

# Predictors for Return to Work After Spinal Cord Injury: A 3-Year Multicenter Analysis

David W. Hess, PhD, David L. Ripley, MD, William O. McKinley, MD, Michael Tewksbury, MBA

**ABSTRACT.** Hess DW, Ripley DL, McKinley WO, Tewksbury M. Predictors for return to work after spinal cord injury: a 3-year multicenter analysis. *Arch Phys Med Rehabil* 2000;81:359-63.

**Objective:** To examine the ability of the Motor Index Score (MIS), in combination with demographic variables, to predict return to work during a 3-year period for individuals with spinal cord injury (SCI).

**Methods:** Prospectively collected data, between 1986 and 1995, submitted to the National Spinal Cord Injury Statistical Center were analyzed to determine the prediction of return to work utilizing variables of education, ethnicity, age, marital status, gender, and MIS. Individuals, aged 18 to 65yrs, employed at the time of their injury, were evaluated at discharge from rehabilitation and at 1 (YR1), 2 (YR2), and 3 (YR3) years postinjury (sample sizes of 1,857, 1,486, and 1,177, respectively).

**Results:** The most important predictors of return to work were education, MIS, ethnicity, and age at onset of SCI. These variables resulted in a high rate of accuracy for predicting across all 3 yrs (YR1, 81%; YR2, 82%; YR3, 77%).

**Conclusions:** The ability to predict return to work after SCI was shown utilizing MIS and demographic variables, with nearly 80% accuracy. This suggests that return to work after SCI is a dynamic process, with the level of importance of each variable changing with time postinjury.

**Key Words:** Spinal cord injury; Return to work; Motor Index Score.

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**S**PINAL CORD INJURY (SCI) has a significant impact on an individual's functional, psychosocial, and financial status. There are enormous "direct" medical costs of caring for individuals with SCI during acute hospitalization, rehabilitation, and postdischarge; however, the "indirect" costs of SCI represented by the loss of productivity and employability must also be considered. Approximately 60% of SCIs occur in individuals between the ages of 16 and 30 yrs,<sup>1</sup> the prime years for the formation of vocational goals and career establishment.

From the Department of Physical Medicine and Rehabilitation, VCU/Medical College of Virginia Hospitals, Richmond, VA.

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Reprint requests to David W. Hess, PhD, P.O. Box 980661, Department of Physical Medicine and Rehabilitation, VCU/Medical College of Virginia Hospitals, Richmond, VA 23098-0661.

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Employment rate estimates for individuals with SCI vary greatly, ranging between 10% and 50%.<sup>1-6</sup> The benefits of working extend beyond financial and social advantages, to include the psychological importance of employment for individuals with SCI.<sup>6-8</sup> Studies have shown that individuals with SCI who are employed feel better about their quality of life than those unemployed,<sup>8</sup> and suggest that employment is related to prolonged survival.<sup>6</sup> Thus, an important goal in SCI rehabilitation involves maximizing vocational potential. Identifying predictive factors of successful return to work (RTW) may assist rehabilitation professionals in improving the vocational outcome of individuals with SCI, thereby decreasing "indirect" medical costs and increasing the quality of life.

Recent trends in medical and rehabilitation reimbursement practices, including the advent of managed care, has resulted in the reallocation of health care and rehabilitation funding. This is particularly apparent in the public rehabilitation sector, where declining funds have caused a shift toward selection of those individuals more likely to RTW.<sup>9</sup> Therefore, it is important for rehabilitation practitioners to be able to predict RTW after SCI. Several studies have researched this issue and have identified factors associated with RTW after SCI including level of education, gender, age, race, injury severity, requirements of previous employment, marital status, Barthel index, Functional Independence Measure (FIM), income, social supports, and participation in a vocational rehabilitation program.<sup>5,6,9-16</sup>

DeVivo and Fine<sup>11</sup> studied the influence of several variables on "return to gainful employment" at 3yrs after SCI. Variables associated with RTW included gender, race, marital status, "extent of lesion," preinjury employment history, Barthel score, incidence of urinary tract infection, and completion of business or trade school courses. Through the use of discriminant analysis, the authors reported 71% accuracy in predicting employment outcome 3yrs postinjury, using a combination of primarily demographic variables. In a related study, DeVivo and colleagues<sup>9</sup> identified seven variables (age, sex, education, motivation, race, functional requirements of prior occupation, and Barthel score) that improved their accuracy of prediction to 79%. Krause and Anson<sup>5,12</sup> reported the relationship of postinjury employment to that of several demographic factors, along with level and completeness of injury. Their studies suggested that the combination of level and completeness of injury was better at predicting employment outcomes than injury level or completeness of lesion alone.

Motor index score (MIS) was chosen instead of level of injury or completeness of injury in this study because MIS is believed to represent a functional interaction between the two. For example, an individual with a cervical motor-incomplete SCI may have a higher MIS than someone with a lumbar-complete SCI. Additionally, two individuals with cervical-incomplete SCIs may have dramatically different MIS and functional abilities, which may give rise to enhanced vocational opportunities.

The objective of this study was to examine the predictive power of the MIS, in combination with demographic variables, to predict an individual's ability to RTW after an SCI. Although

demographic variables are crucial in determining an individual's ability to RTW, it was anticipated that the inclusion of motor function (MIS) present at discharge would significantly increase the predictive value. This is supported by Lazar and coworkers<sup>17</sup> who found MIS useful in predicting self-care abilities during rehabilitation. This study will examine whether variables shown to be predictive at year 1 postinjury continue to be predictive at 2 and 3 yrs postinjury. By utilizing a multicenter database and large sample size, it is hoped that the results of this study will be more generalizable than those of previous studies.

## METHODS

### Subjects

This study applied an analysis of prospectively collected data submitted to the National Spinal Cord Injury Statistical Center (NSCISC) between 1986 and 1995. All centers reporting data were participants in the National Spinal Cord Injury Model Systems (NSCIMS) program, funded by the United States Department of Education's National Institute on Disability and Rehabilitation Research (NIDRR). Eligibility criteria and characteristics for persons enrolled in the NSCISC database include (1) sustaining an SCI by traumatic etiology; (2) receiving treatment at a model SCI system within 60 days of injury; and (3) having had a clinically discernible degree of spinal cord neurologic impairment on admission.

The initial study population drawn from the database consisted of 3,175 individuals, aged 18 to 65 yrs, who were employed at the time of their SCI. Employment is defined by the NSCISC database as individuals legally and gainfully working in the competitive labor market. Subjects used in the analysis were drawn from 17 NSCIMS sites in 5 regional areas (Northeast, 18%; Southeast, 22%; Midwest, 24%; Northwest, 15%; Southwest, 21%). All subjects who had insufficient demographic data to allow for complete analysis were excluded. The sample of those employed at year 1, 2, and 3 were 1,857, 1,486, and 1,177, respectively. Subjects were evaluated at discharge from inpatient rehabilitation, and at 1, 2, and 3 yrs postinjury.

### Independent Variables

**Demographic.** Variables of education, ethnic background (ie, white or nonwhite), age, marital status, and gender were chosen based on previous research identifying them as key predictors of RTW.

**Clinical.** The MIS denotes the total numerical muscle strength values (0 to 5) for the 20 key muscle groups (10 on each side) corresponding to "key" upper and lower extremity spinal cord levels. As per standard protocols,<sup>18</sup> scores ranging from 0 to 100 were assigned at the time of acute care and rehabilitation admission, and at rehabilitation discharge.

### Data Analysis

Data analyses were completed in two stages. Stage 1 was descriptive and summarized demographic (ie, education, age, gender, race, and marital status) information using either one-way analysis of variance (ANOVA) or chi-square. In addition, MIS was added into the equation. Stage 2 analyses involved logistic regression to determine which variables provided the strongest predict predictive power of RTW after SCI. All significant variables were entered into the regression for each time interval (years 1, 2, and 3 postinjury) to obtain unique regression equations for each year.

## RESULTS

During the 1-year follow-up assessment (YR1), 82% (1,523) of the 1,857 cases had employment data available for analysis. Of those cases, 21% (319) of the individuals reported they were working. At the second year follow-up assessment (YR2), employment information was available for 58% (1,077) of the original cases, with 21% (226) of those individuals reporting that they were working. In the third year of follow-up (YR3), the sample consisted of only 40% (743) of the original cases, with 23% (171) reporting that they were working.

Table 1 shows significant differences in age of onset at year 1, with those employed being older than those unemployed. Age differences were not significant at years 2 and 3. Differences in the average level of education were significant across all 3 yrs. The lowest RTW outcomes were observed in individuals with less than 12 yrs of education. Only 11% were reported as employed at YR1, in contrast to 18% of the individuals with 12 yrs of education, and 44% of the individuals with the equivalent of a college degree or greater ( $\geq 16$  yrs). These numbers remain relatively similar for YR2 (<12 yrs, 9%; 12 yrs, 19%;  $\geq 16$  yrs, 52%) and YR3 (<12 yrs, 8%; 12 yrs, 22%;  $\geq 16$  yrs, 48%). Motor index scores were also significant across all 3 yrs, with employed individuals having a higher MIS than those unemployed.

Table 2 shows that married individuals at YR1 and YR2, were significantly more often employed, compared with unmarried individuals. In YR3, marital status was not associated with differences in employment. When examining ethnicity, significant findings were found across all 3 yrs, with white individuals more often employed when compared with those who were not white. With regards to gender, only in YR1 was there a significant difference, with a higher percentage of females returning to work.

### Logistic Regression

Six variables were entered in the prediction of RTW for each of the 3 postinjury years, resulting in a high rate of accuracy for predicting employment status after SCI. The six variables were age at onset, gender, marital status, MIS, years of education, and ethnicity.

The cluster of variables resulted in an 81% prediction accuracy of RTW in year 1. Four variables were highly significant to the prediction: years of education, ethnicity, marital status, and MIS (table 3). The odds increased 1.32 times with each increment of education. The odds for individuals who were married to RTW were 1.7 times greater than those for

Table 1: RTW Postinjury Associated With Age, Education, and MIS

Variables	Year 1 (n = 1,523)	Year 2 (n = 1,077)	Year 3 (n = 746)
Age (yrs)			
Employed	35.3 (11.3)	34.8 (10.8)	32.5 (10.3)
Unemployed	33.9 (12.0)	33.9 (12.1)	34.1 (12.3)
	F = 3.9*	F = .84	F = .12
Education (yrs)			
Employed	13.3 (2.7)	13.5 (2.6)	13.1 (2.3)
Unemployed	11.7 (2.0)	11.7 (2.0)	11.7 (2.0)
	F = 126.8†	F = 128.2†	F = 56.8†
MIS			
Employed	56.7 (22.3)	53.0 (21.9)	50.7 (22.3)
Unemployed	45.4 (24.3)	43.6 (23.0)	43.2 (22.8)
	F = 54.6†	F = 30.3†	F = 14.0†

Data are mean (SD).

\*  $p < .05$ .

†  $p < .001$ .

Table 2: RTW Postinjury Associated With Marital Status, Ethnicity, and Gender

Variables	Working YR1 (n = 1,523)	Working YR2 (n = 1,077)	Working YR3 (n = 746)
<b>Marital Status (%)</b>			
Married	26	26	22
Single	17	17	23
	$\chi^2 = 21.9^*$	$\chi^2 = 13.4^*$	$\chi^2 = .62$
<b>Ethnicity (%)</b>			
White	25	25	28
Not white	12	12	12
	$\chi^2 = 32.5^*$	$\chi^2 = 21.5^*$	$\chi^2 = 21.3^*$
<b>Gender (%)</b>			
Male	19	20	22
Female	27	22	27
	$\chi^2 = 6.3^\dagger$	$\chi^2 = .16$	$\chi^2 = .22$

\*  $p < .001$ .  
 †  $p < .01$ .

single individuals. The odds for whites to RTW were 1.79 times greater than for those who were not white. The odds increased 1.25 times for participants with every increase of 10 points on MIS.

In the analysis of the second year postinjury, the cluster of variables resulted in an 82% accuracy in predicting RTW (table 4). Two variables (education and MIS) were highly significant in predicting RTW. The odds increased 1.45 times for each increment of education, and the odds increased 1.24 times for participants with every increase of 10 points on MIS. The odds for married individuals were 1.76 greater than for single individuals to RTW, whereas there was a slight decrease in the odds (.97) with every 10yrs over the age of onset of 18.

During the analysis of the variables for the third year postinjury, accurate predictions were achieved at a rate of 77%. Four variables were again highly significant to the prediction: years of education, ethnicity, MIS, and age (table 5). The odds for RTW increased by 1.37 for each increment of education. The odds for whites to RTW were 2.21 times greater than for those who were not white. The odds increased 1.19 times for participants with every increase of 10 points on MIS. The odds decreased slightly by .96 times for each 10 years of age at onset.

**DISCUSSION**

Impairments and functional disability secondary to SCI present a significant barrier to vocational capabilities as evidenced by the high unemployment rates observed during follow-up of SCI populations. The 21% (YR1) to 23% (YR3) RTW rate found in this study is similar to that reported in previous studies and shows the importance of further analyzing the many variables associated with RTW after SCI.

Results of this study indicate that the most important variables predicting RTW after SCI are education, MIS, and

Table 3: Prediction of RTW in Year 1

Variables	Beta	SE	Odds Ratio	95% CI
Age	-.0149	.0068	.99	.97-1.0
Gender	-.2066	.1802	.81	.57-1.2
Marital status	.5283	.1519	1.70*	1.26-2.28
Motor index	.2226	.0299	1.25*	1.18-1.33
Education	.2768	.0318	1.32*	1.24-1.40
Ethnicity	.5849	.1677	1.79*	1.29-2.49

Abbreviation: CI, confidence interval.  
 \*  $p < .001$ .

Table 4: Prediction of RTW in Year 2

Variables	Beta	SE	Odds Ratio	95% CI
Age	-.0270	.0089	.97*	.96-.99
Gender	.2150	.2288	1.24	.79-1.94
Marital status	.5633	.1870	1.76*	1.22-2.53
Motor index	.2135	.0376	1.24†	1.15-1.33
Education	.3697	.0405	1.45†	1.34-1.57
Ethnicity	.4710	.2020	1.60	1.08-2.38

Abbreviation: CI, confidence interval.  
 \*  $p < .01$ .  
 †  $p < .001$ .

ethnicity. Education and MIS consistently remained the most important predictive variables throughout years 1, 2, and 3. Interestingly, ethnicity proved to have a greater predictive role as time went on. Marital status, although significant in years 1 and 2, did not have significant predictive value at year 3. Age at injury onset only became important as a variable in years 2 and 3. The use of these variables resulted in an 81% predictive accuracy in year 1, 82% in year 2, and 77% in year 3, consistent with values found in previous research.

Return to work at year 1 correlates with years 2 and 3; however, the weights of the different variables in the equation vary across time intervals. This finding suggests that RTW after SCI is a dynamic process, with the level of importance of each variable changing as time after injury increases. As individuals adjust to their injury, their ability to work changes. The differences in the effect of these variables over time may be an area of future research, to further delineate how each factor changes in importance and why.

**Findings Regarding Individual Factors**

**Education.** Years of education were found to be a consistently predictive variable across the 3yrs. Subjects with less than a high school education were found to have a significantly higher unemployment rate. This is consistent with findings in previous research. Krause and Anson,<sup>5</sup> for example, reported that individuals with 4yrs of college had an employment rate of 72% after SCI, compared with 3% for individuals with less than a high school education. There may be several explanations for this finding. First, more education may reflect a higher socioeconomic status. Mackenzie and colleagues<sup>15</sup> examined the effects of socioeconomic status and annual earned income the year before injury on postinjury employment and found it to be an important factor after controlling for type and severity of injury. Education also increases the range of jobs available to individuals. The more education individuals have, the more likely they are to be employed in a position that requires less physical labor, thereby increasing the potential for RTW in individuals with physical impairment.

**Motor Index Score.** The MIS was found to be a significant factor predictive of RTW across all 3yrs. However, the impact

Table 5: Prediction of RTW in Year 3

Variables	Beta	SE	Odds Ratio	95% CI
Age	-.0381	.0103	.96*	.94-.98
Gender	-.0452	.2445	.96	.59-1.54
Marital status	.2050	.2118	1.23	.80-1.84
Motor index	.1752	.0042	1.19*	1.01-1.03
Education	.3159	.0474	1.37*	1.25-1.51
Ethnicity	.7940	.2388	2.21*	1.40-3.58

Abbreviation: CI, confidence interval.  
 \*  $p < .001$ .

of MIS decreased somewhat from year 1 to year 3. There are several possible explanations for the importance of MIS. Higher MIS should be associated with increased physical abilities. For example, an MIS of 50 or greater in persons with paraplegia would enable complete use of their upper extremities for employment potential. By year 3, many individuals may have furthered their education or received vocational training, enabling them to obtain employment in a less physically demanding job. In addition, some patients may have needed additional time to overcome the psychological impact of their injury, and the process of rehabilitation itself may have taken enough time such that the individual was not ready to RTW at year 1.

**Ethnicity.** Krause<sup>12</sup> showed the importance of ethnicity in predicting RTW outcomes after SCI. Specifically, minority individuals were 2.8 times less likely to be employed than white individuals. Alston and McCowan<sup>18</sup> have also found that African-American men have experienced sociocultural barriers in returning to work. The results of this study support the findings of these previous studies. Race was found to be a significant variable across all years with respect to RTW. Interestingly, ethnicity appears to be more significant at year 3 than at year 1. The reasons for this finding are potentially multifactorial. Krause<sup>12</sup> suggested that since minorities had similar employment rates to those of white individuals before the injury, the disadvantage must have occurred after the injury. However, this may simply be a reflection of socioeconomic status. Additional investigation showed a correlation between lack of education and minority status. The importance of education in RTW has been demonstrated. The lower level of education that minority individuals have as a group suggests that these individuals were probably engaged in jobs that were more physically demanding before injury. These findings reinforce the additional difficulty that minority individuals with SCI have in returning to work. Previous work by Miller and Joe<sup>19</sup> showed that redesigning vocational rehabilitation programs to consider cultural differences could result in increased employment of impaired minority clients. This is certainly an area that requires further study.

**Age.** Age at onset of injury was also found to be an important variable with respect to RTW. Inclusion criteria necessitated that subjects in the study were between the ages of 18 and 65yrs at the time of injury. Basically, the younger individuals were at the time of injury, the more likely they were to RTW. This finding confirms findings of earlier research.<sup>1,5,9-12,15</sup> This relationship appeared to become more significant across the 3-year period. A possible explanation for this trend is that younger individuals may be more willing to undergo retraining than older individuals and completed this by year 3. Younger individuals also tend to be more physically fit in general than older counterparts. Noreau and Shephard<sup>20</sup> reported that individuals who returned to work after SCI were lighter, had a lower body mass index, and higher aerobic power than nonworkers. These findings had no relation to the type of job the patient held.

**Gender.** Gender was not found to be a significant variable. This finding differs from that of previous research. DeVivo and Fine<sup>11</sup> found that females were more likely to be employed after SCI than males. Krause and Anson<sup>5</sup> also suggested that women are more likely to be employed than men after SCI. However, in a follow-up study, Krause<sup>12</sup> failed to find a significant difference for gender after controlling for all other variables. Further, MacKenzie<sup>15</sup> reported that gender was not a significant factor in predicting RTW.

**Marital Status.** The relationship between marital status and employment is a complex one. Mackenzie<sup>15</sup> found that a strong social network was associated with successful RTW after SCI. This would seem to imply that married individuals would be more likely to RTW because of the social support provided by the marriage. However, DeVivo<sup>9</sup> failed to find a significant difference between married and unmarried individuals with respect to RTW after SCI. In this study, marital status was found to be a significant variable during years 1 and 2, but not at year 3. There were indications that for males, marital status and ethnic background may have an interactive effect on their returning to work. Females showed no advantage or disadvantage with regard to marital status across all 3yrs. Additionally, these findings appear to change over time. The reasons for these findings are unclear and offer an area for potential future investigation.

### Study Limitations

The use of a large, longitudinal, multicenter database has inherent limitations with respect to research applications, and this study is not an exception. The decline in the sample size from 1,857 to 1,177 from year 1 to 3 may be a source of error, in that only selected individuals are returning for follow-up.

The lack of an operational definition of employment in these studies is always a salient issue. Some studies have included student, volunteer, and other work-related experiences in the category of employment.<sup>21</sup> In addition, most studies fail to differentiate between full- and part-time employment. This study focused on RTW by limiting subject selection to those individuals who were employed at the time of their injury. This may have resulted in lower reported employment rates than other studies. In addition, most employment studies only show a "snapshot" of the patient's employment status at the time of interview, without any information regarding the patient's ongoing employment status. Cifu and associates<sup>21</sup> showed the need for monthly employment ratios or some other measure that would provide an ongoing picture of sustained employment in studies of this type. Vocational success is not only obtaining a job, but also sustaining employment.

### CONCLUSION

Improving medical care for individuals with SCI is increasing survivability,<sup>6</sup> and those who have "regular occupational income" perceive a higher quality of life.<sup>15</sup> These findings reinforce the need to maximize vocational outcomes for individuals after SCI. This study shows the ability to predict RTW outcome after SCI based on a select set of clinical and demographic variables, with approximately 80% accuracy. The use of the NSCIMS database is more representative of the nationwide population, allowing for greater generalization of the information. The large study sample strengthens the validity of the findings. As with previous research in this area, the importance of education in obtaining returning to work was demonstrated. This information is important for the vocational rehabilitation of individuals with SCI, because it is a variable studied that can potentially be improved by the individual. Marital status, race, and age at injury onset were also deemed to be important variables. The relationship between race and RTW as an important variable was also demonstrated. Finally, the value of the MIS as a predictor of RTW was demonstrated. These findings will hopefully be of use to clinicians, vocational rehabilitation professionals, and individuals with SCI in the ongoing continuum of rehabilitation after SCI.

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