Published in final edited form as:

Arch Phys Med Rehabil. 2012 February ; 93(2): 313–318. doi:10.1016/j.apmr.2011.09.001.

Behavioral Factors Related to Fatigue among Persons with Spinal Cord Injury

Lee L. Saunders, PhD¹ and James S. Krause, PhD¹

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

Abstract

Objective—To examine behavioral risk factors in relation to fatigue after spinal cord injury (SCI), specifically cardiovascular related behaviors, prescription medication use, and alcohol and cigarette use.

Design—Cross-sectional.

Setting—A medical university in the Southeastern United States.

Participants—2296 adults at least one year post-SCI from a large specialty hospital in the Southeast responded to a mail-in survey.

Intervention—None

Main Outcomes Measure—The Modified Fatigue Impact Scale-5 item version was used to assess disabling fatigue.

Results—Of participants, 8.3% had disabling fatigue, 45.3% reported fatigue rarely to never impacted their life, and 46.4% reported having some fatigue. Persons who reported having less exercise than others with a similar injury level were 2.49 times as likely to have disabling fatigue as persons who reported more exercise. Those with a fair or poor diet were also more likely to have disabling fatigue. Use of prescription medication to treat pain was associated with disabling fatigue, as was being CAGE positive. Among non-behavioral variables, race and injury severity were significantly associated with disabling fatigue.

Conclusions—We identified several behavioral predictors of disabling fatigue, including cardiovascular risk factors, prescription medication use, and alcohol use. These factors are important as they are able to be modified and could be potential factors for prevention or intervention.

Keywords

spinal cord injury; fatigue; behavior

© 2011 The American Congress of Rehabilitation Medicine. Published by Elsevier Inc. All rights reserved.

Correspondence to: Lee L. Saunders, PhD, Department of Health Sciences and Research, College of Health Professions, Medical University of South Carolina, 77 President St, C208, MSC 700, Charleston, SC 29425, Phone: 843-792-8828, Fax: 843-792-5649, saundell@musc.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Fatigue is one of the most common symptoms after spinal cord injury (SCI) and can negatively affect functioning.¹ In clinical samples from an outpatient SCI program, 52–57% of participants had clinically significant fatigue, which interfered with their daily function.^{2,3} Generally, fatigue has been reported in 67–74% of those with SCI,^{1,4} with severe fatigue reported by 18%.¹ In one study of those with fatigue, 72% said their fatigue had worsened or stayed the same since its onset.¹ In a larger study capturing all persons within a specified region, 28.4% reported fatigue in the past week.⁵ Fatigue has been negatively associated with social integration and productive activity after SCI, quality of life,⁶ and psychological functioning.¹

As fatigue is a major secondary condition after SCI, several studies have attempted to assess risk factors among the SCI population. Among demographic and injury factors, having an incomplete SCI has been linked with fatigue² as has increasing age;⁷ however, duration of SCI was not significantly associated with fatigue.⁸ Gerhart et al.⁹ found persons who had an increase in physical assistance over time reported more fatigue. Hammell et al.¹⁰ conducted a study that qualitatively looked at behavioral factors related to fatigue after SCI and found side effects of medications, posture, and diet and nutrition to be significantly associated with fatigue. In the area of cardiovascular health, and in line with the finding regarding diet and nutrition, one positive behavioral factor related to decreased fatigue is physical activity.¹¹ On the other hand, persons with SCI who reported being overweight reported more fatigue and also reported that fatigue had more of an impact in their daily life.¹² Use of fatigue-causing pain medicine and the presence of pain have been linked with fatigue.³ While there has been research assessing fatigue after SCI, there has been limited focus on potentially modifiable risk factors, like behaviors, related to fatigue. The studies focusing on behavioral factors have been qualitative in nature or did not assess multiple behavioral factors in the same study.

While behavioral risk factors of fatigue have had limited exposure in the SCI literature, some relationships have been explored in the general population literature. Using the Third National Health and Nutrition Examination Survey (NHANES), Resnick et al.¹³ concluded that increasing body mass index and waist circumference were related to higher fatigue. Additionally, in a younger population, cigarette smoking was related to more self-reported fatigue.¹⁴ Behaviors are important factors leading to health outcomes. The hope is that, once identified, interventions can be developed to reduce the behavior and hopefully reduce the negative health outcomes.

Purpose

The purpose of this study is to examine behavioral risk factors of fatigue following SCI. Defining behavioral risk factors of fatigue is important as they can be modified, allowing for intervention and prevention strategies to be developed. We will assess factors found in previous SCI studies as well as in the general population, including cardiovascular behaviors and prescription medication use. Additionally, we will explore other behavioral risk factors for fatigue not previously included in the literature, including alcohol use and cigarette smoking as these have been shown to be related to other serious outcomes after SCI.¹⁵ We hypothesize that persons who a) are overweight, b) smoke cigarettes, c) use prescription medications to treat pain, stress, or spasticity, or d) have decreased exercise will have increased odds of fatigue.

Methods

Participants

After receiving approval from the Institutional Review Board, participants for a mail-in survey were identified through records at a large specialty hospital in the southeastern United States. There were 4 inclusion criteria: 1) traumatic SCI, 2) 18 or older at assessment, 3) minimum of 1 year post-injury, and 4) had residual effects of their SCI. Out of 3,669 potential participants meeting these criteria, 2,614 returned their survey (71.2% response rate). After response, 65 persons were determined to be ineligible due to full recovery (16), non-traumatic injury (46), or less than 1 year post-injury at survey (3), leaving 2549 for analysis.

Procedures

Five weeks prior to receiving an initial packet of study materials, participants were sent preliminary letters which described the intended research and the method by which they would receive the materials. The initial packet included a letter that described the study and served as implied consent, as well as the survey to be completed and returned by mail. A second mailing was used for all non-respondents. If no response was received to the second mailing, a phone call was made to engage in active conversation with the potential participant. A third mailing was then used for those who had misplaced or accidentally discarded the materials but consented by phone to receive another packet. Participants received \$50 remuneration.

Measures

We used the Modified Fatigue Impact Scale Abbreviated Version (MFIS-5) for our outcome.¹⁶ It is a 5-item shortened measure from the MFIS 21-item measure. We used a cut-point of 15 or more to represent disabling fatigue.¹⁷ The MFIS has been shown to have good reliability ($\alpha=0.80$).¹⁸ Additionally, we asked participants to rate their average fatigue in the past week from 0 (no fatigue) to 10 (fatigue as bad as you can imagine). The two measures of fatigue were highly correlated ($r=0.70$; $p<.0001$).

Hours out of bed per day (0–24) and days out of the house per week (0–7) were used from the Craig Handicap Assessment and Reporting Technique (CHART) to assess mobility.¹⁹ While these items come from the mobility subscale of the CHART, they have been previously used as independent questions.^{20,21} To assess cardiovascular behaviors, participants were asked questions on their overall weight, exercise, and diet habits. Participants were asked about their weight in relation to their height, and responded as normal, overweight, or underweight. Exercise was measured by the question “How much exercise do you get compared to other people with spinal cord injuries who are about the same severity of injury?” and persons were grouped as more, the same, or less. Diet was assessed by, “In general, how healthy is your diet (what you eat and drink)?” and persons were grouped as good/excellent, fair, or poor. Prescription medication usage was assessed for three conditions: pain, stress, and spasticity. Persons responded to the frequency in which they used prescription medication use for 1) pain, 2) stress, and 3) spasticity as never, sometimes, weekly, and daily. There were fewer responses in the middle two categories (sometimes, weekly) for both the stress and spasticity prescription items, and thus those two categories were collapsed for those variables. These variables have demonstrated expected relationships with other variables including intercorrelations between similar patterns of items²² and with external outcomes, including mortality.^{15,23} Lastly, we used the CAGE to assess problem alcohol use.²⁴ Persons who responded positively to any of the four questions (cutting down on drinking, annoyance at other’s concern, guilt about drinking, and using alcohol as an eye opener in the morning) were classified as CAGE positive. For the CAGE,

Cheripitel²⁵ reports excellent sensitivity (0.68–0.89) and specificity (0.85–0.91), and Hays, Merz, and Nicholas²⁶ have investigated internal consistency and report a Cronbach alpha of 0.69. Lastly, we asked participants the number of cigarettes they smoked per day (none, 1–9, 10–19, 20+).

Demographic characteristics included were age at survey, gender, race (white, black, other), and injury severity. Injury severity was first classified by ambulatory status (yes, no), and those who were not ambulatory were classified by injury level (C1–C4, C5–C8, and Non-cervical). This injury severity scheme has been used in previous research.^{27,28}

Analysis

The relationship of each independent variable with the outcome was tested using chi-square tests for categorical variables and t-tests for continuous variables. Only variables significantly associated with disabling fatigue ($p < .05$) were considered for the regression model. As our outcome was disabling fatigue (yes, no), logistic regression was used to assess the association between the independent variables and disabling fatigue.

Demographic and injury characteristics (age, gender, race, injury severity) were entered as statistical control variables, and all behavioral factors (hours out of bed, days out of the house, exercise, diet, weight, prescription medications for pain, stress, spasticity, CAGE, cigarette smoking) were included in the model simultaneously. Since we were including multiple behaviors in the regression model, we assessed collinearity by assessing the change in variance between a model with a single variable and a model with multiple behaviors included. We did not see significant change in the variance for any of the independent variables, and thus concluded that collinearity was not an issue. Odds ratios (OR) and 95% confidence intervals (CIs) are reported. The Hosmer-Lemeshow test was used to assess goodness of fit of model.²⁹ Additionally, the C-statistic, measuring the area under the Receiver Operating Curve, and the Nagelkerke R² are reported. Lastly, we assessed the deviance residuals in the model, and none were greater than 3 or less than –3.

Results

There were 2245 participants included in the final analysis. Persons with missing data were more likely to be female ($p = 0.0385$), non-white ($p = 0.0112$), less severely injured ($p = 0.0323$), and older age ($p < .0001$). Missing data was not related to years post-injury or fatigue.

Participant Characteristics

A total of 75.9% of participants were male, and 73.2% were white. Thirty percent of participants were ambulatory, and, of those non-ambulatory, 10.7% had C1–C4, 25.9% C5–C8, and 33.1% non-cervical level injuries. Participants were, on average, 45.1 (14.2) years of age at survey and 12.5 (9.6) years post-injury. The MFIS-5 in our study showed good internal consistency with a Cronbach's alpha of 0.93. Of participants, 8.3% had disabling fatigue (MFIS-5 ≥ 15), and 45.3% reported fatigue impact to be rarely to never ($0 \leq \text{MFIS-5} < 15$). The average MFIS-5 score was 6.6 (5.2). Additionally, the mean score on the average fatigue in the past week was 3.1 (2.2), with 7.3% reporting average fatigue of 7 or more.

When looking at individual relationships between independent variables and the outcome, all behaviors were significantly related to disabling fatigue (Table 1). Additionally, age and race were significantly associated with disabling fatigue, with older persons being more likely to report fatigue, and black participants being less likely to report fatigue.

The Hosmer-Lemeshow test and C-Statistic suggested good fit of the model (Table 2). Among the demographic and injury controls, race and injury severity were significantly associated with disabling fatigue. Whites (OR=3.00; 95% CI=1.72–5.24) and other races (OR=3.67; 95% CI=1.67–8.08) were significantly more likely to have disabling fatigue than blacks. Each injury level among non-ambulatory participants was significantly less likely to have disabling fatigue compared to ambulatory participants. Among behavioral factors, only number of cigarettes per day, weight, and prescription medication for spasticity were not significantly related to disabling fatigue. Those who reported more hours out of bed and more days out of the house were less likely to have disabling fatigue (OR=0.94; 95% CI=0.90–0.99 and OR=0.31; 95% CI=0.75–0.91, respectively). Persons who reported less exercise than others with SCI (OR=2.74; 95% CI=1.64–4.59), and those who reported a fair (OR=1.87; 95% CI=1.28–2.73) or poor diet (OR=3.13; 95% CI=1.76–5.90) were more likely to have disabling fatigue. Additionally, participants reporting daily use of prescription medication for pain were 3.46 times as likely to report disabling fatigue as those who did not use any prescription medication for pain (95% CI=2.00–6.00). Similarly, those who used prescription medication for stress were also at increased odds for disabling fatigue (OR=2.12; 95% CI=1.39–3.22). Lastly, those who were CAGE positive were 1.65 times as likely to have disabling fatigue as those who were CAGE negative (95% CI=1.16–2.35).

Discussion

Our study confirms disabling fatigue is of concern after SCI, although the prevalence in this study appears to be less than that reported in previous research. We found 8.3% of our cohort with SCI reported having disabling fatigue, 45.3% reported minimal to no fatigue interference, and 46.4% reported fatigue but not disabling fatigue. Previous studies have reported 52–57% of persons with SCI have clinically significant fatigue,^{2,3} and we found 54.7% had some fatigue interference in their life. Our finding of 8.3% with disabling fatigue is lower than a previous study finding 18% had severe fatigue; however, a different measure of fatigue was used by Jensen et al.¹

Our findings confirm the hypotheses that multiple behaviors are related to an elevated risk of disabling fatigue after SCI. Two of the three cardiovascular behaviors (diet and exercise) were associated with disabling fatigue, with those who participated in less exercise or who had a poor diet being at increased odds of disabling fatigue. A relationship between heavy-intensity-exercise and less fatigue has been previously found in persons with SCI who use a manual wheelchair.¹¹ A beneficial relationship of exercise with fatigue has also been shown in other populations. In cancer patients, exercise has been shown to reduce fatigue as well as increase quality of life.³⁰ A relationship between diet and fatigue has not been previously explored in SCI research, but a focus group of persons with SCI, family members, assistants, and therapists found diet to be consistently associated with fatigue.¹⁰ In a study using NHANES data, it was found that persons who are tired or exhausted are more likely to not get the recommended physical activity compared to persons who report they are “energized or fresh.”¹³ The same could carry over into persons with SCI, where those who participate in negative cardiovascular behaviors do not feel as energized as those who do not.

Also consistent with previous research,³ we found daily use of prescription medication for pain associated with increased odds of disabling fatigue. This relationship did not continue for participants who used pain medication more sporadically. We additionally found both daily and intermittent use of prescription medication for stress to be associated with disabling fatigue, but medication for spasticity was not associated with fatigue. Participants could be over medicating or self-medicating using prescription medications, but since we do not know what medications were prescribed to participants, it is impossible to decipher in this study. We also found relationships between days out of the house and hours out of bed

with fatigue, it could be that fatigue is causing the participant to remain in the house or in bed, or that persons are becoming fatigued due to limited time spent out of the house. There has been no previous research in this area, and, due to the cross-sectional nature of the data, we were unable to determine the nature of the relationships.

Our finding that race was significantly related to fatigue was surprising in light of previous research finding no such relationship,³¹ except for higher levels of fatigue among Latino females.³² In our study, blacks were the least likely to report chronic fatigue. Additionally, persons who were ambulatory reported the most disabling fatigue, even after controlling for exercise. Previous research has shown that persons with SCI who are ambulatory, especially who are not independent ambulators, can have more problems than persons who are non-ambulatory, including pain interference, depression, and subsequent injuries.^{33–35} This suggests that while ambulation may be the ultimate goal after SCI, there are negative health outcomes that could affect this group, and clinicians should monitor for these conditions.

Limitations

There were several limitations to the current research. First, our data were cross-sectional, so we were not able to establish causality between the predictors and disabling fatigue. Second, all data was self-report, including fatigue and the behavioral predictors. However, participants were asked about behaviors in a general manner as to minimize recall bias, and we used standardized measures where possible. Additionally, when possible, measures used a recent time period (e.g. during the past 4 weeks for MFIS-5) to minimize recall bias. Similarly, we used proxy variables for exercise, diet, and weight status as clinical measurements were not available. Third, we were not able to measure all potential behavioral factors, and the inclusion of other behaviors may lead to a better predicting model.

Conclusion

We have identified several behavioral predictors of disabling fatigue. Identification of behavioral factors is important as, unlike demographics, they are modifiable. Clinicians who identify persons experiencing disabling fatigue should counsel their patients on the importance of positive cardiovascular behaviors, including diet and exercise. Additionally, healthcare providers should monitor prescription medication use among those experiencing fatigue. Future research would benefit from longitudinal analysis to examine changes in behavior and the effect on reported fatigue. Identification of these relationships would strengthen this line of research and would provide further evidence for the development of intervention strategies in those areas for persons with SCI.

Acknowledgments

Sponsorship: The contents of this publication were developed under grants from the Department of Education, NIDRR grant number H133G050165, and the National Institutes of Health, grant number 1R01 NS 48117. However, those contents do not necessarily represent the policy of the Department of Education or NIH, and you should not assume endorsement by the Federal Government.

We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on me or on any organization with which we are associated AND, if applicable, we certify that all financial and material support for this research (eg, NIH or NHS grants) and work are clearly identified in the title page of the manuscript.

The manuscript submitted does not contain information about medical device(s).

List of Abbreviations

CI	confidence interval
CHART	Craig Handicap Assessment and Reporting Technique
MFIS-5	Modified Fatigue Impact Scale Abbreviated Version
NHANES	National Health and Nutrition Examination Survey
OR	odds ratio
SCI	spinal cord injury

References

1. Jensen MP, Kuehn CM, Amtmann D, Cardenas DD. Symptom burden in persons with spinal cord injury. *Arch Phys Med Rehabil.* 2007; 88:638–645. [PubMed: 17466734]
2. Fawkes-Kirby TM, Wheeler MA, Anton HA, Miller WC, Townson AF, Weeks CAO. Clinical correlates of fatigue in spinal cord injury. *Spinal Cord.* 2008; 46:21–25. [PubMed: 17406379]
3. Lee AK, Miller WC, Townson AF, Anton HA. Medication use is associated with fatigue in a sample of community-living individuals who have a spinal cord injury: a chart review. *Spinal Cord.* 2010; 48:429–433. [PubMed: 19918252]
4. Suzuki R, Krahn GL, McCarthy MJ, Adams EJ. Understanding health outcomes: Physical secondary conditions in people with spinal cord injury. *Rehabil Psychol.* 2007; 52:338–350.
5. Levi R, Hultling C, Nash MS, Seiger A. The Stockholm spinal cord injury study: 1. Medical problems in a regional SCI population. *Paraplegia.* 1995; 33:308–315. [PubMed: 7644255]
6. McColl MA, Arnold R, Charlifue S, Glass C, Savic G, Frankel H. Aging, spinal cord injury, and quality of life: Structural relationships. *Arch Phys Med Rehabil.* 2003; 84:1137–1144. [PubMed: 12917851]
7. Cook KF, Molton IR, Jensen MP. Fatigue and aging with a disability. *Arch Phys Med Rehabil.* 2011; 92(7):1126–1133. [PubMed: 21704793]
8. Pentland W, McColl MA, Rosenthal C. The effect of aging and duration of disability on long term health outcomes following spinal cord injury. *Paraplegia.* 1995; 33:367–373. [PubMed: 7478724]
9. Gerhart KA, Bergstrom E, Charlifue SW, Menter RR, Whiteneck GG. Long-term spinal cord injury: functional changes over time. *Arch Phys Med Rehabil.* 1993; 74(10):1030–1034. [PubMed: 8215852]
10. Hammell KW, Miller WC, Forwell SJ, Forman BE, Jacobsen BA. Fatigue and spinal cord injury: a qualitative analysis. *Spinal Cord.* 2009; 47(1):44–49. [PubMed: 18542089]
11. Tawashy AE, Eng JJ, Lin KH, Tang PF, Hung C. Physical activity is related to lower levels of pain, fatigue and depression in individuals with spinal-cord injury: a correlational study. *Spinal Cord.* 2009; 47(4):301–306. [PubMed: 18936771]
12. Hetz SP, Latimer AE, Arbour-Nicitopoulos KP, Martin Ginis KA. Secondary complications and subjective well-being in individuals with chronic spinal cord injury: associations with self-reported adiposity. *Spinal Cord.* 2011; 49(2):266–272. [PubMed: 20733591]
13. Resnick HE, Carter EA, Aloia M, Phillips B. Cross-sectional relationship of reported fatigue to obesity, diet, and physical activity: results from the third national health and nutrition examination survey. *J Clin Sleep Med.* 2006; 2(2):163–169. [PubMed: 17557490]
14. Corwin EJ, Klein LC, Rickelman K. Predictors of fatigue in healthy young adults: moderating effects of cigarette smoking and gender. *Biol Res Nurs.* 2002; 3(4):222–233. [PubMed: 12184665]
15. Krause JS, Zhai Y, Saunders LL, Carter RE. Risk of mortality after spinal cord injury: an 8-year prospective study. *Arch Phys Med Rehabil.* 2009; 90(10):1708–1715. [PubMed: 19801060]
16. Fatigue and multiple sclerosis: Evidence-based management of strategies for fatigue in multiple sclerosis. Washington, DC: 1998. Multiple Sclerosis Council for Clinical Practice Guidelines.
17. Chwastiak LA, Gibbons LE, Ehde DM, et al. Fatigue and psychiatric illness in a large community sample of persons with multiple sclerosis. *J Psychosomatic Res.* 2005; 59(5):291–298.

18. Fisk JD, Ritvo PG, Ross L, Haase DA, Marrie TJ, Schlech WF. Measuring the functional impact of fatigue: initial validation of the fatigue impact scale. *Clin Infect Diseases*. 1994; 19:S79–S83. [PubMed: 8148458]
19. Whiteneck, GG.; Charlifue, SW.; Gerhart, KA.; Overholser, JD.; Richardson, GN. *The Craig Handicap Assessment and Reporting Technique*. Englewood, CO: Craig Hospital; 1992.
20. Shackelford M, Farley T, Vines CL. A comparison of women and men with spinal cord injury. *Spinal Cord*. 1998; 36(5):337–339. [PubMed: 9601113]
21. Roach MJ, Harrington A, Powell H, Nemunaitis G. Cell telephone ownership and social integration in persons with spinal cord injury. *Arch Phys Med Rehabil*. 2011; 92(3):472–476. [PubMed: 21353829]
22. Krause JS, McArdle JJ, Pickelsimer E, Reed KS. A latent variable structural path model of health behaviors after spinal cord injury. *J Spinal Cord Med*. 2009; 32:162–174. [PubMed: 19569464]
23. Krause JS, Carter RE, Pickelsimer E. Behavioral risk factors of mortality after spinal cord injury. *Arch Phys Med Rehabil*. 2009; 90(1):95–101. [PubMed: 19154835]
24. Ewing JA. Detecting alcoholism. The CAGE questionnaire. *JAMA*. 1984; 252(14):1905–1907. [PubMed: 6471323]
25. Cherpitel CJ. Comparison of screening instruments for alcohol problems between Black and White emergency room patients from two regions of the country. *Alcoholism: Clinical and Experimental Research*. 1997; 21:1391–1397.
26. Hays RD, Merz JF, Nicholas R. Response burden, reliability and validity of the CAGE, short MAST, and AUDIT alcohol screening measures. *Behav Res Meth Instrum Comput*. 1995; 27:277–280.
27. Saunders LL, Krause JS, Peters BA, Reed KS. The relationship of pressure ulcers, race, and socioeconomic conditions after spinal cord injury. *J Spinal Cord Med*. 2010; 33(4):387–395. [PubMed: 21061898]
28. Saunders LL, Krause JS. Psychological factors affecting alcohol use after spinal cord injury. *Spinal Cord*. 2011; 49:637–642. [PubMed: 21102575]
29. Hosmer, DW.; Lemeshow, S. *Applied logistic regression*. 2nd ed.. New York, New York: John Wiley and Sons; 2000.
30. Mock V, Pickett M, Ropka ME, et al. Fatigue and quality of life outcomes of exercise during cancer treatment. *Cancer Pract*. 2001; 9(3):119–127. [PubMed: 11879296]
31. Nisenbaum R, Reyes M, Mawle AC, Reeves WC. Factor analysis of unexplained severe fatigue and interrelated symptoms: overlap with criteria for chronic fatigue syndrome. *Am J Epi*. 1998; 148(1):72–77.
32. Song S, Jason LA, Taylor RR. The relationship between ethnicity and fatigue in a community-based sample. *J Gend Cult Health*. 1999; 4:255–268.
33. Krause JS, Morrisette D, Brotherton S, Karakostas T, Apple D. Pain interference in ambulatory spinal cord injury. *Top Spinal Cord Inj Rehabil*. 2007; 12(3):91–96.
34. Krause JS, Brotherton S, Morrisette D, Newman S, Karakostas T. Does pain interference mediate the relationship of independence in ambulation with depressive symptoms after spinal cord injury? *Rehabil Psychol*. 2007; 52(2):162–169.
35. Krause JS. Factors associated with risk for subsequent injuries after the onset of traumatic spinal cord injury. *Arch Phys Med Rehabil*. 2004; 85:1503–1508. [PubMed: 15375825]

Table 1

Characteristics of spinal cord injury cohort.

Variable	N	Disabling Fatigue (n=187)	Non-disabling Fatigue (n=2058)	p-value*
Row Percent (unless otherwise specified)				
Age at survey [mean (s.d.)]	2245	47.39 (12.10)	44.87 (14.38)	0.0079
Gender				
Male	1703	7.87	92.13	0.1610
Female	542	9.78	90.28	
Race				
White	1644	9.31	90.69	0.0002
Black	470	3.83	96.17	
Other	131	12.21	87.79	
Injury Severity				
C1–C4, Non-ambulatory	241	9.13	90.87	0.1267
C5–C8, Non-ambulatory	582	6.36	93.64	
Non-cervical, Non-ambulatory	742	8.09	91.91	
Ambulatory	680	10.00	90.00	
Hours out of bed [mean (s.d.)]	2245	9.70 (4.89)	12.51 (3.75)	<.0001
Days out of the house [mean (s.d.)]	2245	2.80 (2.25)	4.55 (2.21)	<.0001
Exercise				
More	808	3.34	96.66	<.0001
Same	832	6.49	93.51	
Less	605	17.52	82.48	
Overall diet				
Good/Excellent	1578	5.39	94.61	<.0001
Fair	548	12.96	87.04	
Poor	119	26.05	73.95	
Weight				
Normal	1846	7.10	92.90	<.0001
Underweight	118	16.95	83.05	
Overweight	281	12.81	87.19	
Prescription medication for pain				
Never	779	2.70	97.30	<.0001
Sometimes	575	3.65	96.35	
Weekly	127	7.09	92.91	
Daily	764	17.80	82.20	
Prescription medication for stress				
Never	1524	4.07	95.93	<.0001
Sometimes/Weekly	281	13.52	86.48	
Daily	440	19.77	80.23	
Prescription medication for spasticity				

Variable	N	Disabling Fatigue (n=187)	Non-disabling Fatigue (n=2058)	p-value*
Never	953	5.88	94.12	0.0009
Sometimes/Weekly	212	8.49	9.44	
Daily	1080	10.46	89.54	
CAGE				
Negative	1499	6.87	93.13	0.0004
Positive	746	11.26	88.74	
Number of cigarettes per day				
None	1713	6.83	93.17	<.0001
1–9	217	8.76	91.24	
10–19	192	13.54	86.46	
20+	123	20.33	79.67	

*
p-value represents chi-square test for categorical variables and t-test for continuous variables.

Table 2

Results of the logistic regression model, odds ratios are adjusted for all other variables in the table and represent the odds of disabling fatigue.

Variable	OR	95% CI	p-value
Age at survey	1.00	0.99–1.02	0.6856
Gender (vs. female)			0.6123
Male	0.90	0.61–1.34	
Race (vs. all black)			0.0003
White	3.00	1.72–5.24	
Other	3.67	1.67–8.08	
Injury Severity (vs. Ambulatory)			0.0035
C1–C4, Non-ambulatory	0.48	0.25–0.90	
C5–C8, Non-ambulatory	0.48	0.29–0.79	
Non-cervical, Non-ambulatory	0.48	0.31–0.75	
Hours out of bed	0.94	0.90–0.99	0.0132
Days out of the house	0.83	0.75–0.91	<.0001
Exercise (vs. more)			<.0001
Same	1.40	0.84–2.35	
Less	2.74	1.64–4.59	
Overall diet (vs. Good/Excellent)			<.0001
Fair	1.87	1.28–2.73	
Poor	3.13	1.76–5.90	
Weight (vs. normal)			0.3166
Underweight	1.63	0.96–3.08	
Overweight	1.02	0.64–1.62	
Prescription medication for pain (v. None)			<.0001
Sometimes	0.99	0.51–1.90	
Weekly	1.90	0.80–4.54	
Daily	3.46	2.00–6.00	
Prescription medication for stress (vs. None)			0.0012
Sometimes/Weekly	1.89	1.15–3.09	
Daily	2.12	1.39–3.22	
Prescription medication for spasticity (vs. None)			0.7238
Sometimes/Weekly	0.82	0.43–1.57	
Daily	0.86	0.56–1.30	
CAGE (vs. negative)			0.0056
positive	1.65	1.16–2.35	
Number of cigarettes per day (vs. None)			0.6713
1–9	1.23	0.68–2.24	
10–19	1.16	0.68–1.98	
20+	1.38	0.78–2.47	

Hosmer-Lemeshow chi-square=8.63, DF=8, p=0.3748; C-Statistic=0.859 ; Nagelkerke's $R^2=0.3208$