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# Are Comorbid Pain and Depressive Symptoms Associated with Rehabilitation of Individuals with Spinal Cord Injury?

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**Objective:** To examine the difference in functional outcomes and therapy intensity among individuals with spinal cord injury (SCI) with comorbid depression and pain symptoms compared to those without these symptoms. **Methods:** A retrospective chart review was conducted of 100 patients admitted to a specialized SCI inpatient rehabilitation unit. Standard demographic factors were collected. Patients were divided into 2 groups: those with comorbid depression and pain symptoms and those without. Outcomes were compared between the 2 groups using analysis of covariance (ANCOVA). Age, gender, level of injury, severity of injury, and FIM® admission were included in the model as covariates. Main outcomes included FIM® discharge, length of stay (LOS), intensity of therapy (total physical therapy time [PTt] and total occupational therapy time [OTt]), living arrangement, and vocational status. **Results:** No significant difference was seen between the 2 groups in FIM® discharge or OTt; however, those in the comorbidity group required significantly greater PTt than those without ( $p = .002$ ). Those in the comorbid group also spent longer in inpatient rehabilitation ( $p = .005$ ). The groups did not differ in postdischarge living arrangements or vocational status. **Conclusion:** Inpatient rehabilitation physical therapy and LOS differ substantially among individuals with comorbid depression and pain symptoms. This comorbidity may have a negative impact on functional recovery such that individuals may require more physical therapy time and longer LOS. This may also point to the increased resources required to manage individuals with SCI and comorbid depression and pain symptoms. **Key words:** comorbidity, depression, pain, rehabilitation, spinal cord injuries

Spinal cord injuries (SCIs) encompass a broad range of neurological insults and vary greatly in their traumatic and nontraumatic etiologies. In Canada, approximately 4,300 people annually have an SCI and more than 86,000 individuals live with SCI.<sup>1</sup> Depression and pain are common sequelae of SCI.<sup>2</sup> Differences in study populations and methodologies result in heterogeneous estimates of pain prevalence in the literature (19%-96%).<sup>3</sup> A recent meta-analysis estimates depression prevalence to be as high as 22.2% in patients with traumatic SCI, nearly twice as high as in the general population.<sup>1</sup> Depression has been shown to hinder the rehabilitation process, as depressed individuals have poorer adherence to self-management training and less participation in rehabilitation and peer support groups.<sup>4</sup>

Depression and pain are believed to be highly positively correlated in SCI populations.<sup>3</sup> A recent

study found comorbidity of the 2 occurred in 20% of their SCI sample,<sup>5</sup> whereas previous estimates have ranged from 22% to 35%.<sup>6</sup> Further, studies have reported more severe depression scores in individuals with SCI who have chronic pain compared to those without.<sup>7,8</sup> Pain and depression can worsen over time, even with appropriate treatment.<sup>5</sup> A 3-year longitudinal study reported that the comorbidity of depression and pain exacerbated both complications to a larger extent over time compared to patients who only had either pain or depression.<sup>5</sup>

Cairns et al<sup>6</sup> found that the relationship between pain and depression begins during the course of the individual's inpatient stay and becomes strongly correlated by discharge. Additionally, Ullrich et al<sup>5</sup> reported that high rates of pain and depression can also occur several years post discharge from rehabilitation leading to longstanding treatment-resistant problems. Though most individuals

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with only depression at 1 year post SCI had a successful course of treatment or natural recovery of depression by year 3, individuals with comorbid pain and depression continued to have symptoms of both at year 3. These individuals also had more inpatient, outpatient, and psychologist visits.<sup>5</sup> Given that there are apparent differences in the needs and recovery trajectory of individuals with comorbid pain and depression, this study aimed to explore whether patients with SCI and comorbid symptoms of pain and depressive symptoms also differed in rehabilitation outcomes when compared to those without comorbidity. There is a lack of evidence as to whether the symptoms of depression and pain are associated with functional outcomes during SCI rehabilitation. Therefore, the purpose of this study was to explore whether outcomes and therapy time differed amongst patients with SCI and comorbid depression and pain symptoms compared to those without during inpatient rehabilitation.

## Methods

Ethics approval was granted from the Office of Research Ethics at the University of Western Ontario. A retrospective audit was conducted on consecutive patients admitted to an inpatient SCI rehabilitation unit in southwestern Ontario over a 21-month period. Patients admitted to this unit are 16 years and older and have suffered a traumatic or nontraumatic SCI. The unit consists of 15 beds and offers comprehensive rehabilitation from an interdisciplinary team of health care professionals. Eligible patients were identified by a hospital staff member in Quality Measurement and Clinical Decision Support. Charts were then located by the Health Records Department and reviewed independently by 2 trained researchers. Any disagreements in extraction were resolved through discussion between the 2 researchers. Each chart was reviewed in its entirety; any notes, assessment/evaluations, medications, or documentation pertaining to pain or depression were recorded. Pain was assessed using the hospital's numeric pain rating scale. The scale consists of 4 points: 0 = none, 1 = mild, 2 = moderate, 3 = severe.

Additional data were collected from 2 hospital databases. The first database was the Canadian

Institute for Health Information's National Rehabilitation Reporting System, which provided descriptive patient data including gender, age, admission and discharge dates, FIM<sup>®</sup> scores, date of injury onset, length of stay (LOS), level of injury, injury severity, living arrangement, and vocational status. Living arrangement and vocational status information was collected pre and post rehabilitation. Living arrangement status was identified as living independently versus assisted living. Vocational status was categorized as employed or unemployed. The second database was the INFOMed Development Corporation's software, Promiso<sup>®</sup> (Comox, British Columbia, Canada). The rehabilitation hospital used it to monitor the use of therapists' time and resources on the unit. Therapists are mandated to record the time spent with patients into this database. For each inpatient, the total amount of therapy provided by physical therapy and occupational therapy, or an associated aide, was extracted from this database.

All data were organized and analyzed using IBM SPSS version 23.0 (IBM Corp., Armonk, NY). Means and standard deviations were calculated for descriptive data. FIM<sup>®</sup> gains refer to the difference between FIM<sup>®</sup> scores at discharge and admission. The amount of therapy provided by each therapist was summed. Using the medical records, patients were divided into 2 groups: (1) comorbid pain and depressive symptoms and (2) no comorbidity. The comorbid group consisted of patients reporting both pain and depressive symptoms. The no comorbidity group consisted of patients with either pain or depressive symptoms. Only 9 patients reported no pain or depressive symptoms. Due to the low numbers, these patients were added to the no comorbidity group. Patients were classified as having pain if they had at least moderate pain levels based on the hospital's pain rating scale. Patients were classified as having depression symptoms if any front-line clinician reported them as having at least 2 symptoms of depression as outlined in the *Diagnostic and Statistical Manual of Mental Disorders, 4th ed., text revision (DSM-IV-TR)*<sup>9</sup> in their chart notes over a 2-week period. Chart notes reporting a single incidence of depressive-like symptoms (eg, sad,

crying) were not sufficient to classify a patient as having depressive symptoms.

Outcomes were compared between the 2 groups, those with and without comorbid pain and depressive symptoms, using an analysis of covariance (ANCOVA). Based on previous literature, age, gender, level of injury, and severity of injury were included in the model as covariates.<sup>5</sup> Due to significant difference between the groups in baseline FIM® admission, it was also included as a covariate. Main dependent variables were FIM® discharge, LOS, and intensity of therapy (total physical therapy time [PTt] and total occupational therapy time [OTt]). A logistic regression was conducted to examine the ability of comorbid depression and pain to predict discharge living arrangement and vocational status, after controlling for covariates (age, gender, level of injury, severity of injury, and FIM® admission).

**Results**

One hundred individuals with SCI were included for analysis, including 58 individuals with comorbid pain and depressive symptoms and 42 individuals without. Patient demographic and clinical factors are displayed in **Table 1**. There was no significant difference between groups in baseline age, gender, type of injury, or time since injury ( $p > .05$ ). However, individuals in the comorbid group had significantly more individuals with complete injuries ( $p = .02$ ), with paraplegia ( $p = .02$ ), and with lower FIM® admission scores ( $p = .03$ ).

A multivariate analysis of covariance was performed to examine differences in depressive

symptoms and pain comorbidity on rehabilitation outcomes among individuals with SCI. The dependent variables included LOS, OTt, PTt, and FIM® discharge. The independent variable was comorbidity of depressive symptoms and pain. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance, and multicollinearity. The tests resulted in no violations of assumptions. There was a statistically significant difference between patients with comorbidity compared to those without on the combined dependent variables,  $F(4, 83) = 3.06$ ,  $p = .021$ ; Wilks'  $\lambda = .87$ ; partial  $\eta^2 = .129$ . When dependent variables were considered separately, both LOS [ $F(1, 86) = 8.21$ ,  $p = .05$ ; partial  $\eta^2 = .087$ ] and PTt [ $F(1, 86) = 10.62$ ,  $p = .002$ ; partial  $\eta^2 = .110$ ] reached statistical significance between the 2 groups. The mean scores indicated that those in the comorbid group reported longer LOS and PTt compared to those without the comorbidity (**Table 2**).

Logistic regression was performed to assess the unique contribution of depressive symptoms and pain comorbidity to predict vocational status and living arrangement post rehabilitation among individuals with SCI after controlling for the covariates (**Table 3** and **Table 4**, respectively). The full model containing all predictors was statistically significant for both vocational status [ $\chi^2(6, N=88) = 15.246$ ,  $p = .018$ ] and living arrangement [ $\chi^2(6, N=88) = 26.011$ ,  $p < .001$ ]. However, the addition of comorbidity did not reach significance in either model.

**Table 1.** Patient demographic and clinical factors

Demographic factors	Comorbid pain/depression group (n = 58)	No comorbid pain/depression group (n = 42)	p
Age, years, mean ± SD	49.8 ± 17.4	52.6 ± 20.0	.39
Gender, male, %	64.9	73.8	.23
Type of injury, traumatic, %	47.6	48.3	.76
Severity of injury, complete, %	38.5	16.2	.02
Level of injury, paraplegia, %	60.3	35.7	.02
Time since injury, months, mean ± SD	6.3 ± 5.0	16.0 ± 5.9	.21
FIM® admission, mean ± SD	70.6 ± 2.6	79.6 ± 3.1	.03

**Table 2.** Univariate analysis of those with comorbidity versus no comorbidity

Outcomes	Mean difference (comorbidity - no comorbidity)	F (df)	p	Partial $\eta^2$
FIM <sup>®</sup> discharge	6.76 $\pm$ 5.0	1.82 (1, 86)	.181	.021
OTt, hours	12.48 $\pm$ 7.6	2.73 (1, 86)	.102	.031
PTt, hours	17.55 $\pm$ 5.4	10.62 (1, 86)	<b>.002</b>	.110
LOS, days	17.44 $\pm$ 6.1	8.21 (1, 86)	<b>.005</b>	.087

Note: Bold p values indicate significance at  $p < .05$ . LOS = length of stay; OTt = total occupational therapy time; PTt = total physiotherapy time.

**Table 3.** Logistic regression vocational status after discharge

Variable	B	S.E.	Wald	df	p	OR
Model 1						
Age	.036	.017	4.599	1	.03	1.04
Gender	-1.319	.739	3.190	1	.07	.267
Injury severity	.115	.734	.024	1	.88	1.122
Injury level	-1.538	.665	5.354	1	.02	.215
FIM <sup>®</sup> admission	-.002	.016	.010	1	.92	.998
Constant	1.438	1.440	.997	1	.32	4.211
Model 2						
Age	.032	.017	3.549	1	.06	1.033
Gender	-1.358	.744	3.335	1	.07	.257
Injury severity	.127	.742	.029	1	.86	1.135
Injury level	-1.242	.705	3.099	1	.08	.289
FIM <sup>®</sup> admission	-.007	.017	.179	1	.67	.993
Comorbidity	-.748	.674	1.233	1	.27	.473
Constant	2.327	1.669	1.944	1	.16	10.251

Note: OR = odds ratio.

## Discussion

The current study demonstrated the association of comorbid pain and depressive symptoms with SCI rehabilitation compared to patients without comorbidity. Significantly longer LOS and greater PTt were found among patients in the comorbid group compared to the no comorbidity group. These findings may be explained by the link between post-SCI medical complications (eg, pressure ulcers, urinary tract infections, poor mobility) and symptoms of pain and depression.<sup>8,10</sup> It is also possible that the presence

of comorbid pain and depressive symptoms results in behaviors that contribute to the development of these negative outcomes, thereby resulting in a longer functional recovery period and LOS.

Avluk et al<sup>10</sup> found that individuals with greater intensity of pain, compared to those without, may view their disability as more severe. The perception of greater disability among individuals with both pain and depression may result in decreased motivation in activities and increased avoidance of inpatient-related therapy. Thus, individuals with comorbid pain and depressive symptoms who display avoidance behaviors may

**Table 4.** Logistic regression living status after discharge

Variable	B	S.E.	Wald	df	p	OR
Model 1						
Age	.028	.015	3.602	1	.06	1.029
Gender	-.354	.568	.389	1	.53	.702
Injury severity	.054	.698	.006	1	.94	1.055
Injury level	.234	.580	.163	1	.69	1.264
FIM® admission	-.059	.017	12.140	1	.01	.942
Constant	3.352	1.346	6.206	1	.01	28.561
Model 2						
Age	.030	.015	3.910	1	.05	1.030
Gender	-.312	.574	.295	1	.59	.732
Injury severity	.066	.700	.009	1	.92	1.068
Injury level	.086	.609	.020	1	.89	1.090
FIM® admission	-.056	.017	10.508	1	.01	.945
Comorbidity	.491	.55	.797	1	.37	1.635
Constant	2.804	1.483	3.575	1	.06	16.507

Note: OR = odds ratio.

require longer hospitalization times in order to achieve similar functional gains as those without comorbidity. Vlaeyen and Morley<sup>11</sup> also found that comorbid depression and pain may heighten the perceived threat of functional activities, thus resulting in cessation or avoidance of activities. Furthermore, recent studies among chronic pain<sup>12</sup> and rheumatoid arthritis<sup>13</sup> populations found that those with increased levels of experiential avoidance behaviors had greater levels of long-term disability and decreased quality of life compared to those with lower levels. Future studies that examine the use of motivation and coping strategies to reduce avoidance behaviors may be warranted to evaluate its effect on reducing inpatient LOS amongst individuals with SCI.

Comorbid pain and depression is also concerning as Ullrich et al<sup>5</sup> found that these individuals had the highest levels of health care utilization. The current study expands on this research and found that persons with the comorbidity required greater PTt compared to those without during inpatient SCI rehabilitation. This finding remained significant even after controlling for the potential effects of age, level of injury, severity of injury, FIM® admission, variables that have been

previously shown to be associated with health care utilization.<sup>14,15</sup> However, the current study found that comorbidity was not significantly associated with living arrangements or vocational status post discharge after controlling for the covariates. It may be that comorbid symptoms may have been sufficiently managed during the patients' inpatient stay and did not lead to concerns of independent living. However, further research is warranted, because the current study did not assess effectiveness of managing the comorbid symptoms.

The current study found no significant difference between the 2 groups in functional gain as measured by the FIM® discharge. This is contrary to previous research showing that among individuals with major depressive disorder (MDD), pain and depression had an additive negative effect on functioning and quality of life.<sup>16</sup> The study showed that the greater the symptoms of depression and pain, the greater the impairment in daily functioning. It may be that only those studies that targeted subjects with clinically significant depressive symptoms showed a subsequent association with function. Hence, the current study may not have found a difference in functional outcome between the 2 groups,

because patients with depressive symptomology were included rather than only those with MDD. The lack of difference in functional impairment observed between the 2 groups may also be due to the use of FIM<sup>®</sup> as a measure of function. Previous studies have shown that the FIM<sup>®</sup> may not be a sensitive measure of function among the SCI population.<sup>17,18</sup> The studies found that FIM<sup>®</sup> lacks the ability to measure specific functional skills that may be important for individuals with SCI. Furthermore, it may lack sensitivity to assess functional differences between individuals with SCI. The Spinal Cord Independence Measure (SCIM) is a more effective tool in measuring functional outcomes among the SCI population. The tool contains items that are more relevant to assessing functional outcomes among people with SCI. Furthermore, it has been shown to be more sensitive than the FIM<sup>®</sup> in evaluating changes in functioning among people with SCI.<sup>19,20</sup>

This study has several limitations. First, due to its retrospective design, causation cannot be determined and directionality of the outcomes cannot be confirmed. Further, the analysis is limited by the available outcome measures documented in the medical charts. The association of depressive symptoms with functional limitation was examined; however, it is possible that those with functional limitations may result in higher levels of depressive symptoms. DiPiro and colleagues<sup>21</sup> found that pain and fatigue may mediate the relationship between mobility and depressive symptoms. The study did not examine how individuals in the comorbid group may differ from those with only pain or depressive symptoms. This has important implications for the individual contribution of both of these factors on rehabilitation outcomes. However, since pain and depression often co-occur among the SCI population, the current study did not have sufficient data to conduct a separate subgroup analysis. It is recommended that future studies keep this in mind when conducting sample size calculations.

Despite its limitations, this study has important clinical implications for the management of individuals with SCI during inpatient rehabilitation.

The study demonstrates that the presence of depressive symptoms without a diagnosis of depression along with comorbid pain can have significant implications for SCI rehabilitation outcomes. Individuals with comorbid pain and depressive symptoms may require longer LOS during rehabilitation than those without, and this may be associated with the need for resources including more time with clinicians and greater costs associated with longer hospitalization. Hence, increased depression and pain screening may help clinicians identify individuals who may be at risk and help them develop more comprehensive, holistic treatment plans for these individuals. Exclusively managing pain may not be the optimal treatment strategy. Instead multidisciplinary treatment programs that also target depressive symptoms may be required to effectively manage these individuals. The use of collaborative and multidisciplinary approaches that involve concomitant treatment of pain and depression have been shown to be effective among other populations including older adults with arthritis<sup>22</sup> and individuals with musculoskeletal pain.<sup>23</sup> A systematic review found cognitive behavioral therapy (CBT) to be effective in reducing symptoms of depression among individuals with SCI.<sup>24</sup> Furthermore Norrbrink and colleagues<sup>25</sup> and Heutink et al<sup>26</sup> both found that the use of multidisciplinary CBT improved outcomes among SCI individuals with neuropathic pain.

## Conclusion

The current study demonstrates the importance of assessing pain and depressive symptoms during SCI rehabilitation. The study found that individuals with comorbid pain and depressive symptoms had a greater need for health care resources during inpatient stay in terms of longer hospitalization and greater PTt in order to achieve similar functional gains compared to those without. Providing individuals with more collaborative multidisciplinary treatment may help reduce some burden on the health care system and improve outcomes amongst these individuals.

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