excluded due to wrong diagnoses, and one because of presenile dementia. The final sample

1 consisted of 69 participants. Due to ethical regulations, it is not possible to compare with the
2 non-responders.

3 Descriptives are given in Table 1. The level of physical function is presented as self-
4 reported walking distance without getting tired. No difference was demonstrated within the
5 subgroups tetraplegia (TP) / paraplegia (PP) regarding walking distance ($t = 0.96$, $df = 67$, $p =$
6 0.34).

7 **Table 1 in near here**

8 **Life Satisfaction**

9 The factor structure of the Life Satisfaction Scale has been debated. In order to find
10 interpretable patterns in the Life Satisfaction Scale for this population, an exploratory factor
11 analyses was performed. Two of the items (vocation and partner relationship) were excluded
12 initially because so many in the sample were without work (46%) and 30 % did not answer
13 the question about partnership relation. The analyses gave a three factor pattern: Factor 1,
14 included Contacts, Sexual life and Family life; Factor 2, included Economy and Leisure time;
15 and Factor 3 included Global Life Satisfaction and Activity of Daily Living (ADL). These
16 three factors together explained 72% of the variance. Factor 1 (Eigenvalue 2.41) explained
17 36% of the variance, Factor 2 (Eigenvalue 1.55) explained 22% of the variance and Factor 3
18 (Eigenvalue 1.11) explained 16% of the variance.

19 The results, given in Table 2, demonstrates that the exercisers scored significantly
20 higher on the summed Life Satisfaction Scale ($t = 3.38$, $df = 65$, $p = 0.002$) and on Factor 2
21 (including Economy/Leisure time) ($t = 3.41$, $df = 65$, $p = 0.002$).

22 **Table 2 in near here**

23 Results were compared with a Swedish reference group, a population of persons with
24 SCI⁷. The results are shown in Table 3. Our study group demonstrated significantly higher
25 scores in satisfaction with ADL ($p < 0.01$) than the Swedish SCI group.

26 **Table 3 in near here**

1 **Exercise and type of exercise**

2 Distribution of exercisers and hours of exercise pr. week are presented in Table 1. No
3 significant differences in self-reported exercise habits and hours of exercise pr. week were
4 discovered between incomplete PP and TP subjects ($\chi^2 = 1.079$, $df = 1$, $p = 0.299$).

5 Types of exercise are given in Table 4. To establish representativity, the results were
6 compared to the General Norwegian population ⁸, a Norwegian population of adults with a
7 comparable grade of Cerebral Palsy (CP) ¹⁴ and a population of persons with SCI from UK ¹⁵.
8 The percentage of physically active persons with incomplete SCI was similar to the general
9 population. Persons with incomplete SCI were more physically active than the Norwegian CP
10 population and the population of persons with SCI in UK. The types of exercise in the present
11 study were similar to the General Norwegian population ⁸, except for jogging and Nordic
12 skiing.

13 **Table 4 in near here**

14 **Self-Perceptions and Self-reported physical fitness**

15 As shown in table 2, the exercisers with incomplete SCI scored significantly higher than the
16 non-exercisers on perceived fitness ($t = 3.11$, $df = 63$, $p = 0.004$), but contrary to the
17 expectations they scored significantly lower on perceived exercise mastery ($t = -2.73$, $df = 57$,
18 $p = 0.012$).

19 **Associations with life satisfaction**

20 A regression with life satisfaction as the dependent variable and gender, age, time since
21 injury, injury level, exercise versus non-exercise, exercise hours pr. week, perceived exercise
22 mastery (SPEQ mastery) and perceived physical fitness (SPEQ fitness), as independent
23 variables, was performed. The regression model was significant ($R_{adj}^2 = 0.23$, $F = 3,429$, $p =$
24 0.004). Perceived physical fitness ($p = 0.001$) and time since injury ($p = 0.045$) were the only
25 variables that contributed significantly to the Life Satisfaction in this sample. Entering the
26 variables in different order demonstrated no change in the results.

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 demonstrating increased life satisfaction for persons involved in sports or after four 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, like perception of fitness, may serve as a mediator. This needs further research.

Further, the results of the present study demonstrated 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 demonstrated association with a more physically active lifestyle¹⁷. 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 research¹⁸. 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 SCI⁹. In that

1 population the physically active persons scored higher on both perceived exercise fitness and
2 exercise mastery. However, in this study the exercisers with incomplete SCI reported
3 significantly lower score on perceived exercise mastery, contrary to the results in Sorensen's
4 study. One explanation may be that it is more difficult to perform different types of exercise
5 for persons with physical limitations, as in the present population. Thus the exercisers may
6 become more aware of their physical limitations and consequently perceive a lower level of
7 exercise mastery. Physically inactive SCI persons do not challenge their physical functioning
8 like their more physically active counterparts. Another possible explanation may be related to
9 expectations. Individuals with an incomplete SCI may have higher expectations as to what
10 and how much they can do, and to what extent exercise may restore their function compared
11 to those with complete lesions.

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

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

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

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Table 1**2 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 (SD) | 48 (13.7) | 48 (13.4) | 47 (14.6) |
| Gender: | | | |
| Male | 56 | 36 | 20 |
| Female | 13 | 11 | 2 |
| Time since injury Mean (SD) | 18 (8.1) | 18 (8.7) | 19 (7.3) |
| Walking distance (Tetraplegia/Paraplegia) | | | |
| < 50 metres | 13 (7/6) | 9 (6/3) | 4 (1/3) |
| 50-500 metres | 22 (9/13) | 15 (5/10) | 7 (4/3) |
| > 500 metres | 34 (19/15) | 23 (15/8) | 11 (4/7) |
| Exercise hours pr. 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 |

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1 **Table 2 Comparisons (T-test) of scores on Life Satisfaction and Self Perceptions in Exercise between exercisers and non-exercisers with**
 2 **SCI .**

| | Total sample SCI n=69 Mean (SD) | Exercisers SCI n=47 Mean (SD) | Non-exercisers SCI n=21 Mean (SD) | p* |
|---------------------------|------------------------------------|----------------------------------|--------------------------------------|-------|
| Mean score LiSat | 4,6 (7.3) | 4.8 (0.7) | 4.2 (0.7) | 0.002 |
| <i>Satisfaction with:</i> | | | | |
| Factor 1 | 4.6 (1.0) | 4.8 (0.9) | 4.3 (0.9) | n.s. |
| 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) | n.s. |
| 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 |
| <i>Perception of:</i> | | | | |
| 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 |

3 Factor 1 = contacts, sexual life and family life, Factor 2 = Economy and leisure time, Factor 3 = Global life satisfaction and activity of daily
 4 living. * p values from two-sample t-tests

1 **Table 3 Proportion of individuals with high life satisfaction (score 5-6) in the present**
 2 **study compared with a reference groups, R = Persons with SCI in Sweden.**

3

| | Incomplete SCI | R | z | p* |
|----------------------------|-----------------------|-------------|----------|-----------|
| | n=69 | n=82 | | |
| Global l.s. | 0.51 | 0.49 | 0.24 | n.s. |
| Financial situation | 0.54 | 0.61 | -0.87 | n.s. |
| Leisure | 0.52 | 0.40 | 1.47 | n.s. |
| Contacts | 0.70 | 0.66 | 0.52 | n.s. |
| ADL | 0.78 | 0.39 | 4.85 | 0.000 |
| Sexual life | 0.35 | 0.34 | 0.13 | n.s. |
| Family life | 0.75 | 0.76 | -0.14 | n.s. |

1 **Table 4 Proportion of exercisers and type of exercise in the present 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 | | |

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Appendix 1

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Life Satisfaction Scale

How satisfactory are these different aspects of your life? Indicate the number which 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, etc.) 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 |
|----------------------------|---|---|---|---|---|---|

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