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# Health-Related QOL of Motorists with Spinal Cord Injury in Japan

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***Abstract*****—**The Japanese version of the SF-36 has been employed to assess individuals' health-related QOL (HRQOL). This study aimed to clarify the HRQOL of motorists with a spinal cord injury, in order to compare these individuals' SF-36 scores and national standard values. A total of 100 motorists with a spinal cord injury participated in this study. Participants' HRQOL was evaluated using the Japanese version of the SF-36 (second edition). The score for each subscale was standardized based on data on the Japanese population. The average scores for NPF, NRP, NBP, NGH, NVT, NSF, NRE, and NMH were 10.9, 41.8, 45.9, 47.1, 46.1, 46.7, 46.0, and 47.4 points, respectively. Subjects showed significantly lower scores for NPF and NRP compared with national standard values, which were both ≤ 45.0 points, but relatively normal scores for the other items: NBP, NGH, NVT, NSF, NRE and NMH (> 45.0 points). The average scores for PCS, MCS and RCS were 21.9, 56.0, and 50.0 points, respectively. Subjects showed a significantly lower PCS score (≤ 20.0 points); however, the MCS score was higher (> 55.0 points) along with a relatively normal RCS score in these individuals (= 50.0 points).

***Keywords*****—**Health-related QOL (HRQOL), SF-36, motorist, spinal cord injury, Japan.

## I. Introduction

THE World Health Organization (WHO) defines good health is a state of complete physical, social and mental well-being, and not merely the absence of disease or infirmity. According to [1] and [2], the SF-36 is a scale to assess individuals' general health status and QOL. Fukuhara et al. [3] developed this scale's Japanese version, which includes an item to assess changes in individuals' self-awareness of their health status. The other 35 items are used to assess the following 8 subscales: physical function (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE) and mental health (MH). These 8 subscales are used to calculate the scores for physical component summary (PCS), mental component summary (MCS) and role/social component summary (RCS).

In the study, it was aimed to clarify the health-related QOL (HRQOL) of motorists with a spinal cord injury, in order to compare these individuals' SF-36v2 scores and national standard values.

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## II. Methods

### A. Subject

A total of 100 motorists with a spinal cord injury who lived in Japan participated in this study in 2014. All subjects were informed of the objective of this study, and their consents to participate in this study were obtained. This study has been approved by the Ethics Committee of the Takarazuka University of Medical and Health Care.

### B. Method

The Japanese version of the SF-36 (second edition) was used to evaluate the subjects' HRQOL. This version, which was developed by [4], comprises a total of 36 items and the following 8 subcategories: PF, RP, BP, GH, VT, SF, RE and MH (Table I).

TABLE I
Eight Subcategories of SF-36v2

| | |
|---|---|
| Physical function (PF) | Limitations on physical activities such as climbing stairs, walking, bathing and dressing |
| Role physical (RP) | Limitations in usual role activities (work or housework) because of physical problems |
| Bodily pain (BP) | Severity of bodily pain in the past month |
| General health (GH) | Physical health status (current and prior health) |
| Vitality (VT) | Subjective feeling of well-being including energy and fatigue |
| Social functioning (SF) | Extent to which health interferes with social activities such as visiting friends or relatives |
| Role emotional (RE) | Limitations in usual role activities (work or housework) because of emotional problems |
| Mental health (MH). | Perceptions of mental health |

Subjects' response to each item was encoded, summed, and converted into a score from 0 (the worst possible health status) to 100 (the best possible health status). In this study, the score for each subscale was generated based on the standardized scoring procedure. The raw scores were transformed to Z score using the norms (mean and SD) of the Japanese population in 2007 [4]. Then, the Z score of each subscale was normalized using [4]:

$$\text{PF Z score} = (\text{PF} - 89.13446) / 13.85045$$
$$\text{RP Z score} = (\text{RP} - 89.24007) / 18.80773$$
$$\text{BP Z score} = (\text{BP} - 73.77098) / 22.39818$$
$$\text{GH Z score} = (\text{GH} - 62.91007) / 18.76562$$
$$\text{VT Z score} = (\text{VT} - 62.82787) / 19.46255$$
$$\text{SF Z score} = (\text{SF} - 86.38347) / 19.40441$$
$$\text{RE Z score} = (\text{RE} - 87.84637) / 20.01521$$
$$\text{MH Z score} = (\text{MH} - 71.60598) / 18.62983$$

$$\text{Normalized score} = 50 + \text{Z score} \times 10$$

Normalized scores were NPF, NRP, NBP, NGH, NVT, NSF,

NRE and NMH.

This scale can also be used to calculate the scores for the following 3 types of component summary: PCS, MCS and RCS. In this study, the score for each component summary subscale was generated based on the standardized scoring procedure. The raw scores were transformed to Z score using the norms (mean and SD) of the Japanese population in 1995 [4]. Then, the Z score of each subscale was normalized using [4]:

PCS raw score = (PF Z score×0.67908) + (RP Z score×0.22298) + (BP Z score×0.37244) + (GH Z score×0.36992) + (VT Z score×-0.08420) + (SF Z score×-0.30769) + (RE Z score×-0.14256) + (MH Z score×-0.33155)

PCS score = (PCS raw score×10) + 50

MCS raw score = (PF Z score×-0.20472) + (RP Z score×-0.27243) + (BP Z score×0.14644) + (GH Z score×0.33933) + (VT Z score×0.46413) + (SF Z score×0.06727) + (RE Z score×-0.15597) + (MH Z score×0.44572)

MCS score = (MCS raw score×10) + 50

TABLE II
SAMPLE CHARACTERISTICS (N=100)

| | Number | Rate (%) |
|---|---|---|
| Gender | | |
| Male | 96 | 96.0 |
| Female | 3 | 3.0 |
| Missing values | 1 | 1.0 |
| Age Group | | |
| - 19 | 1 | 1.0 |
| 20 - 29 | 17 | 17.0 |
| 30 - 39 | 31 | 31.0 |
| 40 - 49 | 37 | 37.0 |
| 50 - 59 | 11 | 11.0 |
| 60 - | 1 | 1.0 |
| Missing values | 2 | 2.0 |
| Neurologic Classification | | |
| Tetraplegic | 92 | 92.0 |
| Paraplegic | 0 | 0.0 |
| Missing values | 8 | 8.0 |

RCS raw score = (PF Z score×-0.13048) + (RP Z score×0.40393) + (BP Z score×-0.21786) + (GH Z score×-0.41710) + (VT Z score×-0.13120) + (SF Z score×0.49261) + (RE Z score×0.61022) + (MH Z score×0.10326)

RCS score = (RCS raw score×10) + 50

Three types of component summary were PCS, MCS and RCS.

## III. Data Analysis

With permission of the Medical Outcomes Trust and Shunichi Fukuhara, a nonprofit organization for the SF-36v2TM Health Survey, the raw data were analyzed using the SF-36 software. The 8 subcategories scores (PF, RP, BP, GH, VT, SF, RE and MH), normalized scores (NPF, NRP, NBP, NGH, NVT, NSF, NRE and NMH), 3 types of component summary scores (PCS, MCS and RCS) from SF-36v2 were calculated, respectively. Mean (arithmetic average of a set of scores) and SD (square root of the variance) were calculated.

## IV. Results

### A. Subject Characteristics

Among the study subjects, men and women comprised 96.0 and 3.0%, respectively. They were divided into 6 age groups; 31.0 and 37.0% of the subjects were aged 30-39 and 40-49 years, respectively. The group comprised 92 individuals with tetraplegic, which is also presented in Table II.

### B. Descriptive Statistics of the Subscales

Fig. 1 shows the scores (0-100) for the 8 subscales. The average scores (SD) for PF, RP, BP, GH, VT, SF, RE and MH were 35.0 (26.2), 73.7 (23.9), 64.6 (29.3), 57.2 (20.0), 55.3 (21.4), 80.0 (24.0), 79.9 (24.5) and 66.8 (19.5) points, respectively.

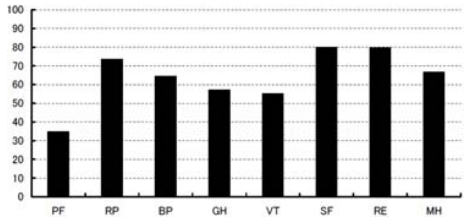


Fig. 1 Descriptive statistics for the eight scales (N=100), Abbreviations: PF- Physical Functioning; RP- Role Physical; BP- Bodily Pain; GH- General Health; VT- Vitality; SF- Social Functioning; RE- Role Emotional; MH- Mental Health

Fig. 2 shows the normalized scores for the 8 subscales. The average scores (SD) for NPF, NRP, NBP, NGH, NVT, NSF, NRE, and NMH were 10.9 (18.9), 41.8 (12.7), 45.9 (13.1), 47.1 (10.7), 46.1 (11.0), 46.7 (12.4), 46.0 (12.2), and 47.4 (10.5) points, respectively. Subjects showed significantly lower scores for NPF and NRP, which were both ≤ 45.0 points, but relatively normal scores for the other items: NBP, NGH, NVT, NSF, NRE and NMH (> 45.0 points).

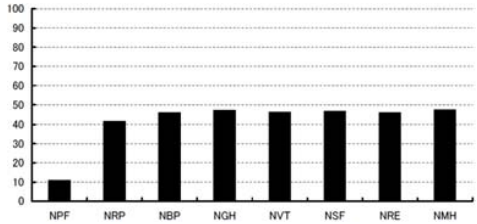


Fig. 2 Mean scores of norm-based scoring for the eight scales (N=100), Abbreviations: NPF- Normalized Physical Functioning; NRP- Normalized Role Physical; NBP- Normalized Bodily Pain; NGH- Normalized General Health; NVT- Normalized Vitality; NSF- Normalized Social Functioning; NRE- Normalized Role Emotional; NMH- Normalized Mental Health

Fig. 3 shows the average scores (SD) for PCS, MCS and

RCS, which were 21.9 (14.9), 56.0 (11.4), and 50.0 (13.6) points, respectively. Subjects showed a significantly lower PCS score (≤ 20.0 points); however, the MCS score was higher (> 55.0 points) along with a relatively normal RCS score in these individuals (= 50.0 points).

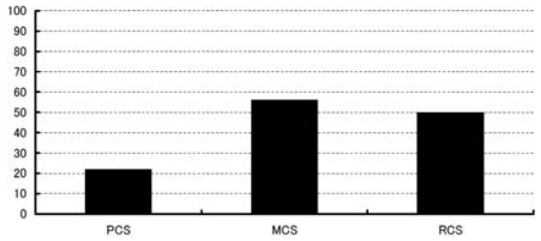


Fig. 3 Mean scores of three summary scales (N=100), Abbreviations: PCS- Physical component summary; MCS- Mental component summary; RCS- Role/Social component summary

## V. Discussion

The spinal cord consists of the nerves that connect the brain with the human body, and is located in the vertebral canal. The vertebral canal lies inside the vertebral column, which is formed by all the vertebrae, the intervertebral discs and ligaments. Spinal cord injury (SCI) has the potential to cause loss of movement and sensation below the site of injury in the patients who experience them. Spinal cord injury is damage to the spinal cord that results in a loss or impaired function such as walking and basic activities of daily living: dressing, bathing, eating, toileting, transferring (walking) and continence.

Frequent causes of damage are trauma (falls, motor vehicle accidents, industrial accidents, sports injuries, gunshot wounds etc.) or disease (poliomyelitis or polio: Poliomyelitis is an infectious disease caused by the poliovirus., spina bifida: Spina bifida is one of a class of birth defects called neural tube defects that happens when a baby's spine does not form normally. Consequently, the spinal cord and the nerves that branch out of it may be damaged etc.).

Tetraplegia or quadriplegia is when patients have a spinal cord injury above the first thoracic vertebra (Th1), paralysis usually affects the cervical spinal nerves, C1 to C8 resulting in partial or complete paralysis of the upper extremities as well as complete paralysis of the lower extremities. This results in the loss of movement and sensation of the upper and lower extremities. Paraplegia is when patients have a spinal cord injury below the first thoracic spinal nerve (Th1), paralysis usually affects the thoracic, lumber and sacral spinal nerves, Th1 to S5 resulting in paralysis of all lower extremities. This results in the loss of movement and sensation of the lower extremities. Patients with paraplegia are able to move their arms and hands.

Patients with a spinal cord injury commonly suffer from motor/sensory dysfunction and limited ADL. The primary medical treatment for a spinal cord injury is life support, followed by minimization of the above-mentioned dysfunction, in order to maintain a favorable QOL.

According to [5], assessments of QOL are increasingly used in medical rehabilitation, embracing a number of conceptual approaches and measurement tools of QOL. Very few studies on QOL have addressed the specific needs of persons with a spinal cord injury. Andresen et al. [6] investigated the health-related QOL of patients with a spinal cord injury. Tate et al. [5] describe two meta-analytical studies on a spinal cord injury as well as several individual studies that focus on predictors and correlates of QOL applied to a spinal cord injury.

The present study aimed to clarify the health-related QOL of motorists with a spinal cord injury, in order to compare these individuals' SF-36 scores and national standard values. The average scores for NPF, NRP, NBP, NGH, NVT, NSF, NRE and NMH were 10.9, 41.8, 45.9, 47.1, 46.1, 46.7, 46.0 and 47.4 points, respectively. They showed significantly lower scores for NPF and NRP, but relatively normal scores for the other items: NBP, NGH, NVT, NSF, NRE and NMH. The average scores for PCS, MCS and RCS were 21.9, 56.0 and 50.0 points, respectively. Subjects showed a significantly lower PCS score; however, the MCS score was higher (> 55 points) along with a relatively normal RCS score in these individuals.

In [7], patients with a spinal cord injury showed significantly lower scores for all subscales, particularly PF and RP, compared with healthy individuals. These results suggest that, although there is an association between neurologic impairment and PF (NPF), RP (NRP) and PCS, these scales only serve as subordinate factors for the HRQOL. In the present study, motorists with a spinal cord injury showed significantly lower scores for PF (NPF), RP (NRP) and PCS, but the MCS score was higher, and the scores for the other items were relatively normal in these individuals.

## VI. Conclusion

In Japan, motorists with a spinal cord injury showed significantly lower scores for physical function (PF), role physical (RP) and physical component summary (PCS), but the mental component summary (MCS) was higher, and the scores for the other items - bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), mental health (MH) and role/social component summary (RCS) - were relatively normal in these individuals.

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