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ORIGINAL RESEARCH

Improvements in Long-Term Survival After Spinal Cord Injury?

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Abstract

Objective: To investigate whether there have been improvements in long-term survival after spinal cord injury in recent decades.

Design: Survival analysis using time-varying covariates. The outcome variable was survival or mortality, and the explanatory variables were age, sex, level and grade of injury, and calendar year. The data were analyzed using the logistic regression model, Poisson regression model with comparison to the general population, and the computation of standardized mortality ratios for various groups.

Setting: National Spinal Cord Injury Model Systems facilities.

Participants: Persons (N=31,531) who survived 2 years postinjury, were older than 10 years, and who did not require ventilator support. These persons contributed 484,979 person-years of data, with 8536 deaths over the 1973 to 2012 study period.

Interventions: Not applicable.

Main Outcome Measures: Survival; survival relative to the general population; life expectancy.

Results: After adjustment for age, sex, race, etiology of injury, time since injury, and level and grade of injury, mortality in persons with spinal cord injury was higher in the 2005 to 2012 period than in 1990 to 2004 or 1980 to 1989, the odds ratios for these 3 periods were .857, .826, and .802 as compared with the 1970 to 1979 reference period.

Conclusions: There was no evidence of improvement. Long-term survival has not changed over the past 30 years.

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Trends in survival reflect underlying changes in lifestyle, health, and medical care. Life expectancy (the average survival time) is a particularly convenient summary measure because it reflects the mortality experience at all ages. It is an unambiguous measure of the vitality of a population and is often used for planning purposes.

Short-term survival after spinal cord injury (SCI) has improved markedly over the past 50 years. In particular, Strauss et al[1] reported that mortality during the first 2 years postinjury was 39% lower in the 1990 to 2004 period than in 1973 to 1979.

The same study reported a much lower reduction—14%, which was not statistically significant—in long-term survivors. In addition, the study found no trend toward improved survival over the 25-year period of 1980 to 2004. That is, life expectancy did not change for those who survived the first 2 years postinjury. Other authors have also found no trend.[2-9] The present work examines mortality in persons with SCI since 1973, focusing on the most recent period 2005 to 2012, to determine whether long-term survival has changed.

We also investigate how well the model from the Strauss et al[1] predicted mortality in the 2005 to 2012 period. That is, we determine the expected number of deaths using that model and compare it with the actual (observed) number of deaths. Any differences may suggest changes in the pattern of mortality in the interim.

Finally, we examine whether the standardized mortality ratio (SMR), that is, the ratio of the mortality rate in persons with SCI to the mortality rate in age- and sex-matched persons in the general population, has changed over time. This is of particular interest because to calculate life expectancy, some researchers

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have applied *previous* SMRs to *current* mortality rates in the general population to calculate mortality rates in persons with SCI required in a life table. It is not always recognized that this approach implicitly assumes that the SMR has remained constant over time. This assumption should be tested, and we do so here.

Methods

The study was approved by the Institutional Review Board of the University of Alabama at Birmingham. The data used here were an updated and expanded version of the U.S. national model systems database from Strauss et al.[1] Briefly, the entire (new) database included 49,241 persons with SCI who contributed 627,097 person-years of exposure and 12,799 deaths over the 1973 to 2012 study period.

Patients were identified and reported as deceased by data collectors at each model systems facility during their routine follow-up procedures. In addition, both the data collectors and the National Spinal Cord Injury Statistical Center (NSCISC) staff conduct periodic searches of the Social Security Death Index (SSDI) (available at www.ancestry.com) and other online databases including obituary files and records obtained from vital statistics departments in each state, for the 59% of patients with complete information. Patients with incomplete information, or those not verified as deceased, were censored at the last known date alive or the date the SSDI was last searched by the NSCISC staff. Data collectors at the centers are required to attempt to locate each patient every 5 years. As a result, few patients have been completely lost to follow-up (of 50,661 patients, only 77 were lost in the 1970s and 1668 in the 1980s). Most of these patients were censored during their first year postinjury and thus did not contribute to the present study. Limited searches of the National Death Index have also been conducted by the staff. The SSDI has been found to be 92.4% sensitive in identifying persons with SCI who are deceased.[10] Deaths most likely to be unreported in the SSDI occur in young persons, women, and unmarried persons.[11] Nonetheless, most, though probably not all, deaths not identified by the SSDI will be found by other follow-up procedures. Restriction to patients with social security numbers did not significantly affect the results of the present study. Specifically, the trends reported here (or lack thereof) were similar.

As in Strauss et al,[1] we performed survival analysis using time-dependent covariates.[12,13] In this analysis, the unit of analysis was not a person, as in many survival analyses, but was instead a person-year. With each person-year, an outcome variable indicating whether the person lived or died in that year was associated with possible explanatory variables such as age and severity of injury.

The analysis was restricted to person-years in which (1) the person was older than 10 years; (2) the level of neurologic injury was known; (3) the American Spinal Injury Association (ASIA) Impairment Scale grade was A, B, C, or D; (4) the person was not ventilator dependent; and (5) time since injury was ≥2.0 years.

List of abbreviations:

ASIA	**American Spinal Injury Association**
CI	**confidence interval**
NSCISC	**National Spinal Cord Injury Statistical Center**
OR	**odds ratio**
SCI	**spinal cord injury**
SMR	**standardized mortality ratio**
SSDI	**Social Security Death Index**

The first restriction was imposed because long-term mortality effects of injury in childhood, when physiological development is incomplete, are different.[14] The fourth restriction was placed because ventilator dependence was the subject of a separate study.[15] Unlike the Strauss et al,[1] the focus here was solely on long-term mortality after SCI—hence the final restriction.

After all exclusions, a total of 31,531 persons, 8536 of whom died during the 39-year study period, contributed 484,979 person-years to the data set.

We used 3 primary methods to analyze the person-years data:

1. Modeling mortality rates in persons with SCI. Specifically, we used the logistic regression model[16] to relate the outcome variable (lived or died) to the set of possible explanatory variables.

   As in Strauss et al,[1] the explanatory variables used herein were age, sex, ethnicity, etiology of injury, level and grade of injury, time since injury, and calendar year. We fit the same model as in Strauss et al,[1] with the exception of an additional term for the most recent calendar year period. We also fit other models, as described below.
2. Comparison of the observed number of deaths in the 2005 to 2012 period with the number expected on the basis of the logistic regression model from Strauss et al.[1,17] There were 2 purposes of this comparison: (a) to determine whether the previous model developed using data from the 1973 to 2004 period adequately predicted mortality in the most recent period, and (b) to examine closely any changes in mortality in the earlier period (1973−2004) and that in the later period (2005−2012). Specifically, we used the model given in table 3 of Strauss et al,[1] which was developed using data from 1973 to 2004 for persons who survived ≥2 years postinjury and in particular calibrated to the 1990 to 2004 time period, to estimate the actual number of deaths in the most recent period (2005−2012). We stratified the results by various subgroups of interest.
3. Modeling trends in SMR. We used the Poisson regression model[18] to examine whether mortality in persons with SCI relative to the general population has changed over time.
   The outcome variable in the model was the ratio of the mortality rate in persons with SCI to the mortality rate in the age-, sex-, and calendar year−matched persons in the general population, which is the SMR. Explanatory variables were age, sex, race, etiology of injury, time since injury, and level and grade of injury. Mortality rates in the U.S. general population were obtained from the Human Mortality Database.[19] Our null hypothesis was that mortality in persons with SCI improved (ie, declined) at the same rate as that in the general population in the study period.

   We also calculated the empirical SMRs[20] for various groups: These are the observed number of deaths for a particular group divided by the number that would have been expected on the basis of the mortality rates of the corresponding age-, sex-, and calendar year−matched persons in the general population.[20]

As will be seen later, the above methods are complementary. We also provide brief descriptive statistics for the previous (1973−2004) and current (1973−2012) populations, as well as life expectancies calculated using the previous and current logistic regression models. Life expectancies were obtained from life tables, which were constructed in the standard way.[1,21]

Results

Summary descriptive statistics for the population are given in table 1. Table 2 presents the comparison of previous and current logistic regression models, which evidently have similar parameter estimates. The odds ratio (OR) for the most recent period, 2005 to 2012, was .857, indicating that the odds of mortality in the 2005 to 2012 period, all else being equal, was 85.7% of that in the reference period, 1973 to 1979. That is, mortality was approximately 14% lower in the most recent period than it was in the reference period. The OR for the immediately previous period 1990 to 2004 was .826. That is, mortality did not improve in the most recent period. In fact, it had increased monotonically since 1979, with successive ORs being .802, .826, and .857.

To further examine a secular trend, we refit the model but instead used a linear term for calendar year. The resulting OR (not shown) was 1.005 (95% confidence interval [CI], 1.000−1.010). That is, there was no trend toward improved survival since 1979. We also fit various alternative models to examine the secular trend. These models demonstrated that the trend reported here (or lack thereof) did not vary by age, sex, etiology of injury, race, or level and grade of injury (test of interaction terms, $P>.10$ in all cases).

The results listed in table 2 also reveals, as expected, that mortality is higher in men, older persons, and those with higher-level or complete injuries. We also examined whether a further stratification of the T1-S5 ABC group (OR, 2.885) was warranted. Biologically, we would expect thoracic injuries to result in higher mortality than do lumbar/sacral injuries because of the impairment of respiratory muscles and the risk of autonomic dysreflexia only at levels T6 and above. There was a modest difference comparing T6 and above to T5 and below (OR, 3.2 vs 2.7), though it was not statistically significant. We also considered the 4 subgroups defined by levels T1-T6 versus T7-S5 and grades A versus B or C. The ORs for these were as follows: T1-T6 A, 3.3; T7-S5 A, 2.7; T1-T6 BC, 3.0; T7-S5 BC, 2.7. Again, the differences were modest and were not statistically significant. To facilitate comparison with Strauss et al,[1] we retained the original model.

Table 3 summarizes the results of the analyses performed using the second method. Overall, there were 3493 deaths, whereas the model predicted 3359. The observed/expected ratio was 1.04 (95% CI, 1.01−1.07), indicating that there were 4% more deaths than expected. That is, the model slightly underestimated mortality (or, equivalently, it overestimated survival). This finding is consistent with the above-mentioned OR of 1.005 for the calendar year effect.

By using data updated through 2012, we calculated life expectancies for the same profiles as in Strauss et al[1]: 25-year-old white men injured 3 years ago due to a nonviolent etiology, stratified by injury level and grade. These life expectancies are given in table 4. The estimates are similar to those given in the 2006 article. Although life expectancy in the general population has increased over the intervening time period, life expectancy of persons with SCI has decreased. For example, life expectancy in the C1-C3 A group is 50% of normal life expectancy (25.4/50.9) calculated using the previous model and time period and 48% (25.0/52.0) using the current model. We return to this issue in the Discussion section.

Table 5 lists the fitted Poisson regression model−based estimates of the SMR. These model-based estimates indicate that mortality rates in persons with SCI did not increase at the same rate as those in the U.S. general population. In fact, the SMR actually increased at a rate of 2.4% (95% CI, 2.1−2.7) per calendar year from 1973 to 2012. That is, mortality rates in persons with SCI did not keep pace with the improvements seen in the general population. We investigated further and found that this estimate of 2.4% did not vary (significantly) according to the other factors in the model.

Table 1 Characteristics of the person-years of exposure data for time since injury at least 2y, stratified by period of injury

Characteristic	Period of Injury			
	1973−1979	1980−1989	1990−2004	2005−2012
No. of person-years	6953	77,921	247,316	152,789
No. of persons represented	3261	13,689	25,829	24,161
No. of deaths in the study period	87	886	4070	3493
Sex: male	81	82	80	78
Age (y)				
10−19	12	5	3	3
20−29	48	41	19	12
30−39	18	29	32	20
40−49	10	12	26	29
50−59	7	7	12	23
≥60	4	6	9	14
Injury level and ASIA grade				
C1-C4 A	5	5	5	5
C1-C4 BC	2	3	3	3
C5-C8 A	22	18	16	15
C5-C8 BC	8	10	9	9
T1-S5 A	34	30	31	32
T1-S5 BC	6	7	8	9
Grade D (all levels)	23	28	28	27

NOTE. Values are column percentages unless otherwise noted.

Table 2 Comparison of previous and current logistic regression models for prediction of mortality for ≥2y since injury

	Previous (2006) Model	Current Model
Variable	Odds Ratio 95% CI	Odds Ratio 95% CI
Sex: male	1.303 (1.20–1.42)	1.325 (1.25–1.40)
Race: white	1.017 (0.95–1.09)	1.052 (1.00–1.11)
Etiology of injury: violence	1.225 (1.11–1.35)	1.214 (1.14–1.30)
Age		
Grade ABC	1.063 (1.06–1.07)	1.061 (1.06–1.06)
Grade D	1.073 (1.07–1.08)	1.072 (1.07–1.08)
Injury level and ASIA grade		
C1-C3 A	7.439 (5.00–11.1)	7.466 (5.65–9.88)
C4 A	6.825 (5.13–9.09)	6.479 (5.26–7.98)
C5 A	5.069 (3.81–6.75)	4.587 (3.72–5.64)
C6-C8 A	3.539 (2.67–4.69)	4.181 (3.41–5.13)
C1-C3 BC	4.279 (2.73–6.71)	4.738 (3.52–6.38)
C4 BC	3.509 (2.55–4.82)	4.230 (3.38–5.29)
C5 BC	3.286 (2.42–4.47)	3.668 (2.94–4.58)
C6-C8 BC	3.054 (2.27–4.12)	3.368 (2.72–4.18)
T1-S5 ABC	2.855 (2.17–3.75)	2.885 (2.37–3.52)
Grade D (all levels)	1.000	1.000
Time since injury (y)		
2.0–3.0	1.114 (0.98–1.27)	1.152 (1.04–1.27)
>3.0	1.000	1.000
Study period		
1973–1979	1.000	1.000
1980–1989	0.829 (0.67–1.03)	0.802 (0.64–1.00)
1990–2004	0.856 (0.69–1.06)	0.826 (0.67–1.03)
2005–2012	Not applicable	0.857 (0.69–1.07)

NOTE. The previous model was developed using data from 1973 to 2004 and the current model using data from 1973 to 2012.

The Poisson regression model can be used to calculate the SMR of mortality (relative to the general population) for any combination of the factors. For illustration, consider the group of 30-year-old white men with paraplegia in 1995 who were injured at least 3 years ago due to a nonviolent cause of injury. The SMR was calculated as follows: $1.81\times0.983^{(30-10)}\times1.03\times1.00\times1.86\times1.00\times1.024^{(1995-1973)}=4.1$. That is, the mortality risk in this group was 4.1 times that in the general population. Repeating the same calculation for the calendar year 2005 yielded an SMR of 5.3.

These Poisson regression model–based estimates of the SMR may be compared with the empirical SMRs that we calculated. For example, in persons aged 20 to 39 years with paraplegia and ASIA grades A, B, or C who survived ≥2 years postinjury, the SMRs were 3.5 in the 1990s and 5.9 in the 2000 to 2012 period, which were clearly similar to the 4.1 and 5.3 noted above.

Figure 1 shows the empirical SMRs for a particular group: persons aged >60 years with paraplegia and ASIA grades A, B, or C who survived ≥2 years postinjury. The SMRs were 1.5 in the 1970s, 1.9 in the 1980s, 2.2 in the 1990s, and 2.6 in the 2000 to 2012 period. The SMR has clearly increased over time because mortality rates in persons with SCI have remained constant, whereas mortality rates in the general population have decreased. This increase in the SMR has significant methodological implications for the calculation of life expectancy, which we address below.

Discussion

The present study reports that mortality in persons with SCI did not decrease in the most recent period of 2005 to 2012 relative to the previous period of 1980 to 2004. Instead, if anything, it increased. We demonstrated this in 2 ways: (1) by showing higher odds of mortality in the most recent period (.857 vs .826: a 4% increase) and (2) by reporting more deaths over the 2005 to 2012 period than what was expected on the basis of the previous model (3493 vs 3359).

Many previous studies have also shown no improvement in survival.[2-9] A few studies that reported supposedly improved survival either did not exclude the first few years postinjury or did not control for age, sex, and severity of disability.[22,23] Middleton et al[24] studied the survival of 2014 persons with SCI over the 1955 to 2006 period and reported life expectancies higher than those reported in other recent studies. However, their empirical data (the reported age-specific mortality rates and SMRs) revealed that life expectancies were overestimated.[25] The empirical life expectancies were, in fact, similar to those reported in other recent studies, including Strauss et al[1] and the DeVivo and Stover study.[26] In addition, Middleton[24(p809)] reported that they did not find any trend toward improved long-term survival. Therefore, we found no evidence that long-term survival in persons with SCI has improved over the past 30 years. However, mortality in the general population has steadily decreased over time.[19] As a consequence, we found that the SMRs for persons with SCI relative to the general population have actually increased significantly since the 1970s.

Life expectancy is obtained from a life table determined entirely from the set of age-specific mortality rates. Those rates are customarily based on empirical data, though when the data are limited it may be necessary to use model-based assumptions.

Table 3 Comparison of observed and expected deaths in the 2005–2012 study period

Variable	Observed	Expected	Observed/Expected	95% CI
Overall	3493	3359	1.04	1.01–1.07
Sex				
Male	2865	2759	1.04	1.00–1.08
Female	628	600	1.05	0.96–1.13
Age (y)				
0–39	443	381	1.16	1.05–1.27
40–59	1731	1638	1.06	1.01–1.11
≥60	1319	1340	0.98	0.93–1.04
Race				
White	2547	2369	1.08	1.03–1.12
Nonwhite	946	990	0.96	0.89–1.02
Etiology of injury				
Violence	488	499	0.98	0.89–1.06
Nonviolence	3005	2860	1.05	1.01–1.09
Injury level and ASIA grade				
C1-C3 A	40	40	1.00	0.69–1.32
C4 A	241	256	0.94	0.82–1.06
C5 A	297	311	0.96	0.85–1.06
C6-C8 A	342	273	1.25	1.12–1.39
C1-C3 BC	39	32	1.21	0.83–1.58
C4 BC	148	129	1.14	0.96–1.33
C5 BC	158	144	1.09	0.92–1.27
C6-C8 BC	192	165	1.16	1.00–1.32
T1-S5 ABC	1223	1222	1.00	0.94–1.06
Grade D (all levels)	813	787	1.03	0.96–1.10
Time since injury (y)				
2.0–3.0	96	69	1.39	1.14–1.67
>3.0	3397	3290	1.03	1.00–1.07

NOTE. Expected values were calculated using the model given in table 3 of the 2006 article.

One common assumption in studies of SCI is a constant SMR over a wide range of age, say, age >65 years. This can give reasonable results if the SMR was determined from current mortality rates.

Table 4 Comparison of previous and current life expectancies of 25-y-old white men injured 3y ago due to a nonviolent etiology

	Life Expectancy (y)	
Group	Previous	Current
General population*	50.9 (100%)	52.0 (100%)
Injury level and ASIA grade		
C1-C3 A	25.4 (50%)	25.0 (48%)
C1-C3 BC	32.2 (63%)	30.6 (59%)
C4 A	26.4 (52%)	26.7 (51%)
C4 BC	34.9 (69%)	32.0 (62%)
C5 A	30.0 (59%)	31.0 (60%)
C5 BC	35.7 (70%)	33.9 (65%)
C6-C8 A	34.7 (68%)	32.2 (62%)
C6-C8 BC	36.7 (70%)	35.0 (67%)
T1-S5 (paraplegia) ABC	37.6 (74%)	37.1 (71%)
Grade D (all levels)	44.7 (88%)	43.6 (84%)

NOTE. Values within parentheses are percentages of normal life expectancy.
* The baseline in the previous study was the 2001 U.S. life table; here it is the 2008 life table. Note that neither baseline was used in calculating life expectancies after SCI.

As already noted, we found that the SMR increased over the study period at a rate of 2.4% per calendar year. It would thus be incorrect to calculate SMRs for persons with SCI on the basis of historical data and then to apply those SMRs to current (or projected) mortality rates (which are usually substantially lower). That is, the SMR is not “portable” over time as some researchers have implicitly assumed.[24]

We found that the percentage of normal life expectancy in persons with SCI has decreased over the past 30 years. That is, the ratio of life expectancy in a particular SCI group to that of persons of the same age in the general population has decreased. It would thus be contrary to the evidence to assume that the percentage of normal life expectancy obtained from a previous study is either applicable today or will apply in the future.

A preliminary study of causes of death (published only as an abstract) provides some possible explanations for the lack of progress in improving life expectancy after SCI.[27] This study reported that age-adjusted mortality rates in persons with SCI have been decreasing for cancer, cardiovascular disease, pulmonary embolism, suicide, and urinary system diseases, just as they have been in the general population. However, these gains in life expectancy have been offset by increases in age-adjusted mortality rates for endocrine (particularly diabetes), nutritional, and metabolic diseases; accidents (particularly accidental drug overdoses); mental disorders (many of which are deaths related to long-term alcohol and/or drug use); homicides; nervous system disorders; diseases of blood and blood-forming organs; and musculoskeletal disorders (often osteomyelitis). Moreover,

Table 5 Poisson regression model—based esimates of the SMR

Variable	Factor*	95% CI
Sex		
Male	1.81	1.54—2.14
Female†	2.29	1.92—2.73
Age		
Grade ABC‡	0.98	0.98—0.98
Grade D§	0.99	0.98—0.99
Race		
White	1.03	0.98—1.09
Nonwhite	1.00	Not applicable
Etiology of injury		
Violent	1.23	1.14—1.31
Nonviolent	1.00	Not applicable
Injury level and ASIA grade		
C1-C3 A	4.75	3.65—6.18
C4 A	4.12	3.46—4.91
C5 A	2.94	2.48—3.50
C6-C8 A	2.71	2.28—3.21
C1-C3 BC	2.57	1.92—3.45
C4 BC	2.69	2.22—3.26
C5 BC	2.37	1.96—2.86
C6-C8 BC	2.16	1.80—2.59
T1-S5 ABC	1.86	1.58—2.19
Grade D (all levels)	1.00	Not applicable
Time since injury (y)		
2.0—3.0	1.07	0.96—1.18
>3.0	1.00	Not applicable
Each calendar year since 1973	1.024	1.021—1.027

* The contribution of each variable to the age-, sex-, and calendar year—specific relative risk of mortality in persons with SCI vs the U.S. general population. As illustrated in the text, the total relative risk is calculated by multiplying the specific factors.

† This model is fit without an intercept term to explicitly show the separate overall effects (SMRs) for men and women. Had we fit a traditional model with an intercept term and a term for men, the intercept would have been 2.29 and the male term —0.48.

‡ A linear age term for persons with grade A, B, or C injury. The variable is equal to (age — 10) for persons with grade A, B, or C injury and to 0 for persons with grade D injury.

§ A linear age term for persons with grade D injury. The variable is equal to (age — 10) for persons with grade D injury and to 0 for persons with grade A, B, or C injury.

the age-adjusted mortality rate for septicemia has not changed in 40 years, and no change was observed in the age-adjusted mortality rate for respiratory diseases (typically pneumonia) between 1980 and 2005 (there has been a slight improvement since 2005).[27] As summarized in another preliminary study, significant gains in life expectancy will therefore not occur until progress is made in reducing mortality in septicemia and respiratory diseases as well as reversing trends in diabetes and accidental deaths.[28]

Strengths of the present study include the large size of the study population, the fact that all severity levels are represented, and the fact that the data span approximately 40 years. Another strength is that the methods used here are powerful and complementary as well as sensitive enough to identify comparatively small changes over time.

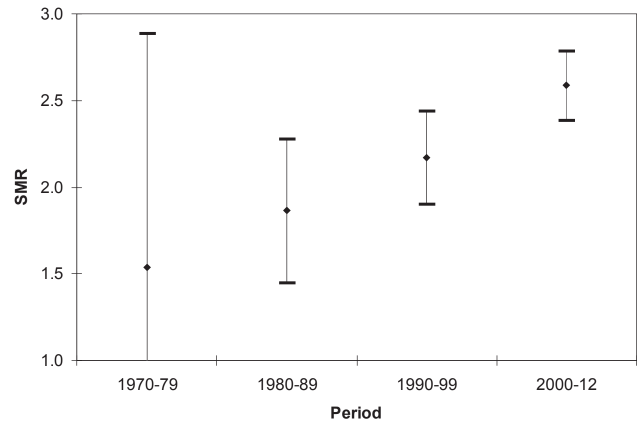

Fig 1 Empirical SMR (with 95% CIs) vs calendar year period for persons aged >60y with paraplegia and ASIA grades A, B, or C who survived ≥2y postinjury.

Study limitations

One limitation of the present study is that the NSCISC database is not population based; thus, it may not represent the entire population of persons with SCI. Indeed, it could be that persons in the model systems facilities may have greater needs and more complications than those served elsewhere. Also, the database does not include detailed information on many comorbid factors, such as smoking, obesity, diabetes, and preexisting conditions. These factors could act as confounders of the results in the present study. For example, if the prevalence of smoking had increased over the study period, it could mask the effect of improvement in survival after SCI. Furthermore, it is possible that recent advances in acute care of persons with SCI have led to a change in the life expectancy of those who survived 2 years postinjury. More recent survivors may thus be more severely involved and, as a consequence, have high long-term mortality than do earlier groups. We are not aware of any evidence to confirm the above 3 limitations, but they remain as possibilities. A final limitation is that the SSDI is only 92.4% sensitive in identifying deceased persons. The results given here are thus, if anything, overestimates of survival.

Conclusions

By using 3 complementary methods, we investigated whether survival in persons with SCI has improved in recent decades. There was no evidence of improvement. Long-term survival has not changed over the past 30 years.

Keywords

Life expectancy; Mortality; Rehabilitation; Survival; Trends

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