

Examining the Incidence of Pediatric Traumatic Spinal Cord Injury in North America: A Systematic Review

Dayton J. Kelly, MSc¹; Adam A. Arthurs, MD^{1,2}; Alanna Campbell¹; Dominique R. Ansell, MD¹; Melanie Squarzo, MD¹; Vanessa K Noonan, MSc, PhD, PT^{2,3}; Nancy P. Thorogood, PhD³; Brian Kwon, MD, PhD²; Marcel F. Dvorak, MD²; Nawal Farhat PhD^{1,2}; Allison W. Willis, MD, MSc^{1,2}; Lisa J. W. Liu, MPH^{1,2}; Jacquelyn J. Cragg, MPH, PhD^{1,2}; James A.G. Crispo, PhD^{1,2}

¹Northern Ontario School of Medicine, Sudbury, Canada; ²University of British Columbia, Vancouver, Canada; ³Praxis Spinal Cord Institute, Vancouver, Canada; ⁴TruEffect Inc., Sudbury, Canada; ⁵University of Pennsylvania Perelman School of Medicine, Philadelphia, USA

Background

Traumatic spinal cord injury (tSCI) is a rare condition that can lead to significant reductions in life expectancy and quality of life. It is characterized by traumatic lesions to the spinal cord and may result in varying severity of motor, sensory, and autonomic deficits. These injuries are particularly important among pediatrics as individuals may live long periods of time with their injury and may have limited participation in activities of healthy development. Limited data is available regarding the epidemiology of tSCI in the pediatric North American population.

Objectives

Use a systematic review approach to summarize:

1. Reports of the incidence of tSCI in North American pediatric populations;
2. Reported estimates grouped by age, sex, cause of injury, and level of injury.

Methods

Study Design & Setting

Systematic review summarizing primary articles reporting tSCI incidence within a pediatric population (≤ 20 years) in North America in the year 2010 or later.

Inclusion & Exclusion Criteria

Incidence estimates relying on self-report data, from populations < 100 persons, or that examined only a subtype of tSCI were excluded.

Search Strategy & Data extraction

We searched (from July 2020 to June 2022) the Cochrane Database of Systematic Reviews, the Cumulative Index to Nursing and Allied Health, MEDLINE, PubMed, and Web of Science. Screening (title and abstract; full text) was completed by two independent reviewers using DistillerSR (Evidence Partners, Ottawa, Ontario, Canada). Reviewers then used a standardized data abstraction form to extract study data. Risk of bias of included studies was assessed using an established tool created by Hoy et al. 2012.

Study Outcomes

Our primary outcome was incidence of tSCI. Secondary outcomes included age-specific, sex-specific, cause-of-injury-specific, and level-of-injury-specific incidence of tSCI.

Statistical Analyses

Incidence estimates were converted to annual incidence proportion per million at risk and summarized using descriptive statistics.

Results

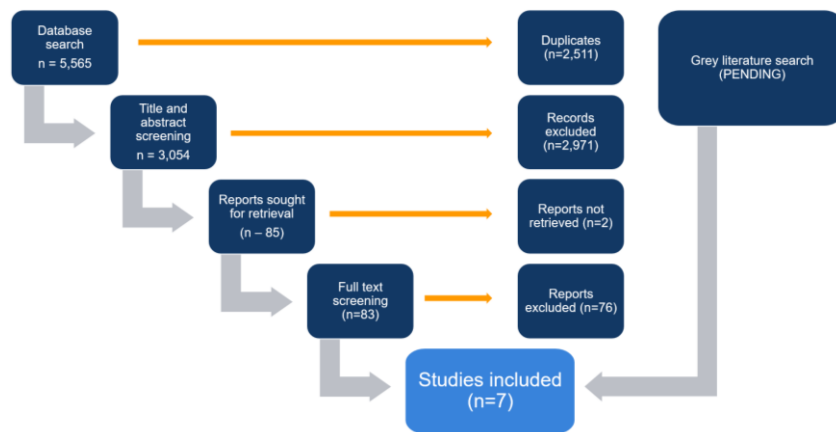


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart of the study selection process.

Table 1. Extracted all-pediatric age, all-sex, all-cause, all-level of injury incidence estimates from included studies (7 of # extracted incidence estimates).

Article	Population	Setting of detection	Age	Sex	Annual Incidence Proportion
Williams et al., 2018	United States (2006, 2009, 2012)	Hospital Admission	0-20	M+F	6/1,000,000
Piatt & Imperato, 2018	United States (1997)	Hospital Admission	0-17	M+F	25/1,000,000
	United States (2012)	Hospital Admission	0-17	M+F	14/1,000,000
Saunders et al., 2015	South Carolina, United States (1998-2012)	Hospital Admission	0-15	M+F	10/1,000,000
Piatt, 2015	United States (2009)	Hospital Admission	0-20	M+F	24/1,000,000
Selvarajah et al., 2014	United States (2007-2010)	Emergency Department	0-17	M+F	17.5/1,000,000
Crispo et al., 2022	United States (2016)	Hospital Admission	0-20	M+F	14.8/1,000,000

Table 2. Median and range of select subgroups of included incidence estimates.

SEX	Annual incidence Proportion per Million at Risk
Male (n=13 estimates)	22 (range: 3.0 – 91)
Female (n=13 estimates)	11.2 (range: 1.5 – 62.5)
AGE	
<15 years (n=16 estimates)	10.6 (range: 1.5 – 22)
≥ 15 years (n=6 estimates)	64.3 (range: 38.2 – 91)
Mechanism of Injury	
Unknown (n=2 estimate)	4.5 - (0-14 years); 27.6 - (15-17 years)
Motor vehicle crash (n=2 estimate)	2.3 - (0-14 years); 19.2 - (15-17 years)
Fall (n=2 estimate)	1.8 - (0-14 years); 8.9 - (15-17 years)
Level of Injury	
Cervical (n=2 estimate)	4.2 - (0-14 years); 25.1 - (15-17 years)
Thoracic (n=2 estimate)	1.7 - (0-14 years); 14.4 - (15-17 years)
Lumbosacral (n=2 estimate)	1.1 - (0-14 years); 8.8 - (15-17 years)
Multiple site (n=2 estimate)	1.4 - (0-14 years); 11.7 - (15-17 years)

Conclusions

Our findings show that tSCI is relatively rare among children living in North America. Incidence rates are age and sex dependent. Future epidemiological studies are necessary to better approximate the true burden of tSCI among children and inform injury prevention efforts.