

Suicide Following Spinal Cord Injury

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Summary

A study of 9135 persons injured between 1973 and 1984 and treated at any of 13 model regional spinal cord injury (SCI) care systems was conducted. Follow-up ended December 31, 1985, by which time 50 persons had committed suicide (6.3% of deaths). Based on age-sex-race-specific rates for the general population, 10.2 suicides were expected to occur. Therefore, the standardized mortality ratio (SMR) for suicide was 4.9. The highest SMR occurred 1 to 5 years after injury. The SMR was also elevated for the first post-injury year, but was not significantly elevated after the fifth year. The SMR was significantly elevated for all neurological groups, but was highest for persons with complete paraplegia. The SMR was highest for persons aged 25 to 54 years, but was also elevated for persons aged less than 25 years. Suicide was the leading cause of death for persons with complete paraplegia and the second leading cause of death for persons with incomplete paraplegia. The most common means of committing suicide was by gunshot. These figures demonstrate the need for increased staff, patient and family awareness of this problem, and improved follow-up assessment and psychosocial support programmes.

Key words: *Spinal cord injury; Suicide; Mortality; Epidemiology*

There have been numerous studies of causes of death following spinal cord injury (SCI) published during the past three decades (Nyquist, 1960; Tribe, 1963; Freed *et al.*, 1966; Nyquist *et al.*, 1967; Wilcox *et al.*, 1972; Geisler *et al.*, 1977; Ducharme *et al.*, 1981; Le *et al.*, 1982; Frisbie *et al.*, 1983; Geisler *et al.*, 1983; DeVivo *et al.*, 1989). Unfortunately, differences in study population characteristics, research design and analytic procedures have led to somewhat inconsistent findings and considerable difficulty identifying trends in causes of death over time. Moreover, because most studies include only a few deaths from any given cause, risk factor analyses for specific causes of death have generally been precluded.

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As life expectancies continue to increase, one cause of death that appears to be occurring more often in recent years is suicide. For example, only one suicide occurred among 150 deaths reported by Tribe in 1963, and no suicides occurred among 54 deaths reported by Freed *et al.* in 1966. However, Wilcox and Stauffer reported in 1972 that 18% of deaths were due to suicide, while in 1982, Le and Price reported suicide as the cause of death for 21% of their series. Geisler *et al.* also reported an increase in suicides from 4.2% of deaths in their 1977 report to 10.8% in their 1983 report.

In recognition of this apparent trend, the primary objective of this study was to determine the percentage of deaths resulting from suicides during the first several years following SCI and to compare the actual number of suicides observed with the expected number of suicides for non-spinal injured persons of comparable age, sex, and race from the general population. A secondary objective was to characterize individuals at increased risk of suicide relative to comparable non-spinal injured persons by age, sex, race, neurologic level of lesion, degree of injury completeness, and length of survival after injury.

Methods

Study population

A collaborative study was conducted on 9135 persons who sustained a SCI between 1973 and 1984, who were admitted within one year of injury to one of 13 federally designated model regional SCI care systems in the following cities, and who survived at least 24 hours after injury: Ann Arbor, MI (n=134); Atlanta, GA (n=244), Birmingham, AL (n=1098); Boston, MA (n=507); Chicago, IL (n=1512); Detroit, MI (n=133); Downey, CA (n=408); Englewood, CO (n=2241); Fishersville, VA (n=938); Houston, TX (n=769); New York, NY (n=650); Philadelphia, PA (n=448); and Rochester, NY (n=53).

Data collection

Information on date of injury, age, gender, race, neurological level of lesion, degree of injury completeness, date of death and/or date last known to be alive was abstracted from each person's medical chart. The primary cause of death for each deceased person was determined from all available information including but not limited to the death certificate, autopsy report, and hospital discharge summary. If the death was ruled a suicide, then additional information concerning the means of committing suicide was collected.

Statistical analysis

For analytical purposes, follow-up of study subjects was terminated on December 31, 1985. Only deaths occurring before this date were considered.

Initially, the percentage of all deaths that were due to suicide was determined by age, sex, race, neurological level of lesion, degree of injury completeness, and length of survival after injury. Next, the number of person years of follow-up was calculated for the entire study population, with each person contributing one

person-year for each year followed from injury until death, loss to follow-up, or study termination (Lilienfeld *et al.*, 1980). Then, the expected number of suicides was calculated using age-sex-race-specific suicide rates published by the United States federal government for 1979 (the mid-year of the study period) (National Center for Health Statistics, 1984).

Finally, standardised mortality ratios (SMRs) for suicide (the ratios of observed to expected numbers of suicides) were calculated along with their approximate 95% confidence limits to assess the impact of SCI on age-sex-race-adjusted suicide rates (Lilienfeld *et al.*, 1980). For simplicity, these SMRs were not multiplied by 100 as is sometimes done. Therefore, an SMR of 1.0 implies no increase in the suicide rate, whereas an SMR of 2.0 implies that the suicide rate for persons with SCI is twice the rate for the general population of comparable age, sex, and race. A 95% confidence interval around the SMR that does not include 1.0 implies a statistically significant increase (or decrease if below 1.0) in the suicide rate for SCI relative to the general population at a two-tailed probability (α) of 0.05. In addition to an overall SMR, the analysis was stratified by age, sex, race, neurological level of lesion, degree of injury completeness, and length of survival after injury to identify significant predictors of increased suicide rates.

Results

At the end of follow-up, 854 persons had died. Cause of death was determined for 796 of these individuals (93.2%). Among those whose cause of death was determined, 50 suicides were observed (6.3%). The leading means of committing suicide was by gunshot wound ($n=25$), followed by poisoning ($n=8$), cutting instruments ($n=5$), suffocation ($n=3$), drowning ($n=3$), and falling from heights ($n=2$). Four suicides were by unspecified means.

Suicide was the leading cause of death for all persons with neurologically complete paraplegia, occurring in 14.7% of cases (Table 1). It was the second leading cause of death for persons with neurologically incomplete paraplegia accounting for 9.2% of all deaths among these individuals. Suicide was the third leading cause of death for persons less than 55 years of age regardless of lesion level and degree of completeness, and the third leading cause of death for all persons between 1 and 5 years after injury (10.4%).

Crude (unadjusted) suicide rates per 10^5 person-years of follow-up by neurological level and degree of injury completeness appear in Table II. The crude suicide rate was substantially higher among persons with neurologically complete paraplegia ($154.1/10^5$ person-years) than it was among other individuals. When all persons were considered in aggregate, the crude suicide rate was $99/10^5$ person-years. However, the crude suicide rate for the general population in 1979 was only $12.4/10^5$, implying that the overall crude suicide rate during the first several years after SCI was approximately 8 times higher than normal, and that it was approximately 12.4 times higher than normal among persons with neurologically complete paraplegia (National Center for Health Statistics, 1984).

These crude suicide rate ratios overstate the actual effect of SCI because persons with SCI are predominantly white males who would normally be at somewhat higher risk for committing suicide. In fact, the crude suicide rate for white males in the general population in 1979 was $20/10^5$ (National Center for Health Statistics,

Table I Percentage of deaths due to suicide during the first 12 years after spinal cord injury for each risk factor

Risk factor	Number of suicides (n=50)	Total number of deaths (n=796)	Suicide percent of deaths
Age			
1-24	14	142	9.9
25-54	33	371	8.9
55+	3	283	1.1
Sex			
Male	46	676	6.8
Female	4	120	3.3
Race			
White	45	559	8.1
Non-white	5	237	2.1
Neurologic category			
Incomplete paraplegia	8	87	9.2
Complete paraplegia	22	150	14.7
Incomplete quadriplegia	10	208	4.8
Complete quadriplegia	10	351	2.8
Years after injury			
<1	9	321	2.8
1-5	35	337	10.4
6-12	6	138	4.3

Table II Suicide rates during the first 12 years after spinal cord injury by neurologic category

Neurologic category	Number of suicides	Number of persons alive at beginning of study	Number of person-years of follow-up	Suicide rate/10 ⁵
Incomplete paraplegia	8	1729	9376.5	85.3
Complete paraplegia	22	2386	14 275.5	154.1
Incomplete quadriplegia	10	2805	14 424.5	69.3
Complete quadriplegia	10	2251	12 405.0	80.6
All persons	50	9135	50 481.5	99.0

1984). Therefore, SMRs were calculated to control the effects of differences in age, sex, and race between the general population and persons with SCI.

Based on age-sex-race-specific suicide rates for the general population, the expected number of suicides in the absence of SCI given the length of time each person was followed was only 10.2. Since 50 suicides were observed, the SMR was 4.9, indicating that persons with SCI were 4.9 times more likely to commit suicide than persons of comparable age, sex, and race from the general population. The 95% confidence interval for the SMR was 3.5 to 6.3 indicating that this increased risk was statistically significant. Nonetheless, as expected, controlling for differences in age, sex, and race led to a significantly smaller estimate of the excess risk of suicide among persons with SCI than was first observed from the crude (unadjusted) rate ratio.

The SMR was highest between the ages of 25 and 54 years, but was also significantly elevated for persons younger than age 25 when compared to the general population ($p < 0.05$) (Table III). Although the SMR was also elevated for

Table III Actual and expected numbers of suicides during the first 12 years after spinal cord injury with standardised mortality ratios and their approximate 95% confidence limits for each risk factor (n=50)

Risk factor	Actual number of suicides	Expected number of suicides	Standardised mortality ratio	95% confidence interval
Age				
1-24	14	3.1	4.5	2.1-6.9
25-54	33	6.2	5.3	3.5-7.1
55+	3	0.9	3.5	0.0-7.4
Sex				
Male	46	9.6	4.8	3.4-6.2
Female	4	0.6	6.3	0.1-12.5
Race				
White	45	8.3	5.4	3.8-7.0
Non-white	5	1.9	2.6	0.3-4.9
Neurologic category				
Incomplete paraplegia	8	1.9	4.2	1.3-7.1
Complete paraplegia	22	2.9	7.6	4.4-10.8
Incomplete quadriplegia	10	2.9	3.4	1.3-5.5
Complete quadriplegia	10	2.5	4.0	1.5-6.5
Years after injury				
<1	9	1.7	5.3	1.8-8.8
1-5	35	5.1	6.9	4.6-9.2
6-12	6	3.5	1.7	0.3-3.1

persons in the oldest age group, the increase was not statistically significant because of the relatively small sample size for that group. The overlapping confidence limits for each age group imply that within the SCI population, the differences in SMRs among age groups were not statistically significant ($p > 0.05$).

Although females had a higher SMR than males, the difference was not statistically significant. Males were at significantly increased risk compared to the general population ($p < 0.05$), but females were not, despite their higher SMR. This was because of the relatively small number of females included in the study.

White persons were at significantly increased risk compared to the general population ($p < 0.05$). However, although the SMR for non-whites was also somewhat elevated, their risk was not significantly different from that of the able-bodied population again because of the relatively small number of nonwhites included in the study ($p > 0.05$).

The highest SMR was found for persons with neurologically complete paraplegia, while the other 3 neurological groups had somewhat comparable SMRs. All neurological groups were at significantly elevated risk compared to the general population ($p < 0.05$).

The SMR was highest between 1 and 5 years after injury, although it was also significantly elevated during the first postinjury year ($p < 0.05$). The smaller increased risk occurring more than 5 years after injury was not statistically significant ($p > 0.05$).

Discussion

In general, our findings are consistent with other recent investigations. Brown

and Staas (1988) found seven times the expected number of suicides among persons with SCI admitted to their facility from 1979 to 1987. Charlifue *et al.* (1988) found 6 times the expected number of suicides among 489 deceased persons with SCI treated at their facility during the past 30 years. Geisler *et al.* (1977) found 5 times the expected number of suicides among persons with SCI treated at their facility, with SMRs of 3.3 for persons with incomplete paraplegia, 7.0 for persons with complete paraplegia, 3.8 for persons with incomplete quadriplegia, and 5.0 for persons with complete quadriplegia.

It is interesting that the highest SMR for both Geisler's sample and our own was for persons with neurologically complete paraplegia. This is consistent with earlier work by Richards (1986) showing greater levels of depression immediately post-discharge in persons with paraplegia than there was in persons with quadriplegia. The psychosocial literature has consistently demonstrated this counter-intuitive lack of correlation between level of neurological loss and psychosocial adjustment (Treischmann, 1988). It has been speculated that because less physical (and therefore social) support is provided to persons with paraplegia than those with quadriplegia, the burden of coping is greater.

Despite the large size of our overall study population, both the actual and expected numbers of suicides among many subgroups were relatively small. Therefore, some SMR confidence intervals were relatively wide. As a result, SMR estimates have been interpreted cautiously.

Cause of death information was unavailable for 58 of the 854 deceased persons (6.8%). If any of these persons committed suicide, the SMR would be slightly underestimated because the person-years these individuals survived up to the time of their deaths were included in the calculation of expected deaths. If these 58 deaths were distributed among all causes in proportion to their occurrence among the 796 persons whose cause of death was known, then 4 would be suicides. This would increase the overall suicide SMR from 4.9 to 5.3 (95% confidence interval=3.9-6.7).

Moreover, 10 of the 796 persons whose cause of death was 'known' died as a result of injuries sustained from events of uncertain circumstances. Since there were 43 confirmed unintentional injuries and 6 homicides in addition to the 50 known suicides, we expect half of these 10 persons committed suicide. If this were true, then the suicide SMR would increase again from 5.3 to 5.8 (95% confidence interval=4.38-7.3).

Another reason for our belief that our estimate of the suicide SMR may be conservative is that several persons died from septicaemia secondary to pressure sores. A few of these, as well as deaths from other causes may in fact have been suicides by self-neglect (Macleod, 1988). However, any such deaths were not included in this study because we had no way to confirm suicidal intentions.

Because the overall purpose of this study was to document causes of death, no effort was made to collect information on unsuccessful suicide attempts in this study population. Since there were more successful suicide attempts than expected, there were probably more unsuccessful attempts as well. However, this issue requires further investigation.

One potential suicide risk factor not considered in our study was marital status. Among non-spinal injured persons, those who are married have been shown to have lower suicide rates than those who have never been married, those who are

divorced, or those who are widowed (Smith *et al.*, 1988). Since previous studies have shown that divorce rates are higher and marriage rates are lower among persons with SCI than comparable individuals from the general population (DeVivo *et al.*, 1985; DeVivo *et al.*, 1989), future studies should consider the effect of marital status on the suicide rate in the SCI population.

Interestingly, a recent study reported a strong link between psychosocial and vocational adjustment and long term survival following SCI (Krause *et al.*, 1987). However, those investigators did not find a relationship between survival and either satisfaction with social life, sex life, or employment. Nonetheless, although their study was not limited to deaths by suicide and the causal nature of the associations was not established, their findings point to the relative importance of psychosocial factors as predictors of survival in this population.

Other potential risk factors whose effects were not controlled in this study include education, socioeconomic status, history of drug or alcohol abuse, and occupational status. Alcohol abuse has been demonstrated to be a significant risk factor for suicide (Beck *et al.*, 1974), and a high rate of both alcohol and drug abuse has been reported in the SCI population (Heinemann, 1986). Sudden loss (as in SCI) and significant stress have also been identified suicide risk factors. Moreover, 80% of persons enrolled in the National SCI Statistical Center database were either working or were students at the time of injury (Stover *et al.*, 1986). However, a much smaller proportion were either working or were continuing their education during the first 5 years post-injury (Stover *et al.*, 1986). Interestingly, this is the time frame that corresponds to the highest excess risk for suicide in the SCI population. Financial stress, social isolation and loss of self-esteem can all accompany loss of work.

Because the characteristics of the SCI population are different from those of the non-spinal injured population, future investigators should attempt to refine further the comparison group used for assessment of suicide risk in the SCI population. If it were possible to control for the potential confounding effects of factors like marital status, occupational status, education level, drug and alcohol abuse in addition to age, sex and race, it is conceivable that the resulting SMR for suicide among persons with SCI would be substantially reduced from what we have reported. Unfortunately, data reported by the National Center for Health Statistics do not allow such comparisons.

In the interim, the question for clinicians is how to respond to these findings. Even if it should turn out that SCI itself is only a marker variable for other factors that explain the incidence of suicide in this population, one is still left with the fact that the rate of suicide as a cause of death is high. Examination of the absolute numbers involved is somewhat reassuring in that only 50 suicides were reported among over 9000 persons over a period of several years following injury. Therefore, despite the fact that suicide is a common cause of death in this population, and that it occurs more often than in the non-spinal injured population, in an absolute sense, it is still a rare event.

How does a clinician or program administrator develop interventions for an infrequent event (or should this be done at all)? It would probably not make sense for programmes to devote massive expenditures of staff time and resources to develop suicide prevention programmes. However, heightened awareness of staff, patient and family (particularly post-discharge) through frank discussion of the

risk of suicide is warranted. Careful assessment and treatment of depression is also always warranted. Threats of suicide should always be taken seriously; perhaps more so in this population. Community based peer-support programmes would be helpful for outreach post-discharge when distance and resources make it difficult for patients to be followed closely by the rehabilitation center. Finally, perhaps the greatest payoff for increased programmatic activity will come from efforts directed at mobilizing social support, improving coping skills and encouraging as rapid involvement in meaningful activities as possible.

References

- BECK AT, RESNICK LP, LETTIERI DJ 1974 The Prediction of Suicide. Charles Press Pub., Maryland.
- BROWN PJ, STAAS WE 1988 Suicide in the spinal cord injury population. *Archives of Physical Medicine and Rehabilitation* **69**:702-703.
- CHARLIFUE SW, BUTT L, WHITENECK GG 1988 Suicide following spinal cord injury: what are the clues? *Archives of Physical Medicine and Rehabilitation* **69**:703.
- DEVIVO MJ, FINE PR 1985 Spinal cord injury: its short-term impact on marital status. *Archives of Physical Medicine and Rehabilitation* **66**:501-504.
- DEVIVO MJ, JENKINS KD, GO BK 1989 Outcomes of post-spinal cord injury marriages. *Archives of Physical Medicine and Rehabilitation* **70**:A50.
- DEVIVO MJ, KARTUS PL, STOVER SL, RUTT RD, FINE PR 1989 Cause of death for patients with spinal cord injuries. *Archives of Internal Medicine* **149**:1761-1766.
- DUCHARME SH, FREED MM, OATES C, RAMOS MU. 1980 The role of self-destruction in spinal cord injury mortality. *Model Systems' SCI Digest* **2**:29-38.
- FREED MM, BAKST HJ, BARRIE DL 1966 Life expectancy, survival rates, and causes of death in civilian patients with spinal cord trauma. *Archives of Physical Medicine and Rehabilitation* **47**:457-463.
- FRISBIE JH, KACHE A 1983 Increasing survival and changing causes of death in myelopathy patients. *Journal of the American Paraplegia Society* **6**:51-56.
- GEISLER WO, JOUSSE AT, WYNNE-JONES M 1977 Survival in traumatic transverse myelitis. *Paraplegia* **14**:262-275.
- GEISLER WO, JOUSSE AT, WYNNE-JONES M, BREITHAUP D 1983 Survival in traumatic spinal cord injury. *Paraplegia* **21**:364-373.
- HEINEMANN AW 1986 Substance abuse and disability: an update. *Rehabilitation Reports* **2**:3-5.
- KRAUSE JS, CREWE NM 1987 Prediction of long-term survival of persons with spinal cord injury: an 11-year prospective study. *Rehabilitation Psychology* **32**:205-213.
- LEE CT, PRICE M 1982 Survival from spinal cord injury. *Journal of Chronic Disease* **35**:487-492.
- LILIENFELD AM, LILIENFELD DE 1980 Foundations of Epidemiology, 2nd edn. Oxford University Press Inc., New York, pp 78-80, 245-246, 353.
- MACLEOD AD 1988 Self-neglect of spinal injured patients. *Paraplegia* **26**:340-349.
- National Center for Health Statistics 1984 Vital Statistics of the United States, 1979: Vol. II, Mortality, Part A. DHSS Pub. No. (PHS) 84-1101, Public Health Service, Washington, p 47.
- NYQUIST RH 1960 Mortality in spinal cord injuries. Proceedings of the Ninth Annual Clinical Spinal Cord Injury Conference, Long Beach, California, pp 109-112.
- NYQUIST RH, BORS E 1967 Mortality and survival in traumatic myelopathy during nineteen years, from 1946 to 1965. *Paraplegia* **5**:22-48.
- RICHARDS JS 1986 Psychologic adjustment to spinal cord injury during first postdischarge year. *Archives of Physical Medicine and Rehabilitation* **67**:362-365.
- SMITH JC, MERCY JA, CONN JM 1988 Marital status and the risk of suicide. *American Journal of Public Health* **78**:78-80.
- STOVER SL, FINE PR 1986 Spinal Cord Injury: The Facts and Figures. University of Alabama at Birmingham, Birmingham, Alabama, pp 53-56.
- TREISCHMANN RB 1988 Spinal Cord Injuries: Psychological, Social and Vocational Rehabilitation. Demos, New York.
- TRIBE CR 1963 Causes of death in the early and late stages of paraplegia. *Paraplegia* **1**:19-47.
- WILCOX NE, STAUFFER ES 1972 Follow-up of 423 consecutive patients admitted to the spinal cord centre, Rancho Los Amigos Hospital, 1 January to 31 December 1967. *Paraplegia* **10**:115-122.