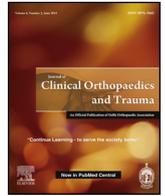




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Full length article

## Incidence of spinal fractures in the Netherlands 1997–2012

J.G. ten Brinke<sup>a,\*</sup>, T.P. Saltzherr<sup>b</sup>, M.J.M. Panneman<sup>c</sup>, M. Hogervorst<sup>b</sup>, J.C. Goslings<sup>a</sup>

<sup>a</sup> Trauma Unit Department of Surgery, Academic Medical Center Amsterdam, The Netherlands

<sup>b</sup> Department of Surgery, Gelre Hospitals, Apeldoorn, The Netherlands

<sup>c</sup> Consumer Safety Institute, Amsterdam, The Netherlands

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### ABSTRACT

**Study objective:** To determine time trends of emergency department (ED) visits, hospitalization rates, spinal cord lesions and characteristics of patients with spinal fractures in the Netherlands. **Methods:** In an observational database study we used the Dutch Injury Surveillance System to analyse spinal fracture-related ED visits, hospitalization rates and spinal cord lesions between 1997 and 2012. **Results:** The total number of ED visits associated with spinal fractures increased from 4,507 in 1997 to 9,690 in 2012 (115% increase). The increase in the total number of fractures occurred in all age groups independently of gender. However, incidence rates increased more strongly with age and were higher in young males and ageing females. The hospitalization rate of diagnosed spinal fractures remained stable between 62 and 67%. The incidence of spinal cord lesions varied between 13.8 and 20.3 per million of the population over a period of 15 years. **Conclusion:** Spinal fracture-related ED visits are increasing in the Dutch population, independently of age or gender. The hospitalization rate and the absolute numbers of spinal cord lesions have remained stable over a period of 15 years. These findings are relevant for public health decision-making and resource allocation.

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### 1. Introduction

Approximately two million patients visit Dutch emergency departments (ED) each year.<sup>1</sup> While only a minority of these patients have a spinal fracture,<sup>2</sup> the consequences can be severe: spinal fractures and associated spinal cord lesions can lead to functional impairment, impaired quality of life, and increased mortality.<sup>3</sup> Although epidemiological studies of osteoporotic and traumatic spinal fractures and spinal cord injuries have been performed,<sup>4,5</sup> there are no data on healthcare demand followed over a period of time of spinal fractures and associated spinal cord lesions across the entire population.

Previous research has shown great variation among nations in the incidence of traumatic spinal fractures and spinal cord lesions (up to a threefold difference), particularly between developed and developing nations.<sup>6,7</sup> Most studies have demonstrated a bimodal age distribution where the first peak is found in young adults between 15 and 29 years of age, and a second peak in adults older than 65 years of age.<sup>6</sup> It has been estimated that in the year 2000 1.4 million patients worldwide suffered from an osteoporotic

spinal fracture, and these numbers are expected to increase due to the ageing population.<sup>8</sup> In the older Dutch population, spinal fracture-related ED visits and hospitalizations are increasing rapidly.<sup>5</sup> However, the incidence of traumatic and osteoporotic spinal fractures and associated spinal cord lesions in the population followed over a period of time has never been investigated. If all spinal fractures can be characterized over a period of time, this will provide data on the magnitude and healthcare demands of the spinal injury population. Such information may offer a rational basis for public health decision-making and resource allocation. The purpose of this study was to answer the following questions: (1) What are the incidence rates of spinal fracture-associated ED visits, hospitalization rates and spinal cord lesions in the Netherlands during a 15-year period? (2) How are these incidence rates distributed over age groups and gender?

### 2. Materials and methods

#### 2.1. Study design and setting

In an observational database study, we collected data on the number of ED visits, hospitalization rates and spinal cord lesions related to spinal fractures in the Netherlands. We used the Dutch Injury Surveillance System (LIS).<sup>9</sup> This data covered the years

\* Corresponding author at: Trauma Unit Department of Surgery, Academic Medical Center Amsterdam, Meibergdreef 9, 1105 AZ, Amsterdam, The Netherlands.  
E-mail address: [j.g.tenbrinke@amc.nl](mailto:j.g.tenbrinke@amc.nl) (J.G. ten Brinke).

1997–2012. LIS gathers data on intentional and unintentional injuries sustained by visitors to the ED. LIS collects data from 14 hospitals in the Netherlands, resulting in a representative 12% sample of injury-related ED visits. Numbers were extrapolated to national estimates. In each year of the study, the Consumer and Safety Institute (Amsterdam, the Netherlands) calculated an extrapolation factor based on the population of the participating hospitals and the Dutch population in that year. The database makes it possible to measure and describe healthcare use during a specific period. A full description of the method has been published by the Consumer and Safety Institute and has been used previously.<sup>5,10,11</sup>

## 2.2. Selection of participants

All persons who attended an ED at one of the LIS hospitals were included. A spinal fracture was defined using the ICD 9th revision (1979).<sup>12</sup> In cases where a patient visiting the ED had multiple injuries, the primary diagnosis registered in the LIS was leading in identifying spinal fractures.

## 2.3. Methods and measurements

To calculate the admission rate, discharge was registered as either treated-and-released or treated-and-admitted. Age-specific rates were calculated in three age groups ( $\leq 24$ , 25–54 and  $\geq 55$ ). Numbers were presented for five-year time intervals between 1997 and 2012 (1997, 2002, 2007 and 2012). Incidence rates were expressed per 100,000 or per million person-years.

## 2.4. Outcomes

The primary outcome measures were incidence rates (per 100,000 or per million of the population) and age-specific numbers that were calculated for the three age groups at five-year time intervals.

## 2.5. Analysis

The overall incidence rate for the population was calculated using 'direct standardization' to correct for changes in demographics. Incidence rates were expressed per 100,000 or per million person-years.

## 3. Results

In the period from 1997 to 2012, a total of 95,933 ED visitors were diagnosed with a spinal fracture in the Netherlands. As shown in Table 1, the total number of ED visits related to a spinal fracture more than doubled from 4507 in 1997 to 9690 in 2012 (115% increase). The overall incidence rate for ED visits due to spinal fractures increased from 27 to 58 per 100,000 persons

throughout the study period (see Fig. 1). In total, 57,000 patients were admitted to hospital after being diagnosed with a spinal fracture at the ED in the period 1997–2012. The absolute number of hospital admissions increased over time from 2826 in 1997 to 5887 in 2012 (see Table 1). However, the hospitalization rate remained stable between 62 and 67% during the study period. In the five-year time intervals between 1997 and 2012, a total of 1052 patients suffered a spinal cord lesion. The absolute number of spinal cord lesions remained constant. The incidence rates varied between 13.8 per million person-years in 1997 and 20.3 in 2007 (see Table 1). Age-specific data are shown in Fig. 2. A decrease in spinal fracture-related ED visits was seen from 1997 to 2002 in all age groups. After 2002 an increase was seen in all age groups, with the biggest increase in the group aged 55+ (145%). Incidence rates were higher in young males and ageing females (see Fig. 3).

## 4. Discussion

From 1997 to 2012, the absolute number of patients who were diagnosed with a spinal fracture more than doubled. An increase similar in magnitude was also found by Oudshoorn et al.<sup>5</sup> who published a trend analysis of spinal fracture-related ED visits between 1986 and 2008, also using the Dutch Injury Surveillance System. However, they focused on patients aged over 65 years. During the period of time studied they saw an increase of 174% in ED visits due to spinal fractures. This is in line with the results of our study: we found an increase of 145% in the age group 55+. Spinal fracture-related ED visits are expected to increase because of increasing life expectancy, the increasing numbers of older fallers, and the increasing numbers of osteoporotic individuals in the population.<sup>13,14</sup> In this study, an increase in the incidence of spinal column fractures was seen in all age groups. An explanation for the increase in the total group can be explained by the increased use of computed tomography (CT) scans. This has led to a considerable increase in the numbers of spinal column fractures detected.<sup>15–18</sup>

A systematic review of overall incidence around the world has found great variation among nations in the rate of traumatic spinal column fractures – ranging from 3.6 to 195.4 patients per million – particularly between developed and developing nations.<sup>6</sup> In 2012, the incidence rate of spinal column fractures in our study was as high as 580 per million of the population. These numbers include osteoporotic spinal fractures. The fact that approximately 90% of spinal fractures are associated with osteoporosis<sup>19</sup> might explain the high incidence rate of spinal column fractures in our study.

Hospital admissions due to spinal fractures increased during the course of our study period from 17 per 100,000 inhabitants in 1997 to 35 in 2012. The Dutch study mentioned above showed an increase in admission rates for the population aged over 65 years from 32.6 per 100,000 inhabitants to 57.5 in the period from 1986 to 2008.<sup>5</sup> In Spain, spinal fractures led to a hospitalization rate of 27.6 per 100,000 inhabitants for individuals aged >30 years in the year 2002.<sup>20</sup>

The incidence of spinal cord injury found in this study for 2012 is 14.5 per million inhabitants. This is in line with figures found in other countries in Europe, which vary between 10.4 and 29.7 per million inhabitants.<sup>21</sup> Nijendijk et al. estimated the incidence of spinal cord injury in the Netherlands to be 11.7 per million inhabitants in 2010.<sup>4</sup> The incidence rate found worldwide varies widely.<sup>22</sup> In part, this is due to local demographic and socio-economic factors.<sup>6</sup> Other important factors seem to be the methodological differences in estimating incidence and the type of registration used.<sup>6,21,23</sup> Meaningful comparison of the incidence of spinal cord fractures across nations requires uniformity in statistical methods and inclusion criteria.

**Table 1**

ED visits, hospitalization numbers and spinal cord lesions due to spinal fractures in the Netherlands 1997–2012.

	1997	2002	2007	2012
ED visits (no.)	4507	4063	7040	9690
Incidence per 100,000	27	24	42	58
Male%	48%	50%	55%	48%
Hospitalization (no.)	2826	2479	4675	5887
(%)	63%	62%	67%	62%
Incidence per 100,000	17	15	28	35
Spinal cord lesion (no.)	215	262	332	243
(%)	4.8%	6.4%	4.7%	2.5%
Incidence per million	13.8	16.2	20.3	14.5

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