Journal of Vocational Rehabilitation 52 (2020) 19–28
DOI:10.3233/JVR-191057
IOS Press


# Gainful employment and earnings among those with spinal cord injury and multiple sclerosis

James S. Krause[a,*], Clara E. Dismuke-Greer[a], Karla Reed[a], Deborah Backus[b] and Philip Rumrill[c]
[a]*College of Health Professions, Medical University of South Carolina, Charleston, SC, USA*
[b]*Shepherd Center, Atlanta, GA, USA*
[c]*College of Education, Health, & Human Services, Kent State University, Kent, OH, USA*

Revised/Accepted July 2019

**Abstract**.
**BACKGROUND:** Spinal cord injury (SCI) and multiple sclerosis (MS) are disabling conditions associated with low employment rates and loss of earnings.
**OBJECTIVE:** Quantify the relationships of demographic, educational, and functional characteristics with gainful employment and earnings after SCI or MS.
**METHODS:** Participants were adults under age 65 with SCI ($n = 1275$) or MS ($n = 1107$) identified through a specialty hospital or a state-based surveillance registry in the southeastern United States. An econometric model of cross-sectional data using a two-step data analytic model examined employment status and earnings. This included one model that was restricted to only those employed (conditional earnings) and another model that included all participants, using $0 earnings for those who were unemployed (unconditional earnings – earnings not conditional upon being employed).
**RESULTS:** Diagnosis was not significantly related to employment status. Several functional characteristics were associated with lower odds of employment and higher unconditional earnings (cognition, walking, shopping independently). Higher conditional earnings were reported by those with MS ($16,405) and those without difficulty in cognition ($8,532) and bathing ($20,932). Higher educational attainment was related to probability of employment and greater earnings.
**CONCLUSIONS:** Those with SCI and those with several types of functional limitations have lower quality of employment, as measured by earnings. Efforts should be made to enhance quality of employment for those at greatest risk for unemployment and underemployment.

Keywords: Spinal cord injuries, multiple sclerosis, employment

## 1. Introduction

One frequent consequence of disability is the restriction of participation in normal daily activities, such as working (World Health Organization, 2018). As such, the employment rate for persons with disabilities is substantially lower than the rate reported for persons without disabilities (18.7% and 65.7%, respectively; US Department of Labor, 2018). Because gainful employment is related to better physical and mental health (Anderberg, Rainer, Wadsworth, & Wilson, 2015; Henkel, 2011; McClelland, 2000; Mood & Jonsson, 2016), promoting successful employment outcomes is important.

Spinal cord injury (SCI) and multiple sclerosis (MS) are two disabling conditions often affecting a person's ability to work. Both conditions result in physical symptoms or impairment that may

*Address for correspondence: James S. Krause, PhD, College of Health Professions, Medical University of South Carolina, 151-B Rutledge Ave, MSC 962, Charleston, SC 29425, USA. Tel.: +1 843 792 1337; E-mail: krause@musc.edu.

predict job loss (Falvo, 2014; Krause & Terza, 2006; Wang, Yang, Yen, & Lieu, 2002), and MS is further associated with cognitive impairment, which is highly related to unemployment (DeLuca & Nocentini, 2011; Roessler, Rumrill, Li, & Leslie, 2015). Although the employment rates for persons with either SCI or MS vary depending on disability severity (Ottomanelli & Lind, 2009; Schiavolin et al., 2013), they are significantly lower than that of the general population. The overall employment rate after SCI is typically less than 40% (Krause, Saunders, & Acuna, 2012; Ottomanelli & Lind, 2009; Young & Murphy, 2009), and employment rates under 50% are commonly reported for people with MS (Julian, Vella, Vollmer, Hadjimichael, & Mohr, 2008; Krause, Rumrill, Dismuke-Greer, & Jarnecke, 2018b; Roessler et al., 2015).

Qualitative research has found people with SCI and MS identify salary/compensation as an important quality outcome (Meade, Reed, Rumrill, Aust, & Krause, 2016; Meade, Reed, Saunders, & Krause, 2015). This may be due, in part, to the elevated lifetime costs associated with SCI and MS, as evidenced by the direct costs of the disability as well as indirect costs related to loss of employment and earnings (Berkowitz, O'Leary, Kruse, & Harvey, 1998; Cao, Chen, & DeVivo, 2011; Naci, Fleurence, Birt, & Duhig, 2010). Furthermore, financial stability after SCI and MS is associated with greater longevity and life satisfaction (Cao, Krause, Saunders, & Bingham, 2014; De Judicibus & McCabe, 2007; Harding et al., 2018; Krause, Saunders, & DeVivo, 2011); therefore, research is needed to understand more fully the individual characteristics related to gainful employment and earnings.

Recent studies of both SCI and MS quantified the relationships between multiple characteristics and earnings, including diagnostic factors. For those with SCI, ambulatory status (a proxy for neurologically complete injuries), was associated with greater probability of employment and higher earnings among those employed (Krause, Dismuke-Greer, Jarnecke, & Reed, in press). For MS, clinical factors, including MS type, severity, and cognitive impairment, were more strongly related to employment status than to earnings among those employed (Krause et al., 2018a). To our knowledge, no studies have directly compared the earnings of those with SCI and MS within the same equation using the same set of predictor variables. Such studies are needed to move from diagnostic specific predictors of quality employment, such as injury severity or MS diagnosis, to inclusion of functional variables that cut across diagnoses.

### 1.1. Purpose

Our purpose was to use a two-step model to quantify demographic, educational, and functional characteristics with the odds of employment and predicted average earnings associated with each characteristic. Earnings reflect total earnings from paid employment. We applied econometric modeling to quantify earnings among all participants, allocating $0 earnings for those unemployed. These are described as *unconditional earnings* because they are not conditional on employment (everyone is included in the analysis). Additionally, we performed economic modeling that was restricted to only those participants who were working, using their total work income as the outcome. These are described as *conditional earnings* because the analysis is conditional on the individual being employed (i.e., only employed participants are used in the calculation). Therefore, the characteristic may be significantly associated with unconditional earnings because it is associated with a greater probability of employment, higher earnings among those employed, or both. In contrast, unconditional earnings reflect solely the relationship of each characteristic with earnings among those employed.

## 2. Methods

### 2.1. Participants

Institutional review board approval was obtained prior to data collection. Participants with MS were enrolled from a specialty hospital in the southeastern United States. Participants with SCI were enrolled through the same hospital and an adjoining state-based registry. The primary eligibility criteria were: (a) diagnosis of SCI or MS, (b) 18 years or older at enrollment, (c) under age 65 at assessment, and (d) at least one year had passed since SCI onset or MS diagnosis. There were 2382 participants, including 1275 with SCI and 1107 with MS.

### 2.2. Measures

Participants completed a self-report questionnaire that included demographic, educational, and functional characteristics and employment history. Covariates included sex, race/ethnicity, age, age at onset/diagnosis (SCI onset or diagnosis of

MS), years since onset/diagnosis, relationship status, highest education level achieved, and functional characteristics. Race/ethnicity was broken into three groups: non-Hispanic White, non-Hispanic Black, and all others. Age at onset/diagnosis and years since onset/diagnosis were broken into categories based on 10-year intervals. Relationship status was categorized as married/member of unmarried couple, divorced/widowed/separated, and never married. Education levels were: (a) no more than a high school diploma, (b) two-year degree/trade school, (c) four-year degree, and (d) postgraduate degree.

Ten functional characteristic items were used, including four items from the United States Census Bureau's 2009 Current Population Survey (US Census Bureau, 2009). These dichotomous yes/no items included: difficulty concentrating, remembering, or making decisions; doing errands alone; seeing; and hearing. Six additional items were used from the 2014 Medicare Health Outcomes Survey (Centers for Medicare and Medicaid Services, 2014). These items asked about difficulty doing the following activities without special equipment or help from another person: bathing, dressing, eating, getting in or out of chairs, walking, or using the toilet. These items were dichotomized into: (a) no, I do not have difficulty; (b) yes, I have difficulty or I am unable to do this activity. Employment was measured as a binary variable, employed vs unemployed at time of data collection. Participants were given the following definition: The terms job, work, occupation, and employment refer to working for pay (they do not refer to volunteer, homemaker, or school activities). They were then asked whether they were employed at three months post injury/diagnosis, one year post injury/diagnosis, or any time after injury/diagnosis. Those who indicated they had worked at some point since injury/diagnosis were then asked: "Are you working for pay?." Earnings were measured with 16 categories ranging from a low of<$10,000 to a high of >$175,000.

### 2.3. Data collection procedures

Prospective participants were sent cover letters, followed by actual materials 4–6 weeks later. They were given the option to complete the self-report assessment by mail or online. Nonrespondents received a second set of materials and a follow-up phone call. A third set of materials was sent if they had lost or discarded the previous materials. Remuneration ($50) was offered to participants who completed the survey.

### 2.4. Statistical analysis

We examined differences in employment status at time of assessment using demographic, educational, and functional covariates using chi-square tests for categorical and binary variables (those with missing values were eliminated). We estimated adjusted probability of employment using a logit model and reported odds ratios (OR) and confidence intervals (CI) for the covariates of the association of employment with demographic and functional covariates. Stata was used to examine the adjusted unconditional earnings associated with covariates using extended interval regression and adjusted conditional earnings using standard interval regression (Stata, 2017a). *Unconditional earnings* uses all participant data by allocating $0 in earnings for those unemployed, whereas *conditional earnings* uses only the annual earnings of those employed.

Standard interval regression is a generalization of censored regression and uses the information on the minimum and maximum values of the intervals so no information is lost in estimation. Interval regression also considers the censored values either at the minimum or maximum value as the value tends toward negative or positive infinity. The extended interval regression model, **eintreg**, fits an interval regression model that allows for endogenous sample selection (Stata, 2017b; i.e., employment and earnings are not independent). Endogenous sample selection via probit within the extended interval regression model was necessary to compute unconditional earnings for both employed and unemployed individuals. Standard interval regression could only be used to compute conditional earnings of those who were employed. We have reported coefficients in dollars of the association of demographic, educational, and functional covariates with earnings, first for those who were employed only (conditional earnings) and then for the entire cohort (unconditional earnings).

## 3. Results

### 3.1. Descriptive and bivariate analyses

Table 1 summarizes the descriptive characteristics and bivariate analysis as a function of diagnosis. Those with MS reported a significantly higher employment rate (SCI = 30.7%; MS = 48.4%). Participants with SCI were predominantly male (74.8%), whereas participants with MS were predominantly

Table 1
Descriptive characteristics as a function of diagnosis

| Characteristic | SCI | MS | Total | *p* |
|---|---|---|---|---|
| Employment status | | | | |
| Employed | 30.7 | 48.4 | 38.9 | 0.000 |
| Sex | | | | |
| Male | 74.8 | 22.8 | 50.6 | 0.000 |
| Education | | | | |
| ≤High School | 48.8 | 27.3 | 38.8 | 0.000 |
| Two-year degree/trade school | 22.0 | 22.5 | 22.2 | |
| Four-year degree | 18.0 | 28.6 | 22.9 | |
| Postgraduate | 11.3 | 21.6 | 16.1 | |
| Race | | | | 0.931 |
| Non-Hispanic White | 67.4 | 66.7 | 67.0 | |
| Non-Hispanic Black | 26.4 | 26.8 | 26.6 | |
| Other | 6.3 | 6.5 | 6.4 | |
| Marital status | | | | 0.000 |
| Married/member of unmarried couple | 44.2 | 65.0 | 53.9 | |
| Divorced/widowed/separated | 23.5 | 19.9 | 21.8 | |
| Never married | 32.2 | 15.2 | 24.3 | |
| Age at onset/diagnosis | | | | 0.000 |
| <30 | 44.9 | 27.5 | 36.8 | |
| ≥30 and < 40 | 20.0 | 34.1 | 26.5 | |
| ≥40 and < 50 | 18.5 | 27.8 | 22.8 | |
| ≥50 | 16.6 | 10.7 | 13.8 | |
| Time since onset/diagnosis | | | | 0.002 |
| <10 | 44.4 | 39.8 | 42.3 | |
| ≥10 and ≤ 19 | 36.2 | 34.9 | 35.6 | |
| ≥20 | 19.5 | 25.3 | 22.2 | |
| Activities of Daily Living | | | | |
| Serious difficulty concentrating, remembering, or making decisions | 21.9 | 40.0 | 30.3 | 0.000 |
| Deaf/serious difficulty hearing | 3.8 | 4.9 | 4.3 | 0.216 |
| Blind/serious difficulty seeing even with glasses | 3.2 | 11.6 | 7.1 | 0.000 |
| Difficulty doing errands alone/shopping | 39.9 | 29.9 | 35.3 | 0.000 |
| Difficulty bathing | 52.2 | 23.9 | 39.0 | 0.000 |
| Difficulty dressing | 44.2 | 20.7 | 33.3 | 0.000 |
| Difficulty eating | 18.7 | 9.8 | 14.5 | 0.000 |
| Difficulty getting in or out of chairs | 47.4 | 24.8 | 37.0 | 0.000 |
| Difficulty walking | 78.0 | 41.8 | 61.2 | 0.000 |
| Difficulty using the toilet | 53.7 | 16.3 | 36.3 | 0.000 |

female (77.2%). There were no differences in race/ethnicity. Participants with MS had higher levels of education, were more likely to be married or part of an unmarried couple, older at onset/diagnosis, and had more years since onset/diagnosis. Of the functional variables, participants with MS were significantly more likely to report difficulty with concentration or memory and with vision, whereas those with SCI were more likely to report difficulty with functional independence (e.g., bathing, dressing, and walking).

### 3.2. *Regression analysis*

#### 3.2.1. *Employment status*

Several covariates were significant for employment status (pseudo-$R^2 = 0.28$; see Table 2). The absence of certain functional limitations was associated with greater odds of employment, including: concentration or memory (OR = 2.47), able to shop independently (OR = 2.39), and walking (OR = 2.90). Diagnosis was not significant. Each successive level of educational attainment was associated with greater odds of employment (two-year degree/trade school = 1.82; four-year degree = 3.50; postgraduate = 4.89). Compared to those in the oldest age at onset/diagnosis category of ≥ 50, those in the two youngest cohorts reported greater odds of employment (<30 = 2.22;≥30 and < 40 = 2.13). Compared to those with the most time since onset/diagnosis, those with the least time since onset/diagnosis reported 1.94 greater odds of employment (CI = 1.45, 2.59). Non-Hispanic Whites reported 2.22 greater odds of employment than non-Hispanic Blacks. Those who were married or part of an unmarried couple reported 1.58 greater odds of employment than

Table 2
The odds of employment related to diagnosis, demographic, educational, and disability characteristics

| | Odds Ratio | $p$ | 95% CI* | |
|---|---|---|---|---|
| Diagnosis (ref: SCI) | | | | |
| MS | 1.30 | 0.07 | 0.98 | 1.71 |
| Sex (ref: Female) | | | | |
| Male | 1.15 | 0.26 | 0.90 | 1.47 |
| Education (ref:≤High School) | | | | |
| Two-year degree/trade school | 1.82 | 0.00 | 1.40 | 2.38 |
| Four-year degree | 3.50 | 0.00 | 2.65 | 4.62 |
| Postgraduate | 4.89 | 0.00 | 3.56 | 6.73 |
| Race (ref: Non-Hispanic Black) | | | | |
| Non-Hispanic White | 2.22 | 0.00 | 1.74 | 2.85 |
| Other | 1.33 | 0.20 | 0.86 | 2.05 |
| Marital status (ref: Divorced/widowed/separated) | | | | |
| Married/member of unmarried couple | 1.58 | 0.00 | 1.20 | 2.07 |
| Never married | 1.06 | 0.72 | 0.76 | 1.49 |
| Age at onset/diagnosis (ref:≥50) | | | | |
| <30 | 2.22 | 0.00 | 1.55 | 3.17 |
| ≥30 and < 40 | 2.13 | 0.00 | 1.49 | 3.06 |
| ≥40 and < 50 | 1.40 | 0.07 | 0.97 | 2.00 |
| Time since onset/diagnosis (ref:≥20) | | | | |
| <10 | 1.94 | 0.00 | 1.45 | 2.59 |
| ≥10 and ≤ 19 | 1.13 | 0.41 | 0.85 | 1.51 |
| Activities of Daily Living (ref: yes) | | | | |
| Serious difficulty concentrating, remembering, or making decisions | 2.47 | 0.00 | 1.92 | 3.20 |
| Deaf/serious difficulty hearing | 1.06 | 0.84 | 0.62 | 1.80 |
| Blind/serious difficulty seeing even with glasses | 1.40 | 0.20 | 0.84 | 2.34 |
| Difficulty doing errands alone/shopping | 2.39 | 0.00 | 1.80 | 3.16 |
| Difficulty bathing | 1.24 | 0.22 | 0.88 | 1.76 |
| Difficulty dressing | 1.09 | 0.65 | 0.75 | 1.59 |
| Difficulty eating | 1.49 | 0.07 | 0.97 | 2.30 |
| Difficulty getting in or out of chairs | 1.01 | 0.96 | 1.42 | 0.72 |
| Difficulty walking | 2.90 | 0.00 | 2.22 | 3.79 |
| Difficulty using the toilet | 1.11 | 0.57 | 0.78 | 1.58 |
| Constant† | 0.00 | 0.00 | 0.00 | 0.01 |

*Confidence Interval. †Constant estimates baseline odds.

those divorced/widowed/separated. Sex was not significant.

### 3.2.2. *Conditional earnings*

Those with MS reported higher conditional earnings (\$16,405; see Table 3). Two of the 10 functional characteristics were significantly related to conditional earnings, with higher earnings for those with no difficulty in concentration or memory (\$8,532) or bathing (\$20,932). Compared to those with lower education levels, higher conditional earnings were observed among those with a four-year degree (\$32,755) and with postgraduate degrees (\$42,748). Those in the youngest age group had significantly lower conditional earnings (\$–10,779). Similarly, compared to those with ≥ 20 years since onset/diagnosis, those with fewer years since onset/diagnosis had lower conditional earnings (<10 = \$–8,283; ≥10 and ≤ 19 = \$–10,096). Males had \$28,143 higher conditional earnings. Non-Hispanic Whites reported \$12,519 estimated greater earnings than non-Hispanic Blacks. There were no observed differences in conditional earnings based on relationship status.

### 3.2.3. *Unconditional earnings*

On average, those with MS had estimated \$17,867 greater unconditional earnings than participants with SCI (Table 4). Higher unconditional earnings were observed among participants who did not have difficulty with concentration or memory (\$25,770), shopping independently (\$26,160), bathing (\$22,088), and walking (\$23,698). The other six function items were not significant. Compared to those with no more than a high school diploma, higher unconditional earnings were observed among those with two-year degree/trade school (\$19,521), four-year degree (\$54,660), and postgraduate degree (\$69,583). Males reported \$26,094 greater estimated unconditional earnings. Non-Hispanic Whites

Table 3
Conditional earnings as a function of diagnosis, demographic, educational, and functional characteristics

| | Coefficient | *p* | 95% CI* | |
|---|---|---|---|---|
| Diagnosis (ref: SCI) | | | | |
| MS | 16405 | 0.00 | 8933 | 23876 |
| Sex (ref: Female) | | | | |
| Male | 28143 | 0.00 | 21558 | 34729 |
| Education (ref: ≤High School) | | | | |
| Two-year degree/trade school | 8639 | 0.06 | –355 | 17632 |
| Four-year degree | 32755 | 0.00 | 24853 | 40657 |
| Postgraduate | 42748 | 0.00 | 34408 | 51087 |
| Race (ref: Non-Hispanic Black) | | | | |
| Non-Hispanic White | 12519 | 0.00 | 4802 | 20236 |
| Other | 11233 | 0.11 | –2342 | 24809 |
| Marital status (ref: Divorced/widowed/separated) | | | | |
| Married/member of unmarried couple | 2083 | 0.62 | –6108 | 10273 |
| Never married | –8603 | 0.10 | –18707 | 1502 |
| Age at onset/diagnosis (ref: ≥50) | | | | |
| <30 | –10779 | 0.04 | –20926 | –632 |
| ≥30 and < 40 | –6019 | 0.25 | –16300 | 4261 |
| ≥40 and < 50 | 5491 | 0.32 | –5234 | 16216 |
| Time since onset/diagnosis (ref: ≥20) | | | | |
| <10 | –8283 | 0.04 | –16013 | –554 |
| ≥10 and ≤ 19 | –10096 | 0.01 | –18132 | –2061 |
| Activities of Daily Living (ref: yes) | | | | |
| Serious difficulty concentrating, remembering, or making decisions | 8532 | 0.04 | 605 | 16460 |
| Deaf/serious difficulty hearing | 13130 | 0.12 | –3510 | 29771 |
| Blind/serious difficulty seeing even with glasses | –842 | 0.92 | –16802 | 15118 |
| Difficulty doing errands alone/shopping | 7918 | 0.12 | –1979 | 17816 |
| Difficulty bathing | 20932 | 0.00 | 7631 | 34234 |
| Difficulty dressing | –11070 | 0.13 | –25223 | 3082 |
| Difficulty eating | –2844 | 0.75 | –20406 | 14718 |
| Difficulty getting in or out of chairs | 8327 | 0.16 | –3220 | 19874 |
| Difficulty walking | 1013 | 0.81 | –7194 | 9220 |
| Difficulty using the toilet | 2143 | 0.72 | –9742 | 14028 |

*Confidence Interval.

reported an average of $27,548 greater earnings. Those married or in an unmarried couple reported $12,736 greater unconditional earnings than those divorced/widowed/separated. Neither age at onset/diagnosis nor years since onset/diagnosis were significant predictors of unconditional earnings.

## 4. Discussion

Gainful employment is an important outcome to the lives of people with disability, yet limited research exists identifying functional characteristics related to employment outcomes across multiple diagnostic groups. Also, there is no single indicator of successful employment after disability, highlighting the importance of considering multiple indicators of employment success, including earnings. We evaluated the relationships of several sets of factors with the odds of gainful employment and quantified the relationship of these factors with earnings. Having achieved higher education; being non-Hispanic White; and having greater functional ability in concentration or memory, independently shopping, and walking were associated with an increased likelihood of being employed, which is consistent with the factors reported in the literature as related to greater odds of employment (Krause, Terza, Erten, Focht, & Dismuke, 2012; Roessler et al., 2015). However, these predictors were not always related to earnings in the same way.

### *4.1. Diagnostic and functional variables*

Although type of diagnosis was not statistically significant in relation to employment when controlling for all other factors (i.e., all things considered equal), employed people with MS had higher conditional earnings and, therefore, higher unconditional earnings ($17,867). Given that several statistical controls were in place for demographic, educational, and functional characteristics, this disparity

Table 4
Unconditional earnings as a function of diagnosis, demographic, educational, and functional characteristics

| | Coefficient | *p* | 95% CI* | |
|---|---|---|---|---|
| Diagnosis (ref: SCI) | | | | |
| MS | 17867 | 0.00 | 9314 | 26420 |
| Sex (ref: Female) | | | | |
| Male | 26094 | 0.00 | 18466 | 33722 |
| Education (ref: ≤High School) | | | | |
| Two-year degree/trade school | 19521 | 0.00 | 9892 | 29150 |
| Four-year degree | 54660 | 0.00 | 45691 | 63629 |
| Postgraduate | 69583 | 0.00 | 59852 | 79314 |
| Race (ref: Non-Hispanic Black) | | | | |
| Non-Hispanic White | 27548 | 0.00 | 18988 | 36108 |
| Other | 14344 | 0.06 | –728 | 29415 |
| Marital status (ref: Divorced/widowed/separated) | | | | |
| Married/member of unmarried couple | 12736 | 0.01 | 3757 | 21715 |
| Never married | –4164 | 0.46 | –15179 | 6852 |
| Age at onset/diagnosis (ref: ≥50) | | | | |
| <30 | 7824 | 0.19 | –3750 | 19398 |
| ≥30 and < 40 | 9884 | 0.10 | –1738 | 21506 |
| ≥40 and < 50 | 11061 | 0.07 | –836 | 22958 |
| Time since onset/diagnosis (ref: ≥20) | | | | |
| <10 | 7957 | 0.09 | –1148 | 17062 |
| ≥10 and ≤ 19 | –4479 | 0.33 | –13485 | 4527 |
| Activities of Daily Living (ref: yes) | | | | |
| Serious difficulty concentrating, remembering, or making decisions | 25770 | 0.00 | 17199 | 34341 |
| Deaf/serious difficulty hearing | 9404 | 0.31 | –8730 | 27537 |
| Blind/serious difficulty seeing even with glasses | 6395 | 0.45 | –10051 | 22841 |
| Difficulty doing errands alone/shopping | 26160 | 0.00 | 16056 | 36264 |
| Difficulty bathing | 22088 | 0.00 | 8563 | 35613 |
| Difficulty dressing | –5468 | 0.45 | –19757 | 8821 |
| Difficulty eating | 6942 | 0.40 | –9362 | 23246 |
| Difficulty getting in or out of chairs | 7239 | 0.24 | –4741 | 19220 |
| Difficulty walking | 23698 | 0.00 | 14299 | 33097 |
| Difficulty using the toilet | 6052 | 0.34 | –6323 | 18428 |

*Confidence Interval.

in outcomes was significant. It raises fundamental questions regarding quality of outcomes for individuals with SCI and the types of factors that may limit employment opportunities. This could relate to different paths to employment. For MS, there is no single time point where employment changes; the declines in job performance and, therefore, job retention tend to be gradual (Moore et al., 2013). For people with SCI, there is a dramatic decrease in the portion of individuals employed immediately after onset, with only a minority proportion of individuals retaining their jobs and others requiring retraining (Krause & Reed, 2009; Krause, Terza, Saunders, & Dismuke, 2010). For those who must re-acquire employment, there are financial disincentives to maximizing earnings, including spend downs for medical expenses and the threat of lost medical benefits. Policymakers need to develop programs that better incentivize people with disabilities to maintain and maximize their employment. Vocational rehabilitation counselors should be advocates for those with disabling conditions.

The characteristics favorable to employment and earnings were unequally distributed based on diagnosis, such that those with MS had more education, particularly a substantially higher proportion of individuals with four-year or postgraduate degrees. This may be attributable, in part, to MS manifesting itself in early to middle adulthood, typically between the ages of 30 and 40. Because SCI is associated with younger age at onset/diagnosis, many individuals have yet to achieve their educational, social, and vocational potential. Therefore, the observed differences in earnings favoring those with MS would be compounded when accounting for the lower overall education level among those employed. The challenge for people with SCI compared to those with MS is to obtain sufficient education and training needed to obtain quality employment. Unfortunately, vocational rehabilitation counselors are often reinforced for maximizing employment rates, rather than promoting quality employment that may allow individuals to increase their earnings to the point where they will improve the quality of their life and help them be less reliant on government benefits. Investments in education may pay large dividends. Even for people with MS who may have significant educational attainment, further education and training may help individuals better retain their employment and continue up the career trajectory.

Several impairment factors were related to employment and earnings. Impairment with concentration or memory was particularly important, being the only functional characteristic predictive of both employment status and conditional earnings. Ability to shop and walk independently were also significantly related to employment status, but not conditional earnings; whereas bathing was related only to conditional earnings. Each of these four characteristics was related to differences in unconditional earnings, ranging from $22,088 (bathing) to a high of $26,160 (shopping). Taken together, cognitive function, independence in taking care of oneself, walking, and getting out in the community are strong correlates of overall unconditional earnings. These findings may have diagnosis-specific implications, as people with MS are more likely to have cognitive impairments, and people with SCI are more likely to experience mobility impairments. That said, these findings should only be generalized to MS and SCI and within the context of the other predictors. For instance, visual and hearing impairments were not significantly related to employment or earnings, but this clearly should not be taken to mean they would be unrelated to employment among people with other diagnoses or in the absence of inclusion of the current lengthy list of functional characteristics.

Findings regarding age at onset/diagnosis and time since onset/diagnosis are of importance, as they were related to employment and conditional earnings in different ways. Those who were younger, both in terms of age at onset/diagnosis and time since onset/diagnosis, had greater odds of employment, yet lower conditional earnings when employed. The lower probability of employment yet higher conditional earnings, among those older and those with more years since onset/diagnosis suggests rehabilitation professionals and counselors may need to work more intensively with those who are older to maintain employment. Here again, the differences in the two diagnostic categories are important; people with MS tend to experience gradual decline in health status over time, so job retention interventions often involve contingency planning for future job-related problems that arise due to those gradual changes. People with SCI experience an acute onset of disability, usually earlier in their work lives, so initial return to work efforts focus on workplace accommodations to address mobility needs, and job retention efforts focus on prevention or resolution of secondary complications of the injury.

Among those who retain or obtain employment after disability onset, the outlook for quality employment is high. The strength of the relationship between education and employment and earnings is well established (Krause & Terza, 2006; Krause, Terza, & Dismuke, 2008; Ramakrishnan, Loh, & Omar, 2011), although the magnitude of the differences in estimated earnings was profound. There were clear benefits of a four-year degree and trends toward even better outcomes among those with postgraduate degrees. It is important to reinforce the importance of education as a means of promoting quality outcomes and potentially reducing the disparities in employment rates and earnings. Although not surprising, it was disappointing to observe significant disparities in earnings related to diagnosis, function, sex, and race/ethnicity. The estimated differences were not trivial, with males having $26,094 and non-Hispanic Whites having $27,548 greater unconditional earnings compared to the reference groups (females, non-Hispanic Blacks).

### *4.2. Study limitations*

Study strengths included: (a) inclusion of both MS and SCI participants, (b) a two-step design including both employment status and earnings, (c) identification of employment outcomes among participants with a wide array of aging characteristics based both on age at onset/diagnosis and years since onset/diagnosis. First, the inclusion of both SCI and MS allows us to compare outcomes between the two diagnostic groups, while also investigating and controlling for functional status. Second, the two-step model allows us to calculate both conditional and unconditional earnings. This provides more detailed information to guide policy decisions. Lastly, the identification of outcomes among participants with substantially different ages and years since onset/diagnosis revealed differences in predictors of employment and earnings that may not be identified otherwise.

The limitations included: (a) the self-report methodology, (b) utilization of a single geographic area, and (c) the potential of selective response to differential response rates. Self-report may result in some inaccuracies in reporting. Therefore, we restricted recall to the last 12 months. Having participants from a single geographic location leads to unknown generalizability. Lastly, differential response is always of concern. There was a higher response rate for those with SCI than MS, which could lead to unknown biases. Most studies are limited either to a single geographic location or to a more limited number of variables, exclusive of quality indicators such as earnings.

### 4.3. Future research

Further research is needed to comprehensively measure factors related to a wider array of quality indicators of employment including job tenure, job lapses, and work life expectancy. Subjective indicators would touch more upon intrinsic or intangible aspects of employment, such as job considerations and job and career satisfaction. To guide policy, we need to develop more comprehensive models combining multiple outcome characteristics. Resources to promote employment after disability will always be limited, and research is needed to guide policy decisions to maximize the effort of every dollar. Lastly, there is a need for longitudinal research to help better understand the processes that lead to quality employment and how they develop over time. It is only through persistent efforts that we will be able to understand better and promote quality employment throughout the work lifecycle.

## 5. Conclusion

Earnings among those with SCI and MS are related to individual, educational, and functional characteristics. Those with MS reported substantially higher earnings, as well as having favorable educational characteristics to promote employment outcomes. Functional status was clearly related to both employment and earnings, suggesting disparities in outcomes for those with greater functional impairments. Although age was associated with a diminished likelihood of employment, among those who were employed, earnings were higher in the older age groups and those with more years since onset/diagnosis.

## Acknowledgments

The contents of this publication were developed under grants from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR grant numbers 90DP0050 and 90RT5035). NIDILRR is a Center within the Administration for Community Living (ACL), Department of Health and Human Services (HHS). The contents of this publication do not necessarily represent the policy of NIDILRR, ACL, HHS, and you should not assume endorsement by the Federal Government.

## Conflict of interest

The authors have no conflict of interest to disclose.

## References

Anderberg, D., Rainer, H., Wadsworth, J., & Wilson, T. (2015). Unemployment and domestic violence: Theory and evidence. *The Economic Journal*, *126*(597), 1947-1979. doi: 10.1111/ecoj.12246

Berkowitz, M., O'Leary, P., Kruse, D. L., & Harvey, C. (1998). *An Analysis of Medical and Social Costs.* New York: Demos Medical Publishing, Inc.

Cao, Y., Chen, Y., & DeVivo, M. (2011). Lifetime direct costs after spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation*, *16*(4), 10-16. doi: 10.1310/sci1604-10

Cao, Y., Krause, J. S., Saunders, L. L., & Bingham, W. (2014). Household income and subjective well-being after spinal cord injury: a longitudinal study. *Topics in Spinal Cord Injury Rehabilitation*, *20*(1), 40-47. doi: 10.1310/sci2001-40

Centers for Medicare and Medicaid Services. (2014). Medicare Health Outcomes Survey (HOS). Retrieved from https://hosonline.org/en/.

De Judicibus, M. A., & McCabe, M. P. (2007). The impact of the financial costs of multiple sclerosis on quality of life. *International Journal of Behavioural Medicine*, *14*(1), 3-11. doi: 10.1080/10705500701316767

DeLuca, J., & Nocentini, U. (2011). Neuropsychological, medical and rehabilitative management of persons with multiple sclerosis. *NeuroRehabilitation*, *29*(3), 197-219. doi: 10.3233/NRE-2011-0695

Falvo, D. R. (2014). *Medical and psychosocial aspects of chronic illness and disability* (5th ed.). Burlington, MA: Jones and Bartlett Publishers, LLC.

Harding, K., Anderson, V., Williams, O., Willis, M., Butterworth, S., Tallantyre, E., Robertson, N. (2018). A contemporary study of mortality in the multiple sclerosis population of south east Wales. *Multiple Sclerosis Related Disorders*, *25*, 186-191. doi: 10.1016/j.msard.2018.08.001

Henkel, D. (2011). Unemployment and substance use: A review of the literature (1990–2010). *Current Drug Abuse Reviews*, *4*(1), 4-27. doi: 10.2174/1874473711104010004

Julian, L. J., Vella, L., Vollmer, T., Hadjimichael, O., & Mohr, D. C. (2008). Employment in multiple sclerosis. Exiting and re-entering the work force. *Journal of Neurology*, *255*(9), 1354-1360. doi: 10.1007/s00415-008-0910-y

Krause, J. S., Dismuke-Greer, C. E., Jarnecke, M., Li, C., Reed, K. S., & Rumrill, P. (2018a). Employment and gainful earnings among those with multiple sclerosis. *Archives of Physical and Medical Rehabilitation*. doi: 10.1016/j.apmr.2018.11.005

Krause, J. S., Dismuke-Greer, C. E., Jarnecke, M., & Reed, K. S. (2019). Differential odds of employment and estimation of earnings among those with spinal cord injury. *Rehabilitation Counseling Bulletin*, first published online 13 May 2019, doi: 10.1177/0034355219848493

Krause, J. S., & Reed, K. S. (2009). Obtaining employment after spinal cord injury: Relationship with pre- and post-injury education. *Rehabilitation Counseling Bulletin*, *53*, 27-33. doi: 10.1177/0034355208329443

Krause, J. S., Rumrill, P., Dismuke-Greer, C. E., & Jarnecke, M. (2018b). Quality employment outcomes after multiple sclerosis: A comparison of participants from a specialty hospital and the National MS Society. *Journal of Vocational Rehabilitation*, *48*(2), 177-186. doi: 10.3233/JVR-180931

Krause, J. S., Saunders, L. L., & Acuna, J. (2012). Gainful employment and risk of mortality after spinal cord injury: effects beyond that of demographic, injury and socioeconomic factors. *Spinal Cord*, *50*, 784-788. doi: 10.1038/sc.2012.49

Krause, J. S., Saunders, L. L., & DeVivo, M. J. (2011). Income and risk of mortality after spinal cord injury. *Archives of Physical and Medical Rehabilitation*, *92*(3), 339-345. doi: 10.1016/j.apmr.2010.09.032

Krause, J. S., & Terza, J. V. (2006). Injury and demographic factors predictive of disparities in earnings after spinal cord injury. *Archives of Physical and Medical Rehabilitation*, *87*(10), 1318-1326. doi: 10.1016/j.apmr.2006.07.254

Krause, J. S., Terza, J. V., & Dismuke, C. (2008). Earnings among people with spinal cord injury. *Archives of Physical Medicine and Rehabilitation*, *89*(8), 1474-1481. doi: 10.1016/j.apmr.2007.12.040

Krause, J. S., Terza, J. V., Erten, M., Focht, K. L., & Dismuke, C. E. (2012). Prediction of postinjury employment and percentage of time worked after spinal cord injury. *Archives of Physical Medicine and Rehabilitation*, *93*(2), 373-375. doi: 10.1016/j.apmr.2011.09.006

Krause, J. S., Terza, J. V., Saunders, L. L., & Dismuke, C. E. (2010). Delayed entry into employment after spinal cord injury: factors related to time to first job. *Spinal Cord*, *48*(6), 487-491. doi: 10.1038/sc.2009.157

McClelland, A. (2000). Effects of unemployment on the family. *The Economic and Labour Relations Review*, *11*(2), 198-212. doi: 10.1177/103530460001100204

Meade, M., Reed, K. S., Rumrill, P., Aust, R., & Krause, J. S. (2016). Perceptions of quality of employment outcomes after multiple sclerosis: A qualitative study. *Journal of Rehabilitation*, *82*(2), 31-40.

Meade, M. A., Reed, K. S., Saunders, L. L., & Krause, J. S. (2015). It's all of the above: Benefits of working for individuals with spinal cord injury. *Topics in Spinal Cord Injury Rehabilitation*, *21*(1), 1-9. doi: 10.1310/sci2101-1

Mood, C., & Jonsson, J. O. (2016). The social consequences of poverty: An empirical test on longitudinal data. *Social Indicators Research*, *127*, 633-652. doi: 10.1007/s11205-015-0983-9

Moore, P., Harding, K. E., Clarkson, H., Pickersgill, T. P., Wardle, M., & Robertson, N. P. (2013). Demographic and clinical factors associated with changes in employment in multiple sclerosis. *Multiple Sclerosis*, *19*(12), 1647-1654. doi: 10.1177/1352458513481396

Naci, H., Fleurence, R., Birt, J., & Duhig, A. (2010). Economic burden of multiple sclerosis: a systematic review of the literature. *Pharmacoeconomics*, *28*(5), 363-379. doi: 10.2165/11532230-000000000-00000

Ottomanelli, L., & Lind, L. (2009). Review of critical factors related to employment after spinal cord injury: Implications for research and vocational services. *Journal of Spinal Cord Medicine*, *32*(5), 503-531. doi: 10.1080/10790268.2009.11754553

Ramakrishnan, K., Loh, S. Y., & Omar, Z. (2011). Earnings among people with spinal cord injury. *Spinal Cord*, *49*(9), 986-989. doi: 10.1038/sc.2011.47

Roessler, R. T., Rumrill, P. D., Li, J., & Leslie, M. J. (2015). Predictors of differential employment statuses of adults with multiple sclerosis. *Journal of Vocational Rehabilitation*, *42*(2), 141-152. doi: 10.3233/JVR-150731

Schiavolin, S., Leonardi, M., Giovannetti, A. M., Antozzi, C., Brambilla, L., Confalonieri, P.,... Raggi, A. (2013). Factors related to difficulties with employment in patients with multiple sclerosis: A review of 2002–2011 literature. *International Journal of Rehabilitation Research*, *36*(2), 105-111. doi: 10.1097/MRR.0b013e32835c79ea

Stata. (2017a). Extended regression models (ERMs). Retrieved from https://www.stata.com/new-in-stata/extended-regression-models/

Stata. (2017b). Stata Extended Regression Models Reference Manual Release 15. Retrieved from https://www.stata.com/manuals/erm.pdf

US Census Bureau. (2009). Current Population Survey (CPS). Retrieved from https://www.census.gov/programs-surveys/cps/about.html

US Department of Labor. (2018). Persons with a disability: Labor force characteristics. News Release. Retrieved from https://www.bls.gov/news.release/disabl.htm

Wang, R. Y., Yang, Y. R., Yen, L. L., & Lieu, F. K. (2002). Functional ability, perceived exertion and employment of the individuals with spinal cord lesion in Taiwan. *Spinal Cord*, *40*, 69-76. doi: 10.1038/sj.sc.3101257

World Health Organization. (2018). Disabilities. Retrieved from https://www.who.int/topics/disabilities/en/

Young, A. E., & Murphy, G. C. (2009). Employment status after spinal cord injury (1992–2005): A review with implications for interpretation, evaluation, further research, and clinical practice. *International Journal of Rehabilitation Research*, *32*(1), 1-11. doi: 10.1097/MRR.0b013e32831c8b19