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Health, Secondary Conditions, and Life Expectancy after Spinal Cord Injury

James S. Krause, PhD[1] and **Lee L. Saunders, PhD**[1]

[1]Department of Health Sciences and Research, College of Health Professions, Medical University of South Carolina, Charleston, SC

Abstract

Objective—To evaluate the association of health status, secondary health conditions, hospitalizations, and risk of mortality and life expectancy (LE) after spinal cord injury (SCI).

Design—Prospective cohort study.

Setting—Preliminary data were collected from a specialty hospital in the Southeastern United States, with mortality follow-up and data analysis conducted at a medical university.

Participants—A total of 1361 adults with traumatic SCI, all at least 1 year post-injury at the time of assessment, were enrolled in the study. There were 325 deaths. After elimination of those with missing data on key variables, there were 267 deaths and 12,032 person-years.

Interventions—None

Main Outcome Measures—Mortality status was determined by routine follow-up using the National Death Index through December 31, 2008. A logistic regression model was developed to estimate the probability of dying in any given year using person years.

Results—A history of chronic pressure ulcers, amputations, a depressive disorder, symptoms of infections, and being hospitalized within the past year were all predictive of mortality. LE estimates were generated using the example of a male with non-cervical, non-ambulatory SCI. Using 3 age examples (20, 40, 60), the greatest estimated lost LE was associated with chronic pressure ulcers (50.3%), followed by amputations (35.4%), 1 or more recent hospitalizations (18.5%), and the diagnosis of probable major depression (18%). Symptoms of infections was associated with a 6.7% reduction in LE for a 1 standard deviation increase in infectious symptoms.

Conclusion—Several secondary health conditions represent risk factors for mortality and diminish LE after SCI. The presence of 1 or more of these factors should be taken as an indicator of the need for intervention.

Keywords

spinal cord injury; mortality; risk; health; economics; life expectancy

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Correspondence to: James S. Krause, PhD, Department of Health Sciences and Research, College of Health Professions, Medical University of South Carolina, 77 President St, C101, MSC 700, Charleston, SC 29425, Phone: 843-792-1337, krause@musc.edu Fax: 843-792-5649.

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Research over the past 3 decades has documented diminished LE after the onset of SCI, with LE inversely proportional to injury severity.[1–3] Although LE has decreased during the first year post-injury, it appears stable after the first year post-injury.[2–4] Since medical management is no longer improving long-term survival rates, epidemiologic studies are needed to identify risk factors for premature mortality, allowing professionals to apply proven intervention strategies to enhance LE. These studies will be most successful when they systematically address multiple risk factors, allowing for diverse intervention strategies.

Krause[5] developed a theoretical risk model [1996] to guide investigations of prediction of LE by accounting for multiple sets of predictive factors including biographic and injury, psychological, socio-environmental, behavioral, and health variables. According to the model, health factors are the most immediate and most important predictors of LE. Health factors may be specific secondary conditions, such as pressure ulcers, or more general indicators of a history of treatment (e.g., hospitalization).[6] They mediate the relationships between health behaviors,[7] such as smoking and alcohol misuse, with LE. Psychological factors,[8] such as personality characteristics, and socio-environmental factors,[9] such as poverty or social support, have less direct impact on LE according to the model. Studies of health factors and mortality after SCI are rare, and findings are not typically translated into differential LE. Studies of causes of death have indicated heart disease, external causes, and respiratory complications as the leading causes of death after the first year post-injury,[2,10] but they do not fully account for the health factors that may lead to diminished LE. Utilizing data from the NSCISC, a network of facilities in the USA contributing data to a common database, several health factors were identified as risk factors including self-rated health, hospitalizations, and having a grade 3 or 4 PU.[4] Another study found having heart disease was predictive of mortality.[11] Although other chronic diseases, including diabetes, hypertension, chronic obstructive pulmonary disease, and asthma were not significant predictors of mortality, the sample was small (n=361, 37 deaths). These studies are limited to mostly basic demographic and injury characteristics that do not help clarify the role of diverse sets of variables in relation to mortality and LE.

In the first of 2 analyses of data from prospective cohort studies, 5 health factors were significantly related to mortality after controlling for demographic and injury characteristics among a sample of 1265 participants over a 7- to 8-year interval (188 deaths).[6] These included days spent in the hospital, amputations or fractures, infections, surgeries for PUs, and PMD. In the second analysis systematically evaluating all components of the full theoretical risk model, 4 health predictors were retained in the model (all except infectious symptoms), along with 2 behavioral factors (prescription medication use, binge drinking days) and 1 environmental factor (low income).[12]

Only a handful of studies examined LE directly, nearly all of which have used NSCISC data. DeVivo et al.[2] reported LE for various ages and injury levels and found the percentage of LE lost ranged from 11.8% for a 20 year old male with a Frankel D injury to 69.5% for a same aged male who was also ventilator dependent. Krause, DeVivo, and Jackson[4] subsequently evaluated a broader range of predictors of mortality and LE. Under favorable health assumptions alone, LE was 56.4% for a person age 50 and 64.8% for a person age 25. Although health factors were considered, 2 socioeconomic factors, workers compensation insurance and the economic subscale from the CHART, were the primary factors associated with greater longevity. Strauss et al.[13] replicated this analysis after the accrual of time and more deaths, finding less substantial effects of economic factors on LE (workers compensation was no longer significant). However, when using actual family income, rather than the CHART subscale, Krause Saunders, and DeVivo[14] found much more substantial effects of economic factors on LE. Two additional studies utilized non-NSCISC data, demonstrating again the importance of familial income[15] and risk behaviors with LE.[16] For instance, after controlling for demographic and injury characteristics, smoking, binge drinking, use of prescription medication, and less days out of the house were significantly associated with decreases in LE.[16]

Summary and Purpose

The existing literature, both conceptual and empirical, clearly implicates secondary health conditions as elevating risk of mortality. By definition, these factors would also lead to diminished LE, although these relationships have never been quantified. However, LE has infrequently been reported in the literature and, with 2 exceptions, has been restricted to analysis of NSCISC data. Our purpose was to evaluate the relationship of secondary health conditions and hospitalizations with LE after SCI. All analyses follow the theoretical risk model, which has been the focus of recent research.[5] The first set of risk factors within the theoretical risk model (demographic and injury characteristics including age, sex, injury severity) are used as statistical controls, with the primary focus on health factors which are the most important predictors within the risk model. Therefore, health factors are evaluated after controlling for demographic and injury characteristics.

Methods

Participants

After receiving Institutional Review Board approval, participants were identified from records of a specialty hospital in the Southeastern United States. There were 3 inclusion criteria: (1) traumatic SCI with some residual impairment, (2) 18 years or older, and (3) minimum of 12 months post-injury. Of 1929 potential participants, 1386 (72%) completed an assessment related to health and secondary conditions. We excluded 25 participants with questionable diagnoses or no date of injury or age, leaving 1,361 for analysis. Figure 1 summarizes participant inclusion in the final analysis.

Procedures

Cover letters were sent to 1929 potential participants to describe the study and explain informed consent. Materials were sent 4 to 6 weeks later. Non-respondents received 2 follow-up mailings and a follow-up phone call. Additional materials were sent if requested by the participant. Participants (n=1386, 72% response rate) received $20 remuneration, and drawings were conducted totaling $1500. Prospective data were collected between July 1997 and April 1998. Mortality status was assessed as of December 31, 2008, the most recent available data using the NDI.[17] Participants who were not found deceased were presumed to be alive as of that date.

Variables and Measures

Demographic and injury variables were included as statistical controls, including sex, age at injury, years since injury, and injury severity. Injury severity was classified into 4 categories using a scheme identical to that used in preliminary studies[6–9,12] and similar to the NSCISC.[4] All non-ambulatory participants were classified according to 3 neurologic levels (C1–C4, C5–C8, non-cervical), whereas ambulatory participants were grouped together regardless of neurologic level (ambulatory status is a proxy for ASIA D).

We measured 5 indicators of health and secondary conditions, including: (a) PU history, (b) PMD (yes/no), (c) symptoms of infections, (d) amputations, and (e) hospitalization. The OAHMQ was used to measure PMD.[18] It is a 22-item measure which was standardized such that scores above the cutoff of 11 indicate PMD. The OAHMQ has been used in previous studies to assess PMD among community dwelling participants with SCI.[19] Kemp and Adams[31] reported a test-retest coefficient of .87 ($p < .001$) and alphas were .93 ($p < .001$). In terms of validity, sensitivity and specificity were reported to be .93 and .87, respectively. A recent study comparing the OAHMQ to the abbreviated version of the Patient Health Questionnaire indicated the OAHMQ produces modestly higher rates of depression.[20]

Symptoms of infection included fevers, sweats and chills, and urinary tract infections in the 12 months prior to the study. Participants were asked the number of occurrences (0, 1–2, 3–6, 7–12, ≥13). A summary measure (summated score) was created similar to that previously reported in the literature.[6] Amputations were defined by having 1 or more upper or lower extremity amputations since SCI onset. Hospitalizations within the last year were dichotomized. PUs was defined as "*open sores* in pressure areas, such as your tailbone, ischium, heel, elbows." PU history was self-classified as: 1) never had PU, 2) only immediately after injury, but rarely since, 3) every couple of years, 4) at least 1 PU per year, and 5) always seem to have PU. For data analysis, we collapsed the middle 3 responses leaving: 1) no history of PU; 2) non-chronic PU (categories 2, 3, 4); and 3) chronic PU.

Statistical Considerations

We used a 2 stage hierarchical model building strategy with a logistic regression model and mortality as our outcome. Person-year data was constructed using the time from survey to mortality or to censoring (December 31, 2008). This method treats each follow-up year for each person as a separate observation.[21] These methods have been used in previous mortality analyses,[4,22] and logistic regression was conducted on the person-year dataset, with mortality as the outcome. This method allows the researcher to take into account varying covariates across time in the calculation of life expectancy.

The first analysis included only demographic and injury characteristics as a baseline model. In stage 2, health variables were added. PU history (reference=none), PMD (reference=no), hospitalizations (reference=0), and amputation (reference=no) were entered as categorical variables and infectious symptoms as a continuous variable. Symptoms of infection was standardized, and the odds of mortality for 1 standard deviation were reported. Hosmer-Lemeshow and global χ^2 tests were used to assess goodness-of-fit of the model.[23] The C-statistic, measuring area under the Receiver Operating Characteristic curve, was used to assess discriminatory ability.[23] A value of 0.5 for the C-statistic represents no better than chance prediction, and C-statistic values approaching 1 represent improved discrimination of the model. ORs with 95% CIs were calculated. We calculated differences in LE by calculating the probability of survival for each year of life through age 100 using methods widely reported in the literature.[15,16,21,24] When calculating life expectancy for different health conditions, all other health outcomes were held to their reference level (i.e. when assessing life expectancy for PMD, all other health conditions were kept at their reference level – specified above).

Results

Participant Characteristics

There were 194 participants (14.3%) with missing data on at least 1 variable. Deceased cases were disproportionately represented among those with missing data (17.9% of the deceased had missing data compared with 13.1% of the survivors; p=<.05). Significant differences were also observed for race, as 63.9% of those with missing data were white compared with 76.9% of those with complete data (p<.05). The average age of onset of those with missing data (34.8) was greater than those without missing data (31.3, p<.001).

There were no differences as a function of sex, injury severity, or injury duration. There were 1,167 participants in the final statistical model, of which 267 (22.9%) died. Mean age at injury was 31.1 years (standard deviation=13.5), with an average of 9.6 (standard deviation =6.8) years since injury. 21.5% of participants were ambulatory. The majority were white (76.9%) and male (74.4%).

Modeling

In the base logistic regression model including only demographic and injury characteristics, chronologic age, years since injury, and injury severity were significant (table 1). The second stage added health conditions to the base model. Each of the 5 health factors were significant in stage 2 (table 2), although years since injury was no longer significant. Compared with the reference group (ambulatory), there were greater odds of mortality with each successive increase in injury severity. Additionally, odds of mortality increased with increasing age and years since injury.

Of the health factors, those who had chronic PUs had 4.52 greater odds of mortality (CI = 2.57, 7.94) and those with non-chronic PUs had a 1.46 greater odds of mortality (CI = 1.08, 1.97). Amputation was associated with a 2.69 greater odds of mortality (CI = 1.44, 5.02). Having been hospitalized at least once in the year prior to the data collection was associated with a 1.63 greater odds of mortality (CI = 1.23, 2.14). A diagnosis of PMD was associated with a greater odds of mortality (OR = 1.60; CI = 1.21, 2.11). Symptoms of infections was also related to mortality, with an increase of 1 standard deviation of infectious symptoms associated with 1.18 greater odds (CI = 1.03–1.36).

Life Expectancy

LE calculations were made for each health condition (table 3) using the results from the final model (table 2). We used a male, injured at 19, with a non-cervical, non-ambulatory injury as the example. Three different age examples are provided: 20, 40, and 60 years. Under favorable conditions (no health risk factors), LE was 45.6 years at 20, an additional 28.7 years at 40, and 14.2 years at 60. The projected lost LE associated with each condition increased with age. The greatest average decline in LE was associated with chronic PUs (50.3%), with substantially less reduction for non-chronic (14.6%). Of the dichotomous variables, the greatest percentage of lost LE was for amputation (35.4%), followed by hospitalization (18.5%), then PMD (18%). LE decreased an average of 6.7% for each standard deviation on the symptoms of infections scale. Although the percentage of lost LE is high for some conditions, 29.8% of participants reported no risk factors and 43.4% reported only one risk factor (table 4). Chronic PUs and amputation, associated with the greatest lost LE, were only reported by 2.7% and 2.1% of the participants, respectively.

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Discussion

The results underscore the profound effects of secondary health conditions on LE after SCI. Whereas previous research had indicated only a modest effect of health on LE,[4,13] the current study suggests substantial lost LE related to several factors. The differences between studies are likely attributable, at least in part, to the data sets utilized. Previous studies were largely based on analysis of NSCISC data, which is limited to a more circumspect number of predictors.

The presence of even a single secondary condition should be considered a threat to LE, with chronic PUs and amputations being particularly problematic. Other secondary health conditions, including infections and clinical depression, are also of concern. The presence of all cause hospitalization was also related to diminished LE, even though the interval

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between data collection and determination of mortality was 10 years (, i.e., hospitalization in the 12 months prior to data collection predicted mortality 10 years later). The pattern of predictors suggests there is likely an overall pattern of diminished health manifested through several secondary conditions, ultimately leading to a heightened risk of mortality and diminished LE. These findings are generally consistent with the existing literature in terms of risk of mortality. There has been insufficient literature on LE from which to draw comparisons.

Although declines in LE associated with secondary conditions were profound, not all participants reported risk factors (29.8% reported no conditions), and another 43.4% reported only 1 condition. Therefore, risk of diminished LE was focused on a subset of participants. Furthermore, the frequency of occurrence of the most important risk factors was rare, as chronic PUs and amputations were reported by less than 3% of the sample. Although non-chronic PUs were more common (54%), the amount of lost LE was substantially less (14.6%) when compared with chronic PU (50.3%).

Several important methodologic considerations are in this study. First, the health risk factors not only vary in terms of their prevalence and association with LE but also in their nature. For instance, amputations are permanent and likely relate to additional chronic conditions, such as diabetes. Although not truly permanent, chronic PUs was defined by essentially having PUs all the time. This is different than how other variables were measured, such as scores consistent with a diagnosis of depression at the time of the study or hospitalization for symptoms of infection within the previous 12 months. Therefore, the nature of the measurement of the variable itself may affect the LE, with the more permanent or chronic measures associated with more diminished LE. Had we been able to reliably measure depression, hospitalization, and symptoms of infection over time, it is almost certain those with chronic levels of these conditions would report greater diminished LE.

Clinical Implications

There are many ways the current findings can be translated into clinical practices. The identification of the predictorswill allow clinicians from multiple disciplines to assess risk for mortality quickly and efficiently. A minimum intervention for any clinician is to share information with the individual who has SCI. Clinicians may utilize the information on the specific risk factors to develop interventions in their own area of expertise. For instance, rehabilitation psychologists should ensure assessments for depression are routine upon outpatient visits and those at high risk for depression are identified and appropriate follow-up is implemented. Reviewing history of infections upon outpatient visits is also important. Other types of assessment, such as skin integrity, are almost certainly more routine. Interventions need to be developed targeting stakeholders more directly by disseminating information to them which may be utilized to promote self-health. Those with SCI certainly know chronic PUs lead to declining health, but knowing the extent to which they result in diminished LE may be more likely to lead to changes in health behaviors.

Study Limitations

There are several study limitations. First, the participant cohort was drawn after the onset of SCI, so substantial mortality could have occurred prior to enrollment. This may affect the absolute LE but would not likely affect the strength of a predictor factor. If so, it would probably diminish the apparent significance of a predictor. Second, there was a 10-year interval between prospective data collection and determination of mortality status, such that health factors may have changed substantially over time. This also may result in underestimating their relationships with mortality, particularly for variables not measured over time (i.e. depression) or only over a relatively short period of time (i.e. hospitalizations, infections). Third, all data were self-report. Although we do not anticipate this as highly problematic given the basic nature of their reporting of variables, any discrepancy of self-report with real status of the variables would result in an underestimate of the true relationships with mortality, and data from self-report and medical records may produce different results.[25] Fourth, we utilized proxy variables for classification of injury severity (use of ambulatory status rather than ASIA grades), and this could have resulted in some differences in absolute LE (i.e., the true relationship of injury severity with mortality may have been underestimated). Fifth, although the NDI is highly accurate, failure to identify any deaths would have artificially inflated LE estimates. However, this would not necessarily result in different patterns of relationships between risk factors and mortality. Sixth, life expectancy estimates are averages. True life expectancy may vary substantially between individuals based on additional characteristics not accounted for in this study. Seventh, the study results are based on data from only one specialty hospital in the Southeastern United States. Lastly, the sample size was large compared with the majority of studies, but still smaller than those using NSCISC data. "Although the initial response rate was high (72%), attrition and enrollment could be selective (e.g., people in poor health less likely to respond).

Future Research

Ongoing research is needed to incorporate *more frequent assessments* of risk and protective factors and *incorporate additional parameters*, including biomarkers of stress, age, and vascular health. These assessments should take place over intervals longer than 10 years. Quality of life indicators also need to be incorporated into the model, as they were among the first factors to be identified in association with mortality.[26–28] We need to identify the underlying mechanisms for the observed findings, as we do not know whether these factors were significant by virtue of being indicators of overall health, or whether the physiologic processes related to amputations actually contribute to premature mortality. Lastly, investigation of an expanded set of risk and protective factors in association with causes of death would dramatically enhance our understanding of premature mortality and guide intervention strategies to promote greater longevity.

Conclusions

Several secondary health conditions represent risk factors for mortality and diminished LE after SCI. Health care providers should take the presence of 1 or more of these factors as an indicator of the need for intervention. Early intervention could potentially lengthen LE.

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List of Abbreviations

ASIA	American Spinal Injury Association
CHART	Craig Handicap Assessment Reporting Technique
CI	confidence interval

LE	life expectancy
NDI	National Death Index
NSCISC	National Spinal Cord Injury Statistical Center
OAHMQ	Older Adult Health and Mood Questionnaire
OR	odds ratio
PMD	probable major depression
PU	pressure ulcer
SCI	spinal cord injury

References

1. NSCISC. Annual Statistical Report. Birmingham, AL: University of Alabama; Nov. 2009
2. DeVivo MJ, Krause JS, Lammertse DP. Recent trends in mortality and causes of death among persons with spinal cord injury. Arch Phys Med Rehabil Nov. 1999; 80(11):1411–1419.
3. Strauss DJ, DeVivo MJ, Paculdo DR, Shavelle RM. Trends in life expectancy after spinal cord injury. Arch Phys Med Rehabil. 2006; 87:1079–1085. [PubMed: 16876553]
4. Krause JS, DeVivo MJ, Jackson AB. Health status, community integration, and economic risk factors for mortality after spinal cord injury. Arch Phys Med Rehabil. 2004; 85:1764–1773. [PubMed: 15520971]
5. Krause JS. Secondary conditions and spinal cord injury: A model for prediction and prevention. Top Spinal Cord Inj Rehabil. 1996; 2(2):217–227.
6. Krause JS, Carter RE, Pickelsimer E, Wilson D. A prospective study of health and risk of mortality after spinal cord injury. Arch Phys Med Rehabil. 2008; 89:1482–1491. [PubMed: 18674984]
7. Krause JS, Carter RE, Pickelsimer E. Behavioral risk factors of mortality after spinal cord injury. Arch Phys Med Rehabil. 2009; 90(1):95–101. [PubMed: 19154835]
8. Krause JS, Carter R, Zhai Y, Reed K. Psychologic factors and risk of mortality after spinal cord injury. Arch Phys Med Rehabil. 2009; 90(4):628–633. [PubMed: 19345779]
9. Krause JS, Carter RE. Risk of mortality after spinal cord injury: relationship with social support, education, and income. Spinal Cord. 2009; 47(8):592–596. [PubMed: 19255586]
10. Lidal I, Snekkevik H, Aamodt G, Hjeltnes N, Biering-Sorensen F, Stanghelle J. Mortality after spinal cord injury in Norway. J Rehabil Med. 2007; 39(2):145–151. [PubMed: 17351697]
11. Garshick E, Kelley A, Cohen SA, et al. A prospective assessment of mortality in chronic spinal cord injury. Spinal Cord. 2005; 43(7):408–416. [PubMed: 15711609]
12. Krause JS, Zhai Y, Saunders LL, Carter RE. Risk of mortality after spinal cord injury: an 8-year prospective study. Arch Phys Med Rehabil. 2009; 90(10):1708–1715. [PubMed: 19801060]
13. Strauss D, DeVivo M, Shavelle R, Brooks J, Paculdo D. Economic factors and longevity in spinal cord injury: a reappraisal. Arch Phys Med Rehabil. 2008; 89(3):572–574. [PubMed: 18295640]
14. Krause JS, Saunders LL, DeVivo M. Income and risk of mortality after spinal cord injury. Arch Phys Med Rehabil. in press
15. Krause JS, Saunders LL. Life expectancy estimates in the life care plan: Accounting for economic factors. J Life Care Plan. 2010; 9(2):15–28.
16. Krause JS, Saunders LL. Risk of mortality and life expectancy after spinal cord injury: The role of health behaviors and participation. Top Spinal Cord Inj Rehabil. 2010; 16(2):53–60. [PubMed: 21960734]
17. [Accessed September 28, 2007.] National Death Index. http://www.cdc.gov/nchs/ndi.htm
18. Kemp BJ, Adams BM. The Older Adult Health and Mood Questionnaire: A measure of geriatric depressive disorder. J Ger Psychiat Neuro. 1995; 8(3):162–167.
19. Craig A, Tran Y, Middleton J. Psychological morbidity and spinal cord injury: a systematic review. Spinal Cord. 2009; 47(2):108–114. [PubMed: 18779835]

20. Krause JS, Saunders LL, Reed KS, Coker J, Zhai Y, Johnson E. Comparison of the Patient Health Questionnaire and the Older Adult Health and Mood Questionnaire for self-reported depressive symptoms after spinal cord injury. Rehabil Psychol. 2009; 54:440–448. [PubMed: 19929126]
21. Strauss D, Shavelle R, DeVivo MJ, Day S. An analytic method for longitudinal mortality studies. J Ins Med. 2000; 32:217–225.
22. Shavelle RM, DeVivo MJ, Strauss DJ, Paculdo DR, Lammertse DP, Day SM. Long-term survival of persons ventilator dependent after spinal cord injury. J Spinal Cord Med. 2006; 29(5):511–519. [PubMed: 17274490]
23. Hosmer, DW.; Lemeshow, S. Applied logistic regression. 2. New York, New York: John Wiley and Sons; 2000.
24. DeVivo MJ. Estimating life expectancy for use in determining lifetime costs of care. Top Spinal Cord Inj Rehabil. 2002; 7(4):49–58.
25. Jones MP, Bartrop R, Dickson HG, Forcier L. Concordance between sources of morbidity reports: Self-reports and medical records. Frontiers in Pharmacology. 2011:2. [PubMed: 21687499]
26. Krause JS, Crewe NM. Prediction of long-term survival of persons with spinal cord injury: An 11 year prospective study. Rehabil Psychol. 1987; 32:205–213.
27. Krause JS, Saari JM, Dykstra D. Quality of life and survival after spinal cord injury. SCI Psychosocial Process. 1990; 3:4–8.
28. Krause JS. Survival following spinal cord injury: A fifteen-year prospective study. Rehabil Psychol Sum. 1991; 36(2):89–98.

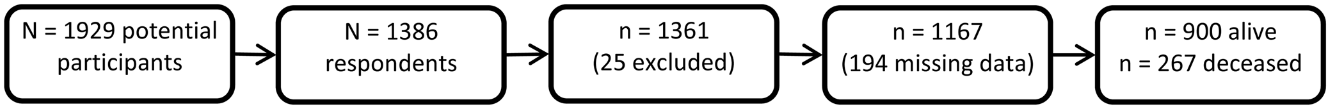

Figure 1.
Flowchart of participant inclusion in the final analysis.

Table 1

Odds ratios, 95% confidence intervals, and mortality rates as a function of demographic and injury characteristics.

Demographic/Injury Characteristics	Mortality			
	Yes (n=267)	No (N=900)		
	Row %		OR* (95% CI)	p-value
Gender				
Male (n=868)	23.7	76.3	1.17 (0.88–1.68)	0.3841
Female (n=299)	20.4	79.6	Reference	
Injury Severity				
C1–C4 (n=158)	36.7	63.3	7.33 (4.14–12.95)	
C5–C8 (n=356)	25.3	74.7	3.77 (2.27–6.26)	<.0001
Non-cervical (n=402)	20.9	79.1	2.58 (1.58–4.24)	
Ambulatory (n=251)	13.9	86.1	Reference	
Years Since Injury	10.4 (7.3)	9.3 (6.6)	1.07 (1.05–1.10)	<.0001
Age at Survey	49.7 (15.3)	38.0 (11.4)	1.08 (1.06–1.10)	<.0001

*OR are controlling for all other variables in the table.

Table 2

Adjusted odds ratios and 95% confidence intervals for the risk variables from the final model.

	Final Model		
Variable	**OR***	**95% CI**	**p-value**
Gender (vs. Female)			0.1442
Male	1.26	0.96–1.83	
Age (vs. 18–34)			<.0001
35–39	1.74	0.93–3.26	
40–44	2.80	1.57–5.01	
45–49	2.47	1.35–4.54	
50–54	3.77	2.11–6.73	
55–59	4.24	2.32–7.75	
60–64	6.48	3.46–12.12	
65–69	9.60	4.93–18.69	
70–74	19.02	10.05–35.99	
75–79	28.80	14.37–57.72	
80+	41.94	19.32–91.04	
Injury Severity (vs. Ambulatory)			<.0001
C1–C4	3.06	1.90–4.92	
C5–C8	1.86	1.19–2.91	
Non-cervical	1.53	0.98–2.39	
Years Since Injury (vs. 10–19)			0.6299
1–4	1.68	0.98–2.39	
5–9	0.95	0.65–1.37	
20–29	1.11	0.81–1.51	
30+	1.01	0.60–1.70	
Pressure Ulcers (vs. Never get them)			<.0001
Non-chronic	1.46	1.08–1.97	
Chronic	4.52	2.57–7.94	
Probable Major Depression (vs. No)			0.0009
Yes	1.60	1.21–2.11	
Hospitalizations (vs. None)			0.0006
1+	1.63	1.23–2.14	
Amputation (vs. No)			0.0018
Yes	2.69	1.44–5.02	
Infections**	1.18	1.03–1.36	0.0159

*controlling for age, gender, years post-injury, injury severity

**OR reported is for 1 *sd* change in infectious symptoms

Table 3

Life expectancies as a function of health status for a hypothetical case at ages 20, 40, and 60.

Health Condition	LE-20YO	% LE LOST*	LE-40YO	% LE LOST*	LE-60YO	% LE LOST*	Avg LE LOST
No health conditions	45.59		28.67		14.17		
Pressure Ulcers							
Non-chronic	40.76	10.6 %	24.72	13.8 %	11.43	19.3 %	14.6%
Chronic	26.65	41.5 %	14.40	49.8 %	5.72	59.6 %	50.3%
Probable Major Depression	39.58	13.2 %	23.78	17.1 %	10.82	23.6 %	18.0%
1+ Hospitalizations	39.37	13.6 %	23.62	17.6 %	10.72	24.4 %	18.5%
Amputation	33.02	27.6 %	18.83	34.3 %	7.90	44.3 %	35.4%
Infections (>1 s.d.)	43.42	4.8 %	26.87	6.3 %	12.90	9.0 %	6.7%

NOTE: example is for a male, with non-cervical, non-ambulatory SCI

* Percentage of lost life expectancy due to the presence of the condition.

Table 4

Percentage of participants affected by specific health factors.

Behaviors	**Percentage**
No conditions	**29.82**
Pressure Ulcers	
Non-chronic	53.98
Chronic	2.66
Probable Major Depression	23.48
1+ Hospitalizations	6.86
Amputation	2.14
Infections Symptoms (>1 s.d.)	18.34
Multiple Conditions	
1 condition only	43.44
2 conditions	18.34
3 conditions	6.34
4 conditions	1.97
5 conditions	0.09

*sum of the # of conditions.