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Employment status, hours working, and gainful earnings after spinal cord injury: relationship with pain, prescription medications for pain, and nonprescription opioid use

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Abstract

Study design Cross-sectional self-report assessment. Econometric modeling.

Objectives Identify the relationship of multiple pain indicators, prescription pain medication, nonprescription opioid use, and multiple indicators of quality employment among those with spinal cord injury (SCI).

Setting Data were collected at a medical university in the Southeastern United States (US).

Methods Participants included 4670 adults with traumatic SCI of at least one-year duration who were enrolled in a study of health and longevity. They were identified from three sources including a specialty hospital and two population-based state SCI surveillance systems. Econometric modeling was used for three outcome variables: employment status, hours per week spent working, and earnings.

Results Several pain parameters were significantly related to multiple employment outcomes. Prescription medication to treat pain was associated with lower odds of employment, fewer hours working, and lower conditional earnings. Non-prescription opioid use was only related to fewer hours working. Painful days, number of painful conditions, and pain intensity were all related to employment outcomes, but the pattern varied by outcome. The number of painful conditions was most consistently related to employment. Multiple demographic, injury, and educational factors were related to employment, with better outcomes among those with less severe SCI and greater educational achievements.

Conclusions The presence of significant pain and use of either prescription pain medications or the use of nonprescription opioids may have a significant adverse effect on both the probability of employment and quality of employment. Rehabilitation and vocational professionals should routinely assess pain and associated medications in vocational and career planning.

Introduction

Traumatic spinal cord injury (SCI) is a severe disabling condition associated with lifelong risk of secondary health conditions adversely affecting participation, including employment [1–4]. Estimates suggest as few as 35–40% of persons with SCI are employed after injury [5–7], and retaining employment after SCI is difficult [8, 9]. Beyond employment rates, the limited existing research on quality employment outcomes reveals lower earnings [10], decreased

job satisfaction [11], and concerns about work intensity (hours employed) after SCI [12]. Furthermore, under-employment and low income are related to a greater risk of mortality [13, 14], highlighting the importance of the inter-relationships between employment, health, and longevity.

Pain is a particularly debilitating secondary health condition faced by persons with SCI [15–17], with chronic pain of more than 12 weeks frequently reported [18]. Chronic pain after SCI has been shown to interfere with activity and participation (e.g., paid employment) [19] and has been identified as a barrier to earning potential [20–22]. A pharmacological approach is often used to treat pain after SCI [16, 23], with evidence showing polypharmacy is more prevalent among persons with SCI when compared with matched controls in the general population, which is associated with a greater risk of drug-related problems [24]. Specifically, misuse of pre-scription pain medications, including prescribed opioids, has

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been indicated in persons with SCI [25, 26], yielding the need for further research on prescription pain medication, opioids, and related consequences with SCI.

Pain and pain medication use could decrease the likelihood of employment after SCI [19], as well as work intensity and earnings for those who are employed. Nonmedical opioid use, either use of opioids that have not been prescribed or using prescription opioids in a manner different from which they were prescribed, may also present a barrier to quality employment. Despite this potential for pain and pharmacological treatments for pain to diminish employment outcomes, there has been a void of research to identify these relationships, with nearly all studies focusing solely on current employment rates [6, 21]. Identifying such relationships is vital, as it could impact decisions made by individuals with SCI and rehabilitation and medical professionals regarding the use of pharmacological treatments for pain after SCI.

Our purpose was to identify the relationship of multiple pain indicators (number of painful days in the last month, number of painful conditions, and average pain intensity), prescription pain medication, and use of nonprescription opioids with multiple indicators of quality employment, while controlling for demographic, injury, and educational characteristics. Quality employment includes employment outcomes beyond employment status alone. They may be objective indicators, as measured in the current study by earnings and work hours, or subjective, such as job satisfaction.

Methods

Participants

Institutional review board approval was obtained prior to data collection. Eligibility criteria at enrollment included: (1) adult, (2) traumatic SCI with residual deficits (noncomplete recovery consistent with American Spinal Injury Association Impairment Scale A–D), and (3) minimum of 12 months post-injury. The study participants were identified from five participant cohorts totaling 4670 participants. The first three cohorts were from a specialty hospital in the Southeastern United States and were first enrolled into a larger longitudinal study of health outcomes at one of three points in time: 1997–1998, 2007–2009, and 2014–2016. Although these three cohorts were first enrolled in longitudinal research and at different points in time, all data used in the current analysis were collected between 2011 and 2016. There were 2516 participants from these three cohorts (cohort 1 = 673; cohort 2 = 1255; cohort 3 = 588).

The other two cohorts were recruited from population-based state SCI surveillance registries in the Southeastern and Midwestern United States, which are inclusive of all civilians treated for acute SCI identified through state hospital discharge data using International Classification of Diseases-9, Clinical Modification codes of 806 and 952, following Centers for Disease Control guidelines [27]. The population-based cohorts were enrolled in 2012–2016 (Southeastern $n = 1018$; Midwestern $n = 1136$). After excluding those who could not be located, the overall response rate was 60.4%. The response rate was higher for participants enrolled through the specialty hospital (73.9%) as opposed to the surveillance systems (49.7%).

Procedures

The data were collected between 2011 and 2016. Preliminary cover letters were sent to potential participants to alert them materials would be forthcoming, followed by the instrument package 4–6 weeks later. There were two follow-up mailings and a follow-up phone call. Participants were paid $50 remuneration to promote response.

Measures

Demographic, injury, and educational variables included sex, race/ethnicity, age at injury onset, years since injury, injury severity, relationship status, and educational milestones. These variables were broken down into discrete categories for statistical analysis (see detail in tables). For instance, injury severity was broken into four groups, with one group comprised of all ambulatory participants and the remaining participants grouped according to the following injury levels: C1–C4 (reference group), C5–C8, and noncervical. Quality employment was defined as any indicator quantifying employment other than simply employment status or employment rates, specifically earnings and hours working per week in this study. Earnings were measured by asking individuals to indicate salary/earnings from their current or most recent post-injury job, with 10 response categories ranging from <$10,000 to $150,000 or more. Hours working per week were measured with a single item stated as, "What is the average number of hours per week you currently work?"

Pain indicators included the number of painful days within the past month, taken from the Behavioral Risk Factor Surveillance System [28]. The Pain Medication Questionnaire assessed the number of painful conditions [29, 30], and average pain intensity was taken from the Brief Pain Inventory [31]. Participants were asked how frequently they take prescription medication for pain, which was coded as never, occasionally, and daily (reference group). Use of nonprescription opioids was classified as yes/no, using the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) developed by the World Health Organization [32, 33].

Analyses

Descriptive statistics were generated to summarize participant characteristics. The Chi-square statistic was used to test group differences. Econometric modeling was used to develop separate models for each outcome. Econometric modeling estimates multiple parameters using a two-part hurdle model. We differentiated between conditional and unconditional earnings and hours, as conditional variables are conditional upon being employed. Therefore, they were only calculated among those who are employed. In contrast, unconditional outcomes were calculated for all participants, allocating a score of 0 for those unemployed (i.e., 0 hours and 0 earnings).

The adjusted *likelihood of employment* was estimated using logit models. We examined the adjusted unconditional *number of hours* associated with each set of predictors using a two-part model with a Poisson family due to the number of hours being a finite count [34]. Marginal effects of each covariate can be interpreted directly. First, a binary choice model was estimated for the probability of observing a positive-versus-zero outcome. Then, conditional on a positive outcome for employment (i.e., employed), a generalized linear model (GLM) assuming a Poisson distribution was estimated for the number of hours. A standard GLM model was used to estimate the number of hours (employed only).

Adjusted unconditional *earnings* associated with each set of predictors were estimated using extended interval regression and adjusted conditional earnings (employed only) using standard interval regression. Interval regression takes into consideration the lower and upper limits of earnings for individuals who reported income <$10,000 and those whose earnings were greater than the upper interval value. A generalization of censored regression, standard interval regression incorporates the minimum and maximum values of the earnings intervals, so information was not lost in estimation. When incorporating interval regression into a two-part model, *intreg*, was used to estimate unconditional earnings (employed and unemployed). This accounts for endogenous sample selection (i.e., employment status and measurement of unconditional estimates are not independent). Standard interval regression, *intreg*, was used for estimating conditional earnings (employed only).

Results

Table 1 summarizes the participant characteristics as a function of cohort. Of the 4670 participants, 4276 had complete data and were included in the econometric modeling.

Regression

Employment status

Injury severity, race/ethnicity, age at onset, years post-injury, relationship status, and educational milestones were all significantly related to employment status (Table 2). The highest odds of employment were observed among Non-Hispanic Whites (OR = 3.41 compared with non-Hispanic Blacks), among the three youngest age groups at onset, among those with 10 or more years post-injury, and those who were married or part of an unmarried couple (OR = 1.58) compared with those divorced/widowed/separated. The odds of employment improved with each successive level of educational attainment.

Those with 0–5 painful days had 1.30 odds of employment relative to those with more than 20 painful days. Those with 6–20 painful days also had greater odds of employment (OR = 1.27). Relative to those with 3–5 painful conditions, those with 0–1 painful conditions (OR = 1.81) and those with 2 painful conditions (OR = 1.70) had higher odds of employment. Average pain was not significant. Relative to daily users, those who never used pain medication (OR = 2.11) and those who used pain medication occasionally (OR = 1.51) had higher odds of employment. Use of nonprescription opioids was not significant.

Conditional hours (employed only)

When considering only employed participants (Table 3), compared with C1–C4, higher average hours per week were observed among C5–C8 (3.99), noncervical (6.30), and ambulatory SCI (11.03). Men reported 4.08 more average hours working compared with women. Participants who were married or part of an unmarried couple averaged 3.14 greater hours than those divorced/widowed/separated. Each of the younger groups based on age at onset reported greater hours than those in the oldest group at onset. The number of hours employed increased with each successive level of education compared with those who had the least education, ranging from 1.33–4.29 greater hours.

Greater conditional hours were reported by those with average pain intensity of 2 or less (1.23). Greater hours were also observed by those with no use of nonprescription opioids (4.87) and those who either never used prescription medication (3.14) or used it occasionally but not daily (1.86).

Unconditional hours (all participants)

Participants with C5–C8 (2.29), noncervical (4.30), and ambulatory (10.75) had higher unconditional hours compared with C1–C4 injury severity (Table 4). Men reported

Table 1 Bivariate comparison of the three cohorts on predictor variables

	Midwestern		Southeastern		Clinical		p-value
	n	%	n	%	n	%	
Injury severity							<0.001
C1–C4, nonambulatory	57	5.1	60	6.1	266	10.6	
C5–C8, nonambulatory	120	10.8	103	10.4	603	24.1	
Noncervical, nonambulatory	201	18.1	166	16.8	844	33.7	
Ambulatory	734	66.0	659	66.7	792	31.6	
Sex							0.518
Female	293	25.8	276	27.1	635	25.3	
Male	843	74.2	742	72.9	1880	74.8	
Marital status							<0.001
Divorced/widowed/ separated	223	19.9	279	27.8	619	24.8	
Married/member of unmarried couple	616	55.1	470	46.9	1163	46.6	
Never married	279	25.0	254	25.3	713	28.6	
Race							<0.001
Hispanic	24	2.2	23	2.3	64	2.6	
Non-Hispanic Black	34	3.1	348	35.3	498	20.4	
Non-Hispanic White	985	90.0	589	59.7	1811	74.2	
Other	51	4.7	27	2.7	69	2.8	
Age at onset							<0.001
<30	369	33.5	268	27.8	1183	47.2	
≥30 and <40	196	17.8	140	14.5	491	19.6	
≥40 and <50	192	17.4	179	18.6	388	15.5	
≥50	344	31.2	376	39.0	445	17.8	
Time since onset							<0.001
<10	518	54.6	640	82.7	1195	51.7	
≥10 and ≤19	339	35.8	106	13.7	552	23.9	
≥20	91	9.6	28	3.6	565	24.4	
Education							<0.001
≤high school	422	39.8	373	47.0	792	35.3	
2-year degree/trade school	339	32.0	274	34.6	657	29.3	
4-year degree	190	17.9	86	10.8	506	22.5	
Postgraduate	109	10.3	60	7.6	290	12.9	
Painful days							<0.001
0–5	627	56.3	352	35.1	1374	55.1	
6–20	254	22.8	285	28.4	622	24.9	
>20 pain days	233	20.9	365	36.4	498	20.0	
Painful conditions							<0.001
0–1	502	45.1	333	33.1	1130	45.3	
2	308	27.7	258	25.7	656	26.3	
3–5	302	27.2	414	41.2	709	28.4	
Average pain intensity							<0.001
≤2	370	33.3	162	16.3	660	26.6	
3–4	325	29.3	200	20.1	644	26.0	
≥5	415	37.4	635	63.7	1175	47.4	
Pain medications							<0.001
Never use	524	46.7	227	22.5	833	33.3	
Sometimes use	231	20.6	235	23.3	596	23.8	
Daily use	368	32.8	546	54.2	1076	43.0	
Nonprescription opioid use							0.237
No	1082	96.4	915	96.4	2416	97.3	
Yes	40	3.6	34	3.6	67	2.7	

1.73 higher average number of hours. Participants who were married or part of an unmarried couple averaged 3.30 greater hours than those divorced/widowed/separated. Non-Hispanic Whites (6.00) and other race (3.98) averaged greater hours than non-Hispanic Blacks. Those younger at injury reported more hours working. Compared with those who had no more than a high school certificate, each successive educational milestone was associated with greater unconditional hours, ranging from 3.39–7.61.

Greater unconditional hours were reported by participants with the fewest painful days (2.14) and those with either 0–1 painful conditions (2.97) or 2 painful conditions (3.38). Greater unconditional hours were reported by those with no use of nonprescription opioids (3.53), no prescription pain medication use (5.68), or occasional prescription pain medication use (3.25).

Conditional earnings

None of the pain parameters was significantly related to conditional earnings (Table 5). Several demographic and injury variables were related to conditional earnings. Higher earnings were reported among those with noncervical SCI ($14,329) and those who were ambulatory ($23,080) compared with C1–C4 injury severity. Higher conditional earnings were observed among men ($19,238), non-Hispanic Whites ($17,042), and those who were married or part of an unmarried couple ($7,481). Those in the age group of 40–49 reported higher conditional earnings ($16,429) compared with those in the oldest group. Higher conditional earnings were observed with each successively higher educational milestone, with the greatest difference between those with postgraduate degrees compared with those with no more than a high school ($42,420).

Unconditional earnings

The pattern for demographic, injury, and educational factors was similar to that of conditional earnings, although the differences were magnified in many cases (Table 6). For instance, non-Hispanic Whites reported $47,258 greater unconditional earnings compared with non-Hispanic Blacks. Those with less severe SCI reported substantially higher unconditional earnings compared with those with the most severe SCI (C1–C4), ranging from a low of $22,970 for those with C5–C8 to a high of $64,995 for those who were ambulatory. Compared with participants with no more than a high school certificate, those with increasing education levels reported higher unconditional earnings ranging from $24,545 to $64,758.

Table 2 Logit model of employment status ($n = 4276$)

	Odds ratio	95% confidence interval		p-value
Injury severity (ref: C1–C4, nonambulatory)				
C5–C8, nonambulatory	1.59	1.11	2.30	0.012
Noncervical, nonambulatory	2.10	1.48	2.98	<0.001
Ambulatory	4.85	3.46	6.81	<0.001
Sex (ref: Female)				
Male	1.08	0.90	1.28	0.413
Marital status (ref: Divorced/widowed/separated)				
Married/member of unmarried couple	1.58	1.29	1.93	<0.001
Never married	1.12	0.88	1.43	0.360
Race (ref: Non-Hispanic Black)				
Non-Hispanic White	3.41	2.66	4.38	<0.001
Other	2.12	1.41	3.18	<0.001
Age at onset (ref: ≥50)				
<30	3.17	2.55	3.95	<0.001
≥30 and <40	2.90	2.26	3.72	<0.001
≥40 and <50	2.16	1.67	2.80	<0.001
Time since onset (ref: <10)				
≥10 and ≤19	1.34	1.11	1.62	0.003
≥20	1.25	1.04	1.52	0.020
Education (ref: ≤High School)				
2-year degree/trade school	1.80	1.49	2.17	<0.001
4-year degree	3.05	2.47	3.77	<0.001
Postgraduate	3.06	2.38	3.93	<0.001
Painful days (ref: >20 pain days)				
0–5	1.30	1.01	1.69	0.045
6–20	1.27	1.00	1.61	0.052
Painful conditions (ref: 3–5)				
0–1	1.81	1.42	2.30	<0.001
2	1.70	1.36	2.14	<0.001
Average pain intensity (ref: ≥ 5)				
≤2	0.98	0.76	1.26	0.880
3–4	1.02	0.83	1.25	0.872
Pain medications (ref: daily use)				
Never use	2.11	1.73	2.57	<0.001
Sometimes use	1.51	1.21	1.88	<0.001
Nonprescription opioid use (ref: yes)				
No	1.62	0.94	2.78	0.081

Table 3 Demographic, injury, educational, and pain-related predictors of conditional hours worked ($n = 1169$)

	dy/dx	95% confidence interval		p-value
Injury severity (ref: C1–C4, nonambulatory)				
C5–C8, nonambulatory	3.99	2.27	5.71	<0.001
Noncervical, nonambulatory	6.30	4.65	7.94	<0.001
Ambulatory	11.03	9.43	12.64	<0.001
Sex (ref: Female)				
Male	4.08	3.31	4.86	<0.001
Marital status (ref: Divorced/widowed/separated)				
Married/member of unmarried couple	3.14	2.15	4.14	<0.001
Never married	−0.91	−2.10	0.29	0.138
Race (ref: Non-Hispanic Black)				
Non-Hispanic White	0.38	−0.97	1.73	0.585
Other	−0.29	−2.43	1.85	0.788
Age at onset (ref: ≥50)				
<30	4.59	3.57	5.60	<0.001
≥30 and <40	3.64	2.40	4.88	<0.001
≥40 and <50	5.73	4.35	7.11	<0.001
Time since onset (ref: <10)				
≥10 and ≤19	1.43	0.55	2.30	0.001
≥20	5.39	4.45	6.33	<0.001
Education (ref: ≤High School)				
2-year degree/trade school	1.33	0.40	2.25	0.005
4-year degree	2.47	1.52	3.42	<0.001
Postgraduate	4.29	3.16	5.42	<0.001
Painful days (ref: >20 pain days)				
0–5	0.85	−0.36	2.07	0.168
6–20	−0.64	−1.84	0.57	0.301
Painful conditions (ref: 3–5)				
0–1	−0.81	−1.95	0.33	0.165
2	0.39	−0.72	1.50	0.492
Average pain intensity (ref: ≥5)				
≤2	1.23	0.13	2.33	0.029
3–4	−1.27	−2.21	−0.33	0.008
Pain medications (ref: Daily use)				
Never use	3.14	2.20	4.09	<0.001
Sometimes use	1.86	0.75	2.98	0.001
Nonprescription opioid use (ref: yes)				
No	4.87	2.08	7.66	0.001

Significantly higher earnings were reported by those with 0–5 painful days ($11,393) compared with those who had more than 20 painful days. Participants with 0–1 painful conditions reported $21,399 greater earnings and those with 2 painful conditions reported $21,301 greater earnings than those with 3 or more painful conditions. Those with no use of prescription medication to treat pain reported $23,916 greater unconditional earnings, and those who occasionally used prescription medication to treat pain reported $10,063 greater earnings than those who used prescription pain medication daily. Pain intensity and the use of nonprescription opioids were not significantly related to unconditional earnings.

Table 4 Demographic, injury, educational, and pain-related predictors of unconditional hours worked ($n = 4342$)

	dy/dx	95% confidence interval		p-value
Injury severity (ref: C1–C4, nonambulatory)				
C5-C8, nonambulatory	2.29	1.02	3.56	<0.001
Noncervical, nonambulatory	4.30	3.04	5.56	<0.001
Ambulatory	10.75	9.47	12.04	<0.001
Sex (ref: Female)				
Male	1.73	0.80	2.65	<0.001
Marital status (ref: Divorced/widowed/separated)				
Married/member of unmarried couple	3.30	2.15	4.44	<0.001
Never married	0.04	−1.32	1.39	0.959
Race (ref: Non-Hispanic Black)				
Non-Hispanic White	6.00	4.91	7.10	<0.001
Other	3.98	1.49	6.47	0.002
Age at onset (ref: ≥50)				
<30	8.41	7.12	9.69	<0.001
≥30 and <40	8.05	6.42	9.67	<0.001
≥40 and <50	6.66	4.92	8.40	<0.001
Time since onset (ref: <10)				
≥10 and ≤19	2.06	0.94	3.17	<0.001
≥20	2.75	1.62	3.88	<0.001
Education (ref: ≤High School)				
2-year degree/trade school	3.39	2.34	4.43	<0.001
4-year degree	7.11	5.79	8.44	<0.001
Postgraduate	7.61	5.92	9.30	<0.001
Painful days (ref: >20 pain days)				
0–5	2.14	0.69	3.59	0.004
6–20	1.42	0.03	2.80	0.045
Painful conditions (ref: 3–5)				
0–1	2.97	1.59	4.34	<0.001
2	3.38	2.06	4.70	<0.001
Average pain intensity (ref: ≥5)				
≤2	0.33	−1.08	1.74	0.646
3–4	−0.21	−1.34	0.93	0.722
Pain medications (ref: Daily use)				
Never use	5.68	4.46	6.91	<0.001
Sometimes use	3.25	1.92	4.57	<0.001
Nonprescription opioid use (ref: yes)				
No	3.53	1.17	5.90	0.003

Table 5 Demographic, injury, educational, and pain-related predictors of conditional earnings ($n = 1170$)

	Coefficient	95% confidence interval		p-value
Injury severity (ref: C1–C4, nonambulatory)				
C5–C8, nonambulatory	9088	−4914	23090	0.203
Noncervical, nonambulatory	14329	872	27785	0.037
Ambulatory	23080	9930	36231	0.001
Sex (ref: Female)				
Male	19238	13610	24865	<0.001
Marital status (ref: Divorced/widowed/separated)				
Married/member of unmarried couple	7481	570	14392	0.034
Never married	−13241	−21459	−5023	0.002
Race (ref: Non-Hispanic Black)				
Non-Hispanic White	17042	7317	26766	0.001
Other	12411	−2579	27400	0.105
Age at onset (ref: ≥50)				
<30	−821	−7743	6101	0.816
≥30 and <40	6576	−1462	14613	0.109
≥40 and <50	16429	7719	25139	<0.001
Time since onset (ref: <10)				
≥10 and ≤19	4794	−1483	10982	0.135
≥20	15269	8908	21629	<0.001
Education (ref: ≤High School)				
2-year degree/trade school	9177	2550	15805	0.007
4-year degree	32774	26045	39504	<0.001
Postgraduate	42420	34575	50264	<0.001
Painful days (ref: >20 pain days)				
0–5	4856	−3584	13296	0.259
6–20	−1896	10225	6434	0.656
Painful conditions (ref: 3–5)				
0–1	3817	−4096	11729	0.344
2	5373	−2334	13080	0.172
Average pain intensity (ref: ≥5)				
≤2	1420	−6220	9059	0.716
3–4	−445	−7028	6138	0.895
Pain medications (ref: Daily use)				
Never use	2218	−4341	8777	0.507
Sometimes use	−2527	−9944	4890	0.504
Nonprescription opioid use (ref: yes)				
No	3350	−16450	23150	0.740

Discussion

The unique contributions of this study include: (1) identification of multiple pain and medication use indicators with employment, (2) multiple indicators of quality employment, and (3) utilization of econometric modeling quantifying conditional and unconditional hours and earnings outcomes.

The primary findings were that pain and pain medication use, including use of nonprescription opioids, are important covariates of quality employment among those with SCI. However, not all of the pain indicators were consistently related to employment outcomes, so it is important to consider the specific employment outcome and pain

Table 6 Demographic, injury, educational, and pain-related predictors of unconditional earnings ($n = 4255$)

	Coefficient	95% confidence interval		p-value
Injury severity (ref: C1–C4, nonambulatory)				
C5–C8, nonambulatory	22970	7916	38024	0.003
Noncervical, nonambulatory	33074	18615	47532	<0.001
Ambulatory	64995	50519	79470	<0.001
Sex (ref: Female)				
Male	16559	9868	23250	<0.001
Marital status (ref: Divorced/widowed/separated)				
Married/member of unmarried couple	17858	10086	25629	<0.001
Never married	−8392	−17724	941	0.078
Race (ref: Non-Hispanic Black)				
Non-Hispanic White	47258	37145	57370	<0.001
Other	28997	12871	45122	<0.001
Age at onset (ref: ≥50)				
<30	35089	26550	43629	<0.001
≥30 and <40	36930	27358	46503	<0.001
≥40 and <50	34803	24875	44732	<0.001
Time since onset (ref: <10)				
≥10 and ≤19	9496	2030	16962	0.013
≥20	17913	10629	25197	<0.001
Education (ref: ≤High School)				
2-year degree/trade school	24545	17040	32050	<0.001
4-year degree	57308	49150	65466	<0.001
Postgraduate	64758	55176	74339	<0.001
Painful days (ref: >20 pain days)				
0–5	11393	1711	21075	0.021
6–20	6374	−2909	15656	0.178
Painful conditions (ref: 3–5)				
0–1	21399	12171	30626	<0.001
2	21301	12503	30100	<0.001
Average pain intensity (ref: ≥5)				
≤2	542	−8671	9755	0.908
3–4	−1083	−8816	6650	0.784
Pain medications (ref: Daily use)				
Never use	23916	16123	31708	<0.001
Sometimes use	10063	1566	18560	0.020
Nonprescription opioid use (ref: yes)				
No	12054	−8619	32726	0.253

indicator when evaluating the potential risks of pain and pain medication with quality employment.

The frequency of treatment of pain with prescription medication was the pain parameter most consistently related to employment outcomes, as participants who did not use prescription medication for pain had over double the odds of employment compared with daily users, as well as higher conditional and unconditional hours per week and higher unconditional earnings. However, it was not related to conditional earnings. Use of nonprescription opioids was associated with fewer conditional and unconditional work hours but not related to earnings. Taken together, it appears that use of prescription pain medications is strongly associated with the diminished ability to obtain and retain employment and to maintain a greater number of work hours; but less strongly related to another quality indicator—conditional earnings. Vocational rehabilitation professionals should routinely screen for prescription use of opioids as a barrier to obtaining and maintaining employment, as well as quality indicators of work intensity (i.e., hours) and earnings.

Of the nonpharmacological pain indicators, the number of painful conditions and the number of days adversely affected by pain were highly correlated with employment outcomes, whereas average pain severity was only related to number of hours working. Overall, this suggests the potential debilitating aspects of painful conditions and adverse effect of pain on employment. It also creates a dilemma for healthcare providers. The presence of multiple painful conditions, leading to days adversely affected by pain, is associated with both lower employment rates and poor quality outcomes. Therefore, healthcare providers should seek effective treatments for pain management. However, those who are treated daily with prescription medications have lower likelihood of employment and work fewer hours per week.

The relationships between demographic, injury, and educational variables with employment outcomes are consistent with previous research [21, 35, 36] and do not require a great deal of elaboration. It is important to note, however, the highly significant associations between injury severity and years of education with multiple employment outcomes. For each of these variables, lower odds of employment were compounded by fewer hours worked and lower earnings. It is also important to note sex differences in quality outcomes, both hours per week working and earnings, even though no differences were observed in the odds of employment. For race/ethnicity, the very large disparities in the odds of employment for non-Hispanic Blacks are particularly of current concern and are compounded by lower conditional earnings. Therefore, non-Hispanic Blacks who are working similar hours as non-Hispanic Whites have lower earnings.

The overall findings have several important implications for clinical and vocational practice. First, the highly significant relationships between multiple pain parameters and quality employment outcomes underscore the interrelationships between health and function and employment. The development of successful interventions for pain may also favorably impact the probability of obtaining and retaining employment and also work intensity (i.e., hours working) and earnings. Second, beyond the effects of the painful conditions themselves, the clear and present relationships with the use of

prescribed and nonprescribed opioids with employment outcomes raises significant concerns. Even if pharmacological interventions are successful in reducing pain, they may adversely affect the ability to obtain and maintain quality employment. Third, the persistent disparities in employment outcomes as a function of injury severity, race/ethnicity, and sex draw attention to the need to work to eliminate disparities in outcomes. Given the overwhelming differences in quality employment related to educational milestones, formal education appears to be the key to promoting employment outcomes.

Study strengths and limitations

There were several important methodologic considerations. First, all data were self-report, highlighting the importance of accuracy of reporting. This may affect the reporting of sensitive information, such as use of nonprescription opioids. Second, all data were cross-sectional and were collected over an approximate 5-year time period (2012–2016). Therefore, we cannot infer causality. The findings do however present a pattern of interrelationships that require strategies for intervention. Third, our direct measurement of opioid use is limited to nonprescribed use, whereas prescription medication to treat pain represents a proxy for opioid use. Use of nonprescription opioids was measured by a single item with the ASSIST; therefore, we cannot determine what substance the individual is using, and different substances within this category may have differing relationships with employment. In addition, the data were taken from a larger study on health outcomes, rather than exclusively focused on pain, so measurement of employment outcomes is limited to those variables utilized in the analysis. We also cannot differentiate nociceptive and neuropathic pain. Fourth, although there are advantages with population-based cohorts, enrollment is more difficult than with clinical cohorts, so response rates are typically lower. This may affect absolute estimates of employment rates but would be less likely to affect the interrelationships between the predictor variables and outcomes. Fifth, there are limits to generalizability, particularly absolute estimates of employment rates and other quality indicators of employment, based on utilization of cohorts from two geographic regions within the United States. Lastly, we recoded response categories to a more manageable and limited number of different groups for the econometric analyses. Some of the distinctions were rather arbitrary.

Future research

Additional research is needed utilizing more detailed assessments of pain, specific pain medications, and additional employment outcomes. Future research should focus on different types of opioid use, including specific substances. It would also benefit from alternative or additional data sources that may measure opioid use more objectively, as the measures used in the current study are general in nature and all based on self-report. Furthermore, longitudinal research is needed to identify these relationships over time, as that would provide more evidence related to causality. Intervention studies are needed to better identify how alternative treatments for pain may also affect vocational outcomes.

Conclusion

Pain and pharmacological treatment of pain are related to employment outcomes, with the specific relationships dependent on the outcome. Disparities in employment rates, which reflect ability to obtain and sustain employment, are compounded by additional disparities in quality of employment for those who have more severe SCI, are non-Hispanic Black, and have lower levels of education.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to the privacy concerns of study participants and are not standardized to be in a publicly interpretable format.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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