



079

Problems in the Health Management of Persons with Spinal Cord Injury

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ABSTRACT. This study was conducted to clarify the features of complications attending spinal cord injury (SCI). A comparison was made of the prevalence of disease among patients with SCI (SCIP) with that in the general population in Japan (National Livelihood Basic Survey). For this purpose, a survey was conducted on 244 males at 8 Rosai Rehabilitation Centers (Workman's Accident Compensation Rehabilitation Workshops). The average age was 49.6 years. To eliminate age effects on this parameter, the prevalence rates were expressed as standardized outpatient morbidity ratios (SOMRs), with the value for the general population set at 100. The SOMR data for cystitis were particularly high (16,278, $p < 0.01$). The SOMRs for other diseases were also high: renal diseases, 2,642; disorders of the skin, 361; gastritis, 339; and hepatic disorders, 381 ($p < 0.01$). These disorders may be regarded as primary or secondary lesions associated with SCI. SCIP with diseases associated with aging, such as hypertension and diabetes mellitus, are on the increase in Japan. The SOMR for hypertension was 250 ($p < 0.01$), and for diabetes mellitus it was 323 ($p < 0.01$). J CLIN EPIDEMIOL 49;5:505-510, 1996.

KEY WORDS. Spinal cord injury, prevalence, health survey, hypertension, diabetes mellitus

INTRODUCTION

For people with traumatic spinal cord injury (SCIP) and undergoing rehabilitation, complications associated directly or indirectly with SCI should be avoided.

The major complications of SCI are urinary tract lesions and decubitus ulcer. Aggravation of the former leads to renal failure, which becomes a major cause of death in SCIP. The onset of urinary tract complications depends directly on the level of medical care, particularly in the acute phase, and on the successful management of the urinary tract. In Western countries, mortality due to urinary tract diseases has decreased drastically since World War II, with cardiovascular lesions as first or second major causes of death [1-6]. In Japan, decrease in renal failure started somewhat after that in Europe and the United States. The prevalence of hypertension and diabetes mellitus is presently high in SCIP [7-10].

Few epidemiological studies have been conducted on the prevalence rates of chronic disease in SCIP, compared to the general population. The manner in which direct or indirect factors associated with SCI affect the onset of chronic diseases has yet to be determined.

In this study, a survey was conducted to determine the prevalence rates of various diseases in SCIP and a comparison was made with the general population. Disease characteristics and health management of SCIP are discussed.

METHODS

Subjects

SCIP at eight Rosai Rehabilitation Centers throughout Japan were surveyed. These rehabilitation centers were established by the Labor Welfare Corporation, an organization affiliated with the Ministry of Labor, to provide accommodation for victims of SCI incurred through work-related accidents, including traffic accidents, during working hours or while commuting. The objective of the centers is to help people resume their work and social life and find new work. For these people, medical rehabilitation has been completed and symptoms have subsided. Expenses are covered by the Workmen's Accident Compensation Insurance Law. SCIP are provided with some income for work (6-8 hr/day) from the centers. Many live in dormitories where meals are provided, although some live at home. They can carry on their daily lives, using wheel chairs at and away from work. The head of each center is a medical doctor, and a full-time nurse is available at each center for matters pertaining to decubitus, urinary tract infection, and the like. Clinics of Rosai Hospitals or other hospitals provide medical assistance as needed.

The proportion of women with SCI is small, and requirements for workshop and vocation assistance are few. Thus, in this study, 307 males at the centers were contacted. Questionnaires providing valid data on SCIP were submitted by 79.5% (244 individuals), and thus were also used. Age ranged from 22 to 69 years, the average being 47.6. Postinjury periods were 17.3 years on average. The average period of residency was as much as 11 years.

The sites of injury are as follows: spinal level of cervical to upper thoracic (C-T5), 23 persons (11%); lower thoracic level (T6-T10), 30 (12%); thoracolumbar transition level (T11-L1), 173 (69%); and sublumbar level (L2-), 18 (8%). Incomplete paralysis

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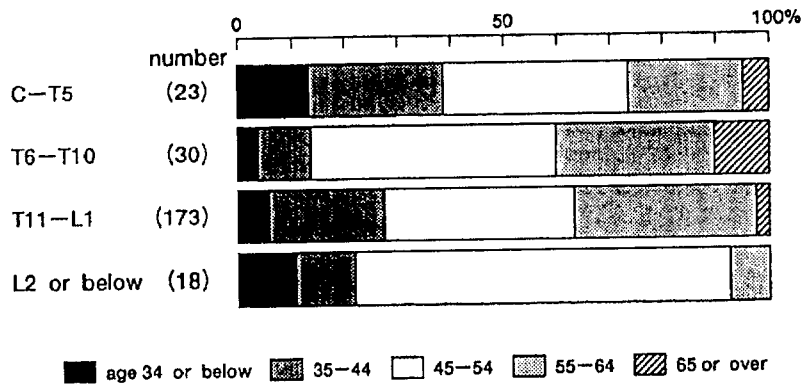


FIGURE 1. Age distribution in subjects with spinal cord injury, by level of affected spine. C, cervical, T, thoracic, L, lumbar.

was seen in 10 subjects (4.1%): 5 with cervical injury and 5 with thoracolumbar injury (Fig. 1).

Control group data (general population) were obtained from the National Livelihood Basic Survey conducted by the Ministry of Health and Welfare in 1989 [11], on 800,000 people in 240,000 households randomly chosen from the National Census of 1985.

Survey Procedures

The survey questionnaire was the same as that of the health survey in the 1989 Basic Survey, and pertained to lesions treated at outpatient clinics, health status, and subjective complaints.

The National Livelihood Basic Survey questionnaire was distributed to households. The survey was conducted in essentially the same way at all eight rehabilitation centers from October 1989 to January 1990. Data on complications attending injury were processed at each center.

Computations

The following two parameters were calculated and the results compared with the general population:

Outpatient rate (per thousand)

$$\text{Outpatient rate} = \frac{(\text{number of outpatients})}{(\text{population studied})} \times 1000$$

Standardized outpatient morbidity ratio (SOMR)

To eliminate age effects, the disease-specific ratio of SCI outpatients to outpatients in the general population served as the standard. An age-adjusted parameter was indirectly calculated as

$$\text{SOMR} = \frac{(\text{total number of outpatients})}{(\text{expected number of outpatients})} \times 100$$

The expected number of outpatients was calculated as follows:

$$\text{Expected number of outpatients} = \sum_i (\text{number of persons in } i\text{th age group in general population} \times (\text{outpatient rate in } i\text{th age group in population studied}))$$

The SOMR was determined on the basis of 1989 National Livelihood Basic Survey data [11].

The level of SOMR significance was determined as follows:

1. When the number of outpatients with SCI was 10 or more, the z value for normal distribution was determined as

$$z = \frac{[(\text{observed value} - \text{expected value}) - 0.5]}{(\text{expected value})^{1/2}}$$

2. When the number was less than 10, it was determined as a Poisson distribution.

RESULTS

Age-specific Outpatient Rate and Locations of Medical Care Facilities

Age-specific outpatient rates for SCIP and the general population are given in Fig. 2. In all age groups, the outpatient rate of disease among SCIP exceeded that of the general population, particularly in the 35- to 44-year age group (47.9%, SCIP; 16.2%, general population). The outpatient rate was greatest in the 65- to 74-year age group, although increase with age was not so pronounced in the SCI group as the control.

Medical care for SCIP was conducted at general or large hospitals (76.4%) and clinics (9.0%). Most SCIP were treated by SCI specialists at hospitals, such as Rosai Hospitals. The general population used clinics (40.0%) and general and large hospitals (26.2%).

Disease-specific Outpatient Rate

Data for this parameter per 1000 persons (SCIP and general population) (males of age 15 years or older) are given in Table 1. The survey specified 39 diseases, excluding dental, ophthalmological, and otorhinological diseases, and a few others.

The most frequently occurring diseases among SCIP (with outpatient rates in parentheses) were cystitis (196.7), hypertension (163.9), and renal lesion (151.6), followed by low back pain and shoulder discomfort (77.9), diabetes mellitus (61.5), and skin disorders (57.4). In the general population, hypertension (45.4) was encountered the most frequently.

Disease-specific Standardized Outpatient Morbidity Ratio

The age-adjusted standardized outpatient ratio with the outpatient rate of the general population set at 100 was determined indirectly (Table 1). Diseases with higher SOMRs were cystitis (16,278) (162 times that in the general population), renal disease (2642), and other urinary system lesions (2214), followed by hypotension (472) and prostate hypertrophy (462) ($p < 0.05$). Diseases with SOMRs of 300 or more included hepatitis and liver cirrhosis (371), disorders of the skin (361), and diabetes mellitus (323) ($p < 0.01$), acute

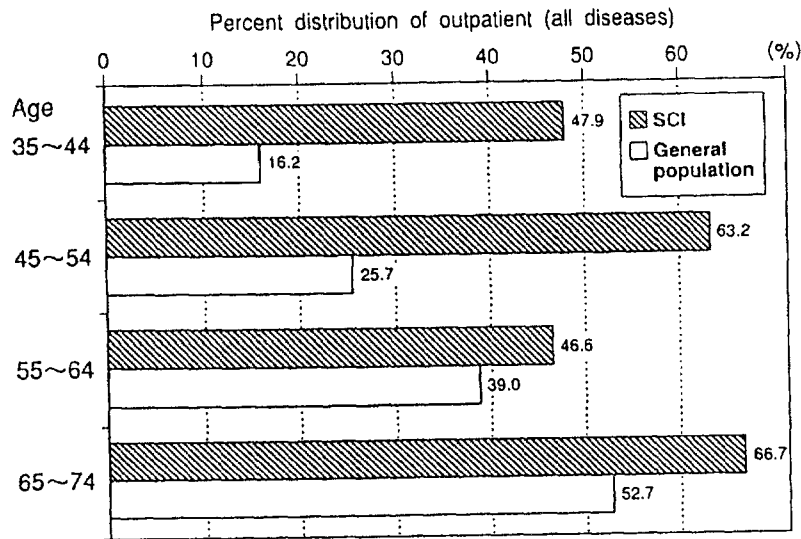


FIGURE 2. Comparison of rates of occurrence of all diseases among outpatients with SCI and the general population, by age.

TABLE 1. Comparison of disease prevalence between those with spinal cord injury and general population

Diseases	Outpatient rate (per 1000 population)		Number of outpatients with SCI	Standardized outpatient morbidity ratio (general population = 100)
	SCI (male)	General population ^a (male)		
All diseases	536.9	224.8	127	337 ^b
Cystitis	196.7	0.9	48	16,278 ^b
Renal diseases	151.6	4.1	37	2,642 ^b
Hypertrophy of the prostate	16.4	3.9	4	462 ^c
Other diseases of the urinary tract	57.4	2.2	14	2,214 ^b
Hypertension	163.9	45.4	40	250 ^b
Hypotension	16.4	2.5	4	472 ^c
Ischemic heart diseases	16.4	9.0	4	146
Other diseases of the circulatory system	8.2	7.0	2	93
Gastritis	45.1	8.9	11	339 ^b
Hepatitis and cirrhosis	45.1	6.8	11	371 ^b
Gastric ulcer and duodenal ulcer	20.5	12.9	5	98
Cholecystitis and cholelithiasis	12.3	2.3	3	348
Acute enteritis and diarrhea	8.2	1.9	2	360
Other diseases of the digestive system	28.7	5.6	7	381 ^b
Lumbago and stiffness in the shoulder	77.9	31.3	19	168 ^c
Neuralgia	24.6	8.2	6	251
Rheumatoid arthritis and other arthritis	12.3	7.5	3	126
Diabetes mellitus	61.5	12.2	15	323 ^b
Gout	4.1	4.1	1	62
Disorders of the skin	57.4	17.2	14	361 ^b
Bronchitis and pneumonia	8.2	4.0	2	207
Acute upper respiratory infections	4.1	11.0	1	52
Asthma	4.1	6.1	1	87
Anemias and blood diseases	8.2	1.9	2	316

^aSource: National Livelihood Basic Survey: 1989. Statistics and Information Department, Ministry of Health and Welfare, Tokyo, 1991.

^b $p < 0.01$.

^c $p < 0.05$.

enteritis and diarrhea (360), cholelithiasis and cholecystitis (348), and anemia and blood diseases (316). The hypertension SOMR was 250 ($p < 0.01$).

Frequency of Hypertension Complicated with Other Diseases

Hypertension in SCIP was sometimes complicated with other diseases: outpatients with hypertension and treated renal lesions, 17.5%; hypertension linked with other treated complications (diabetes mellitus, liver lesion), 17.5%; with treated essential hypertension constituting 68%.

Site-specific Comparison of Outpatient Rates

Outpatient rates for renal disease, hypertension, and diabetes mellitus were compared for sites of SCI as shown in Fig. 3. For renal diseases, the outpatient rate for the C-T5 site was slightly lower than for other sites. The outpatient rates of hypertension and diabetes were closely related to the site of injury. In the case of hypertension, the outpatient rates were 43.4 at C-T5, 166.7 at T6-T10, 161.8 at T11-L1, and 333.3 at L2 or lower. In the case of diabetes, the rates were 0, 33.3, 63.6, and 166.7, respectively. The rates were significantly higher for the site groups below T6 than in the general population ($p < 0.01$).

DISCUSSION

The prevalence rate of disease in SCIP was significantly higher than in the general population in all age groups, owing to complications directly or indirectly associated with SCI. Complication occurrence is largely determined by the degree of medical care and social status of SCIP. Patient attitude is also an important factor. Marital status,

exercise habits, and positive attitudes may possibly in some way predispose the occurrence of decubitus [12,13].

SCI diseases may be classified as (1) primary SCI lesions, (2) secondary complications causally related to SCI, (3) diseases frequently noted in and possibly related to SCI, (4) diseases having no association with SCI.

The first category includes spasticity and neural pain [14-16], orthostatic hypotension and autonomic dysreflexia [17,18], neurogenic bladder [19-21], and other disorders. For such cases, no comprehensive treatment is available, with major reliance being on symptomatic therapy. The onset of primary lesions is closely related to the site of injury. Spasticity and hypotension occur more frequently in T5 (or higher) SCI. The overall SOMR for hypotension in SCIP in this study was 472 ($p < 0.01$).

Typical secondary complications causally arising from SCI are urinary tract lesions [19-21] and decubitus. With aggravation of urinary tract infections, renal lesions occur and give rise to the highest mortality rate in SCIP. Urinary tract complications are closely related to the mode of medical care. Prognosis depends greatly on the quality of acute-phase medical care and proper urinary tract management.

In Europe and the United States, mortality attributable to urinary tract lesions greatly decreased following World War II. According to a survey in the United Kingdom by Whiteneck *et al.* [6], mortality due to urogenital lesions (ICD9) was 24% compared to the overall mortality; cardiovascular disease, 23%; and respiratory disease, 13.8%. The annual prevalence was 23.0% for decubitus and 20.0% for urinary tract infection. The prevalence of urinary tract infection was particularly high (27.8%) in persons older than 60 years.

The incidence of renal lesions also decreased in Japan after World War II, but urinary tract lesion prevalence and mortality

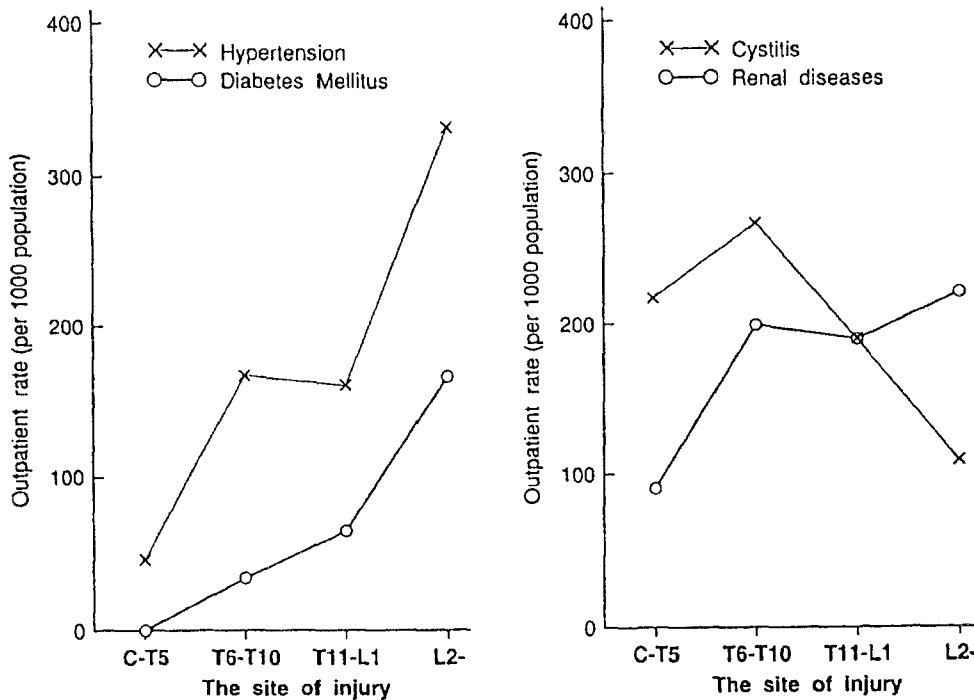


FIGURE 3. Outpatient rate according to site of injury.

rate are higher compared to those in Western countries. According to Nakajima *et al.* [8], the mortality rate among patients discharged from Rosai Hospitals was 38.8% for urinary tract lesions, 20.9% for respiratory diseases, and 9.3% for cardiac disease. A survey essentially the same as that conducted by the 1978 National Health Survey indicated the 3-day prevalence rate for decubitus to be 19.0 per 100 SCIP, and for urinary tract lesions it was 13.0% [8]. The outpatient rate in this study was 19.7% for cystitis and 15.2% for renal lesions. Considering that the survey by Whiteneck *et al.* [6] concerns annual prevalence, the results of Nakajima *et al.* [8] and those of this study indicate a high prevalence of urinary complications.

A comparison of the results of Kadowaki [9] for SCI rehabilitation residents with those of Nakajima *et al.* for communities indicated the outpatient rate for urinary tract lesions in SCIP at rehabilitation centers to be twice that noted in communities. The routine urine tests conducted in the former facilities for the detection of urinary tract infection may be the reason for this. The outpatient rate for decubitus at rehabilitation centers was less than that in communities, owing to preventive education and early treatment.

Diseases frequently noted in and possibly related to SCI are hypertension, diabetes mellitus, and psychiatric disorders such as depression. While the prevalence of urinary tract lesions in SCIP has decreased drastically, the prevalence rates of circulatory diseases and diabetes have increased in SCIP. Some researchers [22] hypothesize that biological aging progresses faster in SCIP than in the general population.

Yekutieli *et al.* [23] found the prevalence rates of hypertension in SCI and control groups to be 24.7 and 10.4%, respectively; cardiac disease, 16.9 and 6.9%; diabetes mellitus, 5.2 and 3%. Lang *et al.* [1] observed the prevalence rate of hypertension to be 20%. No regional survey has provided adequate data on the sites of SCI.

Nakajima *et al.* [8] and Kadowaki [9] indicate that the prevalence rate of hypertension in SCIP considerably exceeds that of the general population. This study shows the SOMR for hypertension to be as high as 250. The SOMR depends on the site of injury; it is less than that in the general population with injury at T5 or higher, and highest at L2 or below.

Essential hypertension was 85% in this study, and the major cause of secondary hypertension was renal disease. In SCIP, if mild cystitis is included, the annual prevalence rate of urinary tract infection becomes quite high and infection may repeatedly go unnoticed. It should be kept in mind that potential renal lesions barely detectable by blood tests and X-ray examination may be present [20].

The incidence of diabetes mellitus is also determined by the site of injury. The lower the site, the higher the outpatient rate for diabetes. The parameter is 0 in people in whom the level of injury is above T5. Duckworth *et al.* [24, 25] and Bauman *et al.* [26] point out that the abnormal sugar tolerance of SCIP is related to insulin resistance.

Factors predisposing toward the above diseases are obesity, lipid abnormality, inadequate exercise and nutrition, and mental stress. SCI patient body weight at rehabilitation centers was significantly less than in the general population [27]. However, SCIP have markedly atrophied muscles in the areas of paralysis [28,29]. The HDL-cholesterol level in SCIP who exercised daily was less than in those not doing so [30]. SCIP perform insufficient exercise at centers compared to the general population, but this alone would not adequately explain why the SOMR data for hypertension and diabetes mellitus are as high as 250 and 323, respectively.

The total serum cholesterol level in SCIP is less than that in control subjects [29,31], HDL-cholesterol is lower or basically the same [31,32]. The results of our study [27] and those of Krum *et al.* [29] indicate alcohol and tobacco consumption by SCIP to be significantly less than that in the control group, thus demonstrating better routine health management for SCIP.

For SCIP, psychosocial factors in addition to SCI-related symptoms should be considered. SCIP complain of pain, insomnia, depression, and other psychoneural symptoms [33]. Endocrine change due to SCI has been shown to be related to depression [34]. Psychoneural stress may possibly lead to hypertension or diabetes.

The prevalence of cardiac diseases in SCIP in Western countries is high [23,29]. However, SOMR data for cardiac diseases in SCIP in this study showed no significant differences from the general population. Nakajima *et al.* [8] also reported that SCIP did not show a high rate of heart disease. The intake of animal lipids in Japan is increasing and this may lead to a greater prevalence of cardiac disease in the general population and in SCIP in future.

Because of the increasing importance of controlling hypertension and diabetes, we intend to proceed with studies to clarify the factors affecting these conditions in SCIP. Studies clarifying the effects of psychosocial difficulties on conditions such as hypertension and diabetes are required.

CONCLUSIONS

In addition to primary and secondary disorders accompanying SCI, age-adjusted parameters for the prevalence of hypertension and diabetes mellitus in SCIP were 2.5–3.2 times those of the general population. This was closely related to the site of injury. In the case of hypertension, outpatient rates were 43.4 at C–T5, 166.7 at T6–T10, 161.8 at T11–L1, and 333.3 at L2 or lower. In the case of diabetes, the rates were 0, 33.3, 63.6, and 166.7, respectively.

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