Prevalence of Spinal Cord Injury in Tehran, Iran

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Received July 8, 2008; accepted November 8, 2008

Abstract

Background/Objective: To determine the prevalence of traumatic spinal cord injury (SCI) in Tehran, Iran.

Methods: A population-based study was performed. In a random cluster sampling, 100 addresses were selected as the starting point of the survey for each cluster consisting of 25 households. To expand the geographic dimension of each cluster, the interviewers skipped 3 of 4 houses in gathering data for each study unit. Each person with traumatic SCI was evaluated initially by a nurse and then by a neurosurgeon by physical examination and spinal imaging at the hospital or at home.

Results: Ninety-seven percent of all surveyed agreed to participate in the study (2,425 households, or 9,006 persons). Four cases of SCI were identified. The point prevalence of SCI was 4.4 [95% CI = 1.2–11.4] per 10,000 people. Over the 5-year period from January 2003 through January 2008, the reported incidence rate of SCI was 2.2 (95% CI = 0.27–8.00) per 10,000 people.

Conclusions: In this, the first published population-based study from Iran, the prevalence of traumatic SCI in Tehran ranged from 1.2 to 11.4 per 10,000 people. More research is required to determine the patterns and causes of SCI. Development of a nationwide SCI registry or surveillance system is fundamental to an understanding of the epidemiology, and hence the prevention, of this costly health problem.

J Spinal Cord Med. August 2009;32(4):428–431

Key Words: Iran; Spinal cord injuries, traumatic; Epidemiology; Prevalence; Outcomes

INTRODUCTION

Spinal cord injury (SCI) is a devastating condition with enormous financial, social, and personal costs (1). Because there is no known cure for SCI, primary prevention is a key strategy. Spinal cord injury is the most expensive traumatic condition in the US. In a prospective population-based cohort study, Johnson et al (2) reported per patient expenditures of almost \$200,000 during the first 2 years after injury that included in-home care, services, and secondary medical

complications. The cost of the average initial admission in the US is approximately \$95,203, with home modifications costing \$8,203, medical services and supplies costing \$7,866, and nurse and home care assistance costing \$6,269 per year (1). An understanding of the prevalence of SCI is essential for planning cost-effective care and for developing preventive strategies (3). Significant variation in prevalence in SCI exists among geographic locales, so these data are paramount for local and regional health care financing (1).

At present, very little is known and reported about the prevalence of SCI in Iran (4–7). This is the first published population-based study from Iran to estimate the prevalence of SCI in Tehran, Iran's capital. Due to Iran's high incidence of road traffic crash fatalities and injuries, epidemiologic data concerning specific causes of spinal injury and SCI and associated risk factors may assist in developing laws and safety guidelines to arrest and reverse this national health care problem (8,9). In this study, we evaluated the prevalence of SCI in metropolitan Tehran, Iran's largest city.

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This study was supported by grant #56 from Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, Tehran, Iran.

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METHODS

A population-based study was performed from September 2007 through January 2008 to determine the prevalence of SCI in Tehran, Iran. Tehran's population census of 7,976,000 was last determined by the Statistical Center of Iran in 2006. We utilized a 2-stage survey strategy. The aim of the first stage was to detect all suspected cases of SCI among the study population. During the second stage, we aimed to confirm cases with definite traumatic SCI and rule out cases that did not meet the criteria for traumatic SCI.

The study population was selected through random cluster sampling. The postal address registry of Tehran was used as the basis for a sampling frame; 100 addresses were randomly selected from a total of 2,148,000 registered addresses. These addresses were considered the survey starting points for each cluster. During the first stage, the interviewers referred to the starting point of every cluster and moved counterclockwise to capture 25 households eligible for inclusion. To expand the geographic dimension of clusters, the interviewers skipped every 3 of 4 houses and asked the fourth household to take part in the study for every study unit. The inclusion criteria were the presence of an adult in the home who agreed to participate in the study and was a resident of Tehran during the last 12 months. The exclusion criteria were inability of the responder to provide reliable answers due to substance abuse or old age. Military residential areas were excluded from the sample. Data were gathered using a standardized structured interview. The responders were asked whether a current or former member of the household (living or dead) had a known history of spinal injury. Names of all household members and their age and gender were also obtained. During the second stage, if a suspected case of SCI was detected in the household, a registered nurse with specific training for this study was dispatched to the household address. The nurse collected information on demographics, date and mechanism of injury, spinal level (cervical, thoracic, and lumbar), type of SCI (complete or incomplete), medical and/or surgical treatments, outcome of treatment (data were recorded according to the ASIA impairment scale), time interval from trauma to surgery (if applicable), and related complications. Then, all survivors were invited to the neurosurgery clinic and examined by a neurosurgeon who confirmed all cases of traumatic SCI. For deceased cases, the neurosurgeon reviewed all pertinent medical records and radiographs to prove or disprove the existence of a true traumatic SCI.

Random subsamples of the study population were surveyed again to control the quality of the data during the first stage. Participating interviewers were given prompt feedback on their performance regarding accuracy and completeness. To minimize data entry errors (SPSS software, Ver. 13, SPSS Inc, Chicago, IL), data were double entered by independent operators, and any mismatches were rechecked with the original source

documents. Point prevalence for traumatic SCI was calculated by dividing the number of definite alive SCI cases by the total number of the study population. The 5-year overall incidence rate was calculated by dividing the number of cases of SCI cases that occurred during the last 5 years (alive or dead at the time of the study) by the total number of the study population. The annual incidence rate for SCI was estimated by dividing the 5-year incidence rate by 5. A CI based on Poisson distribution was determined.

RESULTS

Ninety-seven clusters including 2,425 families (9,006 persons) were evaluated in this study. Mean age of the study population was 33.4 years (95% CI = 33.0–33.8). Three individuals were older than 100 years, and 21 individuals were younger than 1 year of age. Males made up 51.1% of the study population. At the first stage, 11 cases of SCI were identified via the initial interviews. However, during the second stage, after confirmation by the trained nurse and physical examination and review by the attending neurosurgeon of all pertinent medical records, including imaging studies, 7 of the cases were determined not to be traumatic SCI. Therefore, there were 4 documented cases of traumatic SCI, all of which had spinal fractures. No deceased cases of traumatic SCI were detected.

The mean age of the individuals with traumatic SCI was 31 ± 7 years (mean $\pm$ SEM). Two of 4 cases were men (95% CI = 7%–93%). Two of 4 lost their jobs after the injury. The causes of SCI were road traffic crashes ($n = 3$): 1 case of car vs pedestrian accident, 1 involving a car passenger, and 1 involving the driver. One case involved a fall out of a tree.

The mean time interval from injury to operation was 20 ± 9 days (range: 1–40 d). After surgery, 3 of 4 cases with SCI experienced some degree of improvement in motor function, sensation, and urinary and/or stool incontinence. Table 1 shows the details of all cases. Financial support (National Welfare Organization) provided coverage for 1 case of SCI ($n = 1$).

Point prevalence of SCI was 4.4 (95% CI = 1.2–11.4) per 10,000 people. The 5-year overall incidence rate of SCI was calculated at 2.2/10,000 (95% CI = 0.27–8.00), with an estimated annual incidence rate of 0.44/10,000, or 44 new cases of SCI per 1,000,000 people.

DISCUSSION

A few epidemiologic studies have been performed throughout the world estimating the prevalence of SCI (1,10–14). Two papers summarized the internationally available findings on the prevalence rate of SCI. Blumer and Quine (10) and Wyndaele and Wyndaele (11) reported rates ranging from 1.1 to 11.2 and 2.23 to 7.55 per 10,000 people, respectively. Other studies have also evaluated the prevalence rate of SCI, such as the one by O'Connor in Australia (6.81/10,000) and Dahlberg in

Table 1. Characteristics of Patients With Spinal Fracture and Spinal Cord Injury

Case No.	Age (y)	Age at Trauma (y)	Sex	Mechanism of Trauma	Level of Injury	SCI	ASIA	Treatment	Time to Surgery (d)	Outcome of Surgery			
										M	S	I	Complication
1	62	45	M	Fall	Lumbar	Yes	A	Surgery	40	No	No	No	Pressure sore
2	19	16	F	RTC	Cervical	Yes	D	Surgery	30	Yes	Yes	Yes	Pain
3	46	42	M	RTC	Lumbar	Yes	C	Surgery	8	Yes	Yes	Yes	Pain
4	27	20	F	RTC	Thoracic	Yes	C	Surgery	1	Yes	Yes	Yes	—

M, some improvement in motor function; S, some sensory improvement; I, some improvement of urinary/fecal incontinence; and RTC, road traffic crashes.

Helsinki, Finland (2.8/10,000) (12,13). Griffin et al (14) in Olmsted County, Minnesota, noted that the point prevalence of SCI increased from 1.97 per 10,000 population to 4.73 over 30 years (14).

Because there is no data registry system in Iran, a population-based study to determine the prevalence of SCI was deemed necessary in light of the high incidence of traffic-related injuries and fatalities in Tehran and the high costs to society.

This study examined the point prevalence of traumatic SCI and the recent 5-year overall incidence rate of traumatic SCI, which was found to be 2.22 per 10,000 people with an estimated annual incidence rate of 0.44 per 10,000 people (15). To calculate point prevalence, we directly examined all survivors of traumatic SCI in the study sample. The calculated 5-year incidence rate was based on the number of traumatic SCI cases (fatal and nonfatal) that occurred within the last 5 years. Although no deceased cases of traumatic SCI were identified in our study, we remain confident that this study has uncovered all traumatic SCI cases that occurred within the 5-year period. The reason is as follows: we asked adult household members whether any living or deceased members of the household had a known traumatic SCI. It is very unlikely that a responder failed to report a deceased SCI case due to recall bias. The question was quite specific, and most household members have familial relationships. Moreover, our calculation of incidence of traumatic SCI covered a period of 5 years, which is short enough to ensure recall death of a family member due to traumatic SCI by responders. There were a few false-positive cases, which were ruled out during the second stage. This reflects the high sensitivity of the first stage of the study. A sensitive screening strategy is unlikely to miss true positive cases; therefore, missing cases are not likely in this study.

The reported annual incidence of SCI varies from 14.5 to 57.8 cases per 1,000,000 people in different countries (3,16). Our study demonstrated an annual incidence rate of SCI of 44 cases per 1,000,000 people in Tehran. This is higher than that from another epidemiologic study from Iran, which estimated an incidence rate of 30 cases per 1,000,000 people in Kashan, a small city in the center of Iran (4). Differences in incidence and

prevalence may be population or geographic specific or possibly related to the methods of survey. The above-mentioned study from Kashan had used hospital-based data to estimate the incidence rate. It is not surprising that a hospital-based study underestimated the incidence rate of a health problem, in comparison with a population-based study. In this survey, we evaluated individuals with SCI living in a household or who had passed away within the last 5 years. This obviously excluded those who may have had a SCI at the time of death at the accident scene due to the absence of a formal autopsy. This survey, however, accounted for those persons who subsequently passed away in a hospital setting or at home after a formal diagnosis of SCI. The high reported values ($>50/1,000,000$) from Canada (17) and Portugal (16) were thought to be related to the inclusion of fatalities at the scene of trauma. Our study specifically analyzed those living with a SCI or recently deceased persons with a confirmed SCI, which is important because determination of SCI at the scene of fatality is prone to error in the absence of confirmatory examination or autopsy results (1).

In Tehran, the mean age of cases of SCI was 31 ± 6 years. In a previous study of 64 cases of SCI involving the poorest socioeconomic state of Iran in the southeast of the country, the mean age was 27 ± 9 years (5). In reports involving countries with a high incidence of SCI, the average age range is 20 to 40 years of age (1). Developed countries report an older age range for individuals at the time of SCI, possibly because of longer life expectancies and the greater frequency of falls in the elderly. Although only 2 of 4 cases were male in our study, the wide 95% CI (7%–93%) is similar to other similar studies in the literature.

The results of our study are consistent with previous reports that have shown a significant incidence of incomplete SCI, ranging from 34.0% to 59.0% (1). However, in a previous report from the sponsoring institution, a much lower incidence of incomplete SCI was noted in southeastern Iran (5). It is likely that this was due to underreporting of incomplete cases.

As in other studies on the incidence of SCI in Iran (5), this study again demonstrates that road traffic collisions are the leading cause of SCI in Iran. It is similar to other studies

showing that road traffic collisions and falls, respectively, are the first and second major causes of SCI (1).

Regarding the level of SCI, our results contrasted with a previous report on the level of SCI, because 2 of 4 cases in our study had a SCI involving the upper lumbar region vs the cervical region (1). This is in agreement with a previous report from southeastern Iran (5). In this report, the conus medullaris was the level of SCI in 44.7% of cases. We noted that 2 people with SCI complained of chronic pain and 1 person had a chronic pressure ulcer. In Zimbabwe, a low-income country, a majority of individuals with SCI also noted chronic pain as a common finding (18). Pressure sores were a common finding (20%–35%) in developed high-income countries (1).

Limitations

The evaluation of point prevalence of SCI resulted in a large CI. This made it necessary to increase the number of samples. Individuals who were not present at home, such as those hospitalized and in other living arrangements, were not accounted for, and thus more severe injuries might be underrepresented. We asked those interviewed whether there were any family members with a SCI; however, the questions did not specify those living away from home. As the 4 spurious cases illustrate, the persons surveyed might also not be aware that a household member had sustained a very mild SCI in the past, especially if it were successfully treated and no deficits remained. Additionally, immigration of SCI cases, which is highly unlikely, was also not considered in this study. Based on 4 SCI cases, it is impossible to make any conclusions or even imply any trend regarding the risk factors for SCI, including age, sex, etiology of injury, level and completeness of injury, and secondary complications.

CONCLUSIONS

This is the first published population-based study from Iran to estimate the prevalence of SCI in the capital of Iran. Prevalence of traumatic SCI in Tehran ranged from 1.2 to 11.4 per 10,000 people. A multicenter study is needed to provide a larger pool of cases. More research is required to determine the patterns and causes of SCI in Iran. Development of a nationwide SCI registry or surveillance system is fundamental to an understanding of the epidemiology and, hence, the prevention of this costly health problem. Preventive interventions are recommended for any industrialized country.

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