

Research article

# Incidence of spinal cord injuries in Constanta County (Romania) between 2017-2021

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**Abstract:** Background: The purpose of this study was to investigate cases of spinal cord injury (SCI) during the years 2017-2021, in Constanta County (Romania) to update the data on SCI and thus identify the SCI trends in this region of Romania. Methods:

The study retrospectively analysed patients with SCI in Constanța County, whose data (medical records) were provided to us by the Romania Motivation Foundation. This analysis was made for the period January 1, 2017 - August 31, 2021. Results: Ninety-six new traumatic cases of SCI were reported between 2017 and 2021 in Constanța County. It was found that the annual incidence is 2.48 per hundred thousand inhabitants. The male / female ratio was 5:1 and the mean age at injury was  $33.52 \pm 15.1$  ( $33.41 \pm 14.80$  for men and  $33.92 \pm 16.01$  for women). The most common cause of injury was unintentional fall (48.95%), followed by road accidents (39.58%), stab wounds (4.16%), gunshot wounds (3.12%) and injuries caused by diving (2.08%). Fifteen patients (15.62%) were quadriplegic, and 81 patients (84.37%) were paraplegic. The most common level of lesions was C4 (33.33%) in tetraplegics and T12 (25.92%) in paraplegics. The most common associated injury was head trauma (15.8%), followed by limb fractures (9.5%). The incidence rate of SCI in Constanta County increased ( $p < 0.05$ ) and the highest increase in the incidence of spinal cord injuries was observed among patients in the age groups 29 - 49 years.

**Conclusions:** Due to the existence of limitations, it is difficult to obtain accurate epidemiological data for SCI. Therefore, more studies are needed to provide a large amount of data and evidence.

Our data indicate the need to take measures both for prevention and to provide specialized care for this type of traumatic pathology.

**Keywords:** spinal cord injury; traumatic; incidence; unintentional falls; Constanta County (Romania).

## 1. Introduction

Spinal cord injury (SCI) is an injury to the spinal cord that causes changes in its function, which can be temporary or permanent. As a result, patients with SCI usually have severe neurological impairments and permanent disabilities [1]. According to the World Health Organization (WHO) [2], the term "spinal cord injury" refers to "damage to the

spinal cord that results from trauma (a car accident, falls) or disease." Spinal cord injury can also be caused by compression of the cord by a tumor, infection, or inflammation. Some patients have a smaller than normal spinal canal (spinal stenosis) and have a higher risk of spinal cord injury [3].

SCI is a devastating condition that often affects young and healthy people around the world. This debilitating condition not only generates enormous physical and emotional costs for individuals but is also a significant financial burden for the individual in particular and for society in general [4, 5, 6, 7].

This (SCI) has an impact, usually negative, on the patient's physiological, mental, and social condition [8]. In addition, spinal cord injury (SCI) is often followed by complications, which add to the detrimental effect of loss of motor, sensory, and autonomic function on a person's health, participation in social life, and quality of life [9, 10].

SCI can occur at any level of the spinal cord and can be grouped into two classes, namely complete or incomplete [1], and the causes of SCI are traumatic or non-traumatic:

- Traditionally, the traumatic injury of the spinal cord (SCI) is an injury caused by mechanisms external to the individual. In order of frequency with which they are encountered in practice, the causes of traumatic nature are: road accidents, falls (from heights or due to health problems), accidents with firearms or blades, accidents due to sports activities, jumping into the water.

- Non-traumatic causes: infections, poor blood circulation and tumors [11, 12].

SCI is considered to be a major public health problem worldwide, and the incidence of SCI varies greatly from region to region [13]. There is no reliable estimate of overall prevalence, but the estimated overall annual incidence is between 40 and 80 cases per million population. Up to 90% of these cases are due to traumatic causes, although the proportion of non-traumatic spinal cord injuries appears to be increasing [2]. Wyndaele M, Wyndaele JJ. [14] and Skolasky, et al. [15] sustain that the average annual incidence of SCI in developed countries ranges from 10.4 to one million people to 83 to one million people. In developing countries, SCI has a high incidence of 25.5 per million people per year [16, 17]. Most countries report an annual incidence of 15-30 million, and the prevalence ranges from 236 million in India to 1800 million in the United States. Epidemiology varies between regions due to cultural, economic, and social factors [6, 7].

Quantifying the incidence of spinal cord injuries is essential to understand its contribution to the estimates of people with disabilities. Knowing trends in the etiology of acute spinal cord injury would also help identify specific population groups at risk and guide preventive measures.

The analysis of the incidence of SCI in Romania is very useful for the decision makers, because depending on these data it will be possible to take a series of measures such as the number of beds on the specialized departments, the number of places in recovery sanatoriums, respectively the budget necessary for their financing. Such an analysis is also useful to follow the trend of the last decades - whether it is ascending, descending or stationary - so that, depending on this, the measures listed above can be implemented. Knowing the trends in the causes of SCI would also contribute to the identification of certain high-risk population groups, as well as to the identification of preventive measures.

The objective of this study was to assess the trends in the incidence and etiology of spinal cord injuries in Constanța County from January 1, 2017 to August 31, 2021.

## 2. Results

### 2.1 Incidence

Ninety-six new cases of traumatic SCI were reported between January 1, 2017 and August 31, 2021, in Constanta County. The estimated annual incidence of traumatic LS in the county has been found to be 2.48 per one hundred thousand inhabitants. The estimated annual incidence rate was 1.16 cases for one hundred thousand people in 2017, 2.59 cases for one hundred thousand people in 2018, 2.59 cases for one hundred thousand people in 2019, 2.85 cases for one hundred thousand people thousands in 2020 and 3.24 cases for one hundred thousand people in 2021 Figure 1.

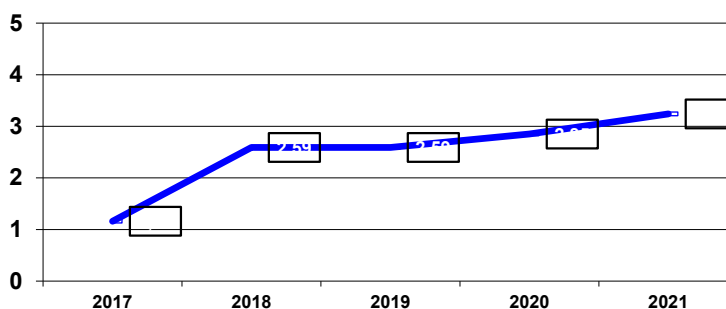


Figure 1. Temporal trends in acute traumatic spinal cord injury incidence rate per one hundred thousand persons in the Constanta County (Romania), 2017-2021

Our data shows that the number of cases of SCI increased significantly from 2017 to 2021, from 9 cases in 2017 to 25 cases in 2021 ( $p < 0.01$ ). The increases in SCI cases are significant only compared to 2017, as can be seen in Table 1.

**Table 1.** Monthly mean SCI cases per every year and comparison with the 2017<sup>th</sup>

Year	Monthly mean SCI	Comparison	p value
2017 (N = 9)	$0.75 \pm 1.35$	2017-2018	$< 0.05$
2018 (N = 20)	$1.66 \pm 1.15$	2017-2019	$< 0.05$
2019 (N = 20)	$1.66 \pm 1.15$	2017-2020	$< 0.05$
2020 (N = 22)	$1.83 \pm 1.11$	2017-2021	$< 0.01$
2021 (N = 25)	$3.12 \pm 0.83$		

The highest value of SCI is recorded in August (13.54%), followed by April (12.50%). And the lowest value of SCI incidence is recorded in November (4.16%) Figure 2.

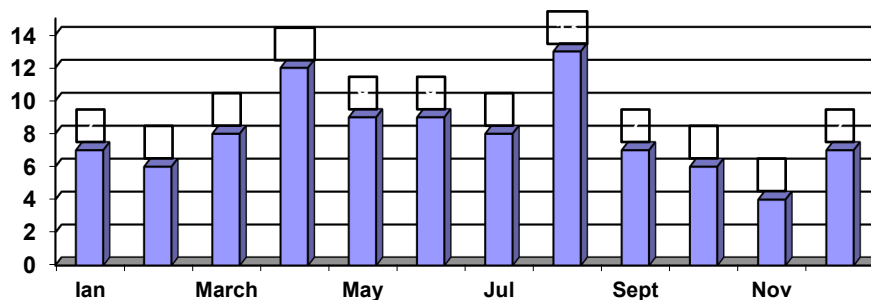


Figure. 2 The number of SCI cases for each month of the year

### 2.2 Sex and age

There were 80 men and 16 women; the male-female ratio was 5:1. The mean age at injury was  $33.52 \pm 15.1$  ( $33.41 \pm 14.80$  for men and  $33.92 \pm 16.01$  for women). The age group with the most frequent injuries was 20-29 years, followed by 30-39 years Figure 3.

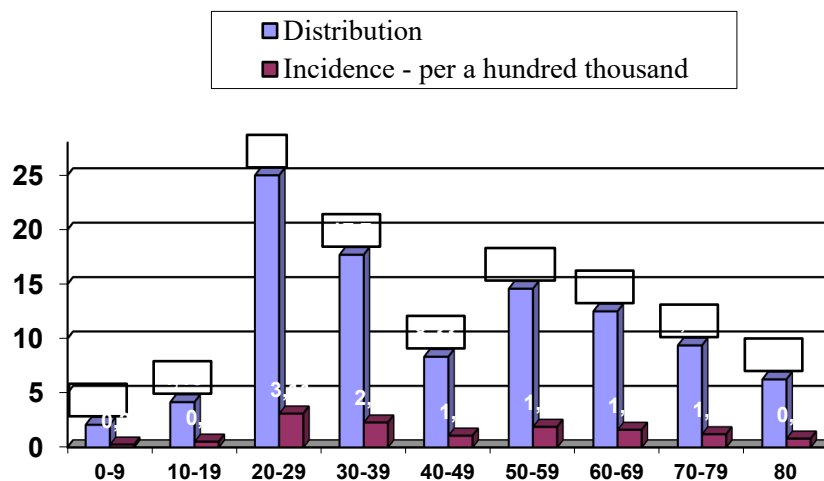


Figure. 3 Distribution and incidence of SCI by age groups

### 2.3 Causes of SCI

The most common cause of injury was the unintentional fall (48.95%), followed by road accidents (39.58%), stab wounds (4.16%), gunshot wounds (3.12%) and injuries caused by jumping into water/diving (2.08%) Figure 4.

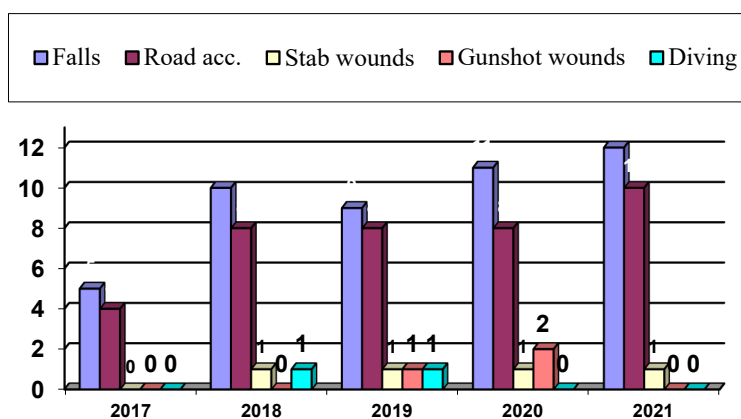


Figure. 4 Trends in etiology of acute traumatic spinal cord injury in the Constanta County (Romania)

Falls were more prevalent in the first, second and seventh decades of age. Road accidents were more common in middle-aged groups. In the 80's the frequency of falls and road accidents was similar Figure 5.

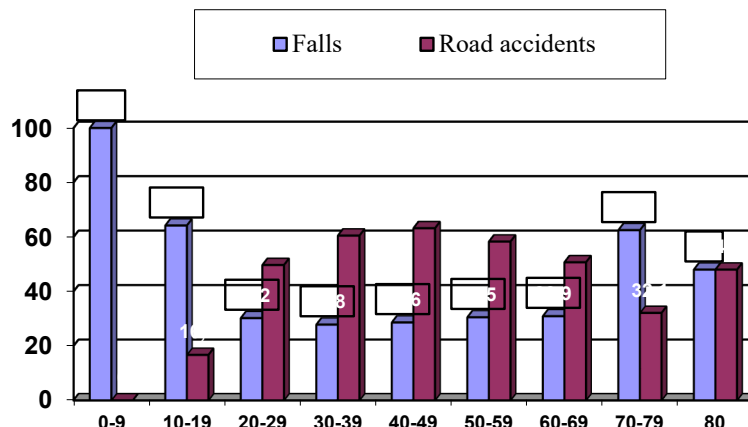


Figure. 5 Age and major cause of SCI

### 2.4 Nivel SCI

Fifteen patients (15.62%) were quadriplegic, and 81 patients (84.37%) were paraplegic. The most common level of injury was C4 (33.33%) in tetraplegics and T12 (25.92%) in paraplegics Figure 6.

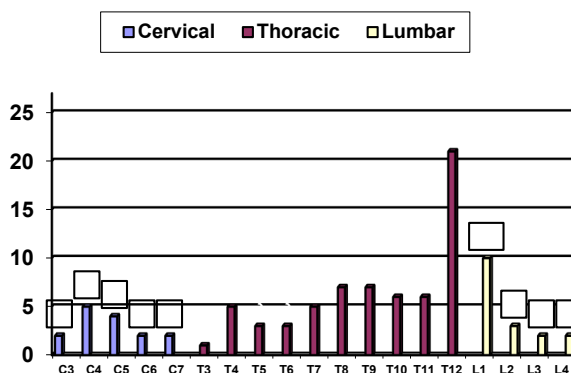


Figure. 6 SCI level

### 2.5 Associated trauma

In 69.4% of cases, no trauma or associated injuries were identified. The most common associated injury was head trauma (15.8%), followed by limb fractures (9.5%), hemothorax (4.8%) and pneumothorax (0.5%).

### 3. Discussion

We evaluated the trends in our county in terms of the incidence and etiology of acute traumatic lesions of the spinal cord from January 2017 to August 2021.

SCI affects the physical, social and psychological well-being of patients and places a substantial burden on health systems, families and communities. An understanding of the incidence of SCI will enable health care systems to implement preventive strategies and allocate resources appropriately for disease management. Preventive measures start to work before accidents occur and involve education, legislation, enforcement plus special engineering and technological measures - primary prevention. And it continues with secondary prevention which is the responsibility of the entire health system - first aid,

recovery, emergency hospitalisation of the injured person. Tertiary prevention continues for the rest of the injured person's life.

Our data show that the incidence of SCI increased significantly from 2017 to 2021 ( $p < 0.01$ ), but this increase is only significant compared to 2017.

The explanations for this significant increase in SCI cases between 2017 - 2018 could be due to: an increase in the proportion of the elderly population, an increase in the number of cars and possibly an increase in the number of people employed in the construction sector. Another explanation could be the refinement of data collection methodology for this traumatic pathology. Analyzing the worldwide incidence of SCI in 2010 overtime, van der Berg found the highest incidence in Canadian studies and the lowest in the Netherlands, Turkey and Australia, and the highest number of SCI cases are still seen among young adults, like in our study. Van den Berg analyzes the incidence of SCI in 2010 worldwide as well as the methodological differences and finds that the results reveal a variety of timescale variation in the incidences of spinal cord injury. The main limitations of the study are the various factors that affect the analysis, such as the case sources, injury stage, and population-age intervals [28]. The annual incidence found by us for Constanta county of 2.48 per hundred thousand inhabitants corresponds to an incident of 2.48 cases/million inhabitants, which means that compared to other regions in the world is:

- lower than the central region of Portugal (58 per million), and Olmsted County in Minnesota (54.8 per million) [19].

- larger than the Rhone-Alpes region of France (12.7 per million), Aragon, Spain (12.1 per million), Southeast Turkey (16.9 per million), and Stockholm, Sweden (19.5 per million) [19].

There are not enough recent studies on the SCI Incidence for Romania or other countries, searching the international databases I found only one study from 2015, which proposes the implementation of national records for improving the SCI data in many countries especially in those from low development or emerging areas [29].

Globally, the incidence of SCI has been reported to be between 6 and 56.1 / million [2, 4, 6 - 8, 12, 14, 16, 17, 20 - 22]. And in the case of our statistics, if we adopt the reporting method used in the other studies, we obtain incidents between 11.6 and 32.4 cases/million inhabitants, which are in line with the average values in the literature. Van den Berg analyzes the incidence of SCI in 2010 worldwide as well as the methodological differences and finds that the results reveal a variety of timescale variation in the incidences of spinal cord injury. The main limitations of the study are the various factors that affect the analysis, such as the case sources, injury stage, and population-age intervals [28].

As for the male-female ratio, it is 5:1 in our study, which is closer to that of Tehssaloniky, Greece 7:1 [19], but higher than that of Canada, USA or Australia. Most studies have shown that traumatic injuries are common in the male population, with a male-to-female ratio of at least 2: 1, sometimes much higher [6, 8, 11, 21-23].

Possible explanations for these data could be higher trauma risk behaviours with more relevant exposures to situations that increase the risk of injury (i.e. alcoholism, higher percentage of men employed in construction, playing extreme sports).

The age segments with the highest share of SCI were in our case those of 20-29 years and 30-39 years. In the literature we also find that men are most exposed to the risk of spinal cord injury in young adulthood (20-29 years), but also at ages over 70 (this is due to several factors, including: impaired mobility and age-related coordination, cognitive impairment and accumulation of medical problems and their associated medications). Women are most at risk in adolescence (15-19 years) and after the age of 60 [7, 8, 21, 24, 25].

The American Association of Neurological Surgeons states that road accidents are the leading cause of SCI in the United States in younger people, while falls are the leading cause of SCI in people over the age of 65. Acts of violence and sports / recreational activities are other common causes of these injuries [11]. The results of other studies have

shown the same [8, 12, 22, 26, 27] - the main cause of SCI was road accidents, followed by unintentional falls.

Instead, our study showed that the main cause of SCI is unintentional falls. This could be due to the pandemic restrictions of the last two years - the obligation to stay longer at home, could lead to more accidents compared to the pre-pandemic period, through less effective neural activation and changes in intrinsic muscular properties. But this is a hypothesis that will have to be verified by future research.

Our data show that in the 70-79 age group and 80+ the most common causes are falls from the same level due to landslides and / or falls on or off the ladder, unlike the younger age groups where in the first places are the falls from one level to another. The second cause of SCI, with a share of 39.58%, is, in our study, traffic accidents. Their highest frequency is found in the younger age groups - between 20 and 60 years. The distribution of causes by age groups shows that there is a stronger association of external causes related to road accidents and younger ages, while the association of injuries with falls is stronger among those older than 65 years. The diversity of causes also tends to be greater among young people than in the elderly. Dynamics that we have encountered also in other studies [6 - 8, 12, 17, 20 - 24, 27].

According to the results of the present study, the most common injury levels were C4 and C5 among tetraplegics and T12 and L1 among paraplegics. Cases with paraplegia were five times more common than those with tetraplegia. A much higher frequency than those reported in other studies [22]. Fifteen patients (15.62%) were quadriplegic and 81 patients (84.37%) were paraplegic. In our study we found that the frequency of SCI differs depending on the months of the year, the highest frequency being in August followed by April. Karacan, I., et al., [2000] found also that the highest number of SCI cases is registered in summer (32%), and in spring it occupies the second place with 27.6% of cases.

Our study has a few limitations, namely - due to the current pandemic context we did not have access to the archives of hospitals in the county, the information being provided only by the reports of the "Motivation" Foundation Romania. Another limitation is related to incomplete records and uneven documentation of data, due to the lack of an ICS registry that would facilitate the provision of a national database for epidemiological and research purposes. Due to these shortcomings, the conclusions cannot be generalized to other regions of the country.

## 4. Materials and Methods

### 4.1 Procedures

The data analysis was performed between January 1 and August 31, 2021, on patients with SCI in Constanta County - Romania. Medical charts were collected by hospital medical staff based on the American Spinal Injury Association Impairment Scale (ASIA) international protocol. All these data were then transmitted to the Motivation Romania Foundation, which made them available for study. These data refer to the age, sex and type of injury of the person. This study also calculated and compared the annual incidence from 2017-2021.

Inclusion criteria: all patients diagnosed with traumatic SCI aged over one month were included in the study.

Exclusion criteria: patients diagnosed with SCI who died before leaving hospital were not included in the study.

### 4.2 Statistical analyses

Data were examined for normality of distribution and analyzed descriptively in terms of frequency and percentages for categorical data and mean  $\pm$  standard deviation for continuous data. Student's t test was used to calculate the differences between patient groups and statistical alpha significance level was accepted as  $p < 0.05$ .

The number of inhabitants to which we will report is 770,783, this representing the total population of the county estimated at the last census, in 2014, according to the Statistical Yearbook of Constanta County [18].

The study was approved by the Ethical Committee of the Balneal and Rehabilitation Sanatorium of Techirghiol, Rehabilitation Division (approval no. 1734 from 02.02.2022).

## 5. Conclusions

**Due to the existence of limitations, it is difficult to obtain accurate epidemiological data for SCI. Therefore, more studies are needed to provide a large amount of data and evidence.**

**Our data indicate the need to take measures both for prevention and to provide specialized care for this type of traumatic pathology.**

**Author Contributions:** conceptualization, DVG, NDC, CO and AO ; methodology, EVI.; software, AEC and DD; validation, EVI and DVG; formal analysis, ADG; investigation, OCT ; resources, LES, EVI and RP; data curation, NDC; writing—original draft preparation, EVI; writing—review and editing, CO; visualization, EVI; supervision, GCM; project administration, DVG and NDC. All authors have read and agreed to the published version of the manuscript. *All authors had equal contribution in this paper.*

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**Institutional Review Board Statement:** The study was approved by the Ethical Committee of the Balneal and Rehabilitation Sanatorium of Techirghiol, Rehabilitation Division (approval no. 1736 from 02.02.2022) and also by the Foundation Motivation Romania's manager (121409/09/2021), complied with the revised ethical guidelines of the Declaration of Helsinki.

**Informed Consent Statement:** Informed consent was obtained from the subject involved in the study.

**Data Availability Statement:** Not applicable.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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