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ORIGINAL ARTICLE

High incidence of acute traumatic spinal cord injury in a rural population in Japan in 2011 and 2012: an epidemiological study

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Study design: Retrospective questionnaire-based epidemiological study.
Background: Physicians treating acute traumatic spinal cord injury (SCI) in Japan noticed an increased occurrence of cervical SCI without skeletal injury.
Objective: To elucidate the precise epidemiology of acute cervical SCI with the aim of planning a prevention program.
Methods: Questionnaires were posted to all hospitals in Tokushima prefecture (around 780 000 inhabitants) to investigate the annual incidence of SCI in 2011 and 2012.
Results: The response rate was 79% in 2011 and 64% in 2012. The returned questionnaires reported on 95 patients in 2011 and 91 patients in 2012, with a mean age of 67.6 and 64.3 years and an annual incidence (per million population) of 121.4 and 117.1, respectively. More than two-thirds of the cases suffered cervical SCI without skeletal injury, and 61% of these were categorized as Frankel D neurological deficits due to low-energy impact as the main cause.
Conclusion: The incidence of incomplete cervical SCI does appear to be increasing, and significant regional differences in the incidence of cervical SCI exist across Japan. We speculate that factors other than age are contributing to this increase.
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Keywords: spinal cord injury; epidemiology; cervical; elderly

INTRODUCTION

In 1990–1992, the Japan Medical Society of Spinal Cord Lesion (JASCoL) conducted a nationwide epidemiological survey on the incidence of acute traumatic spinal cord injury (SCI) using a postal questionnaire and found that the annual incidence was 40.2/1 000 000 population. Three-quarters of the cases involved cervical injury, and the most frequent age at injury was the seventh decade followed by the third decade.[1,2] Since then, there has been a drastic increase in the aging population of Japan. The percentage of people aged 65 years or older increased from 12.1% in 1990 to 23.3% in 2010 (http://www.stat.go.jp/english/data/jinsui/2.htm) and physicians treating cases of SCI have noticed an increase in cervical SCI cases among elderly individuals. JASCoL conducted another nationwide epidemiological study in 2002; however, the precise incidence of SCI could not be established, as the response rate was around 20%.[3]

Accurate information on the occurrence of acute traumatic SCI is important for planning appropriate preventive measures. Tokushima prefecture is located in Shikoku, one of Japan's four main islands, and is surrounded by sea or mountains. It has a population of nearly 800 000 residents, amounting to 0.6% of the Japanese population in 2011 (127.7 million) (http://www.pref.tokushima.jp/english/). Because of the prefecture's geographic characteristics and healthcare system, almost all SCI patients are initially treated in local hospitals. As most of the major hospitals in the study area are affiliated with our hospital, it was convenient to investigate the epidemiology of traumatic SCI in the prefecture. The purpose of this study was to assess the annual incidence of traumatic SCI in Tokushima by means of a questionnaire mailed to local hospitals.

MATERIALS AND METHODS

We posted questionnaires in February 2012 and February 2013 to all hospitals in Tokushima prefecture that might have treated patients who sustained acute SCI; specifically, 96 and 100 departments of orthopedic surgery, neurological surgery and emergency medicine in 2012 and 2013, respectively. Data collected included patient initials, date of birth, age at the time of injury, gender, level of injury (cervical or thoracic/lumbar) and presence of skeletal injury.

Cause of injury was categorized as fall on level surface, fall from <3 m (low fall), fall down stairs, fall from >3 m (high fall), struck by object, road traffic accident (pedestrian, bicycle, motorcycle or car), sports or other. Neurological status at the time of the injury was reported using Frankel's classification, as the previous epidemiological study performed in Japan had used this classification.[1,4] Patient initials and date of birth were cross-referenced to avoid duplicates, and data from only those patients with Frankel A–D neurological deficits were subjected to analysis. We excluded minor deterioration of myelopathy after trauma.

This study was approved by the Ethics Committee of Tokushima University Hospital.

RESULTS

Responses were obtained from 76 and 64 departments in 2011 and 2012, respectively. The departments were spread across four hospitals

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with tertiary emergency departments and another seven core hospitals in Tokushima. All departments at these hospitals replied following our direct request to return the questionnaire. Therefore, we assume that almost all traumatic SCI cases in the prefecture were included in the registration in both years.

Traumatic SCI was reported for 95 patients (69 men and 26 women) with a mean age of 67.6 ± 14.6 years (median, 70; range, 19–89 years; men, 66.0 ± 15.9 years; women, 71.7 ± 9.3 years) in 2011 and for 91 patients (66 men and 25 women) with a mean age of 64.3 ± 16.8 years (median, 67; range, 19–90 years; men, 63.1 ± 17.0 years; women, 67.6 ± 16.1 years) in 2012. On the basis of the estimated 781 416 residents of Tokushima in July 2011 and 776 790 in July 2012, the annual incidence of traumatic SCI was 121.4/1 000 000 in 2011 and 117.1/1 000 000 in 2012.

The number of patients aged ⩾65 years was 45 (47.3%) in 2011 and 49 (53.3%) in 2012. The incidence was highest in the eighth decade, followed by the seventh and ninth decades in both years. In 2011 the eighth and seventh decades were predominant, whereas in 2012 the distribution was fairly even from the fifth to seventh decades (Figure 1, Table 1).

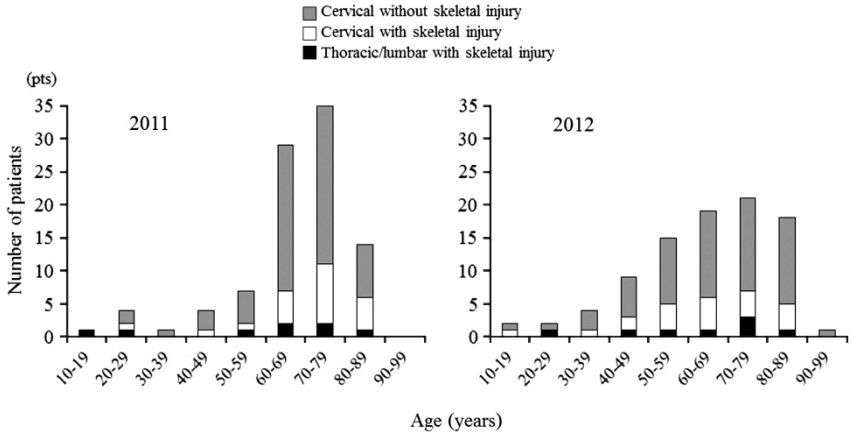

Figure 1 Number of patients with new acute traumatic spinal cord injury in each age group in 2011 and 2012.

Table 1 Number and type of injury by age group

		Age				
		16–30	*31–45*	*46–60*	*61–75*	*76+*
Cervical without skeletal injury	2011/2012	3/2	1/6	10/13	32/22	19/19
Cervical with skeletal injury	2011/2012	1/1	1/3	2/6	7/5	11/6
Thoracic/lumbar with skeletal injury	2011/2012	2/1	0/0	1/3	3/3	2/2
Population	July 2011	106 718	141 778	155 903	160 215	106 608
	July 2012	104 778	141 759	149 839	163 022	108 535
Annual incidence/1 000 000	2011	56.6	14.1	83.4	262.2	300.2
	2012	38.2	63.5	140.2	184.0	248.8

The population-adjusted annual incidence was calculated from in July each year.

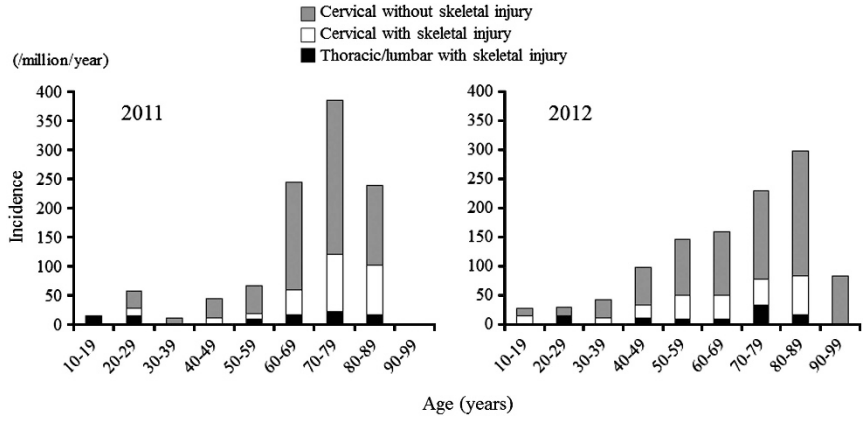

Figure 2 Population-adjusted annual incidence of new acute traumatic spinal cord injury in each age group in 2011 and 2012.

The population-adjusted annual incidence for those aged ⩾65 years was 215.7/1 000 000 in 2011 and 230.4/1 000 000 in 2012, whereas that in the population aged between 15 and 64 years was 106.4/1 000 000 in 2011 and 90.8/1 000 000 in 2012. The highest incidence (384.5/1 000 000) was observed in patients in the eighth decade in 2011 (Figure 2, Table 1).

Cervical SCI comprised more than 90% of all injuries in both years. About three-quarters of the patients with cervical SCI showed no skeletal injury, and their mean age was of 67.6 years in 2011 and 65.5 years in 2012 (Table 2). Only 3 of 127 patients in both years had Frankel A deficits and 61% had Frankel D deficits. About 40% of the patients with cervical SCI with skeletal injury showed complete neurological deficits at the time of injury. Of the 16 patients with thoracic/lumbar injury, 13 had Frankel C or D neurological deficits.

The cause of cervical SCI without skeletal injury was mainly low-energy impact (Figure 3). In cases of cervical SCI without skeletal injury, fall on a level surface and low fall comprised more than half of the events, followed by road traffic accidents. In cases of cervical SCI with skeletal injury, low fall was the main cause of injury, followed by fall from height in both years (Figure 4). The causes of thoracic/lumbar SCI varied in both years.

Table 2 Number, gender, age, and neurological deficits for each type of cervical spinal cord injury

Level and skeletal injury	*Men/women, mean age Frankel A/B/C/D*	
	2011	*2012*
Cervical without skeletal injury	45/20, 67.6 years 1/4/17/43	45/17, 65.5 years 2/5/20/35
Cervical with skeletal injury	18/4, 70.6 years 8/1/6/7	15/6, 61.7 years 9/0/8/4
Thoracic/lumbar with skeletal injury	6/2, 58.8 years 2/0/0/6	6/2, 62.0 years 0/1/6/1

DISCUSSION

As Japan has no national database of injury cases, the method used in this study may be the only means of ascertaining the epidemiology in a given area. The high similarity between the results obtained in both years indicates high survey reliability. It also suggests that the present method is suitable for conducting local epidemiological surveys, although personal relationships may be necessary to obtain high response rates.

To our knowledge, the annual incidence reported here is relatively high compared with that reported in the English literature.[5] A similar study conducted in Kochi, the neighboring prefecture, showed a similar incidence.[6] As both studies seemed to involve departments at major hospitals that might treat SCI, the number of patients with minor neurological deficits who may not be transferred to SCI units or who may be regarded as having significant acute deterioration of mild cervical myelopathy could have contributed to the increased annual incidence, although minor neurological deterioration of

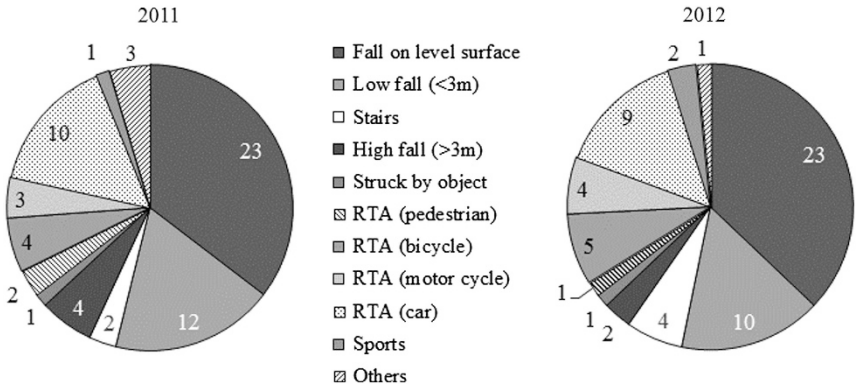

Figure 3 Causes of cervical spinal cord injury without skeletal injury in 2011 and 2012.

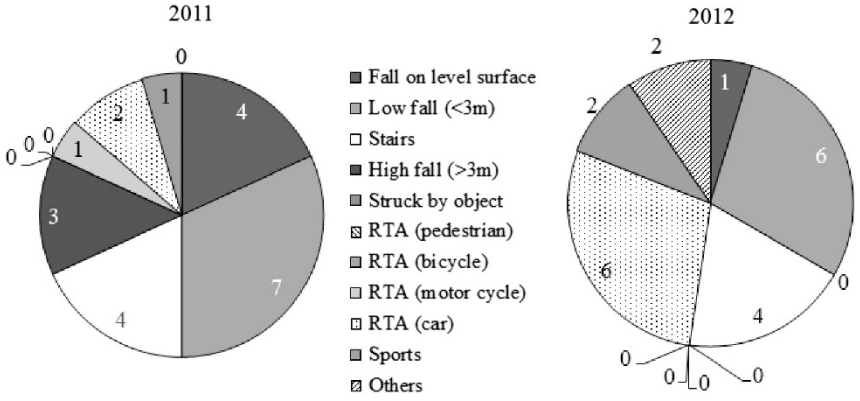

Figure 4 Causes of cervical spinal cord injury with skeletal injury in 2011 and 2012.

preexisting myelopathy was not included in this study. However, even after excluding Frankel D patients, the incidence was still high (49.9/1 000 000 in 2011 and 65.7/1 000 000 in 2012).

As expected, low-energy impacts accounted for more than 50% of the causes of cervical SCI without skeletal injury (Figure 3). The causes of cervical SCI with skeletal injury varied (Figure 4), and 6 of 16 thoracic/lumbar injuries in both years were caused by high fall.

Similar surveys have been conducted in other areas in Japan, for example, in Fukuoka and Hokkaido prefectures. Although these surveys also showed that cervical injury without skeletal injury was predominant, the annual incidence was around 40/1 000 000, which is similar to the national incidence reported in the early 1990s. Changes in the Japanese population in the last 20 years have been significant; the ratio of people aged $\geqslant$65 years has increased. This ratio as of 2011 was 27.0% in Tokushima and 28.8% in Kochi, whereas that in Fukuoka and Hokkaido was 22.3% and 24.7%, respectively. We assume that this increase is the major reason for the peak shift and the increased incidence in cervical SCI. It is apparent, however, that population changes alone cannot explain the increased number of SCI cases because the elderly population in Fukuoka and Hokkaido is notably higher than that in the early 1990s.

Japanese are a rather homogeneous race, and it is well known that they have a narrow spinal canal and a high incidence of ossification of the posterior longitudinal ligaments.[7] The Japanese Orthopedic Association conducted a survey on the number of surgeries performed in board-registered hospitals in Japan in June and July of 2009 but reported no area-related differences (http://www.joa.or.jp/jp/media/comment/pdf/investigation_2009.pdf). It is not surprising that there are no area-related differences in spinal canal diameter, as most spine surgeries, including those of the cervical spine, are performed by orthopedic spine surgeons in Japan.

Tokushima and Kochi are both situated in mountainous areas; therefore, the local geographic environment might have contributed to the high incidence. However, many cases of SCI were also reported by hospitals located in flat areas.

Although many patients were in Frankel C or D, their burden on society is likely to be high. The narrow design of old traditional houses in Japan makes it difficult for elderly SCI patients to return their home, and it is common that such patients live only with their spouse at the time of injury. Therefore, prevention is of utmost importance.

The present study showed not only a high incidence of cervical SCI in Japan but also significant regional differences. Further studies are necessary to elucidate the detailed situation at the time of injury to plan a practical means of reducing the occurrence of SCI.

DATA ARCHIVING

There are no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

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