Disability and Worklife:
The Case of Spinal Cord Injury

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Abstract

In this paper we report on the econometric estimation of the worklives of victims of spinal cord injury (SCI). Applying logistical regression to a longitudinal panel with data on injury severity as well as numerous demographic variables, we arrive at models that correctly predict work status correctly in as high as 92% of the cases. We find that work status at injury, education and a stable marriage are positively associated with returning to work and keeping a job. We find that disabled blacks are less likely to find employment even after adjusting for the higher rate of unemployment among minorities. We find that ADA has had a positive effect on employment and increasing Social Security Disability benefits a negative effect.

We use the results of the econometric analysis to estimate worklife based on current and unknown work status. We use both normal life expectancy and the reduced life expectancy associated with the specific SCI. We compare our estimated worklives to those published by Gamboa in *The New Worklife Expectancy Tables* finding that Gamboa's estimates are considerably lower in most cases than our models would predict.

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Introduction

In this paper we present the results of an econometric study of the workforce participation of spinal cord injury (SCI) patients. The study was conducted using data from the National Spinal Cord Injury Database maintained at the Spain Rehabilitation Center, University of Alabama at Birmingham. The data set is unique in that it contains health, sociological and economic data on a large spinally-injured cohort over a long time period.

The use of a database that includes an objective, medical measure of physical condition reduces the problems inherent in using data based on self-reported disability such as the *Panel Study of Income Dynamics* (PSID), *The Current Population Survey* (CPS) and the *Survey of Income and Program Participation* (SIPP). These problems include the implicit assumption that a medical impairment is a disability, direction of causality, lack of comparability across subjects and the use of a claim of disability by healthy individuals to retire early (Baldwin and Johnson, 2001; Hale, 2001; Kirchner, 1996; Skoog and Toppino, 1999). Though these biases are well known and have been extensively studied in the literature on disability and work, forensic economists continue to use these data to construct worklife tables.

We also answer a question not before directly addressed in the return-to-work literature: if a disabled individual can find work, how does that individual's worklife differ from that of the able-bodied? This question is of critical importance not only for forensic studies but also for policy makers considering changes in social programs that provide support and retraining for the disabled. Only with knowledge of worklife can social policies be made in a cost-benefit setting.

As we shall see, SCI patients are far more likely to work than has been suggested by studies performed using the SIPP and CPS. We show that paraplegics, who are classified under SIPP and CPS as severely disabled, have a workforce participation rate far higher than documented by previous studies. However, even less severely afflicted SCI patients, including those currently working (with the possible exception of those with professional degrees), do have significantly reduced work lives. This finding rebuts the proposition that accommodating disability restores the ability to fully participate in the workforce.

Previous Research

A threshold challenge to all studies of the effects of physical limitations on work is differentiating impairment from disability. An inability to lift heavy weights above one's head would be disabling for a construction worker but vocationally irrelevant for a computer programmer.

Studies of the effects of injury characteristics on return to work found in the vocational rehabilitation, spinal cord injury and traumatic injury literatures tend to use data with more precise information or description on type of impairment (DeVivo, et al 1982; Krause, 1992; Krause and Anson, 1996; Crisp, 1990) than those found in the economic literature. These data sets, however, have frequently been too small or specialized for inference to the general population (e.g., Wehman, et al, 1994) and the studies have not generally focused on the questions that most interest forensic economists. Finally, studies of labor force reentry reported in the rehabilitation literature, while informative, do not provide guidance regarding the duration of post-injury employment. This leaves unanswered the key question of whether programs to train and place the disabled in jobs fully restore their human capital.

Forensic economists have studied workforce participation of the disabled using data from the Current Population Survey (CPS) and the Survey of Income and Program Participation (SIPP). The CPS and SIPP rely on self-reported rather than objectively-measured limitations on activities of daily living or ability to work, and classify disability and degree of disability on the basis of the type and amount of government aid payments rather than some measure of ability to work. As Kirchner has noted, there has been a tendency for researchers to let the available data drive the analysis, however inappropriate to the task the data may be (Kirchner, 1996).

There is also an inherent bias towards over-reporting disability by those who do not work due to the moral hazard created by government transfer programs (Better, et al, 1979; Wall, et al, 1977). Two specific factors that create a bias toward over reporting disability are the loss of federally provided health insurance and the difficulty of reestablishing disabled status if the return to work is unsuccessful in the long run. Another problem with the classification of disability is that early retirement and participation in a disability program can be due to an occupational limitation rather than the inability to work (e.g., railroad employees, military). Further, as payments under these programs can be substantial, there is a strong disincentive for recipients to reenter the workforce (Bound, 2002).

There is also a bias towards underreporting disability by those who are employed. An employed individual adequately coping with a biomedical limitation may not consider herself/himself “disabled.” Hence the denominator of the employment rate calculation is inflated and the numerator deflated. Given the demonstrable biases in the data, one can infer little from its analysis.

A common criticism of the use of worklife studies is that the broad categories presented in the studies are of limited use in assessing outcomes for an individual. Specifically problematic in studies of the effects of disability on worklife is that factors found important in the rehabilitation literature such as age at injury, time since injury, marital status and medical indicia of disability are not considered in the economic literature.

Finally, previous forensic studies do not differentiate on the basis of whether the individual is in the workforce at the time of the evaluation despite the demonstrated importance of this factor in estimating worklife of the non-disabled. This shortcoming limits the usefulness of current disability-oriented WLE tables such as the *New Worklife Expectancy Tables* (Gamboa, 1998). Current workforce status is an important predictor of worklife and there is no a priori reason that it is any less important for the “disabled” than for the able-bodied.

The Data

Since 1973 the National Spinal Cord Injury Statistical Center (NSCISC) has collected data on SCI patients from regional Model Spinal Cord Injury Care Systems located throughout the United States (Stover et al., 1999). Data are collected during the initial hospitalization and during each annual evaluation and thus are longitudinal. These data include information on injury severity, hospitalization and inpatient rehabilitation period, post-discharge rehabilitation, mortality and demographics such as age when injured, education, sex, race, marital status and employment status. Injury severity ranges from no residual neurological impairment to complete tetraplegia. We used two of measures of injury severity, the "Category of Neurologic Impairment" and the "ASIA Impairment Scale". The Category of Neurologic Impairment indicates whether the injury was in the cervical segments of the spinal cord (tetraplegia) or lower (paraplegia). The ASIA Impairment Scale measures the level of residual neurologic function during the current annual evaluation. The levels are either A) no sensory or motor function is preserved in the sacral segments S4-S5; B) sensory but not motor function is preserved below the neurological level and extends through the sacral segments S4-S5; C) motor function is preserved below the neurological level, and the majority of key muscles below the neurological level have a muscle grade less than 3; D) motor function is preserved below the neurological level, and the number of key muscles below the neurological level with a muscle grade 3 or greater is greater than or equal to the number of key muscles below the neurological level with grades less than 3; or E) sensory and motor function is normal. Level A is termed a "complete" deficit whereas levels B, C, and D are termed "incomplete". As of September 2000, the database contained records for 98,110 annual evaluations of 20,143 subjects.

Our study used a subset of this data limited to annual evaluations after 1976 in which the patient was age 25 to 65, not a student or incarcerated and with abnormal neurologic function.

The variation of employment rates of patients in the SCI database by age and employment status in the previous period is shown in Figure 1. After age 20 until about 55 years of age, roughly 85 percent of those employed in one period remain employed in the next. After age 55, that percentage begins to drop sharply. This result does not differ dramatically from findings for the able-bodied. Beyond age 20, approximately 10 percent of those who are unemployed in one period find employment in the next. This percentage drops steadily as age increases. Combined, these trends define the trend of the overall employment rate, which peaks at age 27 at about 36% and falls steadily thereafter. Clearly, employment status is a very strong predictor of the status in the next year.

Variation in the employment rate by age and disability status is illustrated in Figure 2. As expected, employment rates are lower for tetraplegics than for paraplegics and lower for those with complete compared to incomplete deficits. Employment rates peak in the late 20's and decline thereafter.

The Models

The data consist of records for individuals at given points in time, and includes a variable indicating whether the subject is employed fulltime in the competitive labor market at the time of the evaluation. The structure of the data is a cross-sectional time series.

As the dependent variable is binary, the assumptions necessary for the use of linear regression analysis are violated. Therefore, we used logistic regression to estimate the probability of employment given a set of medical and demographic characteristics. The logistic model takes the form:

$$P(\text{work}) = \frac{1}{1 - e^{-Z}}$$

where Z is the linear combination of explanatory variables $X_1,\ldots,X_n$, and regression coefficients $B_0,\ldots,B_n,$

$$Z = B_0 + \sum_{i=1}^{n} B_i X_i \, .$$

The percent of the population employed, categorized by age, sex and race, was matched to each record. A trend variable is included as well as a five-year, phased-in dummy for the passage of the Americans with Disabilities Act (ADA) and a variable that measures the ratio of average Social Security Disability payment to average wage.

We initially modeled the probability of employment by pooling data from all annual evaluations of non-student study participants. This corresponds to the literature in SCI return-to-work studies and previous econometric studies of worklife. We then separated the data into two groups according to workforce participation during in the previous evaluation. The first group consists of annual evaluations for those who worked during the previous year's evaluation and the second includes those who did not work.

As the intervals between evaluations are not of equal duration, in a second analysis we limited our data to those observations for which there was an evaluation in the previous year. This definition of last period employment status is consistent with that typically used in worklife expectancy tables. Our definition differs from the standard, however, in that we do not differentiate between those who are in the labor force and unemployed and those that are not in the labor force. Both are classified as not in the labor force.

The model was tested using variables indicating degree of injury, current age, years since injury, sex, race, education, national unemployment rate and marital status. We defined the variables for degree of impairment cumulatively, in other words the variable that indicated paraplegic ASIA A (most severe) is also classified as ASIA B and C. This scheme allows us to measure the marginal effect of increasing injury severity within the general categories of paraplegia and tetraplegia.

Also tested in the models were a time trend, measured as the number of years past 1970, the passage and implementation of the Americans with Disabilities Act (ADA), and the degree to which disability benefits programs replaced earnings. Because the employment rate increases at first with age, then declines, we incorporated linear, quadratic and cubic terms for age. We tested for interactions between age, education and ADA effect and severity of injury. Statistically insignificant variables were dropped, except for age when age^2 was significant.

Econometric Results

Our results for the whole sample, which does not split the observations based on the previous employment status, are presented in Table 1. Some basic findings were 1) generally, the more severe the injury the less likely the patient is employed; 2) education offsets impairment and returns to education are substantial; 3) uneducated tetraplegics are particularly unlikely to find employment; 4) marriage is associated with a higher likelihood of successfully finding work; and 5) SCI patients with professional degrees are no less likely to be employed than the able-bodied.

Like previous researchers (James, et al, 1993), we found that African American SCI patients are 25% less likely to find work than Latino and Asian patients and about 50% less likely than whites even though, unlike previous studies, we have incorporated a race-specific measure of unemployment into our analysis. We also found that employment after SCI is sensitive to economic conditions as measured by the percentage of the population cohort employed. To the best of our knowledge, this result has not been previously reported.

Work status prior to injury has a strong effect on subsequent likelihood of working. Those who were employed or in school when injured are twice as likely to be employed than the previously unemployed or homemakers. Finally, we found that implementation of the ADA coincides with a three percentage points or 20% increase in the likelihood of employment. All variables were significant at better than the 5% level.

It is well known that the probability of an individual working in a subsequent period is highly correlated with their current workforce and employment status. Most worklife expectancy tables, therefore, are constructed so as to consider the current period status. To estimate this conditional worklife expectancy, we estimated models for two groups, those currently employed and those not currently employed.

The results for the divided sample are shown in Table 2. For those who are currently unemployed, years of education, disability status, and age are all highly relevant as to the likelihood that they will be employed next year – even more relevant than to those who are currently employed. More education increases the likelihood of employment next year. Disability status is less important for those currently employed than for those who were unemployed. This is logical because if an SCI patient has found a job, that job probably accommodates their impairment and is likely to continue.

Our results are consistent with our expectations and the unconditional model results reported above. Of note is the magnitude and sign of the intercepts indicating the high likelihood of remaining in the same state from period to period. Education remains the most important factor in getting or keeping a job though it is less important, as expected, for those who have a job. Those working are not affected by changes in economy-wide unemployment, implying that the physically impaired are not the "last hired and first fired." Disability benefits have the expected effect of discouraging the unemployed from securing work but the magnitude of the effect is surprisingly strong. If, for example, benefits as a percent of average wage were to move up ten percentage points from 38% to 48%, the probability of employment for an SCI patient currently not employed decreases by 1.4 percentage points, from 4.7% to 3.3%, a 30% decline. All variables are of the expected sign and all except age are significant at better than the 5% level. This model successfully predicts employment status in 86% and 93% of the cases for those working and not working in the previous period, respectively compared to 79% for the pooled model.

Education remains the key factor for effectively competing in the labor force and our research shows that likelihood of employment increases with education. We found that high school, college, doctorate and professional degrees all increase the likelihood of work, while a master's degree was not significant at the margin. As expected, the more severe the injury the less the likelihood of employment for those in or out of the labor force the previous year. Unlike other studies, we found sex to be insignificant. This is probably because we used sex-specific rates of employment which capture the lower likelihood that a woman will be in the labor force and employed than a male of comparable age and education.

The effect of race is troubling. Disabled non-whites have a significantly lower probability of finding and keeping a job than whites all else being equal. Previous research has also found this effect. Consistent with prior research, we find that probability of working increases with time since injury and age, to a point, after which it levels and then falls. Age has a typically non-linear effect and employment falls steeply with the advent of the typical retirement age. Similarly, as the time injury approaches five years, the probability of working increases, and levels off thereafter. This is likely due to the time required to complete physical and vocational rehabilitation.

Estimating Worklife

Expected worklife is the sum over the remaining life span of the product of the annual probabilities of 1) being alive, 2) being in the workforce if alive and 3) being employed if in the workforce. In this study, we have modeled the probability of being employed if alive, which combines 2 and 3.

Accurate estimates of worklife are critical for both policy analysis and estimation of economic loss in litigation. It is not possible to analyze the benefits of programs and policies designed to assist the physically impaired to reenter the competitive labor market without some measure of the duration of employment. Similarly, policy makers must know the magnitude of the costs of these moral hazards that discourage labor market reentry by, for example, making the program difficult to reenter once a participant has left to reenter the workforce.

Forensic economists are frequently called upon to compare lifetime income "before and after" a disabling incident. As discussed earlier, the data on which economists rely to make these estimates is ill suited to that purpose and imparts bias to their estimates.

In addition to worklife expectancy, life expectancy is also reduced by SCI, the degree of reduction depending on the severity and completeness of the injury. Estimates of worklife for policy analysis purposes must incorporate the reduction in life expectancy, whereas those used for forensic purposes frequently do not. Therefore, in this study, we compute worklife using both normal and reduced life expectancy.

To compute life expectancy, standard statistical and actuarial methods (see, e.g., Strauss, DeVivo and Shavelle, 2000; Strauss, Shavelle, DeVivo and Day, 2000) were applied to a database of 30,000 persons with spinal cord injury. Briefly, we constructed a set of person-years for the 18,872 persons injured since 1973 who are not ventilator dependent, identified variables associated with survival by using logistic regression, and then used the model to compute age-specific mortality rates for any given profile of disability. These rates were used to construct a life table, which gives the life expectancy and the chance of living any number of additional years.

We estimated the annual probabilities of employment using both sets of models. The estimation procedure using the grouped model is straightforward; we simply changed the time dependent variables in the equation for each incremental year of life and calculated the probability of working. This probability was multiplied by the probability of being alive (either normal or SCI-specific) and the products were then summed over the life span.

Using the two-state worklife model is more complex. The logit equations yield probabilities of future employment given the prior year employment status and the demographic characteristics and medical data that were used as explanatory variables in the model. The probability of full employment next year is computed as,

$f(X) = 1/(1+e^{-(a_0 + a_1 X_1 + a_2 X_2 + \ldots)})$ if the person is currently employed, or

$g(X) = 1/(1+e^{-(b_0 + b_1 X_1 + b_2 X_2 + \ldots)})$ if the person is currently unemployed.

Here X_1, X_2, etc. are the explanatory variables a_0, a_1, a_2, etc. are model coefficients for previously employed persons and b_0, b_1, b_2, etc. are model coefficients for previously unemployed persons.

After the current year, the employment status are no longer known. However, our equations can still be used by multiplying the probability estimated with each equation by the probability of the corresponding employment status from the previous period. For example, suppose an individual is currently employed. The probability of employment next year can be computed as

$$p_1 = f(X_1). ,$$

where, X_t is the set of explanatory variables during year t.

The probability of employment during the second year is

$$p_2 = p_1 f(X_2) + (1-p_1) g(X_2),$$

and, during year t it is

$$p_t = p_{t-1} f(X_t) + (1-p_{t-1}) g(X_t).$$ [1]

Example

For illustration, we consider a 30-year-old, married white male who was a student when injured 8 years ago. We assume that the ratio of Social Security Disability Income to average annual wage is 35% and the unemployment rate is 5%.

[1] We found that the probabilities using the working, not working and work status unknown models tend to converge in the "out" years in almost all scenarios. In some scenarios, the not working and work status unknown probabilities cross and then converge.

Worklife expectancy is predicted using both normal life expectancy and our estimate of the reduced life expectancy resulting from the SCI. Clearly, the more accurate prediction is that which uses the reduced life expectancy. However, in forensic applications such as estimating lost income, the analyst must use a normal life expectancy to properly evaluate the magnitude of loss. For this reason and because the use of normal life expectancy allows us to isolate the effect on employment, this presentation is important.

Our estimates are presented in Tables 3, 4 and 5 for three different levels of education.

With a normal life expectancy, we find that the difference in expected worklife between the able-bodied and SCI victims declines markedly with education and is economically insignificant for those with professional degrees. For the relatively uneducated, on the other hand, the difference is significant, ranging from 50% to 78%. The return on education is dramatic: a four year investment in education increases worklife by 10 years and the additional years to receive a professional degree or Ph.D. increases worklife by an additional 6 years.

Current work status is, not surprisingly, a more important predictor of worklife for SCI persons than for the general public. Someone with SCI who is currently employed has an approximately 30% to 50% longer expected worklife than someone who is unemployed. This suggests that job placement is almost as important as education in making SCI victims economically productive and that policies that discourage return to work have very substantial indirect costs. The life expectancy effects are predictable; people with

SCI have substantially reduced life expectancy in all but the least severe cases and that reduction in life expectancy reduces the economic payoff from education and job placement significantly.

Comparison of Worklife Estimates to Previous Research

In the forensic literature, the only published worklife tables for the disabled are those produced by Vocational Econometrics, Inc. (Gamboa, 1998). These tables were developed from workforce participation information from the CPS and life expectancy tables published in Richards (1999). Like ours, Gamboa's tables differ somewhat from the standard worklife presentation in that the "worklife" incorporates both probabilities of being in the workforce and being employed. This difference is unimportant for our purposes. The Gamboa tables also do not differentiate on the basis of current employment status and are based on normal, not reduced, life expectancy.

Gamboa classifies subjects as "severely disabled" or "not severely disabled" on the basis of the CPS disability criteria. He estimates worklife for these groups for three educational levels, 12 years of formal education (high school), 13 to 15 years (some college) and 16 years or more (college degree). This combines all with a college degree or greater so the educational classes do not correspond directly to ours.

For our illustrative subject, the Gamboa estimates of worklife would be 2.7 and 22.0 years for a severely and not severely disabled high school graduate and 5.3 years and

25.7 years for corresponding college graduates. The Gamboa worklife estimates for the "severely disabled" are approximately one-third of our estimates for an ASIA B tetraplegic high school graduate (6.1 years) and college graduate (18.0 years). Gamboa's estimated worklife for a not severely disabled college graduate is within a half year of our estimate for an ASIA D Paraplegic with a bachelor's degree. His estimate for a not severely disabled high school graduate (22.0 years) is 30% to 80% higher than our estimate for a similarly educated ASIA D Paraplegic.

Conclusions

Our findings on probability of working are consistent with the literature in disability research. The likelihood of finding work indeed increases with education and benefits from a stable marriage. The more severe the injury, the less likely an individual is to find work and, if found, the less likely to remain employed. We find that the employment prospects for the physically impaired are affected by the state of the overall job market and that the disabled are not the last hired and first fired. African Americans with SCI are even less likely to find work their than white counterparts with the same disability. We find some evidence that ADA has improved the prospects for employment of SCI patients.

Our work extends the previous research on return-to-work after SCI by providing an empirical basis for estimating how long an injured individual is likely to work. Our models of worklife on the basis of current status provide a vehicle for performing cost-benefit analyses of employment placement programs.

Our results differ substantially from the conclusions reached by Vocational Econometrics. Except in the extreme cases, we find that SCI patients will have significantly more years of productive work than does VEI, though we agree that severe disability can have a profound effect on worklife. It appears that one of the causes of this discrepancy is that VEI underestimates the impact of education on the ability of the physically impaired to work. This may result from the well-known problems with the CPS data upon which they relied.

Unfortunately, we cannot completely resolve the issue of the effects of income support programs on likelihood of working. Though our results suggest that these programs provide a strong disincentive to work for those currently not working, we did not have income support information for the individuals in the database.

We believe that our findings can be extended to forms of disability other than SCI, though this extension should be done with caution given the unique nature of the health problems associated with living with SCI.

Figure 1
Employment Rate by Age and Last Year's Employment Status

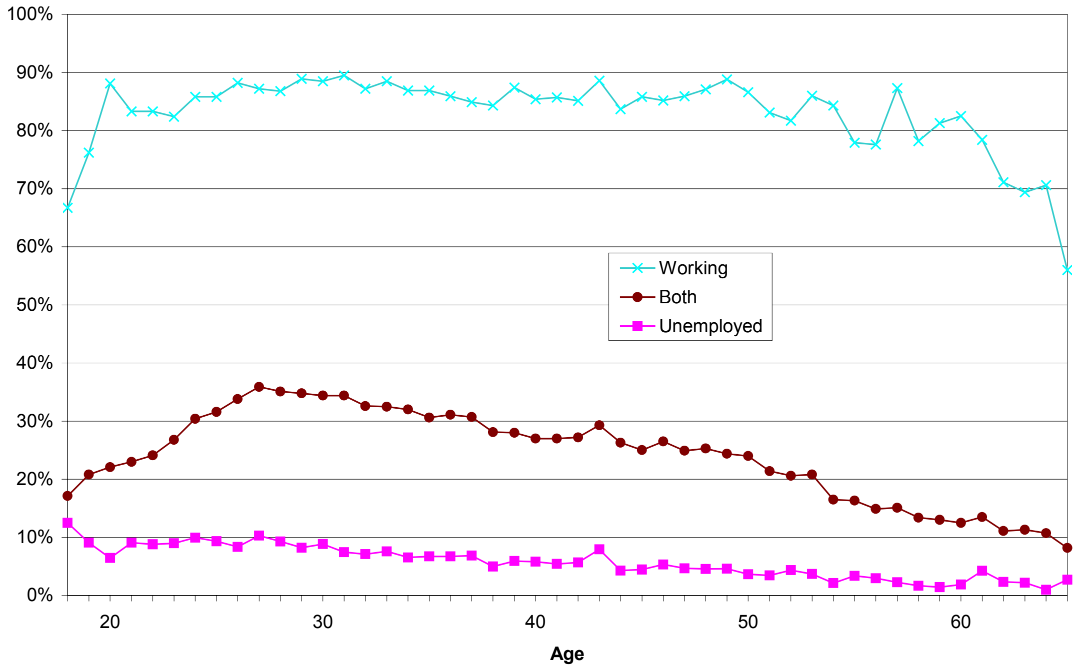

Figure 2
Employment Rate by Age and Disability

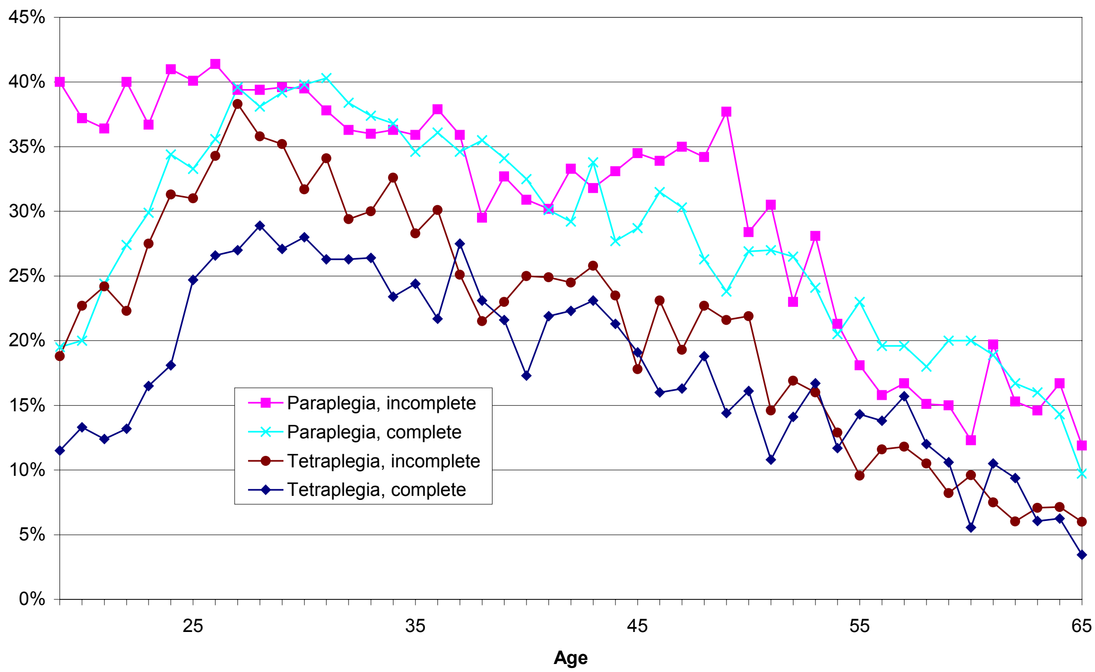

Table 1
Regression Results – Single Sample

Variable	Coeff	s.e.	Chi-Square	Pr > ChiSq	Mean Value
Intercept	-2.935	0.15	402	0.0000	1
High School Grad	1.030	0.04	665	0.0000	0.61
Bachelor's Degree	2.404	0.05	2705	0.0000	0.15
Professional / Ph.D	3.279	0.10	1154	0.0000	0.01
ASIA C Paraplegic	-0.216	0.04	33	0.0000	0.39
ASIA D Tetraplegic	-0.293	0.04	43	0.0000	0.51
ASIA C Tetraplegic	-0.596	0.04	191	0.0000	0.38
Violent Cause of Injury	-0.188	0.04	24	0.0000	0.17
Non HS Grad Tetraplegic	-0.267	0.04	37	0.0000	0.24
Black	-0.286	0.06	24	0.0000	0.19
White	0.471	0.05	96	0.0000	0.72
Single	-0.426	0.03	219	0.0000	0.37
Widowed, Separated, Divorced	-0.455	0.03	230	0.0000	0.25
Years Since Injury	0.200	0.01	620	0.0000	3.8
Age	-0.019	0.00	101	0.0000	37
$(\text{Age-mean})^2$	-0.001	0.00	31	0.0000	101
Phased Dummy for ADA	0.217	0.03	59	0.0000	0.30
Unemployed at Injury	-0.806	0.04	386	0.0000	0.17
Employed as Percent of Population	1.205	0.14	77	0.0000	0.82

Table 2
Regression Results – Sample Divided by Previous Work Status

	Working Last Year					Not Working Last Year			
Working This Year	8,389	86%			2,210	2,210	7%		
Not Working This Year	1,407	14%			30,927	30,927	93%		
Total	9,796				33,137	33,137			
Variable	**Coeff**	**s.e.**	**Chi-Square**	**Pr > ChiSq**	**Coeff**	**Coeff**	**s.e.**	**Chi-Square**	**Pr > ChiSq**
Intercept	0.840	0.253	11	0.0009	-1.590	-1.590	0.669	6	0.0175
High School Grad	0.369	0.107	12	0.0006	0.874	0.874	0.081	116	0.0000
Bachelor's Degree	1.013	0.117	74	0.0000	2.057	2.057	0.094	477	0.0000
Professional / Ph.D	1.652	0.258	41	0.0000	2.871	2.871	0.190	228	0.0000
ASIA B Paraplegic	-0.149	0.073	4	0.0418					
ASIA D Tetraplegic					-0.175	-0.175	0.071	6	0.0141
ASIA C Tetraplegic	-0.388	0.080	24	0.0000	-0.311	-0.311	0.087	13	0.0004
Non HS Grad Tetraplegic					-0.338	-0.338	0.088	15	0.0001
Black	-0.454	0.153	9	0.0029					
White	0.295	0.127	5	0.0202	0.468	0.468	0.067	49	0.0000
Single	-0.227	0.076	9	0.0027	-0.230	-0.230	0.058	16	0.0001
Widowed, Separated, Divorced	-0.348	0.078	20	0.0000	-0.223	-0.223	0.063	13	0.0004
Years Since Injury	0.120	0.028	18	0.0000					
Age	0.004	0.005	1	0.4590	-0.042	-0.042	0.003	170	0.0000
$(\text{Age-mean})^2$	-0.001	0.000	21	0.0000					
Phased Dummy for ADA					0.271	0.271	0.070	15	0.0001
Benefits as Percent of Earnings					-3.606	-3.606	1.648	5	0.0287
Unemployed at Injury	-0.48	0.1049	21	0.0000	-0.359	-0.359	0.073	24	0.0000
Employed as Percent of Population					1.108	1.108	0.259	18	0.0000

Table 3
Expected Worklife
Current Work Status Unknown

	Using Normal LE		
	HS	BA	Prof
Par D	13.8	25.2	31.8
Par B	12.1	23.6	30.7
Tet D	11.5	23.0	30.2
Tet B	6.1	18.0	26.1
Normal	28.0	31.6	33.6

	Using SCI LE		
	HS	BA	Prof
Par D	13.2	23.9	30.0
Par B	10.8	20.6	26.1
Tet D	10.6	20.9	27.0
Tet B	5.1	14.6	20.3
Normal	28.0	31.6	33.6

Table 4
Expected Worklife
Not Currently Working

	Using Normal LE		
	HS	BA	Prof
Par D	11.9	22.9	29.9
Par B	10.7	25.5	28.9
Tet D	10.1	20.9	28.5
Tet B	5.3	16.3	25.6
Normal	26.1	30.5	32.8

	Using SCI LE		
	HS	BA	Prof
Par D	11.3	21.7	28.2
Par B	9.4	18.7	24.5
Tet D	9.2	18.9	25.4
Tet B	4.3	13.1	18.9
Normal	26.1	30.5	32.8

Table 5
Expected Worklife
Currently Working

	Using Normal LE		
	HS	BA	Prof
Par D	17.8	29.1	37.1
Par B	16.5	28.1	35.6
Tet D	16.9	28.4	36.7
Tet B	11.1	27.0	33.8
Normal	28.1	31.6	33.7
	Using SCI LE		
	HS	BA	Prof
Par D	17.0	27.4	34.6
Par B	14.6	23.8	29.8
Tet D	15.5	25.3	31.9
Tet B	9.5	18.7	24.7
Normal	28.1	31.6	33.7

References

Baldwin, Marjorie L. and William G. Johnson, "Dispelling the Myths about Work Disability," Prepared for the 1998 IRRA Research Volume, *New Approaches to Disability in the Workplace*, 2001.

Better, S. R., P. R. Fine, D. Simison, G. H. Doss, R.T. Walls and D. E. McLaughlin, "Disability Benefits as Disincentives to Rehabilitation," *Milbank Memorial Fund Quarterly,* 1979, 57, 412-427.

Crisp, Ross, "Return to Work After Spinal Cord Injury," *Journal of Rehabilitation,* January, February, March 1990.

DeVivo, M. J. and P. R. Fine, "Employment Status of Spinal Cord Injured Patients 3 Years After Injury," *Archives of Physical Medicine & Rehabilitation,* 1982, 63, 200-203.

DeVivo, M. J., R. D. Rutt, S. L. Stover, and P. R. Fine, "Employment and spinal cord injury," *Archives of Physical Medicine and Rehabilitation,* 1987, 68, 494-498.

Gamboa, A. M., Jr., *The New Worklife Expectancy Tables Revised 1998 By Gender, Level of Educational Attainment, and Level of Disability*, Vocational Econometrics, Inc., 1998.

Hale, Thomas W., "The Lack of Disability Measure In Today's Current Population Survey," *Monthly Labor Review*, June 2001, 124(6) 37-40.

James, M., DeVivo M. J. and J. S. Richards, "Post Injury Employment Outcomes Among African-American and White Persons with Spinal Cord Injury," *Rehabilitation Psychology,* 1993, 38, 151-164.

Kirchner, Corinne, "Looking Under the Street Lamp: Inappropriate Uses of Measures Just Because They Are There," *Journal of Disability Policy Studies*, 1996, 7 (1), 77-90.

Krause, J. S., "Employment after Spinal Cord Injury," *Archives of Physical Medicine & Rehabilitation*," 1992, 73, 163-169.

Krause, J. Stuart and Carol A. Anson, "Employment After Spinal Cord Injury: Relation to Selected Participant Characteristics," *Archives of Physical Medicine & Rehabilitation*," 1996, 77, 737-743.

Krause, J. S., D. Kewman, M. J. DeVivo, F. Maynard, J. Coker, M. J. Roach, and S. Ducharme, "Employment after spinal cord injury: an analysis of cases from the model spinal cord injury systems," *Archives of Physical Medicine and Rehabilitation,* 1999, 80, 1492-1500.

Krause, J. S., M. Sternberg, J. Maides, and L. Lottes, "Employment after spinal cord injury: differences related to geographic region, gender, and race," *Archives of Physical Medicine and Rehabilitation,* 1998, 79, 615-624,

McShane, S. L. and J. Karp, "Employment following spinal cord injury: a covariance structure analysis," *Rehabilitation Psychology,* 1993, 38, 27-40.

Richards, Hugh, *Life and Worklife Expectancies*, Tucson AZ: Lawyers & Judges Publishing Company, 1999.

Skoog, Gary R. and David C. Toppino, "Disability and the New Worklife Expectancy Tables From Vocational Econometrics, 1998: A Critical Analysis," *Journal of Forensic Economics*, 1999, 12(3), 239-254.

Strauss, D. J., M. J. DeVivo and R. M. Shavelle, "Long Term Mortality Risk After Spinal Cord Injury," *Journal of Insurance Medicine*, 2000, 32, 11-16.

Strauss, D. J., R. M. Shavelle, M. J. DeVivo, and S. M. Day, "An Analytic Method for Longitudinal Mortality Studies," *Journal of Insurance Medicine,* 2000, 32, 217-225.

Stover, S. L., M. J. DeVivo, and B. K. Go, "History, implementation, and current status of the national spinal cord injury database," *Archives of Physical Medicine and Rehabilitation,* 1999, 80, 1365-1371.

The National Spinal Cord Injury Statistical Center, The University of Alabama at Birmingham, Birmingham, Alabama. *The Model Spinal Cord Injury Care Systems' Data Collection Syllabus for the National Spinal Cord Injury Database*, November 1995.

Walls, R. T., C. Masson, and T. J. Werner, "Negative Incentives to Vocational Rehabilitation," *Rehabil Lit.,* 1977, 38, 143-150.

Wehman, Paul, Martha Booth, Debbie Stallard, Anita Mundy, Pam Sherron, Michael West and David Cifu, "Return to work for Persons with Traumatic Brain Injury and Spinal Cord Injury: Three Case Studies," *International Journal of Rehabilitation Research,* 1994, 17, 268-277.