Special issue article

Relationship of psychology inpatient rehabilitation services and patient characteristics to outcomes following spinal cord injury: The SCIR rehab Project

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Context and objective: To evaluate the effects of psychological interventions on rehabilitation outcomes, including residence and functional status at discharge, and residence, school attendance, or employment, and physical, social, occupational, and mobility aspects of participation 1 year after spinal cord injury (SCI).

Design: Prospective observational cohort study.

Setting: Six inpatient rehabilitation facilities in the United States.

Participants: Inpatients with SCI 12 years of age and older.

Interventions: Usual rehabilitation care.

Outcome measures: Functional Independence Measure at rehabilitation discharge and 1-year injury anniversary; discharge destination and residence at 1-year anniversary; Craig Handicap Assessment and Reporting Technique, Diener Satisfaction with Life Scale, Patient Health Questionnaire, employment or school attendance, rehospitalization, and occurrence of a pressure ulcer at 1-year anniversary.

Results: More time in psycho-educational interventions was associated with better function, discharge to home, home residence at 1 year, and the absence of pressure ulcers at 1 year. More psychotherapeutic sessions focusing on processing emotions and/or locus of control were associated with poorer function at discharge and 1 year, less physical independence and community mobility, lower satisfaction with life, and the presence of pressure sores at 1 year.

Conclusions: Psychological services are an important component of comprehensive medical rehabilitation and tailored to patient needs and readiness to benefit from rehabilitation. Services focused on remediating deficits tend to be associated with negative outcomes, while services intended to foster adjustment and growth tend to be associated with favorable outcomes. Further research is needed to determine the optimal type and timing of psychological services during inpatient rehabilitation based on individuals' strengths and vulnerabilities.

Note: This is the sixth in this third series of SCIR rehab articles.

Keywords: Spinal cord injuries, Rehabilitation, Rehabilitation psychology, Paraplegia, Tetraplegia, Participation, Quality of life, Employment, Functional outcome, Practice-based evidence, SCI model systems, Interventions, Psychological, Depression

Introduction

Spinal cord injury (SCI) is an often overwhelming and life-changing condition that results in physical, emotional, social, and socio-economic changes; it is one of the most expensive health conditions to treat.¹ Accrediting

organizations require patient access to psychological services as an essential component of an integrated team approach during inpatient rehabilitation. CARF International (formerly the Commission on Accreditation of Rehabilitation Facilities) and the World Health Organization stress the importance and value of rehabilitation psychological services for patients in inpatient rehabilitation settings.^{2,3} Because the

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consequences of SCI can be wide-ranging and health care resources are limited, it is imperative that we evaluate the effectiveness of rehabilitation psychology interventions. Interventions provided by rehabilitation psychologists take into account biological, psychological, social, and environmental issues⁴ and focus on the patient and family members. Psychologists tailor their intervention to reflect the needs of patients and family members; services may be provided individually or in groups.

There is little evidence to determine which components of psychological interventions are effective and efficient. It is important to study the effectiveness of interventions given the paucity of information. Psychological interventions following SCI typically consist of individual and family therapy and consultation with the rehabilitation team.⁵ Rehabilitation psychologists often address emotional reactions including grief, anxiety, depression, post-traumatic stress disorder, chronic pain, and adjustment disorders. Psycho-educational topics include self-care behaviors, coping strategies, behavioral pain management, and emotional reactions; they are addressed during individual and group sessions, with or without family members.⁶ At times, the psychologist assumes the role of an advocate and educator by intervening with the team to help team members appreciate individual differences and resolve conflicted interactions.⁷

Psychological interventions for individuals who sustain traumatic SCI often focus on depression and anxiety because symptoms of these conditions occur frequently.⁸ Depression is one of the most studied symptoms in the SCI literature.⁹ It hampers the rehabilitation process and is associated with numerous negative outcomes including secondary complications,¹⁰ lower functional status,¹¹ and poorer community integration.¹² Prevalence estimates of depression after SCI range from 10 to 37%, based on diagnostic interviews. Comparable rates, from 20 to 43%, have been reported during inpatient rehabilitation, while the rates for those living in the community range from 11 to 60%.^{13,14} Because individuals experiencing emotional distress during acute rehabilitation are at increased risk for long-term adjustment difficulties, early detection and prevention of the disabling effects of depression following SCI are a priority for the rehabilitation team.

It is important to provide education to persons with SCI about the consequences of pain, a frequent symptom that co-occurs with depression.¹⁵ Pain is estimated to affect 48–94% of persons with SCI.¹⁶ Self-medication of pain with alcohol and narcotic analgesics is not uncommon.⁶ Chronic pain is associated with lower quality of life.¹⁷ Thus, pain is a clinical issue

that requires early detection, patient education, and treatment to enhance quality of life. Up to 40% of those who sustain SCI use alcohol or other substances or have a substance abuse history.¹⁸ Substance abuse has been associated with difficulties in multiple aspects of rehabilitation, including higher risk for depression, pressure ulcers, longer length of stay (LOS) in acute rehabilitation, and non-compliance with self-care regimens.^{18–21}

Acute rehabilitation is an important time to identify patient needs and develop psychotherapeutic and educational interventions. Coping effectiveness training is one intervention that has been the focus of research; it can reduce depressive symptoms significantly.²² Pollard and King²³ reported that acquisition of coping strategies during acute rehabilitation is associated with lower levels of anxiety and depression several years later. Interventions that promote adjustment during acute rehabilitation can have a lasting effect on quality of life.²³

Few studies describe the relationship between intensity or focus of psychological services and outcomes after traumatic injury. Heinemann and colleagues²⁴ reported a positive association between intensity of psychological services and functional gain for patients who sustain traumatic brain injury; in contrast, Johnston and Miller reported a negative relationship in an SCI sample.²⁵ To date, there is little evidence to determine which components of psychological interventions are effective and efficient. It is important to study how interventions impact outcomes whether associated positively or negatively with patient outcomes.

Needed are studies of how psychological services during inpatient rehabilitation affect outcomes at discharge and longer term after SCI. This article evaluates the benefits of psychological interventions on patient outcomes. Data are from the SCIRehab Project, a collaboration between practitioners and investigators who sought to illuminate the relationships between (1) patient and injury characteristics, and (2) rehabilitation services on functional, social, and psychological outcomes.

Methods

The practice-based evidence research methodology²⁶ used in this study has been described previously^{27–29} and is summarized in the first article of this series.³⁰

Study sample and facilities

We enrolled patients who were 12 years of age or older, gave (or whose parent or guardian gave) informed consent, and were admitted to one of six SCI programs for initial rehabilitation: Craig Hospital, Englewood, CO; Shepherd Center, Atlanta GA; Rehabilitation

Institute of Chicago, Chicago, IL; Carolinas Rehabilitation, Charlotte, NC; Mount Sinai Medical Center, New York, NY; and MedStar National Rehabilitation Hospital, Washington, DC. Enrollment began in the fall of 2007 and concluded 31 December 2009.

Patient demographic and injury characteristics

We abstracted patient demographic and injury characteristics (patient data) from medical records as part of the SCI Model Systems protocol. In brief, we used standardized information collected by the National Institute on Disability and Rehabilitation Research SCI Model Systems.¹ Form I was collected after discharge and contains information from injury through rehabilitation discharge. Patient data include the International Standards of Neurological Classification of SCI and its American Spinal Injury Association Impairment Scale (AIS)³¹ that describe neurologic level and completeness of injury; the Functional Independence Measure (FIM[®]), which describes functional independence in motor and cognitive tasks at admission³² and was Rasch-transformed as described in the first article in this series;³⁰ and the Comprehensive Severity Index (CSI[®]), a disease-specific measure of illness severity through the rehabilitation stay.³³ We characterized body mass index (BMI) as obese (BMI ≥ 30) and not obese (BMI < 30). Additional patient data include: days from injury to rehabilitation admission, age, gender, marital status, race, occupational status and highest level of education achieved before injury, primary payer, and whether the injury was work related. We categorized alcohol use before injury as (1) alcohol involved in injury regardless of alcohol use history, (2) history of alcohol abuse but no alcohol involvement in injury, (3) no history of alcohol abuse and no alcohol involvement in injury, and (4) no information about alcohol was available. Nurses recorded pain scores for each rehabilitation day; we abstracted the highest score recorded from the admission and discharge periods (first and last 3 days, respectively) and from each tenth day during the stay, then averaged the scores to determine the mean high pain score over the stay.

Service characteristics

Psychologists provided details about each treatment session during inpatient rehabilitation. They used handheld personal digital assistants to record service details after each patient encounter.^{34,35} As described in Wilson *et al.*³⁴ the psychology taxonomy included the date, duration (number of minutes), and the type of intervention provided – assessment, psychotherapeutic intervention, psycho-educational intervention, consultation,

patient classes provided by psychologists, and time that psychologists spent in interdisciplinary conferences on the patient's behalf. Table 1 lists these activities along with the specific topics included in the two most common activities: psychotherapeutic and psycho-educational interventions. We quantified intensity by the number of sessions in which each topic was addressed since time was collected for the high-level activity but not for each topic separately. Thus, the number of sessions for each psychotherapeutic and psycho-educational topic is included as a predictor variable in the regression models described below, and listed with mean number of sessions (SD) per patient in Table 1.

Rehabilitation outcomes

Rehabilitation outcomes were recorded at discharge and 1-year injury anniversary. These outcomes and the processes of recording them are described by Whiteneck *et al.*³⁰ Follow-up status at the injury anniversary was reported on the Model Systems Form II. Data derived from Form II included a Rasch-transformed FIM motor measure; subscales from the Craig Handicap Assessment and Reporting Technique (CHART) that measure Physical Independence, Social Integration, Occupation, and Mobility;³⁶ the Diener Satisfaction with Life Scale (SWLS);³⁷ depressive symptomology as measured by the Patient Health Questionnaire (PHQ-9);³⁸ place of residence, employment, or school attendance; and presence of a pressure ulcer. Rehospitalization after rehabilitation discharge was dichotomized as present at interview or not. Problem drinking was determined from a series of Form II questions. Participants were asked first, 'Do you drink any alcoholic beverages (such as beer, wine, wine coolers, or liquor)?' If the response was affirmative, participants were asked to report the frequency and quantity of drinking. Using a modified version of the National Institute on Alcohol Abuse and Alcoholism National Advisory Council criteria,³⁹ we defined problem drinking by binge use (more than five drinks on one occasion) or, for men, typical consumption of more than three drinks per day, or for women, more than two drinks per day.

Statistical analysis

We used ordinary least-squares stepwise regression modeling to predict outcomes at discharge and 1-year after injury. We used linear regression⁴⁰ for outcomes that are continuous and logistic regression for dichotomized ones,⁴¹ entering three groups of independent variables sequentially: (1) patient characteristics as listed above; (2) psychology service variables, including time spent

Table 1 Psychology services (hours) and number of sessions of each topic in psychotherapeutic and psycho-educational services, $n = 1032$

Psychology activities and interventions	Mean (SD)
Length of rehabilitation stay (days)	55.7 (36.6)
Hours of psychology services	
Assessment	1.0 (1.9)
Psychotherapeutic intervention	3.8 (5.1)
Psychoeducational intervention	3.1 (3.2)
Consultation	0.8 (2.0)
Interdisciplinary conference on patient's behalf	1.9 (1.7)
Classes provided by psychologist	0.3 (0.6)
Number of sessions in which each psychotherapeutic topic was discussed	
Desensitization to negative stigmas	0.2 (0.7)
Processing emotions	3.9 (7.4)
Emotional adjustment	4.4 (5.2)
Circumstances associated with injury	1.3 (3.2)
Family functioning or coping	3.5 (7.0)
Building rapport engagement	0.7 (1.8)
Positive reinforcement	3.3 (6.8)
Pain management	0.5 (1.7)
Locus of control issues	0.9 (2.0)
Peer mentor facilitation	0.4 (1.3)
Number of sessions in which each psycho-educational topic was discussed	
Goal setting	1.7 (3.8)
Substance use/abuse	0.4 (1.1)
Coping with and adjusting to SCI	3.7 (5.1)
Wellness and life style modification	1.5 (3.2)
Relationship issues	1.2 (2.4)
Sexuality after injury	0.8 (1.2)
Problem solving and decision-making skills	1.6 (3.1)
Self-advocacy and assertiveness	1.0 (1.5)
Pain management	0.4 (1.2)

in each type of psychology service, the number of sessions for each topic of psychotherapeutic and psycho-educational intervention, and rehabilitation LOS; and (3) rehabilitation center. For linear regressions, the adjusted R^2 reduces the unadjusted R^2 to take into account the number of predictors in the model; it indicates the amount of variation explained in the outcome by the independent variables, and thus the strength of the model. Adjusted R^2 values range from 0 (no prediction) to 1 (perfect prediction). For logistic regressions, the maximum re-scaled R^2 (Max R^2), also known as the Nagelkerke Pseudo R^2 or Cragg and Uhler's R^2 , is reported as a measure of the strength of the model.⁴² This value is scaled the same as the R^2 and reflects the relative strength of the logistic model. We estimated discrimination by using the area under the receiver operator characteristic curve (c) to evaluate how well the predictors in the model distinguished patients who achieve an outcome from those who did not. Values of c closer to 1 indicate better discrimination.

For each linear regression, we report the adjusted R^2 ; for logistic regression, we report the c statistic and the Max R^2 , first for the prediction of the outcome with only patient characteristics included as independent

variables. Next, we report the same statistics for the combination of service variables and patient characteristics. Finally, to determine the added effect of rehabilitation center, we added dummy variables indicating the center. The change in the adjusted R^2 or c statistic/Max R^2 indicates the additional explanation contributed by service and center variables, respectively.

For all outcome models, we report parameter estimates based on the regressions including patient and service variables, but not center, indicating the direction and strength of the association between each independent variable and the outcome. In the linear regression models, we report semi-partial Omega R^2 s, which indicate the proportion of the variance in the dependent variable that is associated uniquely with the predictor variable. In the logistic regressions, we report odds ratios (OR) to indicate the magnitude of the association of the predictor variable with the outcome. An OR of 2 indicates that the outcome is twice as likely for each unit increase of the independent variable, and an OR of 0.5 indicates that the outcome is half as likely. In all regression models, we report the P value associated with each significant predictor.

Results reported here are for a primary analysis subset, a randomly selected 75% of patients; we tested

the regression models with a validation subset which contained the remaining 25% of the sample. For linear outcomes, we compared the shrinkage of the original model R^2 (all patient and service variables as the independent variables) to the R^2 for the same outcome using the 25% sample and only the significant variables from the original model.⁴³ We defined a well-validated model by relative shrinkage (relative difference in R^2) less than 0.1, moderately validated models by relative shrinkage between 0.1 and 0.2, and poorly validated models by relative shrinkage greater than 0.2. For dichotomous outcomes, we calculated the Hosmer Lemeshow (HL) goodness of fit test for the original model and its replication in the validation subset. We defined well-validated models by both HL P values greater than 0.1 for both models, moderately validated models by HL P values of 0.05 to 0.1 for both, and poorly validated models by HL P values less than 0.05 for one or both models.

Results

Patient characteristics

Demographic and injury characteristics for the primary analysis sample of 1032 patients are reported in the first article in this series.³⁰ There were no significant differences between the primary analysis and validation subsamples on any dependent or independent variables used in the regression models. The sample was 81% male, 71% white and 22% black, 38% married, and mostly not obese (82% had a BMI of <30). The average age was 38 years (SD = 17). Most patients' health care costs were covered by private insurance (64%), 18% by Medicaid, 11% by workers compensation, and 7% by Medicare. Educational attainment ranged from less than high school education (19%), to high school diploma (48%), to some college education (23%); educational attainment was unknown for 10%. The majority of patients (66%) were working before injury and 15% were students; 11% were unemployed and 8% were retired. Vehicular crashes were the most common cause of injury (49%), followed by falls (25%), sports injuries and violent acts (11% each). The mean motor FIM score at admission was 23.5 (SD 11.3) and the cognitive score was 28.7 (SD 6.1). The corresponding Rasch-transformed FIM measures were 17.8 (SD 12.6) for the motor component and 73.6 (SD 18.1) for the cognitive component. The mean CSI score was 40.0 (SD 31.6), which indicates a moderate level of medical severity, but considerable variability in severity. An average of 31.0 days (SD 27.8) elapsed from injury to rehabilitation admission; the mean rehabilitation LOS was 55.7 days (SD 36.6).

Psychological services

Almost all patients (98%) received psychological services; the mean number of hours per patient was 11 (SD 10, range 0–82 hours) during 13 776 therapy sessions (11 786 individual sessions and 1990 group sessions). Psychotherapeutic (mean 3.8 hours SD 5.1) and psycho-educational (mean 3.1 hours SD 3.2) interventions comprised the bulk of the services. The most common psychotherapeutic services focused on emotional adjustment, processing emotions, and family functioning or coping; the most common psycho-educational interventions focused on helping patients to cope with life stressors and promoting post-SCI adjustment (Table 1).

Associations of psychological services with outcomes at discharge and 1-year anniversary

Patient characteristics account for a large proportion of variation in outcomes measured at rehabilitation discharge and at 1-year anniversary. Time receiving specific psychological services or their component activities – number of sessions of psychotherapeutic or psycho-educational interventions – account for a small but statistically significant proportion of variance for several outcomes. Fifteen patients did not have a high pain score reported and one patient did not have a CSI score; thus, regression models are based on 1016 patients.

Discharge motor FIM

Patient characteristics accounts for 65% of the variation in discharge motor FIM (Table 2). Patients with AIS A, B, or C injuries have lower motor FIM scores than patients with AIS D. Admission motor FIM is also a strong predictor of discharge motor FIM. Older age, higher medical severity, longer time from injury to rehabilitation admission, and obesity are associated with lower function. The variance explained increases from 65 to 68% with the addition of psychology service variables. Longer LOS, and more time in psychotherapeutic counseling and classes led by psychologists, along with more frequent sessions focused on goals using a psycho-educational approach are associated with higher motor function; more time spent in consultation with other team members on patients' behalf and more psychotherapy services focused on processing emotions, locus of control issues, and circumstances associated with the SCI are associated with lower function. Adding rehabilitation center to the model increases the variance explained to 71%.

FIM motor measure at 1-year anniversary

Psychological services account for small increases in explained variance in motor FIM scores 1-year after

Table 2 Prediction of Motor FIM* at discharge and at one year post injury

	Discharge motor FIM*			One-year motor FIM*		
Observations used	1016			846		
Step 1: Pt characteristics: adjusted R^2	0.65			0.51		
Step 2: Pt characteristics + treatments: adjusted R^2	0.68			0.52		
Step 3: Pt characteristics + treatments + center identity: adjusted R^2	0.71			0.53		
Independent variables**	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²
Neurological group	–	<0.001	0.065	–	<0.001	0.087
C1-4 ABC	–13.005	<0.001	–	–27.270	<0.001	–
C5-8 ABC	–9.831	<0.001	–	–21.471	<0.001	–
Para ABC	–3.955	<0.001	–	–17.152	<0.001	–
All Ds (reference)	0.000	–	–	0.000	–	–
Admission FIM motor*	0.450	<0.001	0.076	0.611	<0.001	0.040
Comprehensive severity index	–0.050	<0.001	0.008	–0.128	<0.001	0.015
Days from trauma to rehabilitation admission	–0.058	<0.001	0.015	–0.125	<0.001	0.020
Age at injury	–0.076	<0.001	0.008	–0.174	<0.001	0.010
BMI ≥ 30	–1.890	0.001	0.003	–	–	–
Primary payer	–	–	–	–	0.024	0.004
Medicare	–	–	–	–1.596	0.539	–
Medicaid	–	–	–	–3.895	0.010	–
Worker's compensation	–	–	–	–3.803	0.042	–
Private insurance/pay (reference)	–	–	–	0.000	–	–
Rehabilitation LOS	0.054	<0.001	0.008	0.082	0.000	0.007
Psychology hours of specific treatments:	–	–	–	–	–	–
Classes provided by psychologists	0.837	0.044	0.001	–	–	–
Consultation	–0.719	<0.001	0.005	–	–	–
Psycho-therapeutic interventions	0.489	<0.001	0.005	–	–	–
# Sessions of psychotherapeutic and psycho-education interventions:	–	–	–	–	–	–
Psycho-education: goal setting	0.402	<0.001	0.006	–	–	–
Psycho-therapeutic: circumstances associated with injury	–0.278	0.002	0.003	–	–	–
Psycho-therapeutic: locus of control issues	–0.535	<0.001	0.004	–0.942	0.001	0.006
Psycho-therapeutic: processing emotions	–0.283	<0.001	0.005	–	–	–

*Motor FIM was Rasch-transformed.

**All patient characteristics (described in Methods) and treatment variables listed in Table 1 were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

injury (R^2 increases from 0.51 for patient characteristics alone to 0.52). Longer LOS and fewer psychology sessions focused on locus of control issues are associated with higher motor FIM (Table 2).

Discharge location

Most patients (89%) were discharged home (Table 3). Patient factors are the strongest predictors of discharge to home (c statistic = 0.79, Max R^2 = 0.23) and include higher admission motor FIM, being married, and more hours spent in psycho-educational sessions. Older age, black race or Hispanic ethnicity, higher pain scores during rehabilitation, and more psychology sessions focused on locus of control and facilitating peer mentoring are associated with lower

likelihood of home discharge. The addition of psychology treatment variables increase the variance explained slightly; more time spent in psycho-educational interventions is associated with greater likelihood of discharge to home while more psychotherapeutic sessions focused on locus of control issues and peer mentor facilitation are associated with a lower likelihood.

Residence at 1-year injury anniversary

Psychological services account for a small but statistically significant increase in variance accounted for above patient variables in predicting home residence at 1-year injury anniversary (c statistic 0.68–0.74, Max R^2 0.08–0.17; Table 3). Marriage and

Table 3 Prediction of discharge location, place of residence at 1-year anniversary, and working or being in school at 1-year anniversary

Outcome:	Discharged to home			Reside at home at 1-year anniversary			Work/School at 1-year anniversary		
# Observations used	1016: Yes = 904, No = 112			865: Yes = 816, No = 49			844: Yes = 229, No = 615		
Step 1: Pt characteristics: $c/\text{Max } R^2$	0.79/0.23			0.68/0.08			0.81/0.33		
Step 2: Pt characteristics + treatments: $c/\text{Max } R^2$	0.80/0.26			0.74/0.17			0.81/0.34		
Step 3: Pt characteristics + treatments + center identity: $c/\text{Max } R^2$	0.83/0.30			0.77/0.19			0.83/0.35		
Independent variables*	Parameter estimate	Odds ratio	P value	Parameter estimate	Odds ratio	P value	Parameter estimate	Odds ratio	P Value
Neurological group							–	–	<0.001
C1-4 ABC							–1.764	0.171	<0.001
C5-8 ABC							–0.975	0.377	0.002
Para ABC							–0.360	0.698	0.185
All Ds (Reference)							0.000	–	–
Admission FIM motor-Rasch transformed	0.046	1.047	<0.001						
Days from trauma to rehabilitation admission				–0.009	0.991	0.015			
Age at injury	–0.047	0.954	<0.001	–0.031	0.969	0.002	–0.028	0.972	0.001
Marital status is married	0.638	1.892	0.013	1.078	2.939	0.005			
Race	–	–	0.003				–	–	0.009
All other minorities	–0.589	0.555	0.203				–0.839	0.432	0.040
Black	–0.832	0.435	0.001				–0.628	0.533	0.011
Hispanic	–1.229	0.293	0.017				**	**	**
White (reference)	0.000	–	–				0.000	–	–
Occupational status at injury							–	–	<0.001
Unemployed/other							–0.859	0.424	0.028
Student							1.757	5.793	<0.001
Retired							–0.644	0.525	0.255
Working (reference)							0.000	–	–
Highest education achieved									
High school							0.420	1.521	0.145
College							1.077	2.937	0.001
<12 years/other/unknown (reference)							0.000	–	–
Primary language is English				1.174	3.235	0.016			
Primary payer							–	–	0.001
Medicare							–0.873	0.418	0.157
Medicaid							–0.797	0.451	0.005
Worker's compensation							–1.022	0.360	0.005
Private insurance/pay (reference)							0.000	–	–
Alcohol group							–	–	0.036
Alcohol involved in injury							–0.874	0.417	0.005
History alcohol abuse but not involved in injury							–0.296	0.744	0.240
No history alcohol abuse or involvement in injury							–0.064	0.938	0.777
No Information about alcohol involvement/history (reference)							0.000	–	–
Pain score during rehabilitation	–0.149	0.861	0.002						
Psychology hours of specific treatments:									
Classes provided by psychologists				–0.735	0.480	0.002			
Psycho-education	0.102	1.108	0.009						
# Sessions of specific psychology treatments:									
Psycho-education: goal setting				0.261	1.298	0.001			
Psycho-therapeutic: building rapport/engagement							–0.176	0.838	0.010
Psycho-therapeutic: locus of control issues	–0.116	0.891	0.042						
Psycho-therapeutic: peer mentoring	–0.184	0.832	0.015						
Psycho-therapeutic: positive reinforcement				–0.093	0.911	<0.001			

*All patient characteristics (described in Methods) and treatment variables listed Table 1 were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

**Hispanic combined with all other minorities

more psycho-educational sessions focused on goal setting are associated with a greater likelihood of home residence. Older age, longer time from injury to rehabilitation admission, more time spent in classes led by psychologists, and more psychotherapeutic sessions focused on positive reinforcement are associated with lower odds of home residence at the injury anniversary. The addition of rehabilitation center increases the c statistic to 0.77, Max $R^2 = 0.19$.

Employment or school attendance at 1-year anniversary

Patients who were students before injury (working is the reference group) are almost 6 times more likely to be working or attending school at the 1-year injury anniversary, and patients with a college education are 3 times as likely (the reference group is less than 12 years of education combined with unknown years of education). Patients with tetraplegia (reference group is AIS D) and those of black race or other minority status or with alcohol involved in the SCI were less likely to be working or attending school. Payer also was a statistically significant predictor: patients covered by Medicaid and workers compensation were less likely to be attending school or working. Patient variables explain most of the variation in this outcome; however, more psychotherapeutic sessions focused on building rapport and engagement also are associated with a lower likelihood of employment or school attendance (Table 3).

Societal participation

The addition of psychological services to patient variables results in small increases to the R^2 in models for CHART Physical Independence ($R^2 = 0.41$ to 0.44), Mobility ($R^2 = 0.28$ (no change)), Occupation ($R^2 = 0.24$ to 0.25) and Social Integration ($R^2 = 0.14$ to 0.15 , Table 4). Higher participation scores are associated with younger age, having a college education, higher admission motor FIM, and lower pain ratings during rehabilitation. Payer is also a significant predictor: having Medicaid as a primary payer is associated with lower levels of Social Integration and Mobility, while workers compensation is associated with lower Physical Integration scores. Student status before SCI is associated with higher Occupation and Mobility scores; being retired is associated with higher – and being unemployed is associated with lower – Social Integration scores (working is the reference group). More time in classes led by psychologists is associated with higher Physical Independence and lower Occupation scores. More psychotherapeutic sessions

focused on processing of emotions is associated with lower Physical Independence and Mobility scores, while more sessions focused on emotional adjustment is associated with higher Mobility scores. The addition of rehabilitation center increases the variance explained in each model by 1%.

Mood and life satisfaction

The predictors accounted for little variance in depressive symptoms ($R^2 = 0.10$) 1 year after injury (Table 5). Psychological services are not significant predictors of depressive symptoms. Variance explained by psychological treatments for the satisfaction with life model increased to 0.12 from 0.09 for patient variables alone. More psychotherapeutic sessions involving family functioning or coping are associated with higher life satisfaction; more sessions focused on peer mentor facilitation and processing emotions are associated with lower life satisfaction.

Rehospitalization and pressure ulcer at 1-year anniversary

Thirty-six percent of patients were rehospitalized and 14% reported a pressure ulcer at the 1-year interview (Table 6). Psychological services are not associated with rehospitalization. Adding treatment variables increased the R^2 from 0.67 for patient variables alone to 0.69 for rehospitalization; longer rehabilitation LOS is associated with less rehospitalization. For the model predicting report of pressure sores at the 1-year anniversary, adding treatment variables increased the R^2 from 0.70 for patient variables alone to 0.76. More time focused on psycho-educational topics is associated with a lower risk of pressure ulcers; more psychotherapeutic sessions focused on wellness and life style modification and more psycho-educational sessions on locus of control issues are associated with a higher likelihood of pressure ulcers.

Problem drinking at 1-year anniversary

Sixteen percent of patients who completed the interview questions about drinking met criteria for problem drinking. Problem drinking at the 1-year anniversary is associated with younger age, non-minority status, paraplegia, and shorter rehabilitation stays. In addition, more psychotherapeutic sessions focused on desensitization to negative stigma are associated with problem drinking, which increased the predictive power from 0.71 for patient variables alone to 0.73 (Table 7).

Discussion

Clinically intuitive associations include the finding that more time receiving psychotherapeutic counseling,

Table 4 Prediction of social participation

Outcomes:	CHART: Physical Independence			CHART: Social Integration			CHART: Occupation			CHART: Mobility		
# Observations Used			844			818			833			831
Step 1: Pt characteristics: adj. R^2			0.41			0.14			0.24			0.28
Step 2: Pt characteristics + treatments: adj. R^2			0.44			0.15			0.25			0.28
Step 3: Pt characteristics + treatments + center identity: Adj. R^2			0.45			0.16			0.26			0.29
Independent variables*	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²
Neurological group	–	<0.001	0.026				–	0.038	0.005	–	0.001	0.011
C1-4 ABC	–24.450	<0.001	–				–12.859	0.007	–	–11.587	<0.001	–
C5-8 ABC	–10.152	0.010	–				–5.184	0.247	–	–7.130	0.013	–
Para ABC	–3.872	0.229	–				–4.747	0.197	–	–6.754	0.004	–
All Ds (Reference)	0.000	–	–				0.000	–	–	0.000	–	–
Admission FIM Motor-Rasch transformed	0.967	<0.001	0.036	0.175	0.002	0.009	0.794	<0.001	0.026	0.367	<0.001	0.014
Admission FIM Cognitive-Rasch transformed				0.097	0.014	0.005						
Comprehensive severity index	–0.151	0.001	0.007									
Days from trauma to rehabilitation admission	–0.259	<0.001	0.034				–0.129	0.003	0.007	–0.127	<0.001	0.020
Traumatic etiology		0.009	0.006				–	0.008	0.009			
Medical/surgical/other	–9.123	0.090	–				–10.716	0.087	–			
Violence	–6.447	0.070	–				–10.992	0.007	–			
Sports	–10.557	0.003	–				2.025	0.619	–			
Fall	–0.998	0.707	–				–7.219	0.017	–			
Vehicular (reference)	0.000	–	–				0.000	–	–			
Age at injury	–0.339	<0.001	0.011	–0.303	<0.001	0.024	–0.388	<0.001	0.011	–0.487	<0.001	0.042
Gender is male							–9.674	0.001	0.009			
Marital status is married				8.387	<0.001	0.027	7.244	0.009	0.005	4.333	0.015	0.004
Race				–	0.029	0.006				–	0.002	0.010
All other minorities				0.041	0.990	–				–2.220	0.536	–
Black				–4.743	0.005	–				–7.211	<0.001	–
Hispanic				–5.771	0.185	–				–0.702	0.887	–
White (reference)				0.000	–	–				0.000	–	–
Occupation status at injury				–	<0.001	0.021	–	0.019	0.006	–	0.015	0.007
Unemployed/other				–6.814	0.004	–	–2.779	0.483	–	–4.377	0.086	–
Student				0.575	0.807	–	9.818	0.015	–	5.287	0.040	–
Retired				10.324	0.001	–	–10.011	0.053	–	2.734	0.436	–
Working (reference)				0.000	–	–	0.000	–	–	0.000	–	–
Highest education achieved	–	0.001	0.008	–	0.050	0.004	–	0.000	0.016	–	<0.001	0.014
High school	6.620	0.016	–	1.821	0.338	–	5.281	0.107	–	3.164	0.128	–
College	11.838	<0.001	–	5.146	0.023	–	15.476	<0.001	–	9.761	<0.001	–
<12 years/other/unknown (reference)	0.000	–	–	0.000	–	–	0.000	–	–	0.000	–	–
Primary language is English							13.395	0.010	0.005	12.281	0.001	0.009
Primary payer	–	0.009	0.006	–	0.012	0.008				–	0.010	0.007
Medicare	–5.886	0.198	–	–4.901	0.136	–				1.649	0.651	–
Medicaid	–2.145	0.439	–	–5.843	0.002	–				–6.733	0.001	–
Worker's compensation	–11.498	0.001	–	–1.911	0.406	–				0.442	0.862	–
Private insurance/pay (Reference)	0.000	–	–	0.000	–	–				0.000	–	–

psychologist-led classes, and more psycho-educational sessions addressing goal setting are associated with higher motor FIM scores at discharge. Ievleva and Orlick⁴⁴ noted that persons with sports injuries healed faster, 5 weeks compared to 14 weeks, if they used goal-setting, imagery, and positive-talk strategies. It may be that psychologically resilient patients are able to engage successfully in an interactive, education-focused intervention that allows them to set and pursue goals.⁴⁵ Similarly, more hours spent in psycho-educational sessions are associated with home discharge. It maybe that resilient patients, those with less need for intensive psychotherapeutic interventions, receive and benefit from an intervention focused on empowering them to achieve higher levels of independence. This hypothesis is consistent with Connor and Davidson's⁴⁶ research that demonstrated how focusing on a person's strengths allows them to become more engaged, allowing problem resolution. White *et al.*⁴⁷ examined associations between resilience and adjustment after SCI. Persons who reported greater resilience had fewer depressive symptoms, greater life satisfaction, and functional independence. Further research is needed to identify the specific personality characteristics that are associated with the potential to benefit from growth-oriented psychological interventions.

The finding that more time in classes led by psychologists is associated with higher physical independence is consistent with a hypothesis that resilient patients receive proportionally more educational interventions which allows them to achieve higher levels of independence. The finding that more psychology sessions focused on emotional adjustment are associated with higher mobility scores may reflect a focus on emotional adjustment rather than processing of emotions. Processing emotions is defined as validation and normalization of emotions associated with trauma and loss. Thus, more resilient patients are ready to deal with adjustment processes, while less resilient patients focus on processing emotions associated with trauma and loss. Individuals with lower resiliency and hardiness experience higher levels of perceived stress and vulnerability.⁴⁶ Readiness to spend time in psychological interventions focused on emotional adjustment demands of an engaged, insightful, motivated, and empowered patient, whereas processing emotions is a passive activity that relies on a psychologist to normalize and make sense of trauma.

We observed a weak association between psychotherapeutic sessions focused on family functioning or coping and life satisfaction. Consistent with the literature on social support and quality of life after injury,⁴⁸ a

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Table 5 Prediction of mood state (PHQ-9) and life satisfaction (SWLS)

Outcome:	PHQ9			SWLS		
Observations used		797			735	
Step 1: Pt characteristics: adj. R^2		0.10			0.10	
Step 2: Pt characteristics + treatments: adj. R^2		0.10			0.12	
Step 3: Pt characteristics + treatments + center identity: adj. R^2		0.10			0.13	
Independent variables*	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²
Neurological group						
C1-4 ABC				–	0.001	0.015
C5-8 ABC				–2.888	0.007	–
Para ABC				–0.482	0.639	–
All Ds (reference)				–2.135	0.010	–
All Ds (reference)				0.000	–	–
Admission FIM motor-Rasch transformed				0.077	0.016	0.006
Days from trauma to rehabilitation admission	0.025	<0.001	0.019			
Age at injury	0.033	0.016	0.005	–0.107	<0.001	0.033
Gender is male	–0.864	0.050	0.003			
Occupation status at injury	–	0.001	0.016			
Unemployed/other	2.084	<0.001	–			
Student	–0.209	0.714	–			
Retired	–1.073	0.164	–			
Working (reference)	0.000	–	–			
Injury is work related	1.562	0.002	0.010			
BMI ≥30	–1.684	<0.001	0.015			
Primary payer				–	0.001	0.016
Medicare				2.126	0.082	–
Medicaid				–2.167	0.003	–
Worker's compensation				–1.826	0.036	–
Private insurance/pay (reference)				0.000	–	–
Pain score during rehabilitation	0.390	<0.001	0.033	–0.391	0.001	0.013
# Sessions of psychotherapeutic interventions:						
Family functioning or coping				0.198	0.001	0.012
Peer mentoring				–0.645	0.034	0.004
Processing emotions				–0.165	0.003	0.010

*All patient characteristics (described in Methods) and treatment variables listed Table 1 were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

psychotherapeutic focus on relational issues suggests that the patient has a support system and is concerned with relational issues. We also found that more psycho-educational sessions are associated with a lower risk of pressure ulcers. Again, patients' ability to benefit from an educational model suggests a higher level of resilience and readiness to assume responsibility for self-care.

We observed several counterintuitive relationships between psychological services and patient outcomes. More time spent by psychologists consulting with team members and more psychology sessions focused on processing emotions, locus of control issues and circumstances associated with injury are associated with lower functional status at discharge. It may be that patients who are less resilient or emotionally healthy require more intensive psychological consultation regarding non-compliance with the rehabilitation program or low motivation to participate in therapies. Patients who require sessions focused on regaining

control are less resilient and less capable of adapting and managing their control issues. They require an emotional 'holding environment' in which emotional processing is a prominent activity. In contrast, resilient patients are able to process actively their emotional states and move on to active coping.^{49,50} The finding that more psychology sessions focused on locus of control and peer mentor facilitation are associated with a lower likelihood of home discharge may reflect a similar process. Patients for whom psychologists spend more time facilitating interactions with a peer mentor often are struggling with adjustment issues and experience higher levels of stress and vulnerability; team members often encourage peer mentoring as an approach to promoting hope and increasing motivation.⁴⁶

A more encompassing explanation of the negative relationships between psychological services and outcomes is that delivery of specific types of psychological services is a surrogate for greater psychological need that was not assessed by the patient characteristic

Table 6 Prediction of rehospitalization since rehabilitation discharge and presence of pressure sore at 1-year anniversary

Outcome:	Rehospitalization			Pressure Sore at 1-year		
Observations used	936: Yes = 338, No = 598			922: Yes = 127, No = 795		
Step 1: Pt characteristics: <i>c</i> /Max <i>R</i> ²	0.67/0.11			0.70/0.11		
Step 2: Pt characteristics + treatments: <i>c</i> /Max <i>R</i> ²	0.69/0.14			0.76/0.17		
Step 3: Pt characteristics + treatments + center identity: <i>c</i> /Max <i>R</i> ²	0.70/0.16			0.76/0.18		
Independent variables*	Parameter estimate	Odds ratio	<i>P</i> value	Parameter estimate	Odds ratio	<i>P</i> value
Neurological group				–	–	0.003
C1-4 ABC				0.428	1.534	0.414
C5-8 ABC				0.832	2.299	0.099
Para ABC				1.517	4.560	0.001
All Ds (reference)				0.000	–	–
Admission FIM motor-Rasch transformed	–0.023	0.977	0.001	–0.050	0.951	<0.001
Comprehensive severity index	0.014	1.015	<0.001	0.016	1.016	<0.001
Days from trauma to rehabilitation admission	0.010	1.010	<0.001	0.009	1.009	0.005
Gender is male	–0.379	0.685	0.040			
Occupation status at injury	–	–	0.014			
Unemployed/other	0.218	1.244	0.357			
Student	–0.689	0.502	0.003			
Retired	–0.069	0.934	0.838			
Working (reference)	0.000	–	–			
Primary payer	–	–	0.010			
Medicare	0.649	1.914	0.054			
Medicaid	0.537	1.710	0.005			
Worker's compensation	0.397	1.487	0.111			
Private insurance/pay (reference)	0.000	–	–			
Alcohol group				–	–	0.012
Alcohol involved in injury				0.569	1.767	0.073
History alcohol abuse but not involved in injury				0.792	2.207	0.003
No history alcohol abuse or involvement in injury				0.132	1.141	0.645
No information about alcohol involvement/history (reference)				0.000	–	–
Pain score during rehabilitation	0.063	1.065	0.041			
Rehabilitation LOS	–0.015	0.986	<0.001	–0.012	0.988	0.008
Assessment hours				–0.260	0.771	0.001
Psycho-education hours				–0.111	0.895	0.013
# Sessions psycho-education: wellness and life style modification				0.184	1.202	<0.001
# Sessions psycho-therapeutic: locus of control issues				0.083	1.086	0.045

*All patient characteristics (described in Methods) and treatment variables listed Table 1 were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

variables. Low levels of resilience become evident during the course of rehabilitation and result in greater psychologist attention to patients' coping deficits. Psychologists provide services to remediate these deficits and spend more time with team members to help them facilitate rehabilitation goals. Consistent with this explanation is the finding that more psychotherapeutic sessions focused on processing emotions is associated with lower physical independence and mobility at follow-up. The need to process emotions may reflect difficulty participating actively and integrating changes that promote adjustment. Peer mentoring is one component of a treatment plan to address this issue. Thus, it is understandable that peer mentor facilitation and processing emotions are associated with lower levels of life satisfaction.

The finding that more psychotherapeutic sessions focused on positive reinforcement is associated with reduced likelihood of home residence at the injury anniversary may also reflect resilience issues. Resilient patients find more positive reinforcement, allowing psychologists to focus on active processes of coping and adaptation.

We also observed that more psychotherapeutic services focused on building rapport and engagement are associated with a lower likelihood of employment and school attendance. Patients who require more time focused on rapport building and establishing engagement are less able to benefit from an active therapeutic process. Similarly, more time in classes led by a psychologist is associated with lower CHART occupation scores. Psychologist-led classes often focus on topics

Table 7 Prediction of problem drinking at 1-year post injury

Problem drinking at 1-year			
Observations used	781: Yes = 122, No = 659		
Step 1: Pt characteristics: $c/\text{Max } R^2$	0.71/0.12		
Step 2: Pt characteristics + treatments: $c/\text{Max } R^2$	0.73/0.14		
Step 3: Pt characteristics + treatments + center identity: $c/\text{Max } R^2$	0.73/0.15		
	Parameter estimate	Odds ratio	P value
Neurological group	—	—	0.002
C1-4 ABC	−0.522	0.288	0.016
C5-8 ABC	0.041	0.505	0.840
Para ABC	−0.243	0.380	0.140
All Ds (reference)	0.000	—	—
Age at injury	−0.031	0.969	<0.001
Race			<0.001
Non-white	−0.537	0.341	<0.001
White (reference)	0.000	—	—
Rehabilitation LOS	−0.013	0.987	0.003
# Sessions psycho-therapeutic: desensitization to negative stigmas	0.301	1.351	0.016

*All patient characteristics (described in Methods) and treatment variables listed Table 1 were allowed to enter the models.

Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

such as identifying and reducing substance abuse risk. It is understandable that classes focused on substance abuse would be observed because the consequences of alcohol abuse include adjustment issues including depression, establishing healthy lifestyles, and preventing urinary tract infections and pressure ulcers following disability.⁵¹ Heinemann and colleagues⁵² report that persons with SCI who drink more report spending less time in productive activities. Another association consistent with this hypothesis is that psychotherapeutic sessions focused on wellness, life style modification, and locus of control are associated with a greater likelihood of pressure ulcers 1 year after injury. It may be that patients requiring more sessions on these topics have poor health behaviors and risky lifestyles that require intervention. This hypothesis would explain why psychotherapy sessions focused on desensitization to negative stigma are associated with a greater likelihood of pre-injury problem drinking. It may be that patients who medicate their negative moods with alcohol and other drugs experience negative disability stigma more acutely.

Age is related to several discharge and 1-year outcomes. Older age is associated with lower function at discharge, lower likelihood of home discharge and home residence at 1-year anniversary, lower participation scores, and lower risk of problem drinking at 1-year anniversary. These findings are consistent with earlier reports that illustrate the consequences of age-related declines in function and risk for substance use disorders.⁵³ Race and ethnicity are associated with few outcomes. Black and Hispanic patients were less likely to be discharged home than were white patients, although there were no

differences in residence by the 1-year anniversary. However, black and Hispanic patients had a lower risk of problem drinking at the 1-year anniversary than did their white counterparts. The extent to which racial disparities in rehabilitation outcomes are related to income, accessible housing options, and insurance coverage requires further investigation.

Study limitations

The participating rehabilitation centers serve patients with diverse clinical and demographic characteristics. However, they are not a probability sample of the rehabilitation facilities that provide care for patients with SCI in the United States. The participating facilities include some of the largest SCI rehabilitation programs in the United States. All facilities have long records of operation and employ experienced staff. Thus, these results may not generalize to all rehabilitation centers; the consequences of unique referral patterns are unknown. In addition, 9% of eligible patients declined enrollment; self-selection may bias the results. The taxonomy and data collection system used to document psychology interventions was developed for this study. While it is comprehensive, it has not been used widely and opportunities for validation are limited. The service data may lack sufficient specificity and may not capture adequately the complex aspects of psychological services. Our speculation about the importance of patient resilience should be investigated in a comprehensive manner that considers a broad array of personality characteristics influencing patient outcomes given that psychological interventions accounted for a relatively small proportion of additional variance.

Data on the assessment of depression and anxiety were missing for about 40% of the participants, limiting our ability to examine subgroups of study participants with extreme levels of emotional distress. Missing depression and anxiety data are not associated with patient-specific variables and appear to reflect psychologists' inconsistency in administering the instrument.

Conclusion

Psychological services are an important component of comprehensive medical rehabilitation. This study is the first to describe associations between psychological services and rehabilitation outcomes during inpatient care for SCI. Negative associations of some components of psychological services with outcomes appear to reflect patients' needs, particularly the comprehensive needs of patients who are less resilient and thus at risk for negative psychological, functional, and participation outcomes. Positive associations with outcomes appear to reflect patients' capacity to benefit from psychological services. The findings should be interpreted cautiously given that all critical patient characteristics associated with need for services were not documented. Further research is needed to determine the optimal type and timing of psychological services during and after inpatient rehabilitation based on individuals' strengths and vulnerabilities.

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