

Table 4: Survival of spinal cord injury (one-year and ten-year mortality) by Region and Author(s) of published data

Region	Country	Author(s) of published data	Observation period	Survival		Comments
				1-year mortality	10-year mortality	
Asia, East						
	China, Tianjin	Ning ¹	2004-2008	1.4% (n=12)		All deaths occurred during hospitalisation, patients had cervical TSCI. Among the 12 patients, 42% (n=5) were 60 years or older, 10 were males and 11 died of respiratory failure.
	Taiwan	Chen ²	1992–1996	6% (n=73)		Of those who died in hospital, 40 died of respiratory failure, 22 of associated injuries, 7 died of complications (renal failure, pressure sore, gastrointestinal bleeding) and 3 committed suicide.
	Taiwan	Chen ²	1992–1996	11% (n=33)		Of the 33 elderly patients who died in hospital, 17 died of respiratory failure, 12 of complications and 3 committed suicide.
	Taiwan	Yeh ³	1977-1989	5.8% (n=94)	n/r*	Of those who died, 26.5% had complete lesions in the cervical region and 3.4% were incomplete. 3% had complete paraplegia and 1.5% were incomplete.
	Taiwan (Hualien County)	Lan ⁴	1986-1990	10.1% (n=10)	n/r	Nine cases were tetraplegic, 6 of these died from respiratory failure during acute care. The paraplegic patient died 8 months post injury from pressure sore- related septicaemia.
Asia, South						
	Bangladesh	Hoque ⁵	1994-1995	7% (n=18)	n/r	The leading cause of death resulted from respiratory complications and these deaths occurred in the very early period of admission.
	India (Haryana)	Singh ⁶	2000-2001	4% (n=21)	n/r	16 of the cases that died were of cervical spine injury with complete neurological deficit.
	Pakistan	Masood ⁷	2003-2007	10.7% (n=23)	n/r	Died during hospitalisation.
Asia, Southeast						
	Thailand (Chiang Mai)	Kovindha ⁸	1985-1991	8% (n=31)	n/r	Four of the cases who died were high tetraplegics who refused treatment. 23 cases died during acute stage and 4 cases after 6 weeks of admission.
	Thailand (Bangkok)	Parajareya ⁹	1989-1994	16% (n=35 died in acute care hospital)	n/r	Respiratory complications accounted for 89% of total deaths (n=219). 68% of the deaths had complete cervical injury.

Australasia

Australia	O'Connor ¹⁰	1986-1998	5.7%	14.3%	110 deaths occurred in the first two months.
Australia (NSW)	Soden ¹¹	1955-1994	n/r	SMR 2.3	Total of 195 deaths, expected 85 deaths. Study cohort was 335 individuals with SCI who had died. Leading causes of death were pneumonia and influenza (n=27) and septicaemia (n=25).
Australia (NSW)	Yeo ¹²	1955-1994	n/r	9% (n=132 died within 18 months; 12% with tetraplegia and 5% with paraplegia)	Total 1,453 SCI patients, 55% with cervical lesions and 45% with thoracic/lumbar lesions. A further 14% (n=197) died after 18 months; 60% of these deaths occurred in people with cervical lesions and 40% with thoracic/lumbar lesions.
Australia (Victoria)	Cheshire ¹³	1959-1966	6.1% (n=20)	6.1% (n=20)	Acute deaths from SCI <60 days; chronic deaths from SCI > 60 days post accident. Acute respiratory deaths were responsible for 70% of the SCI deaths.

Europe, Eastern

Russia (Novosibirsk)	Silberstein ¹⁴	1989-1993	17% (overall mortality, n=33) and 14% (postoperatively, n=27)	n/r	Most patients who died (85%) had injuries of the cervical spine at the level of C4 and above.
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Europe, Western

Denmark	Hartkopp ¹⁵	1953-1971 and 1972-1990	n/r	14.5% (n=52 out of a total of 359; SCI at first inclusion period, dead at 1973): 16.4% (n=87 out of a total of 529; SCI at second inclusion period, dead at 1992)	Most common causes of death was lung disease, such as pneumonia, suicide and ischaemic heart disease. Among tetraplegic individuals, 76% of deaths were caused by lung disease and pneumonia.
Greece (Thessaloniki)	Divanoglou ¹⁶	2006-2007	18.8% (n=12) compared with 0% in Stockholm		Major cause of deaths in Thessaloniki was pneumonia +/- sepsis (50%) followed by UTI and cardiac arrhythmias.
Israel	Catz ¹⁷	1959-1992	4.8% (n=12)	19% (n=47)	n/r
Israel	Zeilig ¹⁸	1948		50% (n=10) died 50 years later, average age at death was 60 years.	Participants (20: 19 males, 1 female) with SCI that occurred during the 1948 Israel War of Independence. No regular follow-up during the first 20 years post injury. Mean age at injury was 22.6 years. No individuals with complete tetraplegia. There were 13 paraplegia ASIA A cases, 4 paraplegia ASIA C-D and one tetraplegia ASIA C.
Israel	Tchvaloon ¹⁹	1962-2004		7.1% (n=10)	143 SCI patients following road accidents. Age at injury 37.8 years (mean). 43% were cervical, 49.3% thoracic and 7.7% lumbar. 41% were complete at admission to rehabilitation (Frankel grade A). Maximum survival was 43.3 years after injury.

	Italy	Pagliacci ²⁰	1997-1999		16% (n=82) after post-discharge; mean time of 3.8 years. 7% (n=36) had died prior to the survey.	511 persons out of 608 first-admission SCI patients who were discharged between 1997-1999 from 7 spinal units and 17 rehabilitation units were located and surveyed.
	Norway	Lidal ²¹	1961-1982	n/r	36.7% (n=142)	142 of 387 patients with traumatic SCI died during the observation period. The main causes of death were pneumonia/influenza (16%), ischaemic heart diseases (13%) and urogenital diseases (13%). Main risk factors for higher deaths were: higher age at injury, tetraplegia and functionally complete SCI.
	Norway (Hordaland and Sogn og Fjordane)	Hagen ²²	1952-2001	21% (n=83)	10.8% Median (Range 7.4%-33.3%)	First year mortality differences may be due to a combination of societal variables (car use, age of population) and emergency medicine procedures. Suicide was relatively high. Main causes of death after TSCI were: cardiovascular (39%), respiratory disease (35%), neoplasm 17%, nervous system disease (17%), genitourinary disease (12%), suicide and accidental poisoning (6%)
	Portugal (Coimbra)	Martins ²³	1989-1992	56% (n=223)	n/r	398 new cases of SCI were identified for the period 1998-1992. Of these, 64 (16%) were dead on arrival at hospital, 159 (40%) died during acute care, and 13 died after several months.
	Sweden (Stockholm)	Divanoglou ¹⁶	2006-2007	0% deaths in Stockholm compared to 18.8% (n=12) in Greece		Major cause of deaths in Thessaloniki was pneumonia +/- sepsis (50%) followed by UTI and cardiac arrhythmias.
Latin America, Tropical	Brazil	Brasil ²⁴	1986-1995	10.9% (n=18)	n/r	164 patients with traumatic SCI. Of these 18 died (15/100 cervical SCI, 2/27 thoracic and 1/37 thoraco-lumbar). Highest death rate was in the cervical complete cases.
	Brazil	Neumann ²⁵	2001-2005	26.2% died during acute care.		84 patients with cervical SCI. 26% of patients with complete cervical lesion (n=28) died in hospital. Number dropped to 5.2% when cases with significant brain injury or haemodynamic instability were excluded.
	Brazil (San Paulo)	Barros ²⁶	1982-1987	21% (n=90)		In hospital deaths, mostly by respiratory failure
North America, High Income	Canada (Ontario)	Furlan ²⁷	2007	8% (n=37)	n/r	The vast majority of deaths in the acute and chronic stages following SCI were attributed to cardiac arrhythmias (37.8%), respiratory complications (37.8%) and coagulation-related complications (10.8%).

Canada (Ontario)	Couris ²⁸	2003-2007	12% (n=109)		Of the 109 patients who died during their index admission, 92 (84%) were aged 60 or older, 79 (72.5%) were men, 77 (70.6%) were injured after a fall, 91 (83.5%) had a cervical SCI and 55 (50.5%) scored 0 on the Charlson co-morbidity index.
Canada (Toronto)	Kattail ²⁹	1996-2007	4% (Note: included 272 cases with no spinal cord lesion)	n/r*	569 patients (mean age of 50 years) with acute spinal trauma. This included 268 cases with ASIA E and 4 Unknown ASIA.
Canada (Ontario)	Pickett ³⁰	1997-2001	In Hospital Mortality 8% (n=12)		Mortality was 18% in patients over 60 years compared to 5% in patients younger than 60 years. SCI was the direct cause of death in 9 cases (75%) all of which involved C1-C2 or C2-C3 fracture-dislocations.
Canada (Alberta)	Hamilton ³¹	1975-1988	n/r	3% (n=6)	Of the 174 paediatric cases, 6 died (5 had complete cord injuries).
Canada (Manitoba)	Hu ³²	1981-1984	n/r*	10.7% (n=13)	Retrospective cross-sectional study of 122 patients with neurological injury. Mortality increased with increasing age at injury.
USA	Shavelle ³³	1973-2003	61% (n=491)	n/r	Study group: 810 persons injured at 20 years of age and older who were ventilator dependent at discharge from rehabilitation. 319 persons survived the first year. Of the group where cause of death was known (69%), 31% of deaths were caused by pneumonia and other respiratory diseases.
USA	Burney ³⁴	1982-1989	17% (Acute care deaths due to SCI with other injuries); 6.9% (Acute deaths with only SCI)	n/r	Based on 2,946 patients entered in the Major Trauma Outcome Study (MTOS) database
USA	Samsa ³⁵	1940-1987	n/r	15%	Population of veterans with traumatic SCI (n=13,519)
USA	Stover ³⁶	1984	n/r	14%	Based on entire National Database (approx. 10,000 plus cases). Incomplete paraplegics have the highest survival rate, followed by complete paraplegics, incomplete tetraplegics and complete tetraplegics. Leading causes of death were pneumonia, septicaemia and pulmonary emboli.
USA (Southeast)	Krause ³⁷	1997-2005	n/r	16.2% (n=225)	Participants: 1389 adults with traumatic SCI occurring at least 1 year prior to the study in late 1997 and early 1998
USA (South Carolina)	Saunders ³⁸	1981-1998	44% (n=1,894)	n/r	Of 4,353 persons with SCI, 40% died either immediately or shortly after injury. Of 2,779 people admitted to hospital, 5.5% died in hospital. Traumatic Brain Injury and one or more concomitant injuries were the variables most associated with mortality in the early phase. Within hospital, sustaining a cervical injury, having a high AIS score (>4) and having a complete neurological injury level increased mortality.
USA (Southeast)	Krause ³⁹	1997-1998		14.8% (n=179)	Participants: 1,209, mean age at injury was 32 years, with average of 9 years since their injury. 54% had cervical injuries.

	USA (California)	Krause ⁴⁰	1996	n/r	16% (n=52)	278 people out of 330 with SCI in 1985 were alive in 1996.
	USA (Oklahoma)	Price ⁴¹	1988-1990	8% (n=30)	n/r	376 persons were hospitalised with SCI. Of these, 30 died during hospitalisation and rehabilitation.
	USA (Maryland)	Bohlman ⁴²	1950-1972	37% (n=67)	n/r	180 patients with cervical level SCI, 113 survived for at least one year. 86 of these patients had follow up for 2 to 16 years.
	USA (California)	Kraus ⁴³	1970-1971	48.3% (n=299 out of 619 cases)	n/r	Deaths occurred during the period from injury date to hospital discharge. 79% of the cases were dead on arrival, the remaining 21.4% died on ward.
	USA (California)	Kraus ⁴⁴	1970-1971	n/r	53.9%	Five to six-years after SCI, 35 out of 320 (or a total of 334 persons died out of 619 cases) persons had died. Cause of death in the 35 cases was primarily due to cardio-respiratory or renal complications.
Sub-Saharan Africa, East						
	Malawi (Blantyre)	Brown ⁴⁵	1972-1973	12%	n/r	n/r
Sub-Saharan Africa, Southern						
	Zimbabwe	Levy ⁴⁶	1988-1994	49% (n=67)	n/r	136 people with traumatic SCI were sent to rehabilitation centres. Ten died in the rehabilitation centre from septicæmia due to pressure sores. Two-thirds who died were tetraplegics. A further 57 had died before one year. Two-thirds who died were tetraplegic.
	South Africa (Cape Province)	Key ⁴⁷	1963-1967	13% (38 out of 300 SCI cases died in hospital)	n/r	63% who died while in hospital were tetraplegics. Another 3% (n=9) died after discharge primarily from bed sores (septicæmia) and pneumonia.
Sub-Saharan Africa, West						
	Nigeria	Nwuga ⁴⁸	1974-1977	84% (n=64)	n/r	12 people out 76 SCI cases survived. C4-C8: 28.2 (Mean number of days survival post discharge) T1-T6: 62.7 (Mean number of days survival post discharge) T7-T12: 68.9 (Mean number of days survival post discharge) L1-S5: 190.7 (Mean number of days survival post discharge)
	Nigeria (Enugu)	Nwankwo ⁴⁹	1996-2000	11% (n=8 out of 74 patients)	n/r	All were complete tetraplegics, died of respiratory insufficiency within one week of admission.
	Nigeria (Enugu)	Nwadinigwe ⁵⁰	1996-2001	34.3% (n=36 out of 104 patients)	n/r	Of those who died, 89% had cervical spinal injury and died mainly from respiratory failure.
	Nigeria (Lagos)	Obalum ⁵¹	1992-2006	18% (n=82)	n/r	39% of the deaths (n=32) were due to respiratory failure. Associated head injuries accounted for 29% (n=24) deaths. Most deaths (72%) were of patients with cervical spine injury.
	Nigeria (Ilorin)	Solagberu ⁵²	1995-1999	26% (n=10 out of 39)	n/r	Of those who died, 70% had cervical SCI. All died within 12 days.

			patients)		
Nigeria (Plateau State)	Igun ⁵³	1984-1997	26% (n=18)	n/r	68 cases were treated for SCI. At 30 days post injury, 18 people had died; 67% had cervical injuries and 33% had thoraco-lumbar injuries. A total of 5 patients died from thromboembolic disease, two from acute ascending cord oedema in tetraplegic patients and 11 from seticaemia from bed sores.
Nigeria (Zaria)	Iwegbu ⁵⁴	1973-1982	25% (n=12)	n/r	25% of 48 patients died within 10 weeks of admission. Of 6 admitted tetraplegia cases, only one survived. 10 of the 12 who died had bed sores at time of death. All had urinary infections.
Sierra Leone	Gosselin ⁵⁵	2002-2004	29% (n=7 out of 24 patients died in hospital)	83%	24 patients were admitted with SCI. 7 died while in hospital and a further 13 died after 10 to 28 months after discharge (4 out of 24 patients were lost to follow-up).

* Not reported

** Source/: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, /World Population Prospects: The 2008 Revision/, <http://esa.un.org/unpp>

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